



# H2-international – e-Journal

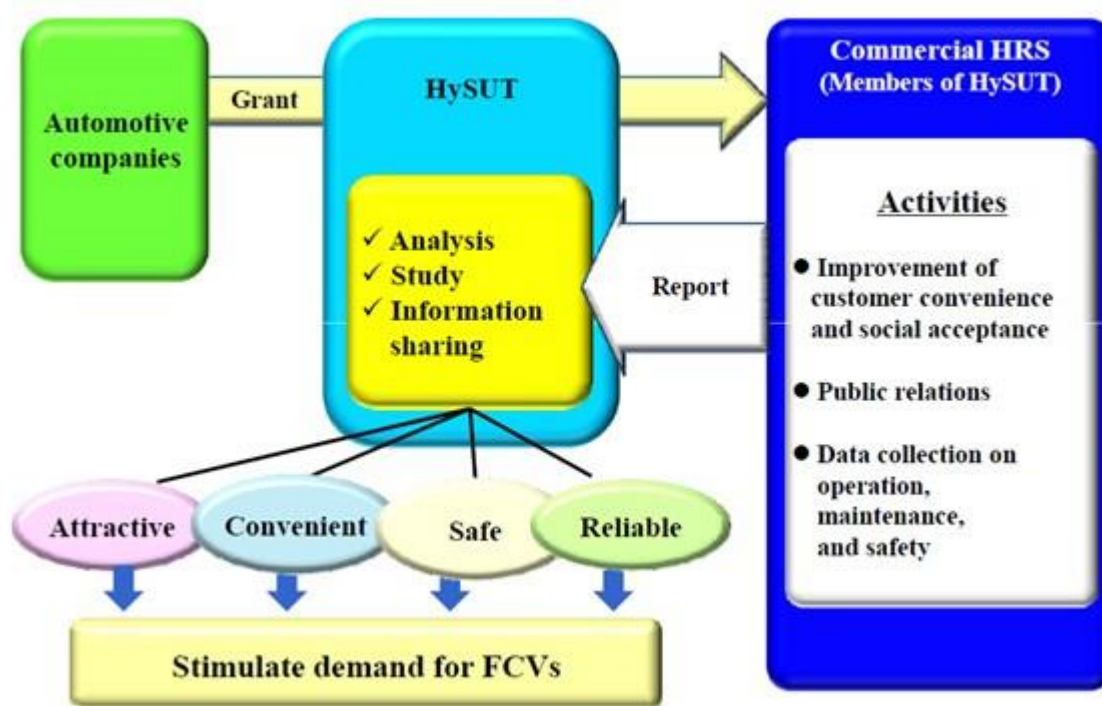
March 2016

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## Japan's 2016 Fuel Cell Budget



*Support Program to Stimulate Demand for FCVs, © HySUT*

Japan's federal R,D&D budget for the 2016 fiscal year, which starts April 1, 2016, is 37.1 billion yen (285 million Euro), according to a recent report from Technova, a Japanese advanced technology consultancy. The total includes continuing support for the successful [Ene-Farm](#) residential fuel cell program, which will support an estimated 50,000 residential installations this year. The program had been scheduled to end in 2015, but its success, and the government's strategic commitment to residential fuel cells, has led to continuing support for at least another year.

Other major programs include support for hydrogen fueling station deployment: the government has a goal of 100 stations, with 81 open or under way today. Research into the bulk shipment of hydrogen saw an increase though overall spending on hydrogen R&D will decline.

These totals do not include direct support for fuel cell vehicle purchases of 2 million yen per vehicle. If one assumes 1,500 FCEVs sold in Japan next year, a reasonable guess given demand for Toyota's *Mirai* and Honda's entry early in 2016 with a redesigned *Clarity*, the cost of the vehicle program could reach three billion yen (23 million Euro).

The new target date for completion of the current build-out of hydrogen fueling stations in Southern Japan is now March, 2016, according to HySUT, the Japanese private sector collaborative that developed the first generation of hydrogen stations. The latest total of stations operating or under development is 81, including mobile

fueling sites, with 37 in the Tokyo metropolitan area and the rest located across southern Japan, extending past Fukuoka to Saga in southwest Japan. As of October 1, 28 stations were operating.

Items	FY2016	(FY2015)
Market Support	23.2 bil	-
- Subsidy for Ene-Farm	17.0 bil	22.2bil
- Subsidy for H2 infrastructure	6.2 bil	9.6 bil
R&D on Hydrogen	13.9 bil	11.9 bil
- R&D on Hydrogen	4.5 bil	4.15 bil
- R&D on Hydrogen Carrier	3.35 bil	2.05 bil
- R&D on innovative hydrogen storage and supply	1.7 bil	16.6 bil

© METI, via Technova

HySUT ...

- reported the progress in a presentation at the 2015 *Fuel Cell Seminar* in Los Angeles, CA, November 17.
- will spend at least the next two years focusing on technical issues such as station performance and new technologies.
- has also taken on a coordinating role in behalf of the auto industry in what it calls “support programs aiming to stimulate demand for FCEVs”. This includes training and employee education but also data gathering, analysis and information sharing on issues relating to customer satisfaction.
- will also exchange some data with the US Department of Energy, quite an unusual step for Japan.

*Author: Robert Rose*

## Plug Power: Unshakable growth

Whichever enterprise figure is in the focus of the stock market, it will become the basis for share price development: With around US\$ 31.5 million in the third quarter, Plug did deliver the expected turnover revenue, but had to continue posting a loss that the stock market took as a negative sign (expressed in US cents per share). This meant that the stock price, which had meanwhile went from trading at around US\$ 1.70 to an impressive US\$ 3.00, suffered a severe drop to about US\$ 2.00 after news of the financial figures broke. In contrast, [Tesla](#)'s evaluation was primarily based on the number of vehicles sold during the quarter and not on losses or reduced liquidity during the same period – a bit of a different view on everyone.

Plug is in a good position! The company got drowned in quotes (resulting in over US\$ 234 million worth of orders, with new ones amounting to more than US\$ 160 million). Placements are made by both existing customers as well as new ones from other

regions of the globe besides Europe. During the fourth quarter, [FuelCell Energy](#) gained another six customers and installed 15 new H2 filling stations. Sufficient liquidity of above US\$ 115 million enable the organization to cope with the high growth on its own. What is especially important is that the gross profit margin is scheduled for a notable increase one step at a time and that the target for 2016 is to retain a profit, meaning to break even and beyond.



*Forklift trucks near Prelodis in France, © Plug Power*

The other news is that the company wants to sustain a 25% gross profit margin. Big customers like Walmart support FuelCell's goals. In 2016, Walmart alone has ten additional logistics centers that could be the next in line for having their fleet of forklift trucks retrofitted. Plus: Large forwarders like FedEx are being mentioned on internet forums with increasing frequency as potential major customers, as Plug had already retrofitted ground support equipment at FedEx airfields. The company based in Latham, New York, was also able to contract MMM to supply fuel cell stack components. MMM has had experiences with the technology for many years.

To sum it up: Growth first needs money to heave the company into a good position (capacities, infrastructure, personnel, etc.). This seems to have been implemented well in 2015, and it has paved the way to make this year the first in the company's history that will close with a profit. The stock market could very well bid on it!

