



## H2-international – e-Journal

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# Ten Years of HZwei News



*HZwei Cover April 2006*

Ten years ago, Hydrogeit Verlag printed its first issue of the HZwei magazine – the German counterpart of H2-international. Entitled “H2Tec” in 2000, the Magazine for Hydrogen and Fuel Cells had been published for six years prior under SunMedia before the people responsible for it intended to go their separate ways – because the industry hadn’t advanced as quickly as they had expected.

Every six months and in comparably simple layout, H2Tec had reported about the activities in the H2 and fuel cell industry on no more than 20 pages. A lot has happened since then: Circulation increased to 4,500 and the time between issues was cut in half. The number of pages grew as well – first to 32 and meanwhile to 56.

After ten years, HZwei’s editors can now rightly claim to have created the only well-established long-running trade publication on hydrogen and fuel cells across the German-speaking region. And what exciting developments did this decade have to offer?

Although everything took much more time than we had hoped, we are now seeing the first commercially available fuel cell cars that ordinary citizens are able to buy or lease (see [The Toyota Mirai Is Here](#)) – and this despite the continued hesitation of German carmakers to enter into the market. The number of H2 filling stations increased to 54 in Europe and 20 in Germany. The fuel cell heating systems that had

been on everybody's wish list for a long time are – finally – available to consumers or will be available to them this year (see [Fuel Cell Manufacturers Target Installers](#)).

At the same time, however, many companies and applications could not share in the success on the market: For example, MTU Friedrichshafen exited the industry many years ago. Instead, the company widely regarded to be its successor, FuelCell Energy, is enjoying tremendous growth and is being flooded with as many orders as never before. Masterflex has long since parked its fuel cell cargo bike in the garage. In place of German in-house developments, almost all fuel cell heating systems include a stack built in Asia. The question repeatedly asked back then was where the fuel cell would be produced in the future. This question can now be answered: The fuel cell won't be a made-in-Germany, but an imported-to-Germany product.

Another crucial stage that the HZwei editorial staff was allowed to witness was the first edition of the National Innovation Program Hydrogen and Fuel Cell Technology (NIP) – from the founding of NOW to the negotiations over NIP 2. Our preliminary assessment of the EUR 1.4 billion program is that the industry used it almost like a self-service store to help themselves to various demonstration and research projects, but that the program failed to deliver much of anything and that neither the infrastructure expansion, nor the number of heating systems came even close to matching previously set targets.

In other words: If the German Taxpayers Association were to check how much money was spent on which project, it would deliver a harsh verdict, as some things could hardly be seen as benefitting taxpayers.

All in all, we look back at the past decade with mixed feelings. What remains is the hope that over the next ten years, customers and consumers alike could finally be convinced of the advantages of H2 and fuel cell technologies.

We would also like to use this opportunity to thank all our loyal HZwei and H2-international subscribers as well as those who made the success of HZwei possible.

Sincerely,

Sven Geitmann

*Editor of HZwei & H2-international*

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## The Toyota Mirai Is Here



*Europe's First Customer Nikolaus W. Schües Reports*

What furthered my interest in hydrogen was a presentation in 1989 by Joachim Gretz, the head of the EU's Joint Research Center in Ispra, Italy, about the then running Quebec project. I had already been interested in the technology many years prior to that event: I can still remember clearly how the board chair of German Shell, Johannes Welbergen, told me during a conversation that H<sub>2</sub> was the future for which we still had to wait for a long time to come. Rudolf von Bennigsen-Foerder, the then board chair of VEBA, expressed the same sentiment during his presentation before the Christian Democratic Union's economic council, whose president I was at that time.

As more details emerged during a Rotary presentation, I suggested to our friend – the then senator Hansjörg Sinn – that we establish a non-profit association to speed up the arrival of this future. We founded the Association for the Promotion of Hydrogen in the Energy Industry, with professor Sinn as chair and me as secretary. I later assumed the role of chair myself, succeeding Mr. Fürwentsches and Mr. Gretz as the head of the association.

Organizations which backed us from the start were Airbus as well as Hamburger Hochbahn and former HEW, or what is today Vattenfall. The then mayor of Hamburg, Henning Voscherau, was one of the association's founding members. The Hamburg



Senate was also committed to our goals by having Hochbahn procure fuel cell buses. Today, the state-owned business serves as a prime example of renewable energy use: From 2020 on, Hochbahn will no longer buy any diesel buses. Hochbahn's subsidiary hySolutions bundles all H2 expertise and is one of the business leaders in the field in Germany. Günter Elste deserves the highest gratitude and admiration for his accomplishment as former president of Hochbahn.

Over the past 27 years, we have initiated various campaigns – some of our efforts invited derision, but we never wavered from our course. The ecological benefits do jump to mind first, but personally, I have always considered the economic and geopolitical aspects to be more important, even now. My article in the International New York Times was entitled: Defence by wind and solar through hydrogen.

### **The very first Mirai**

On Nov. 10, 2015, I was the first private-sector customer in Europe to be able to drive a mass-produced hydrogen car with a fuel cell, the Mirai by Toyota. Mirai is Japanese and means "future." Production figures are still small, but at least it's no longer a prototype. Nevertheless, we have to remember that the development for this type of engine is still in its infancy, just as gas engine advances were 100 years ago. This may help to imagine what potential for fuel cell development lies ahead of us over the coming years.