[Risk warning: see also next article](#)

*Author: Sven Jösting*



## FuelCell Energy: Stock Price Gets Cosmetic Changes



*Fuel cell power plant, © FuelCell Energy*

To free FuelCell Energy from the shackles of “penny stock life,” the company based in Danbury, Connecticut, took the radical step of merging its shares (reversal stock split) at a ratio of 12:1, effective from Dec. 4, 2015 (see [graph](#)). Considering the organization’s more than 300 million outstanding shares (more to say, 475 million fully diluted ones, and 40 million after the split), this move was to be expected: The company was running the risk of being dropped from Nasdaq, as the bid price had been below the important US\$ 1.00 requirement for some time now. The process usually results in shares trading lower right after the split, but it is still the right thing to do to make them more attractive to institutional investors. Indeed, it is only “cosmetic surgery,” with no impact on the business itself. The more important news are the large-scale orders that FuelCell Energy has been able to secure one after another. The company’s production currently adds up to 70 MW worth of energy per year. From 90 MW on, the business model would be profitable – in my opinion, it will only be a matter of time until FuelCell Energy can break even, as it has already proven how to successfully turn fuel cell ideas into concrete large-scale projects.

The publication of the fourth-quarter figures on Oct. 31, 2015, show: Backlog has reached US\$ 381 million. The forecast is an annual installation of 100 MW of new

systems. FuelCell Energy has bid for multiple project contracts (around the globe). Overall, project volume is projected at up to US\$ 2 billion. The company has also announced that it had received an additional US\$ 30 million in funds from PNC Energy Capital. This means that cash reserves are now at US\$ 85.7 million plus the US\$ 36 million from the line of credit granted by shareholder NRG Energy.

On an important side note: FuelCell Energy designs large turnkey systems, provides the capital required for them and sells them at a later date or agrees to contracting models, i.e., long-term supplier contracts for power and heat. Taxation issues are taken into account as well, as the sale of electricity allows for higher profit margins than the one-time sale of a plant. Additionally, FuelCell Energy sees growing interest in know-how and technologies thanks to the *Conference on Climate Change* in Paris. All in all, these are good reasons to assume that the current stock price low won't be permanent – despite the fact that the most recent figures were admittedly disappointing.

January 2016 should get us an important decision on the large Beacon Falls project (63 MW). FuelCell Energy expects to be among the favored bidders. Order placement is scheduled for the first half of this year.

### **Risk warning**

Each investor must be aware of his or her own risk assessment when buying or selling shares and consider spreading the risk as a sensible precaution. The fuel-cell companies mentioned in this article are Small and Mid Cap, i.e., these are not default values and the volatility is significantly higher. This article is not to be taken as a recommendation what shares to buy or sell – it comes without any explicit or implicit guarantee or warranty. All information is based on publicly available sources and the assessment made in this article represents exclusively the author's own opinion.

*Author: Sven Jösting*

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## **New DOE Funding Available**

The US Department of Energy intended to issue a Funding Opportunity Announcement (FOA) early in December 2015 offering up to \$ 35 million over several years for various research, demonstration and analytical topics. Most of the effort is focused on hydrogen station cost reduction and improvements in fuel cell performance and durability. The projects would take place over one to five years; with multiple winners contemplated in each area of interest, the average annual federal grant will be relatively small. Here is a list of areas of interest and financial allocations.

- Advanced high temperature water splitting. (\$ 5 M over 2-3 years)
- Advanced compression to 875 bar in pursuit of lower cost hydrogen fueling stations. (\$ 5 M over 2-3 years)
- Advanced thermal insulation for automotive applications (\$ 2 M for 2-3 years)
- Innovative component manufacturing and demonstration. (\$ 6 M for 304 years)

- Support for communities seeking to adopt hydrogen and fuel cell technologies. (\$ 0.25 M for 1-3 years)
- Additions to existing national lab efforts on fuel cell performance and durability. (\$ 6 M for 2-4 years)
- Additions to existing national lab efforts on hydrogen storage. (\$ 7 M for 1-3 years)
- Various analyses. (\$ 4.5 M for 3-5 years)

More details may be found at <https://eere-exchange.energy.gov>



This FOA continues a trend in recent years for the DOE hydrogen program to spread its money rather thinly. With about \$ 100 million annually the fuel cell office supports programs in 27 states. Projects rarely receive more than \$ 3 million from the Fuel Cell Technologies Office. (The Solid State Energy Conversion Alliance, a separate office focusing on SOFC cost reduction, typically grants \$5 million or more. Recently it awarded \$ 7.5 M each to FuelCell Energy and LG Fuel Cell Systems (see picture) for research into system reliability.

DOE also announced an interest in projects focusing on specialized materials for hydrogen transport and catalysts for fuel cells; DOE is also looking for a company desiring to use a new hydrogen sensor developed by Los Alamos National Laboratory. Funds for these projects are available under the Small Business Innovative Research (SBIR) program, which focuses specifically on helping US small businesses.

Details may be found at [www.energy.gov](http://www.energy.gov)

*Author: Robert "Bob" Rose*

## From f-cell to e-cell – (Almost) everything screams battery



The [\*World of Energy Solutions \(WES\)\*](#) is slowly turning into a battery-only exhibition. The event, whose most recent instalment took place in Stuttgart from Oct. 12 to 14, 2015, was originally launched as the regional fuel cell conference f-cell. Fifteen years ago, a small number of hydrogen and fuel cell experts met in the *House of Economy* in Stuttgart to talk about their research at test labs and workshops. The conference was accompanied by a small exhibition showcasing products of businesses mostly based in Germany's Swabia region. The annual gathering became one of the world's most important dates in the calendar of the fuel cell community, but other topics have meanwhile begun to capture the attention of the audience for around the past three years – especially the issue of battery development. Faced with this turn of events, the question is which path the organizers of the former f-cell intend to take over the coming years.

Actually, now should be the time to plan for the market rollout of fuel cells. It was the reason why Peter Sauber, Founder of *f-cell* and organizer of the conference, had already established *green2market* last year. The event was thought to complement the science and research focus of *f-cell* by providing a forum for marketing and sales discussions. The fuel cell community, however, passed up on the opportunity: The first edition of *green2market* in 2014 did not take place, as there were too few registrations for it, and even the second attempt grappled with a modest number of participants. It seems that fewer companies than Sauber expected were pushing for market readiness.

This alone would not be noteworthy if there had not been other indications pointing into the same direction: For example, the changing face of the *f-cell*, which – with each passing year – has become ever less the event it once was. It seems likely that Messe Stuttgart, which has hosted the industry event on the city's trade show premises since 2012, aimed for the change, as it launched the *Battery+Storage* in the same year. Originally advertised as a complement to the fuel cell technology show, the event and its counterpart were both quickly taken over by the battery industry. A quick run-down of the list of members sitting on the WES advisory council will confirm these suspicions: There are much fewer fuel cell experts on the council than there had been previously.



**Development: worse than expected**

In 2011, Sauber was still in high spirits: “This was the best f-cell we ever had.” The 2011 edition was said to have had 46 exhibitors and 1,000 industry representative at the *House of Economy*. As the location became too small, Sauber decided to have the following event take place on Stuttgart’s trade show premises. Messe Stuttgart must have certainly been happy about the offer to host a sensibly managed event, as hopes were that the trade show had some potential for growth and justifiably so.

The change in location from the *House of Economy* to the *International Congress Center (ICS)* and the added number of trade show topics did greatly increase the numbers of exhibitors that year. The first edition of the three-event combo attracted 140 exhibitors and all in all 3,233 attendees – as many as never before. Back then, Sauber confidently spoke of a “launch befitting the scope” of the endeavor.

One year after, the organizers agreed on the new name *World of Energy Solutions*, which has since stood above the three conference titles *f-cell*, *Battery+Storage* and *e-mobility solutions*. As expected, the individual events did lose in importance, but the organizers hoped to up participant numbers again by broadening the range of what was offered. Reality proved them wrong.

**e-mobil BW**

The *e-mobil BW Technology Day* has been around since 2011. It was initially designed by the agency e-mobil BW as a regional event for the electric transportation industry and organized in collaboration with Peter Sauber Agentur. After the event received a more international focus (*e-mobil BW conference*) in the following years, its name was changed to e-mobility solutions.

The battery sector has been able to make inroads at the ICS over the past three years, but by doing that it began to push out the original *f-cell* participants. Whereas the 64 exhibitors of the *Battery+Storage* had booked “regular” size booths in 2013, the 91 f-cell exhibitors had reserved smaller spaces or had joined up to rent out shared booths. In 2014, the trade show already listed more battery than fuel cell exhibitors, but their total number was a mere 138 – not the 200 the organizers had been hoping for. The event continued with its changed makeup in 2015 – and the number of exhibitors decreased again, this time to 120.

The conference part of the trade show hasn’t had any better luck: After around 600 participants in 2013, numbers went downhill, to 550 in 2014 and to 500 attending the symposium last year. Overall participation was around 3,000 over the years, but showed a significant decline in 2015 with around 2,700 attendees. Despite the numbers, Sauber has not lost his confidence. When asked by *H2-international* about the current situation, he attributed the downward trend, for example, to the lack of commitment by Chancellor Angela Merkel to electric transportation, as was evidenced by the fact that she did not promise the expected additional support during the *National Conference* in June 2015. “In spite of last year’s slump, we are in a good position,” Sauber concluded.

**Key topic: Energy storage**

Another reason for the drop to ever lower numbers may be the fact that especially energy storage has become the topic of presentations and discussions elsewhere in the trade show world. For instance, *Energy Storage – The International Summit for*

*the Storage of Renewable Energies* had its launch in Düsseldorf in March 2012. Within three years, the conference and its accompanying exhibition (20 exhibitors) have become serious competition, as Messe Düsseldorf has managed to bring in well-known partners, such as the German Association of Energy and Water Industries, the German Energy Storage Association, EUROSOLAR and OTTI.

### Leading trade show

In 2016, the [\*Energy Storage Europe\*](#) has been listed as Germany's leading global trade show on energy storage for the first time. The listing enables start-ups to receive back up to 70% of their exhibition costs as part of a BMWi grant program.

During the first year, the conference organizers counted 350 industry experts. In 2015, there were 1,800 participants across five conferences. After 67 exhibitors in the previous year, last year's trade show boasted 93 organizations covering the entire energy storage range from batteries and Power-to-Gas to hydrogen. And in 2016, the organizers expect another significant increase (around 125 exhibitors and 3,000 visitors).

The World of Energy Solutions did, in fact, try to get institutional support for the Battery+Storage by asking the German Engineering Association (VDMA). According to Dr. Eric Maiser, head of VDMA Battery Production, however, the association was focused more on mechanical engineering and battery cell production (consumer electronics), which means it shared little with the fuel cell industry. Dieter Manz, CEO of Manz, even admitted: "Electric transportation is currently not on our radar." Additionally, 2015 brought about somewhat of a marketing blunder, when the VDMA did not present its recent business climate survey "at the *World of Energy Solutions*," as claimed in a Messe Stuttgart press release on the WES opening, but had already done so on June 15, 2015. Until today, there hasn't been any institution that could support f-cell based on mutually shared ideas or professional input.

### New focus: coming in 2016

This meant that the WES PR material has put the spotlight on batteries in recent years. Both the press releases of Messe Stuttgart and the previous press conferences mostly revolved around the manufacturing of these power storage devices, so that the f-cell logo can still be found on the website and the schedule, but hardly has anything to point to anymore.

When asked by *H2-international* about whether there were already plans in October 2015 to change the frequency of the event, Ulrich Kromer von Baerle, CEO of Landesmesse Stuttgart, replied: "Right now, we are not thinking about taking a break in 2016, but we'll have to assess that at a later time." Still, it should be clear by now that the organizer had originally hoped for a more positive *WES* outlook. After all, a trade show host strives for the maximum utilization of hall capacities. Some changes will be needed to achieve that goal – especially in light of the *30th Electric Vehicle Symposium*, which is scheduled to take place between Oct. 9 and 11, 2017, at the same time as the *WES*.

The 2016 date has already been set as well: October 10 to 12. Until then, however, Landesmesse Stuttgart, Peter Sauber and Stuttgart Region Economic Development Corporation should think about how to make the event more appealing again – both for the attendees and the exhibitors. If the entire "World of Energy Solutions" is to be

represented, it needs other well-known players as exhibitors and/or partners at the latest in 2017. Another important issue will be how and if the event can hold the interest of the fuel cell community. The cozy atmosphere of the House of Economy is no more and the information exchange so essential to the industry has taken a dive because of it. It is time to rekindle the flame – whether by gaining strong partners, or offering intriguing side events or networking opportunities.

It is not the organizer's job alone, however, to present novelties. The different market players, the many large and small companies, research institutes and also the associations and agencies: All of them will have to contemplate over the next months and years about where they are heading. Whoever wants to still do years-long research does not need a trade show – a conference to present results would be enough. But whoever wants to market products requires the appropriate platform to meet up with the right contacts at one central spot. And whoever wants to advance products and sell them as well requires both, which is why the combination of conference and trade show has such appeal.

I would wish the *WES* or *f-cell* – whichever name they will keep on using – all the best for returning to old strength, as it has been a constant and influential event on the long and winding road towards fuel cell advancement over the past 15 years.

*Author: Sven Geitmann*

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## ESE and IRES Become One



Messe Düsseldorf and the European Association for Renewable Energy (EUROSOLAR) agreed at the end of last October to work together more closely in the future. They signed a collaboration agreement to better link the *International Renewable Energy Storage Conference (IRES)* with the *Energy Storage Europe (ESE)*. The tenth year since its inception will see IRES – which is considered by its organizers to be the “leading conference on research and social aspects of energy storage” – merge with ESE, a conference primarily focused on economic and financial issues. After participants who came to the conferences over the last two years voiced their confusion about which event was more appropriate to attend, the new contract and the combination of the best of both worlds is hoped to make up for the prior lack of clarity. Most probably, there will be a combined conference ticket for the key issues.

Hans Werner Reinhard, CEO of Messe Düsseldorf, explained: “Many visitors will now find it infinitely easier to create their own individual program tailored exactly to their needs.” Irm Scheer-Pontenagel, CEO of EUROSOLAR, added: “The conference partnership guarantees that researchers, scientists, industry and business representatives as well as politicians can enter into a dialog with one another.”

## H2 Storage Ground Under



© RAG

Europe's first research facility to test the storage opportunities for hydrogen at former natural gas reservoirs was inaugurated last fall in Austria's city of Pilsbach. On October 5, Austria's Minister for Transport, Innovation and Technology, Alois Stöger, celebrated the inauguration of the plant, which is part of the EUR 4.5 million project Underground Sun Storage, in the presence of the project partners and many invited guests. The core of the plant consists of four alkaline electrolyzer stacks, with two each housed in two 40-foot containers by Etogas, a company based in Germany's Swabia region. Their units (maximum rated output power: 1.2 MW) use water and sun or wind energy to create 250 Nm<sup>3</sup> of hydrogen per hour, which is mixed with natural gas and stored in naturally formed pore systems below ground. The expressed aim of the Austrian consortium is to evaluate the impact of hydrogen on underground reservoirs, research which has rarely been done before.

"As an Austrian business and Power-to-Gas pioneer, Etogas takes special pride in supporting this project and supplying it with our innovative electrolysis systems," Managing Partner Dr. Karl Maria Grünauer, said. Markus Mitteregger from consortium leader RAG Rohöl-Aufsuchungs Aktiengesellschaft added: "As an energy source, gas can be transported safely and without above-ground pipes across the underground infrastructure and stored ecologically sustainable in also available naturally occurring reservoirs. Thanks to its excellent geological conditions for underground storage, Austria can contribute a great deal to supply security."