Sometimes, I'm asked: How does the fuel cell system work? There are two tanks underneath the back seats. They can hold up to five kilograms of gaseous hydrogen at 700 bar. Refilling the tank takes three minutes (for around 4 to 5 kg) in Hamburg's HafenCity. The fuel cell produces power through a chemical process with the help of oxygen. The generated electricity is fed directly to the electric engine at each of the two front wheels. This means there is no longer a transmission shaft that is powered by the engine. The result is rapid acceleration, no sound, no smell, no emissions – only H2O dripping from the exhaust.

You refill a Mirai almost in the same way as you would refuel any gas-driven car: The nozzle is tightly locked in place because the tank holds gas, not a liquid. The fuel costs EUR 9.50 per kilogram; you can drive around 100 kilometers per one kilogram of H2 gas.

Another question that may pop up: How far can I go with 5 kilograms in my tank? I drive in stop-and-go mode through the city. My experience is that you can go just about 370 kilometers with the car in winter. The German FAZ had test drivers travel from Dusseldorf via Hamburg – Berlin – Munich to Frankfurt, meaning on the highway, but not too fast. They were able to go as far as 470 kilometers on one tank. The Handelsblatt had the same experiment conducted, with good results.

Hamburg has three filling stations, whereas Germany has a mere 14 right now. Plans are to increase that number to 40, in a few years to 400. We need 1,000 H2 filling stations to be able to go everywhere and also come back safely.

### **Don't buy, just lease**

Yet another question is: How much does the Mirai cost? The list price is EUR 78,000. However, customers won't be allowed to pay that amount for the car, as it is only sold with a leasing contract: Four years set at a monthly rate of EUR 1,020, excluding

VAT but including service and maintenance as well as winter and summer tires. The Tesla Model S with an 85 kWh battery and comparable equipment: monthly leasing rate of EUR 1,256 (excl. VAT).

When I accepted delivery of the car, I gave Toyota my first recommendation: The car should have a water catch tank, as below zero degrees Celsius and soon thousands of fuel cell cars on the road could create icy conditions that would be especially unwelcome at sidewalk crossings. That's Toyota: Recommendation endorsed! "We need to improve the Mirai even further," the father of the project, Yoshikazu Tanaka, wrote to me from Tokyo.

Why are the Japanese – and also Korean carmakers (Hyundai) – the ones offering fuel cell cars and rapid technological advancements? Akio Toyoda, president of Toyota, did not revel as other did in the opportunities of diesel technology, but paved the way for fuel cells to conquer the market. And even the chicken-and-egg question he decided on his own. Faced with the dilemma of whether to wait on a network of filling stations to be built or to design a fuel cell car first, he told his employees: We will provide the chicken, the fuel cell car. And he advanced it to mass production, albeit the number of units is still small.

The Mirai cannot be bought but only leased for four years, which covers insurance, maintenance and other services. After four years, the customer can choose a new model. In probably two years, I will get a fuel cell Lexus. The first Mirai car was presented to Japanese Prime Minister Shinzo Abe; the second went to the governor of California. The first Mirai in Europe went to Denmark, the second to the UK and the third one to me, to Hamburg.

When I'm asked how I would rate Tesla's battery-driven car, my answer is: I have never been behind the wheel of one, but the driver of one once overtook me on the road. Well, that's great! But it's not what I'm looking for in a car. The battery, which will undoubtedly be improved over the coming years, still leads into a technological dead end. There are around 45 million cars in Germany alone. The large battery will have to be replaced every three to four years, which adds up to around 10 to 15 million batteries each year. Under ecological aspects, it's a no-brainer despite the "Yes we can" that has become so popular in Berlin's political circles. I doubt it because batteries cannot be recycled that easily. Daimler did develop a post-lifetime scenario, but according to experts, it will be of too little use, i.e., the storage capacity of the largest battery stack will only be enough to cover one day worth of power supply across Germany.

As I said, I focus on the geopolitical aspects: Hydrogen from wind or solar generated domestically through electrolysis – no dependence on countries which could not be accurately described as prime examples of democracy. The political keyword is: "Power to gas." The German word Wasserstoff is not a very popular one. In the minds of Germans, it still carries negative emotional overtones of Wasserstoffbomben (hydrogen bombs) and the Hindenburg catastrophe. The English "hydrogen" seems like the more appropriate choice.

Hydrogen gas can be stored indefinitely, whereas electricity cannot – unless you pump water into a basin on higher ground and if needed, let it flow down again to generate electricity. That may work in Norway but will be difficult to implement in

Germany considering our comparably flat terrain. There are, however, more than enough salt cavities in which the gas can be stored.

Some years ago, our hydrogen association and the German federal states of Schleswig-Holstein and Hamburg commissioned the Bolków Foundation to conduct a study on how to use the power that was generated by wind turbines but could not be fed into the grid. The recommendation was to use the power for electrolysis to generate and store an unlimited supply of hydrogen through electrolysis. H<sub>2</sub> gas is needed in the industry and as soon as the carmakers wake up, there will be an endless demand for it.

Hydrogen can also be added to our natural gas pipelines or converted into CH<sub>4</sub>, meaning methanized and vice versa. Nobel laureate Carlo Rubbia has put forward these and many other useful suggestions.

### **More than electrical resistance**

Almost all oil companies except for Shell show no or little interest in the technology. For example, Exxon focuses on algae harvesting as an alternative. The finance ministry worries more about its fuel tax revenue (in 2015 mineral oil taxes raked in EUR 40 billion, plus EUR 19 billion in VAT on gas and diesel – a tax on top of a tax). The export industry is thinking of its customers in the oil-producing countries. In turn, the oil-producing nations are thinking of their export earnings (e.g., Russia). And the oil corporations want to keep their profits and the financial authorities their corporate taxes.

The carmakers would like to continue equipping established car models with conventional engines. In Las Vegas, VW just presented the Budd-e, a battery car which is scheduled for mass production in 2020, in addition to a Golf with a battery-driven engine.

All of that won't help – the time for mass-market hydrogen will come. The agreements made in Paris need to be fulfilled; it's not only about air pollution but noise emissions as well. There are no limits to wind, solar and water power. Just recently, Rome and Milan had to restrict car usage throughout their cities. Now, it's also Stuttgart – and let's not even talk about Beijing. Additionally, Google is looking to develop the new self-driving car. It will be a fuel cell one if it wants to have a future.

Conclusion

I'm looking forward to what the future holds because I will keep heading into the same direction at the same speed. Like the saying goes: Don't just complain, do something!

[This article is based on a presentation held by author Nikolaus W. Schües at the Rotary Club in Hamburg-Altona, Germany, on Jan. 22, 2016, entitled "Mirai – The future of the hydrogen industry."](#)

*Author: Nikolaus W. Schües*

## Joi – A New Player on the Market



At the beginning of this year, Joi Scientific became the latest newcomer competition in the H2 industry. Shortly after, the company announced that it had successfully completed its first round of funding. "Joi Scientific's Hydrogen 2.0 technology is a new approach to make hydrogen a practical, clean and cost-competitive energy source. It is no longer just an energy carrier," CEO Traver Kennedy said. In a first funding effort, the American company based in the Kennedy Space Center in Florida received more than USD 5 million to realize its ideas. The main investor is Dean Woodman, who opened Merrill Lynch's first investment banking office in San Francisco in 1965 and also ensured initial funding for his son's sports camera venture, GoPro.

Details about the company have been sketchy. The only thing known until now is that a group of leading international managers, who all believe in hydrogen as an alternative energy source, have been involved in the project. And: "Additional information about Joi Scientific, the company's technology and its customers will be available later in 2016."

[www.joiscientific.com](http://www.joiscientific.com)



## Ballard: China Outlook Strikes Optimistic Chord



*H2 bus at London Tower Bridge*

The conference call of Canadian-based Ballard Power Systems about the latest figures from the last quarter of 2015 – and consequentially, for all of last year – revealed some very intriguing news, comments and plans for the future. I will refrain from discussing the figures (or losses posted) and interpreting them (how the individual business fields developed). Instead, I will focus on the excellent outlook and quote CEO Randy MacEwen: “We delivered a number of landmark achievements in 2015 in each of our two growth platforms. These achievements position us strongly for growth and improved financial performance in 2016 and beyond.”

### **Be ready for mass production**

What this means in detail: There are one hundred and fifty fuel cell hybrid buses in use in 20 cities around the world. But these buses are mostly prototypes. Still, by Ballard’s own account, the trial runs helped the company to acquire the industry’s most extensive expertise over the past 25 years. The buses ran up more than 8 million kilometers and transported over 10 million passengers. They are driven under very different circumstances at each location (road and weather conditions, H2

infrastructure, etc.), geographically or climate-wise, especially when in daily use. London boasts eight buses with 20,000 hours in operation. Extremely rare downtimes make for high reliability.

The market now offers the seventh generation of fuel cell stacks for buses. Their price tumbled by 65% over the past six years and is said to decrease by another 30%. Five hundred to a thousand fuel cell buses are planned to gain traction on Europe's roads between 2017 and 2020, which sounds like a big number but seems negligible compared to the potential for the technology in China.

Ballard received USD 48 million in firm orders in 2015. The company has already been contracted to manufacture 300 buses. I expect the first contracts for railway vehicles to be signed this year – after test runs and prototypes. If one's estimate is based on the envisioned fuel cell production of 12,000 units per year, Ballard can look forward to tremendous growth rates and will now end the time for trial runs in favor of large-scale market deployment.

China has announced the general outline of the thirteenth Five-Year Plan: Especially the transportation infrastructure and measures to combat pollution – primarily, air pollution – take priority. In the future, authorities will be required to have 50% of their vehicle fleet equipped with electric engines, which includes fuel cell technology. There are plans to purchase 5,000 electric vehicles and 5,000 buses with hybrid technology. By 2020, there are supposed to be five million electric vehicles on the road. They, too, will make use of fuel cell technology. An extraordinary opportunity.

### **Ballard captures strong position**

Ballard also does work for Volkswagen, which bought patents and purchases additional engineering services from the Canadian enterprise. Audi is VW's main driver of developments in electric transportation. It's interesting to hear members of Ballard's board of directors saying that the company had expertise and intellectual property in fuel cell technology which would be relevant and crucial to the entire automotive industry. To me, this means Ballard holds key patents. In other words: There won't be a way around Ballard for the global car industry, which gives me hope that the company will be able to generate license revenue in the future. Another interesting fact is that the milestones agreed upon with VW were not only achieved but exceeded – a better-than-expected performance.