The project, for which planning and financing started in 2012, was supported with EUR 2.8 million from the Austrian Federal Ministry for Transport, Innovation and Technology as well as the country's Climate and Energy Fund.

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## From SolviCore to Greenerity

Umicore and Solvay, the former mother companies of SolviCore, sold their joint venture in July 2015 to Toray Industries, a chemical company based in Japan. On Jan. 1, 2016, business management was handed over to Greenerity, a 100% subsidiary of Toray. SolviCore was founded in 2006 as a specialist for membrane-electrode assemblies (MEA). The headquarters in Hanau-Wolfgang is said to be kept, as is the entire staff.

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## 474 Fuel Cell Heating Systems after 7 Years



*Dr. Klaus Bonhoff*

Despite the fact that the envisioned number of 800 fuel cell heating systems was not even close to have been achieved, there was a lot of praise going around when the partners of the *Callux* project celebrated the completion of the Field Test of Residential Fuel Cells on Nov. 26, 2015. In the Erich Klausener Hall at the Federal

Ministry of Transport and Digital Infrastructure (BMVI) in Berlin, Parliamentary State Secretary Norbert Barthle said *Callux* was “highly gratifying – a wonderful project.”

The final event started with a short movie in which the project partners and many satisfied customers of the test run extolled the virtues of the new technology. Immediately thereafter, Barthle explained in his opening speech in reference to these “testimonials” – at least, that is what he called the ad clips – and the seven-year field test: “This project has brought together companies usually seen as competitors. [...] In my view, the results speak for themselves.”

### **No to costs, yes to availability**

*Callux* was introduced at the same location in September 2008 as the first pioneering project of the *National Innovation Programme Hydrogen and Fuel Cell Technology (NIP)* with the aim of installing 800 fuel cell units outside of the lab by 2015. The project, which ran from July 1, 2008, to June 30, 2015, led to various technological advancements as well as many, many experiences based on over 5 million operational hours.

System costs were cut down by 60% over three generations; both manufacturers and technicians were trained to boost unit availability to above 96%. Electric efficiency is now up to over 33%. All in all, the project created more than 3 million kilowatt-hours of electricity. One system alone saves one to two tons of carbon dioxide per year, depending on the type of building.

The criticism lodged against the project and the “mere around 500” units that were actually installed was rejected by Barthle: “Such complaints don’t consider the bigger picture.” He said that the federal government supported research into any technology, but that ultimately “marketing is the companies’ business.” The market decided what would win over customers in the end. Dr. Klaus Bonhoff, CEO of NOW, also stressed the project’s successes: “Despite the total number not matching target figures, the 1,000 units installed make Germany the leader in Europe.” He even went as far as saying that, “NIP paved the way for an accelerated market introduction.”

### **In retrospect**

*“The consortium partners are optimistic that the first stage of the project until 2012 will already result in so many fuel cell heating installations across Germany that the second stage can be used to start market rollout.” (Callux press release from 2008)*

Regarding Japan and the much more than 100,000 systems in operation there, NOW’s President provided the following – very brief – explanation: “Competition is good for business.” A similarly short reply was given by the *Callux* spokesperson when *H2-international* asked him why the mark of 500 [fuel cell heating systems](#) had already been mentioned in an announcement last spring: “The number was rounded up. That’s nothing unusual.”

### **Many setbacks**

Conversely, Alexander Dauensteiner, spokesperson and Head of Product Management Innovation at Vaillant, talked about the “many, many setbacks,” but insisted that the “fuel cell is the right device at the right time.” Afterward, he again used the metaphor of a marathon run, during which “you’ll need someone to provide

you with that cereal bar and that glass of water.” What he was referring to was the BMVI’s financial support, which could be better compared to Thanksgiving turkey and Christmas cider than to bread and water, to stay with the image. Overall, the government threw EUR 75 million at the project, EUR 36 million of which were grants.



*Alexander Dauensteiner*

After 474 systems have now been in operation for an average of two to three years each, the *Callux* partners expect installation figures to increase to 26,000 by 2020, and even to 165,000 by 2025. This kind of growth, however, would require 1,500 fuel cell units in operation until the end of 2016.

Whether this is a realistic goal will depend mainly on how the expected technology rollout program is implemented (see [interview](#) next page). Barthle was confident that it would be achieved: “We are at the beginning of commercial market entry.”

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## Technology Rollout Program Not Before Mid-2016



Thorsten Herdan, © BMWi

Most of his working life, Thorsten Herdan held jobs in the industry developing combustion technology. After having been elected secretary-general of the *International Council on Combustion Engines*, the mechanical engineer also served as chair of the Research Association for Combustion Engines for fourteen years. Since 1999, he has headed Power Systems, a sector group of the German Engineering Federation – from 2000 on, he has been responsible for Energy Policy there as well. The now 49-year-old switched roles in June 2014, when he went into politics and took up the position as Director General Energy Policy at the Federal Ministry for Economic Affairs and Energy (BMWi). Current events have had us contact him about the latest news on the *Technology Rollout Program (TEP)* and the goals of his ministry.

*HZwei: Mr. Herdan, if I may ask, what prompted you to change sides by leaving the industry and going into politics?*

Herdan: I was very delighted about the offer I received and, of course, it is and has been a very interesting challenge. Today, I can confirm it was worth the effort. I really enjoy working on energy policies, as it allows me to play an active role in shaping the country's energy transformation.



*HZwei: Shortly after you started working for the BMWi, you quoted the ministry's website during an online interview when saying that not only does "nuclear energy need to be replaced by renewables, but an integrated approach" was required. What role do fuel cells have in this integrated approach?*

Herdan: The energy transformation is Germany's path to a safe and secure, as well as sustainable and economically successful future. Its core element besides the growing expansion of renewables is the penetration of the market with efficient energy conversion technologies. Regarding overall efficiency, the aim must be to develop an integrated energy approach incorporating the consumption sectors power, heat and transportation. Hydrogen and fuel cell technology will play a key role in reshaping the industry.

*HZwei: You also spoke a lot about efficiency increases and said: "The decrease in power and heat consumption is what will really bring the country's energy transformation forward." However, not once did you mention fuel cells as an option. Why not?*

Herdan: That the fuel cell is key to covering future energy demand is indisputable. Its conversion efficiency, the combination of heat and power and the local zero-emission output offers many advantages for stationary and mobile energy supply.

*HZwei: During another interview in March 2015, you explained that it was your intent to give the heat segment more priority within the Market Incentive Program (MAP), for instance, by providing more subsidies for solar thermal and biomass. You did adjust the MAP accordingly, but excluded fuel cells in the revision of the law. Why?*

Herdan: We use several, technology-specific subsidy measures to advance the energy transformation in the heat market. Anyone thinking about using fuel cells had already been able to apply for the KfW programs for CO<sub>2</sub> building renovation. We will now expand financial assistance even further by offering a separate program at the KfW to boost the mass market rollout of the fuel cell. The market incentive program for renewable energies is a horse of a different color: With it, we try to encourage the installation of – as the name says – renewable energies. The fuel cell would not match the program's objective.

*HZwei: All right, then we move on to NIP: Currently, fuel cell professionals are eagerly awaiting the announcement of a political decision and they are asking themselves what the new National Innovation Programme Hydrogen and Fuel Cell Technology, NIP 2, will actually look like. First, could you confirm that there are actually plans for another ten-year subsidy program?*

Herdan: At the NIP general assembly held last year in conjunction with the status seminar of the BMWi Energy Research, our Parliamentary State Secretary Uwe Beckmeyer stressed the success of NIP in his opening words and promised further support for the NIP follow-up program. In other words: The program will continue. At present, all departments involved in NIP – BMVI, BMWi, BMBF and BMUB – are working out the details.

*HZwei: The transportation ministry contributed much more financial resources to NIP 1 than your ministry did. Which of them will be managing NIP 2?*

Herdan: As I already mentioned, there are four ministries participating in the NIP 2 consultations. Because of the greater financial contribution, the program will – again – be headed by the transportation ministry.

*HZwei: During the NIP general assembly, the BMVI already pledged EUR 160 million to the project until 2018 – primarily intended for the transportation sector, for expanding the H2 infrastructure. Regarding your contribution to the program – with a greater focus on stationary systems – which amount of financial resources are we talking about?*

Herdan: Your question refers to the fields mentioned in the NIP list of measures. The BMWi will continue its support for applied research, having allocated more than EUR 20 million per year to it within the budget of the energy research program. A new field is the market uptake of stationary fuel cell technology. From 2016 on, we plan to support the market uptake of stationary fuel cells with a power of up to 5 kWel through the Technology Rollout Program. To implement it, we have a million-euro budget in the double digits available for 2016 through 2018.

*HZwei: As you already mentioned, the negotiations about the design of the so-called Technology Rollout Program for stationary fuel cells continue. Could you please elaborate on what is being negotiated about still?*

Herdan: The follow-up first required an update of the available forecasts and assessments, which allowed us to develop the cornerstones of the new subsidy program. This task was given to IZES, which had already developed a TEP design in 2012 on behalf of the BMWi. Additionally, we needed to make sure that our subsidy program was in line with the competition policies of the EU Commission. Moreover, the program needed a sensible alignment with other mechanisms (e.g., the ones based on the [CHP Act revisions](#)). Finally, there were and there are many rather administrative issues to resolve regarding application and approval. I expect the program to be ready for launch in mid-2016.

*HZwei: What actually are the exact goals of the program?*

Herdan: As part of the current NIP, the national pioneering project [Callux](#) proved successfully that fuel cell heating systems are ready to enter the residential market. Based on the experiences with this program, we are now taking the next step: Starting this year, we will use a grant program to support the market uptake of highly innovative stationary fuel cell heating systems in smaller sizes of up to 5 kWel as part of the Market Incentive Program Energy Efficiency. The demand-based approach with subsidies being reduced over time is intended to up sales, reduce costs and sharpen the technology's competitive edge. It will be closely monitored by NOW to track technological and economic milestones and to give recommendations on further research and development whenever possible.

*HZwei: This translates into which fields of application at which power levels?*

Herdan: TEP is limited to power levels of up to 5 kWel, as this segment is seen as the most promising in terms of demand and the manufacturers of these systems are ready for mass production. The program primarily addresses private homes whose owners are in the middle of deciding with what to replace the old heating system and may be interested in a highly efficient fuel cell system to generate power and heat. Support for these systems at industrial and commercial businesses may follow a bit later.

*HZwei: What about bigger plants, meaning fuel cell systems above 5 kWel?*

Herdan: Our first priority is to give the industry a noticeable boost by subsidizing smaller systems in higher quantities. In our view, which was affirmed by the IZES study, it would be too early to establish a technology rollout program for plants above 5 kWel. The currently available fuel cell systems have very different specifications and applications, and some of them are very technologically advanced whereas others are not. There is still some research and development work to be done to make the systems market-ready. This means that the BMWi will continue its efforts into researching and developing fuel cell CHP systems for commercial or industrial use in order to advance those systems and reduce their price.

*HZwei: Will this program stay limited to German products or is it also available to manufacturers from abroad?*

Herdan: The program is open to all fuel cell manufacturers on the market. Limiting the program to German manufacturers only wouldn't even be possible because of competition regulations. One should not forget as well: The more suppliers are on the market, the greater the competition will be and naturally, this will also benefit the end customer.

*HZwei: In the end, the Renewable Energy Law was the downfall of many local manufacturers because of systems at cutthroat prices coming from Asia. How do you want to prevent a similar development during the rollout of fuel cell technology?*

Herdan: I do not believe there is a risk of Asian manufacturers dominating the market in the foreseeable future. The industry in Germany is in a good position, especially thanks to strong research efforts into energy applications. In contrast to PV technology, a stationary fuel cell for the efficient power and heat generation at private homes is a complex technology that cannot be copied that easily. On a side note, German manufacturers have already started to collaborate with partners, for example, from Japan, to advance the technology on the German market.

*HZwei: Would you be able to tell us something more about the added conditions? There is said to be an investment subsidy, but for how long and how much will be granted?*

Herdan: The final IZES report was presented at the BMWi on Nov. 18, 2015, including recommendations on TEP design. The presentation was attended by all in all 20 representatives from federal (BMWi, BMUB, BMVI) and state (NRW, Bavaria, Hesse, BW) departments as well as industry associations (heating systems, fuel cells, CHP plants). All of the participants welcomed the BMWi initiative for such a program. The recommendation was to design a TEP limited to eight years and with investment subsidies decreasing over time. The exact subsidy amounts haven't been

specified yet, for example, because the increased subsidy levels of the CHP Act require a reassessment of the ones suggested by IZES. Our aim is to find the right subsidy levels for enabling a market uptake.

*HZwei: Although you cannot say something about the precise subsidy amount, one may reckon that you based your consultations on the strategy paper Advancement of the National Innovation Programme, which was published by the NOW advisory council in summer 2013?*

Herdan: Of course, we have a very good understanding of these strategy papers and lists of measures within the department – otherwise, the government would not need to establish and maintain these committees.

*HZwei: The then chair of the advisory council, Dr. Werner Tillmetz, explained in October 2013 at exactly this stage in his HZwei interview: “After the first analyses, the government would have to allocate EUR 1.6 billion to the task. Spread out over ten years, it really isn’t much for a promising technology and for a booming economy.” What part of his statement still holds true today?*

Herdan: As it stands, I cannot agree to it. One should keep in mind that a great deal of financial resources have been devoted to researching and developing the technology. The money put into it has to be earned first as well. Furthermore, I expect that the federal government will base its assistance for the NIP follow-up on the investment pledges by the industry. As far as I know, the industry promised to provide around two billion euro over ten years.

*HZwei: So everything will stay as it was, especially considering the task allocation between NOW and project host Jülich as well as during the application process?*

Herdan: When it comes to follow-up programs, procedures are examined in detail, but I see no reason to reinvent the wheel.

*HZwei: Mr. Herdan, I thank you for our interesting interview.*

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## New Rule for Fuel Cell Heating Systems



© Callux

The *German CHP Act (KWKG)* has been a long-time source of subsidies for stationary units producing heat and power as efficiently as possible. Once every few years, these types of laws are revised and naturally, the revisions spark heated debates months before any political decision is made. Just in the nick of time – shortly before the end of last year – the Bundesrat finally approved the *CHP Act 2016*, so that it could go into effect on January 1.

It took almost a year to pass the new CHP Act: First, there was the discussion of the ministerial draft in July 2015, which formed the basis for devising the act approved by the federal parliament last September. The first through third reading of the draft in the German Bundestag came at the end of last year, before the new CHP Act was passed by the Bundesrat on Dec. 18, 2015.

The most important changes compared to the 2012 version are the reduced payments for self-consumption, which were adjusted downwards to 4 cents per kilowatt-hour for plants of up to 50 kW and 3 cents/kWh for plants from 50 to 250 kW (all amounts in EUR). The previous version of the act had granted 5.41 cents/kWh and 4.0 cents/kWh, respectively. Additionally, any owner of larger plants for self-

consumption – which used to be subsidized with 2.4 cents/kWh between 250kW and 2MW and with 1.8 cents/kWh for systems above 2 MW – will no longer receive any support from the program. The feed-in into the public grid used to be subsidized with 5.41 cents/kWh over ten years for smaller systems. Here, the subsidy level was raised across all categories (for systems up to 50 kW to 8 cents/kWh), but the grant period was reduced to 60,000 full hours in operation. Still, it is more than the 45,000 hours initially planned as part of the ministerial draft.