As Ballard put it: "We believe that our team produces the world's best automotive fuel cell stack and we even developed new proprietary technology to strengthen Ballard's position in competing with the automotive industry." – My thought: Things couldn't be better.

### **Materials handling**

Almost 10,000 forklift trucks – most of them equipped with Ballard's fuel cell stacks – have already been sold on the market via Plug Power. Ballard sees opportunities here to do business with other forklift truck manufacturers as well. Hyster-Yale, too, is gaining a foothold in the industry through its acquisition of fuel cell producer Nuvera Fuelcells. Plug, however, has meanwhile begun to install its own fuel cell stacks (ReliOn), which will lead to an eventual drop in the number of orders for Ballard. Still: This segment is said to be not that profitable, so that an entry into fuel cell markets promising higher growth rates and better margins would make sense. I'd be curious

to know, however, whether Plug isn't using Ballard's patents, which would generate license revenue for the company at a later date.

Ballard's subsidiary Protonex is said to contribute USD 20 million to revenues this year. In my eyes, more important than the amount of revenue (and profits) it will create is the trust the US military has put into the company, enabling all branches to place orders with Protonex. This should pave the way for a considerable growth in orders in the future. As one of the biggest US employers, the military has come to realize the potential offered by fuel cells and hydrogen as well as their ecological benefits (see the cooperation with GM and Boeing).

Conversely, the Backup Power segment seems to make few inroads, appears to be not very profitable and may simply require too much capital. There are those big growth opportunities (e.g., in India), but it seems as if Ballard may just pass up on the opportunity altogether. Either the company will sell its investments in this field, establish a joint-venture, bring its assets into another company in the industry or even trade IP – whatever the decision, it will definitely be made in 2016.

### **Conclusion**

Ballard is in the perfect position and is increasingly aligning its interests. Shrinking the executive board and/or replacing board members by other experienced personnel is a sign of change as much as a cut in costs. The company has already netted USD 58 million in firm orders for 2016 – more than last year's total revenue of USD 56.5 million. China is the driver of company turnover, as it offers by far the greatest potential – despite simultaneous developments in fuel cell use in other countries and the increasing prominence fuel cells are gaining in other big important markets, such as the automotive industry. The same is true for batteries in hybrid engines, with Toyota being the frontrunner in this segment. But China offers economies of scale that, of course, will exert a positive influence on costs/prices for fuel cell stacks. And considering the around one billion vehicles in use around the world, there will be no other choice than to gradually replace fossil fuels by green hydrogen. Ballard is one of the big players in the industry – although the stock price hasn't yet caught up with the company's rosy outlook.

### **Risk warning**

Investors must understand that buying and selling shares is done at their own risk. Consider spreading the risk as a sensible precaution. The fuel cell companies mentioned in this article are small and mid-cap ones, i.e., they do not represent stakes in big companies and the volatility is significantly higher. This article is not to be taken as a recommendation of 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 assessments put forth in this article represent exclusively the author's own opinion. This article focuses on mid-term and long-term perspectives and not short-term profit. The author may own shares in any of the companies mentioned in this article.

*Author: Sven Jösting (written in March 2016)*

# Tesla: After Shard Drop, Shares Experience Strong Rebound



*No display, no card reader, only a charger*

The losses of the US-based company increased during the last quarter of 2015 to USD 320 million. Over the entire year, they added up to around USD 980 million. Whether you choose GAAP (the default rulebook) or the visually more enticing non-GAAP accounting standards (with the latter, the result per share seems to improve “cosmetically”) is not the main question. The larger issue is whether the trend points to a balanced result or even a profit. That was now the plan for 2016, as CEO Elon Musk announced. The currently slow pace of production of the new Model X is said to increase gradually but steadily. The forecast was at 1,000 units per week.

## **Did CEO Musk profit indirectly from the shares' ups and downs?**

Entirely in passing, there was this Reuters news piece, according to which company founder Musk had pledged more than seven million shares from his around 25% stake in the company as collateral for a “private loan” of USD 1.7 billion (that must have happened when the stock price was around USD 240). Compared to that, his headline-grabbing contribution of tens of millions to the last capital increase seems almost like a forgettable incident. In my opinion, both leave a bitter aftertaste, as loan collateral in form of shares can be considered a temporary partial liquidation. The ones providing the loans, the banks – at least, that is my assumption (no guarantee it



really happened that way) – may have safeguarded by hedging. Because the share price has meanwhile dropped by more than 40%, I'm wondering whether Musk or only the banks embarked on this journey. If only the banks were involved, they may urge for more collateral, as the 1.7 billion loan is now secured to a much smaller degree. Or they may have been able to secure the loan by buying shares after the stock virtually crashed.

What looks like the most probably scenario to me is that shares were basically sold short because the loan amount matched almost exactly the stock price drop of the shares secured as collateral. In short: A smoke screen that is easy to see through but can be classified as a "mental game." Meanwhile, the CEO has profited – indirectly – or he has safeguarded, at least that is how I see it. He himself rated his company performance at previous stock prices of around USD 250 as "sufficient" – appropriate to the situation. News that again propelled the strongly weakened stock in (a calculated?) response to the top focused on the potential of the upcoming Model 3.