Fuel cell systems have their own special transition rule in the CHP Act, according to the BHKW info center. It applies as long as the *technology rollout program* (TEP, see [interview](#) page 16) has not been implemented. This means that operators of fuel cell systems can claim incentives based on the 2012 CHP Act if a binding order for a CHP plant is placed by Dec. 31, 2016, and the system is brought into operation by Dec. 31, 2017.

The VDI Society Energy and Environment (GEU) welcomed the extent of planning security introduced with the revisions, but criticized the target figures of the expansion (110 TWh/a by 2020 and 120 TWh/a by 2025) as not ambitious enough. The General Manager of the German Association of Local Utilities (VKU) and former parliamentary state secretary at the BMVI, Katherina Reiche, had already complained in summer 2015: “Unfortunately, the now envisioned subsidy conditions won’t suffice when taking a look at the most recent and efficient plants.” More precisely, she called on the federal government to stick to the expansion targets laid down in the coalition agreement. She said: “The formula needs to be: Two times 25 – 25 percent CHP by 2025.” The current targets are equal to a 19% share in 2020 and a 20% share in 2025.

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## OWI develops APU package of diesel and fuel cell

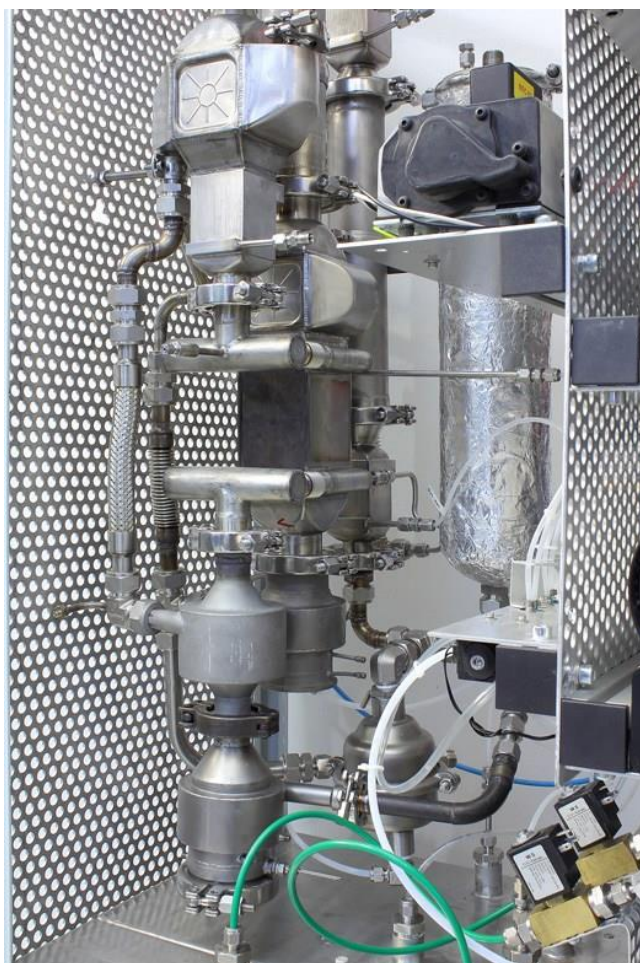
An autonomous fuel cell system developed jointly by several research partners does a quiet job of converting diesel fuel into electrical energy – without the help of an engine or generator. When the project supported by the Federal Ministry for Economic Affairs and Energy reached its conclusion, the technical maturity of the system was demonstrated with success during stand-alone operation of the fuel cell stack and the power module.

As a so-called Auxiliary Power Unit (APU), the fuel cell system for non-stationary applications developed under the auspices of the *MÖWE* project supplies transportation means such as caravans or boats with electrical energy. The APU offers a maximum net power output of 3 kWel to supply electricity to devices like air conditioning or refrigerators. To make the most of the diesel available on board, the fuel is first converted into a fuel gas rich in hydrogen. Afterward, the fuel cell will convert the gas into electricity.

### How to Replace Conventional Diesel Units

The fuel cell system consists of a diesel and water tank, a module to create

hydrogen, a module including a low-temperature polymer membrane fuel cell (NT-PEM with 90 cells), a battery and power electronics. The development objective was to enhance process management, reduce complexity and elevate individual components as well as modules to technical maturity. To simplify the complex unit, the developers streamlined the process chain: Fuel gas that the fuel cell cannot convert is not burnt in a separate component anymore, but is oxidized directly during combustion on the reformer part. The new design no longer requires an additional fuel gas burner, including related system components. Additionally, it does away with the need for a cooling circuit and increases functional safety through the use of metal felt instead of a fuel-injection nozzle.



*Diesel powered fuel cell system, © OWI*

Another essential step was the start-up acceleration achieved by enhancing the H<sub>2</sub> production module. The employment of a burner-side mixer, which could either be used as a start-up burner or a mixing unit based on the cool flame technology shortened the ramp-up time of the fuel processor to a good half hour. And a new start-up approach further decreases the time required to fire up the entire system to under 30 minutes, as it enables a simultaneous, responsive heat-up of the catalytic reactors.

As soon as the reformer reaches the necessary operating temperature for oxidative steam reforming (OSR), air is let in to be mixed with fuel and steam. The resulting, albeit temporary, partial exothermic oxidation of the fuel gas releases heat directly



into the reformer component. The aim was to find a quicker way to provide reforming and supply heating to the water-gas shift reaction of the H<sub>2</sub> production module. At the same time, the process allows the fuel cell to reach operation temperatures more quickly. When the approach was implemented, the different operation modes could be seen in the mixer. It required no changes to the components of the hydrogen module.

In operation mode A, the metal-felt evaporators are being preheated electrically. In mode B, the two start-up burners are ignited to preheat the reformer catalysts. Mode C will start the cool-flame operation at the burner-side mixer, in order to directly heat the reformer through catalytic combustion. As a result, the heat-up of the reformer will also be visible at the outlet.

As soon as the temperatures required for OSR operation is reached at the inlet and in the middle of the reformer, the system will change to reforming mode (mode D). OSR is used to heat the water gas-shift reactors and, optionally, the selective oxidation reactor. When all system components have reached their operation temperatures, OSR will switch to steam reforming (SR). This strategy helped push the time needed until steam reforming was in effect down to between 20 and 25 minutes.

### **Current state of development**

March 2015 was the month in which design and installation were concluded and the demonstration system was brought into operation. The functional capabilities of the system were showcased successfully during stand-alone operation of the fuel cell stack and the power module over a sample test cycle. During the run, the system operated without being connected to the lab infrastructure (stand-alone run). Tanks supplied all required transfer fluids. The amount of inlet air was regulated by a fan. The electrical energy created was consumed to supply internal system components, charge the battery or otherwise utilize the energy. During the demonstration, the use cases for electrical loads were construction site floodlights requiring around 300 watts each as well as a temperature control system with a power output in the range of 1 kW. The battery was used to initiate several stand-alone system start-ups.

### **Benefits**

Compared to other fuel cell systems in similar applications, the advantages of this development combining diesel-steam reforming and a polymer electrolyte fuel cell are:

- As the system is run by diesel, it does not require additional fuel. Diesel is available everywhere and possesses a high energy density.
- Steam reforming results in extremely high H<sub>2</sub> gains at great partial pressures (up to 70% dry, no N<sub>2</sub> dilution).
- The NT-PEM fuel cell is market-ready, offers a long lifespan and short start-up times.

One challenge with which the developers were faced throughout the entire joint *MÖWE* project was the impact of the reformer operating temperature on stability when using a low-temperature PEM and commercially available diesel. A long-term test of the reformer with heating oil low on sulfur confirmed that catalyst degradation

caused by sulfur and soot when reforming can be largely avoided by implementing a new regeneration approach.

### **With what to replace conventional generators**

Portable generators with an output of around 3 kWel have so far been only available with gas or diesel engines. Noise and emission regulations, however, restrict their use on parking lots for motor homes or in port areas. Conversely, the fuel cell system presented above is low on noise, emissions and vibrations. The developers see the diesel-fuel cell APU as a promising technological approach that could spark the interest of several market segments, such as motor homes or yachts.

### **Project partners**

- MAHLE Behr GmbH & Co. KG, Stuttgart
- ENASYS GmbH, Berlin
- inhouse Engineering GmbH, Berlin
- OWI Oel-Waerme-Institut GmbH, Herzogenrath

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## **Fellbach and the Nineteenth H2 Station**



*H2-Station Fellbach, © CEP*



Another hydrogen filling station has been brought into operation, this time in Fellbach, north-east of Stuttgart. The fifth of its kind in Baden-Wurttemberg is a multi-energy station by Total. It operates with 700 bar of filling pressure and is supplied by hydrogen generated on-site through solar and wind power. The inauguration ceremony in the presence of representatives from politics and members of the *Clean Energy Partnership* was held on Oct. 1, 2015.

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## An airport's search for sustainability



### *Stuttgart airport turns into fairport STR*

Innovative projects are something of a tradition at Stuttgart Airport: Echterdingen is home to several [fuel cell airplane models](#), Baden-Wurttemberg's first public hydrogen filling station set up in 2009 and hybrid technology field tests since 1991. The most recent project involves field-testing six electrically powered buses for regular day-to-day use. On Oct. 13, 2015, Stuttgart Airport presented its new electric bus fleet, which is expected to provide "more sustainable" passenger transportation around the airfield.

At the same time the [World of Energy Solutions](#) took place on the nearby trade show premises, Professor Georg Fundel, CEO of Stuttgart Airport (FSG), inaugurated the first *eCobus 3000* together with Winfried Hermann, minister of transport and infrastructure of the state of Baden-Wurttemberg. The *eCobus 3000* is one of six electrically driven buses of the Cobus brand used across an airport's maneuvering areas and aprons. The three-meter wide bus can carry up to 112 passengers and possesses a lithium-titanate battery (95 kWh) offering a rated capacity of 160 kW.

Cobus Industries, known as one of the leading manufacturers of buses used at airports, also supplied Stuttgart Airport with the other six vehicles, which are still running on diesel. The new buses, however, will reduce energy demand per passenger by around 80% compared to the diesel version, saving more than 22 tons of CO<sub>2</sub> each year. The technology was thoroughly put to the test at the airfield before positive results made it the world's first electric airport bus employed in day-to-day operations.

FSG receives 40% of the additional costs incurred compared to diesel-run vehicles from Baden-Württemberg's state initiative *Electric Transportation II*. The set-up of new filling stations as well as the power infrastructure was also supported by subsidies: The European Union and the Federal Ministry for Economic Affairs and Energy contributed more than half a million euro to the project.

### **One dozen electric vehicles around the airport**

During the presentation of the new electric buses, Fundel's team also showcased another six electrically driven off-highway vehicles, which are thought to jointly provide clean transportation around Stuttgart Airport. Both the buses and a baggage carousel run on electricity, while a pushback vehicle (*model F110*) that operates on battery power moves the jets out of their parking spaces. All of them are part of the e-fleet program. Additionally, there is a fuel cell car (Mercedes B-Class *F-CELL*) which has already been in use in Follow Me mode since 2010, an electric van (Mercedes *Sprinter*) for airport transports and a hybrid vehicle (Opel *Ampera*) for airport police, as well as two electrically driven baggage tractors.

Airport manager Fundel explained during the presentation of the vehicle fleet: "Electric engines are a perfect fit for airport processes, as mileage is small (80 kilometers per day; editor's note). After thorough testing, we're getting down to business. Wherever feasibility, sustainability and work safety go hand in hand, we will rely on electric transportation in the future." Transport minister Hermann added: "The decision pleases me greatly, as it will mean that – as "fairport" – the state's primary airport will continue to be a driving force of ecological sustainability across Germany and Europe."

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read more: [www.h2-international.com](http://www.h2-international.com)

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## Events

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- March 15th 2016, **The Commercialisation of Hydrogen & Fuel Cell Technology**, in Birmingham, United Kingdom, [www.climate-change-solutions.co.uk](http://www.climate-change-solutions.co.uk)
- March 15th to 17th 2016, **Energy Storage Europe**, Düsseldorf, Germany, [www.energy-storage-online.com](http://www.energy-storage-online.com)
- March 15th to 17th 2016, **International Renewable Energy Storage Conference (IRES 2016)**, Düsseldorf, Germany, [www.eurosolar.de](http://www.eurosolar.de)
- March 16th 2016, **5th Conference Power-to-Gas & Power-to-X for Europe's Energy Transition**, at Messe Düsseldorf, Germany, [www.otti.eu](http://www.otti.eu)
- April 13th to 14th 2016, **Grove Conference Fuel Cells Science and Technology**, in Glasgow, United Kingdom, organized by Elsevier, [www.fuelcelladvances.com](http://www.fuelcelladvances.com)
- April 25th to 29th 2016, **Group Exhibit Hydrogen + Fuel Cells + Batteries**, in Hannover, Germany, [www.h2fc-fair.com](http://www.h2fc-fair.com), [www.hannovermesse.com](http://www.hannovermesse.com)
- April 27th to 28th 2016, **Electric Vehicles Europe 2016**, in Berlin, Germany, [www.idtechex.com/electric-vehicles-europe](http://www.idtechex.com/electric-vehicles-europe)
- May 30th to 31st 2016, **The Future of Electric Vehicles**, in Frankfurt am Main, Germany, [www.claridenglobal.com](http://www.claridenglobal.com)
- June 13th to 16th 2016, **World Hydrogen Energy Conference 2016**, in Zaragoza, Spain, [www.whec2016.com](http://www.whec2016.com)

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## Companies

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### Electrolyzers

#### **AREVA H<sub>2</sub>Gen**

- **AREVA H2Gen GmbH**, Maarweg 137, 50825 Cologne, Germany, Phone +49-(0)221-888244-88, Fax -67, [www.arevah2gen.com](http://www.arevah2gen.com)



#### **Diamond Lite SA**

- **Diamond Lite S.A.**, Rheineckerstr. 12, PO Box 9, 9425 Thal, Switzerland, Phone +41-(0)71-880020-0, Fax -1, [diamondlite@diamondlite.com](mailto:diamondlite@diamondlite.com), [www.diamondlite.com](http://www.diamondlite.com)



- **Giner, Inc.**, 89 Rumford Avenue, Newton, Massachusetts 02466, USA, Phone +1-781-529-0500, [information@ginerinc.com](mailto:information@ginerinc.com), [www.ginerinc.com](http://www.ginerinc.com)

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### Energy Storage

- **GKN Powder Metallurgy**, GKN Sinter Metals, PO Box 55, Ipsley House, United Kingdom – Redditch B98 0TL, Worcestershire, [www.gkn.com/sintermetals](http://www.gkn.com/sintermetals)



- **Hydrogenious Technologies GmbH**, Weidenweg 13, 91058 Erlangen, Germany, Phone +49-(0)9131-12640-220, Fax -29, [www.hydrogenious.net](http://www.hydrogenious.net)