The announcement that the market-ready Model 3 (allegedly priced at USD 35,000 before subsidies) would be presented at the end of March 2016 and would be available for pre-order – by advance payment – has recently led to strong growth in share prices to again USD 230 (after the shares had been quoted at as low as USD 140). Tesla continues to rely on word-of-mouth and pays, in my opinion (but without guarantee), existing customers USD 1,000 to get new consumers on board and offers another USD 1,000 to these new buyers (source: Seeking Alpha). I have great doubts about the viability of this strategy in creating sufficient demand. I will go even further and say that I believe it is necessary for Tesla to run large advertising campaigns to present the new models. So far, the company has refrained from doing just that because there were enough first movers. A glance at the competition and their huge ad budgets means that Tesla would have to dig deep into its pockets, something that seems to have been neglected by analyst estimates. We would be talking here not about a few million, but about tens or hundreds of millions.

### **Will the Gigafactory be downsized?**

There are a number of opinion pieces on the Gigafactory for lithium-ion batteries which say that every milestone took longer to achieve than had been expected, starting with the number of employees (one of the basic requirements by the state of Nevada to grant considerable tax cuts) to the ramp-up of production (as reported previously, the lithium supply seems to be not that easily secured). Regarding batteries – which, of course, play a vital part in large-scale production – rumors are that Tesla will favor a temporary solution of continuing to order cells from Asia and at the same time possibly reduce the very capital-intensive investment in the megafactory or extend the period of investment, in order to retain more liquidity.

Surprisingly, Tesla had meanwhile gotten the backing of Daimler head Dieter Zetsche, who reversed his stance on batteries, which he said were better than previously thought because it had been possible to reduce charging times and increase the mileage (500 kilometers are considered achievable). Daimler is currently building its own battery factory for EUR 500 million and has recently ended its cooperation with Tesla, which means that Tesla will certainly not receive any more battery orders from the German carmaker.



Also surprising was Zetsche's negative view of fuel cells: He considered the hydrogen infrastructure to be insufficient. I have a different perspective on it, as I believe that the market for combinations of fuel cell and batteries will continue to grow the more H2 filling stations there are. Both electric transportation solutions clearly exist side by side. There is no either-or, as the use of both types of electric cars depends on many factors (purpose, range, price, etc.). At the end of 2017, Tesla intends to enter the arena with a car facing considerable competition, so that the grandiose targets of selling several hundred thousand units by 2020 have to be taken with a grain of salt – also because the production would require a considerable amount of “fresh” capital. Additionally, there is the question of when the Gigafactory will start churning out batteries and under which conditions. Tesla's sister company SolarCity (where Musk's are top managers) received a battery order of around USD 15 million for a project in Hawaii – which leaves me wondering about the company's true motives.

### **Concluding thoughts about Tesla**

In my opinion, the temporary but dramatic stock price tumble has not yet reached its end. The shares will continue to fluctuate based on how the company will be evaluated over the coming 12 to 18 months. My recommendation to rely on selling options, or even short selling (only for experienced investors) or book profits, has fully paid off. The share rebound is still in full force, which netted the company over USD 10 billion and put its market capitalization at above USD 30 billion. Tesla must now prove that it doesn't have to rely on further capital increases and can stand on its own. Some good news will come in from time to time and even periods of higher-than-usual evaluation (profits from short selling through returning shares to cover the short position). But there are reasons to be cautious in the face of a USD 12 billion loss (when shares reached their lowest point) in market capitalization after only two months into the new year. Many Buy-side analysts will need to “rethink” their assessment method and their analyses are based on sometimes hardly robust calculation models. The competition isn't taking a nap either. Companies like GM are said to own battery designs that could surpass Tesla's (in terms of weight, costs, range, etc.). This year seems to be crucial to many businesses – in a positive as well as (and especially) in a negative sense.

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*Author: Sven Jösting (written in March 2016)*

## Kapferer Succeeds Müller



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A former state secretary with the German health ministry succeeds a former state secretary for the chancellor – albeit not politically but in a lobby group. Hildegard Müller, who became a member of the German parliament in 2002 and worked closely with Chancellor Angela Merkel between 2005 and 2008, stepped down from her post as chair of the German Association of Energy and Water Industries (BDEW) at the end of January this year. In October 2008, the former head of the youth organization of Germany's Christian Democratic Union at federal level took the much debated step of switching from politics into business and has since lobbied for 1,800 energy companies, including the German big four. On May 1, 2016, she took on a job at one of the four big players, RWE, and will assume “a management board position in a corporation,” as the Essen-based company put it. There, she is believed to make a fine addition to the team and considerably strengthen and advance the energy provider's agenda during its difficult restructuring process by allegedly heading a new subsidiary primarily dealing with electricity from renewable sources.

The new person at the helm of the BDEW is Stefan Kapferer, another well-connected politician, but from the Free Democrats. The now 50-year-old went in 2011 from the federal health ministry to the ministry of economy, before leaving for Paris in October 2014 to take on the position of deputy secretary-general of the OECD.