### Event Organizers



- **22nd Group Exhibit Hydrogen + Fuel Cells + Batteries**, HANNOVER MESSE 2016, April 25 – 29, Tobias Renz FAIR, Phone +49-(0)30-60984556, [tobias@h2fc-fair.com](mailto:tobias@h2fc-fair.com), [www.h2fc-fair.com](http://www.h2fc-fair.com)
- **GL events Exhibitions**, 59, quai Rambaud, CS 50056, 69285 Lyon Cedex 02, France, Phone +33-(0)478-17633-0, Fax -2, [www.gl-events.com](http://www.gl-events.com)

### Fuel Cells



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- **FuelCell Energy Solutions GmbH**, Winterbergstr. 28, 01277 Dresden, Germany, Phone +49-351-2553739-0, Fax -1, [www.fces.de](http://www.fces.de), Stationary fuel cells for commercial and industry: CHP solutions, hydrogen production and power storage
- **Heliocentris Energy Solutions AG**, Rudower Chaussee 29, 12489 Berlin, Germany, Phone +49-(0)30-340601-500, Fax -599, [info@heliocentris.com](mailto:info@heliocentris.com), [www.heliocentris.com](http://www.heliocentris.com)



- **Tropical S.A.**, 17 Krokeon Str, 10442, Athens, Greece, Phone: +30-(0)210-5785455, Fax: -7, [info@tropical.gr](mailto:info@tropical.gr), [www.tropical.gr](http://www.tropical.gr)



### Fueling-Recirculation and Air-Supply



- **Busch Clean Air S.A.**, Chemin des Grandes-Vies 54, 2900 Porrentruy, Switzerland, Phone +41 (0)32-46589-60, Fax -79, [info@buschcleanair.com](mailto:info@buschcleanair.com), [www.buschcleanair.com](http://www.buschcleanair.com)

### Gas Diffusion Layers (GDL)



- **SGL Carbon GmbH**, Werner-von-Siemens-Str. 18, 86405 Meitingen, Germany, Phone +48 (0)8271-83-3360, Fax -103360, [fuelcellcomponents@sglgroup.com](mailto:fuelcellcomponents@sglgroup.com), [www.sglgroup.com](http://www.sglgroup.com)

### Hydrogen Distribution



- **Hydrogenious Technologies GmbH**, Weidenweg 13, 91058 Erlangen, Germany, Phone +49-(0)9131-12640-220, Fax -29, [www.hydrogenious.net](http://www.hydrogenious.net)



- **Wystrach GmbH**, Industriestraße 60, Germany – 47652 Weeze, Phone +49-(0)2837-9135-0, Fax -30, [www.wystrach-gmbh.de](http://www.wystrach-gmbh.de)

## Membrane and Separator



-  **FuMA-Tech Gesellschaft für funktionelle Membranen und Anlagentechnologie mbH**, Carl-Benz-Str. 4, 74321 Bietigheim-Bissingen, Germany, Phone +49-(0)7142-3737-900, Fax -999, [www.fumatech.com](http://www.fumatech.com)



- **Plansee SE**, Bipolar Plates, Interconnects and Metal Supported Cells, 6600 Reutte, Austria, Phone +43-(0)5672-600-2422, [www.plansee.com](http://www.plansee.com)

## Organization



- **Deutscher Wasserstoff- und Brennstoffzellen-Verband**  
**German Hydrogen and Fuel Cell Association**, Deutscher Wasserstoff- und Brennstoffzellen-Verband e.V. (DWV), Moltkestr. 42, 12203 Berlin, Germany, Phone +49-(0)30-398209946-0, Fax -9, [www.dwv-info.de](http://www.dwv-info.de)
- **hySOLUTIONS GmbH**, Steinstrasse 25, 20095 Hamburg, Germany, Phone +49-(0)40-3288353-2, Fax -8, [hysolutions-hamburg.de](http://hysolutions-hamburg.de)



- **National Organisation Hydrogen and Fuel Cell Technology (NOW GmbH)**, Fasanenstr. 5, 10623 Berlin, Germany, Phone +49-(0)30-3116116-15, Fax -99, [www.now-gmbh.de](http://www.now-gmbh.de)

## Reformers

- **WS Reformer GmbH**, Dornierstraße 14, 71272 Renningen, Germany, Phone +49-(0)7159-163242, Fax -2738, [www.wsreformer.com](http://www.wsreformer.com)

## Research & Development

- **Fraunhofer ICT-IMM**, Reformer and Heat Exchanger, Carl-Zeiss-Str. 18-20, 55129 Mainz, Germany, Phone +49-(0)6131-9900, [info@imm.fraunhofer.de](mailto:info@imm.fraunhofer.de), [www.imm.fraunhofer.de](http://www.imm.fraunhofer.de)



- **Fraunhofer ISE**, Heidenhofstrasse 2, 79110 Freiburg, Germany, Phone +49-(0)761-4588-5202, Fax -9202, [www.h2-ise.de](http://www.h2-ise.de)

## Suppliers

- **Anleg GmbH**, Advanced Technology, Am Schornacker 59, 46485 Wesel, Germany, Phone 0281-206526-0, Fax -29, [www.anleg-gmbh.de](http://www.anleg-gmbh.de)



- **Borit NV**, Bipolar plates and interconnects, Lammerdries 18e, 2440 Geel, Belgium, Phone +32-(0)14-25090-0, Fax -9, [contact@borit.be](mailto:contact@borit.be), [www.borit.be](http://www.borit.be)



- **HIAT gGmbH**, Schwerin, Germany, CCMs / MEAs / GDEs for PEFC, DMFC & PEM-Electrolysis, [www.hiat.de](http://www.hiat.de)



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### System Integration



- **Deutsches Zentrum für Luft- und Raumfahrt (DLR) / German Aerospace Center**, Institute of Engineering Thermodynamics Energy System Integration, Pfaffenwaldring 38-40, 70569 Stuttgart, Germany, Phone +49-(0)711-6862-672, Fax -747, [www.dlr.de/tt](http://www.dlr.de/tt), [www.dlr.de/tt](http://www.dlr.de/tt)



- **FLEXIVA automation & Robotik GmbH**, Power Electronics – Hybrid Energy System Solutions, Weißbacher Str. 3, 09439 Amtsberg, Germany, Phone +49-(0)37209-671-0, Fax -30, [www.flexiva.eu](http://www.flexiva.eu)

### Testing



- **TESTSOLUTIONS SMART Testsolutions GmbH**, Röttestrasse 17, 70197 Stuttgart, Germany, Phone +49 (0)711-25521-10, Fax -12, [sales@smart-ts.de](mailto:sales@smart-ts.de), [www.smart-testsolutions.de](http://www.smart-testsolutions.de)



- **TesTneT Engineering GmbH**, Schleissheimer Str. 95, 85748 Garching / Munich, Germany, Phone +49-(0)89-237109-39, [info@h2-test.net](mailto:info@h2-test.net), [www.h2-test.net](http://www.h2-test.net)

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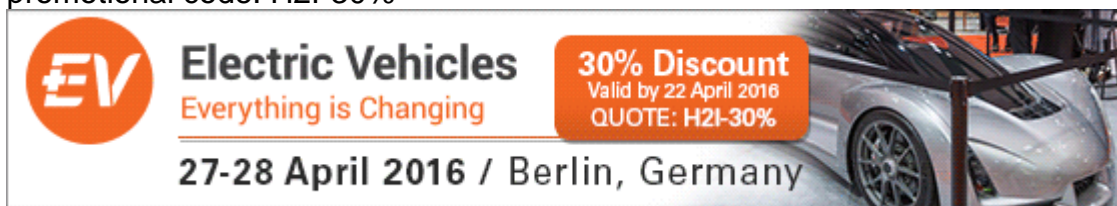
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