## Fuel Cell Manufacturers Target Installers



*50 Years of SHK Essen*

Is that already the market for fuel cell heating systems which everyone has worked toward for so long? No, not quite, because the Technology Rollout Program (TEP) has not yet come into force. And as long as neither manufacturers nor customers have some kind of planning security, nothing will happen. That much became clear during the SHK Essen in Germany. But TEP could apparently become a reality this summer, prompting several manufacturers of heating systems to announce their market entry for the fourth quarter. Initially, it was said that TEP would start in January – later, it was postponed to May. At least at the end of this year, we may actually have a full-fledged market for fuel cells in the heating segment.

Almost all big manufacturers of heating systems presented their current fuel cell system generations on the Trade Show for Sanitary Facilities, Heating, Climate Protection and Renewable Energies in Essen, Germany. Most of them intend to share in the technology's advancements despite their rather cautious approach to the market so far. But none of them can afford to stay on the sidelines here. Whereas big players, such as Vaillant, Viessmann or Junkers, have already made fuel cell systems part of their product portfolio, others (e.g., Brötje) made no efforts to exhibit anything alike at their booth.

### **Target group: Installers**

Even Vaillant and the others had nothing truly new to show attendees – at least, nothing related to fuel cells. Only Buderus presented the concept study of its next



system generation scheduled for 2018 (to quote a trade show visitor: “Oh man...that looks truly awesome!”). All others showcased systems of which the public had already been long aware from extensive field tests. Especially at the big-size booths, the main target group were the installers. Everywhere you could see throngs of sales representatives praising the feature highlights of their heating systems, with industry professionals trailing behind them.

At Vaillant’s exhibit, an eloquent sales professional tried his best to extol the virtues of xellPOWER in front of a group of building service technicians. They, however, seemed quite hesitant at first in light of the technology’s novelty status and the high price, but were interested nonetheless. However, they didn’t seem to be quite ready yet to believe that “this device will succeed ecoPOWER 1.0,” as the sales rep announced. The xellPOWER manufacturer based in Remscheid, Germany, sees the main use for its device in the refurbishment of existing building stock, where the high-temperature unit and its SOFC stack can guarantee high flow temperatures and long-term reliability during what should be uninterrupted operation. “The fuel cell unit cannot be started more than 200 times. Afterward, it’s finished. That means 20 restarts per year,” one of the company’s employees explained.

Mass production is scheduled for the fourth quarter this year, meaning for December 2016. The system will be priced at around EUR 30,000. Vaillant expects that everyone owning such a system can receive EUR 10,000 in grants, so that he or she would be left with paying the other EUR 20,000.



*Big crowds at the larger booths*

### **Once on the market...**

Viessmann has meanwhile put its second generation out on the market: It's year two after the introduction of Vitocalor 300-P. The German and EU programs for demonstration systems, respectively callux and ene.field, have resulted in several

dozen systems in trial runs, although the contingent of ene.field is exhausted, so that “regular” sales are now being pushed to the forefront. The company based in Allendorf, Germany, shows the list price of its system to be around EUR 20,000 (incl. VAT).

At the very end of hall 3 in the left-hand corner was the booth of elcore, which has been offering a commercially available product for about the same price as Vaillant since 2015. Elcore was at the SHK to try and get into contact with other companies and establish its own distribution network. Without a big parent company to back the organization, the Bavarian enterprise will have to rely entirely on cooperation partners to be able to bring its modules to the boiler rooms of potential customers. The team of Manfred Stefener, however, seemed confident and motivated enough to accomplish such a feat. Over one hundred units had already been in operation, elcore said. And the staff increase to now 80 employees proves that the investors behind the endeavor continue to share the team’s belief in the success of the business.

The rear right-hand corner of hall 3 was occupied by the small booth (40 m<sup>2</sup>) of SenerTec. The company best known for its Dachs – and celebrating its 30th anniversary this year – is said to greet the market with a fuel cell module originally developed by Baxi Innotech. At the request of BDR Group, the business’s 150 employees and around 1,000 partner companies set out to achieve market readiness with the module. The Dachs InnoGen system, which used to be called Gamma Premio and now houses a fuel cell unit by Toshiba, is thought to be available at the end of the year for around the same price as the ones by elcore and Vaillant.

*“Our fuel cell unit only goes to selected technicians who have been trained by us as well.”  
A Buderus employee*

SOLIDpower was indeed present at the trade show, but only as one of the exhibitors at a joint booth of the EnergyAgency.NRW. The bluegen unit showcased there is planned for commercialization from 2017 onward (priced at around EUR 25,000 minus about EUR 12,000 in grants). Until then, the ene.field program will have more systems to show for. So far, the company has installed 670 of these systems around the globe, about half of them in Germany.





*Empty fuel cell showcase*

Contrarily, Remeha and Brötje did not display anything fuel cell-related, and the GC Group, which Brötje has been part of since 1999, had hardly anything to say about it too. The Fuel Cell Cluster OWL, which was said to have been founded at the end of 2014 by Karl Brand Haustechnik, was nowhere to be seen.

Additionally, the 50th anniversary of the SHK Essen came with a widely announced special presentation of fuel cells, which was pretty disappointing after all. Hall 2 had only three fuel cell heating systems between the meeting point for trainees and the booth of the professional association of the trade: Vitovalor 300-P by Viessmann, xellPOWER by Vaillant as well as Logapower FC10 by Buderus, although the last one will be commercially available only from July 2016 on, as will be CeraPower by sister company Junkers. Except one company employee, there was no staff present to answer any questions.

### **Vaillant doesn't like bad bargains**

As one few companies, Vaillant organized a press conference in Essen. There, Tillmann von Schroeter, who took over management of Vaillant Deutschland one year ago from Andree Groos, explained: "We've achieved market readiness and will begin deployment in fall. The fuel cell is a very popular and very efficient technology." As proof, he pointed to the fast-paced sale of the 150 test units in operation. Overall, Vaillant has tested 250 modules through callux and ene.field. He added: "In the pilot stage, an amount short of EUR 20,000 is an attractive end customer price – including grants, of course. Our aim is not to incur any losses by selling." Furthermore, Vaillant expects to market "a three-digit figure" of units within the first 18 months after deployment.

Von Schroeter also summed up last year's developments and noted that many regular customers of oil heating systems had used the currently low oil price to upgrade theirs. Whereas the number of low-temperature oil-fired boilers continued to decrease across the entire industry, sales of condensing oil boilers rose by 30%. Von Schroeter said: "Gas and oil were decisively stronger than renewable energies. CHP sales were on the wane."



*Tillmann von Schroeter*

The manufacturer of heating systems views the introduction of the efficiency labels as an important instrument to heighten interest in new technologies. They have already been a must for new systems, but from 2017 on, they will also be required for heating modules older than 15 years (70% of all heating systems, according to the German Federal Ministry for Economic Affairs), so that building owners become aware of old and often inefficient systems. Alexander Dauensteiner, spokesperson of the Fuel Cell Initiative (IBZ) and a Vaillant employee, said: "The efficiency labels will offer transparency to anyone who intends to modernize their heating system in the boiler room, and it will be a help in deciding on a new heating unit." All fuel cell heating systems have an energy rating of A++.

### **Public funding**

Subsidies have been available through the Federal Office for Economic Affairs and Export Control (BAFA). As an especially energy-efficient and forward-looking technology, fuel cell heating systems enjoy an investment grant of altogether EUR 3,515. Additionally, the CHP Act offers 8 cents for each kilowatt-hour fed into the public grid and 4 cents for each kilowatt-hour of self-consumption.

## CHP Act Amendment Boosts Demand



*This 4.3-m-stack offers 400 kW*

“Through the first six weeks of this year alone, we received more requests than during all of 2015,” Andreas Frömmel from German FuelCell Energy Solutions reported during the E-world 2016. That should come as no surprise: Large-scale fuel cell plants have gained in popularity ever since the German parliament amended the CHP Act at the end of last year and put the transition rules on paper (see [New Rule for Fuel Cell Heating Systems](#)). Plants ordered until the end of 2016 and built by the end of 2017 can still receive the full CHP benefits as per the CHP Act from 2012 – independently of their power output. This section of the law will benefit even megawatt-size power plants.

The biggest fuel cell module of the Dresden-based company costs EUR 1,500 per kilowatt of installed capacity. “This will make it possible to produce power below 10 cents per kilowatt-hour,” Frömmel, who is in charge of business development at FCES, said. Put into perspective: Production costs are at around a tenth of what owners of residential fuel cell heating systems have to pay per kilowatt-hour (see [Fuel Cell Manufacturers Target Installers](#)).

A fuel cell plant of about 1.4 MW capacity is scheduled to go online in mid-2016. It will be the biggest of its kind in Europe, according to the manufacturer. The new power plant is a project of E.ON subsidiary Connecting Energies and will be set up in Mannheim at Friatec, a manufacturer of corrosion-resistant materials. The fuel cell for the construction project will be supplied by FCES. The power plant is expected to provide 11.2 GWh of electricity as well as around 6,000 MWh of heat from natural gas for in-house use. This will cover around 46% of the location’s total electricity demand. The electrical efficiency is at 47%.

These kinds of power plants could be operated under leasing, contracting and power purchase agreements (PPAs), Frömmel explained. He added: “The business model puts the technological risks squarely on our shoulders.” The US parent company has been managing around 110 plants worldwide, of which four are located in Europe and one in Germany. That will now change.

*Author & photo: Nils Hendrik Petersen*

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## Fuji Electric: Far East Takeover

Japanese Fuji Electric bought up N2telligence, based in Wismar, Germany, at the beginning of this year. The company, which had introduced several TriGeneration and QuattroGeneration modules in collaboration with its Japanese partner (see [ZBT system](#)), announced in a press release that Fuji Electric Europe had acquired a majority stake (70%) in N2telligence on Jan. 11, 2016. The company name was subsequently renamed to Fuji N2telligence. “The aim,” CEO Andreas Exler told H2-international, “is to join forces in order to achieve a better market penetration of stationary industrial fuel cells.” The business founded by Lars Frahm and Andreas Exler is the second one besides FuelCell Energy to benefit as a fuel cell enterprise from the amendment of the [CHP Act](#).

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## Green Hydrogen Use in Refineries



*HyCO4 refinery in Rotterdam*

At the beginning of this year, the German Hydrogen and Fuel Cell Association had its first-ever H2 economic forum in the German capital. On Feb. 18, 2016, around 50 representatives from politics and business were invited to the Dutch embassy in Berlin to discuss green hydrogen opportunities with Germany's federal environment minister, Barbara Hendricks. After the DWV had already organized a Parliamentary Evening at the British embassy last November (see [DWV to Pave the Way for Green Hydrogen](#)), the association – which celebrates its 20th anniversary this year – tried out a new format in 2016, with good results.

Monique van Daalen, the Dutch ambassador to Germany, and her business delegation had already met with professionals from the German hydrogen and fuel cell industry during the World of Energy Solutions in October 2015. In the spirit of good cooperation, she instantly voiced her willingness to host the new economic forum at her country's embassy in Berlin.

In her speech, the German environment minister stressed the benefits of hydrogen for energy storage and at the same time distanced herself from pure biofuels in light of the years-long and sometimes harsh back and forth of the ILUC debate (see box). Hendricks made it very clear: "I want to get away from crops being diverted to biofuel production. I believe we need other, better fuels."



## ILUC

ILUC, also known as indirect land use change, suggests that the European biofuel policies will lead to an expansion of farming areas for regenerative resources in Europe and other countries, resulting in a global displacement of agricultural production. Attempts to restore the resource imbalance on the livestock and feed market will then lead to changes in land use – for example, overseas (e.g., tropical deforestation). *Source: ufop*

## Open to discussion

The debate that followed soon turned to current EU legislation as the key issue. For example, Ruprecht Brandis, director of external affairs at BP Europe, agreed with Hendricks's statement that there had been "mixed experiences with biofuels over the last years" ("biofuels won't grow into the sky"). Brandis added: "It is our aim to make green hydrogen part of the biofuel quota." He explained that BP was pushing for the relevant legal framework and called on the Federal Environment Ministry (BMUB) and the EU Commission to support the efforts – mainly the ones that would allow the use of green hydrogen in refineries.

Tudor Constantinescu, the principal adviser to the EU Commission's Director General in all things energy, subsequently entertained the possibility of hydrogen playing an important role in the future, especially in decarbonization, efficiency increases and development. He stressed that H2 technology had made good progress over the past years, but also acknowledged the deficits in the current regulatory framework. Nevertheless, he was highly confident that the rules could be adapted to include green hydrogen to the appropriate extent as a zero-emission fuel based on electricity.

Norbert Salomon, the deputy director-general of emission control also indicated that he was open to a debate about the rules by saying: "You don't need to try and convince us; we are already convinced. [...] There is no disagreements about content. [...] We need hydrogen in refineries." But he also voiced a note of caution, explaining that the mineral oil industry had long been in disagreement about what to make of green hydrogen use in refineries. He said: "Meanwhile, the mineral oil industry has started speaking with one voice. It wasn't always like that."

In principle, he confirmed that there were indeed some legal hurdles in the EU that would need to be addressed. He said: "The regulations are very clear regarding hydrogen use in refineries: None allowed." The EU Commission would have to agree to any amendments in this case. When Constantinescu hinted that the commission was open to suggestions from EU member states ("The good will is there."), it was Oliver Weinmann, CEO of Vattenfall Europe Innovation, who rose to speak. Summing up the preceding statements, he said that the only change that was apparently needed was a revision of a table value in the current law, but that this value could easily be changed by introducing the relevant ordinance.

This gave DWV's chair, Werner Diwald, hope that there would be enough time until this summer to make a concrete suggestion on how to structure the ordinance and resolve the issue before the general election in 2017.

## Regulations

On Oct. 9, 2014, the German Bundestag introduced a rule that allowed the government to issue ordinances relevant to electricity-based fuels and the Federal Immission Control Act (section 37d of the BImSchG). In September 2015, the

amendment of the EU directive – which grants the authority to issue ordinances – came into force. By devising a regulation as an EU member and submitting it to the EU Commission, the German federal government would be able to establish the legal framework that could allow green hydrogen use in refineries and consider it for the climate protection quota.

### **Green washing?**

After the official part was over, one question during the numerous subsequent discussions was: What are the benefits and drawbacks of green hydrogen in refineries? Whereas some of the participants viewed it as an opportunity, a lucrative business case, others saw the risk of clean hydrogen again “green-washing” the mineral oil industry. The DWV, however, believed that the advantages outweighed the disadvantages, by “developing a business model to enable the necessary infrastructure for a long-time expansion of CO<sub>2</sub>-free transportation through fuel cell vehicles.” But some skeptics warned that only a small percentage of the hydrogen used for refining may no longer come from fossil sources (natural gas reforming). They were afraid that this small percentage could be enough for marketing departments to create a new generation of “ecological” fuels, although the benefit to the environment would hardly be noticeable.

Only time will tell whether this individual measure will give an impetus to the H<sub>2</sub> economy overall or rather tarnish its long-term outlook, something that could be a topic for the next H<sub>2</sub> economic forum.



### **Netherlands**

The Netherlands, which have held the EU presidency since January this year, boasts

more than 90,000 electric vehicles – but also H2 buses (see photo). Much larger Germany had only 40,000 units to show for until the beginning of 2016.

### DWV's list of demands

1. The use of electricity-based fuels that are produced by renewable energy from non-biological sources (e.g., hydrogen) should be considered for the climate protection quota during fuel production – especially in the Federal Immission Control Act.

2. From 2017 on, the obligation to introduce the second generation of biofuels should explicitly include the relevant electricity-based fuels or hydrogen. The requirement of reducing GHG emissions through second-generation biofuels and power-based fuels should be at least

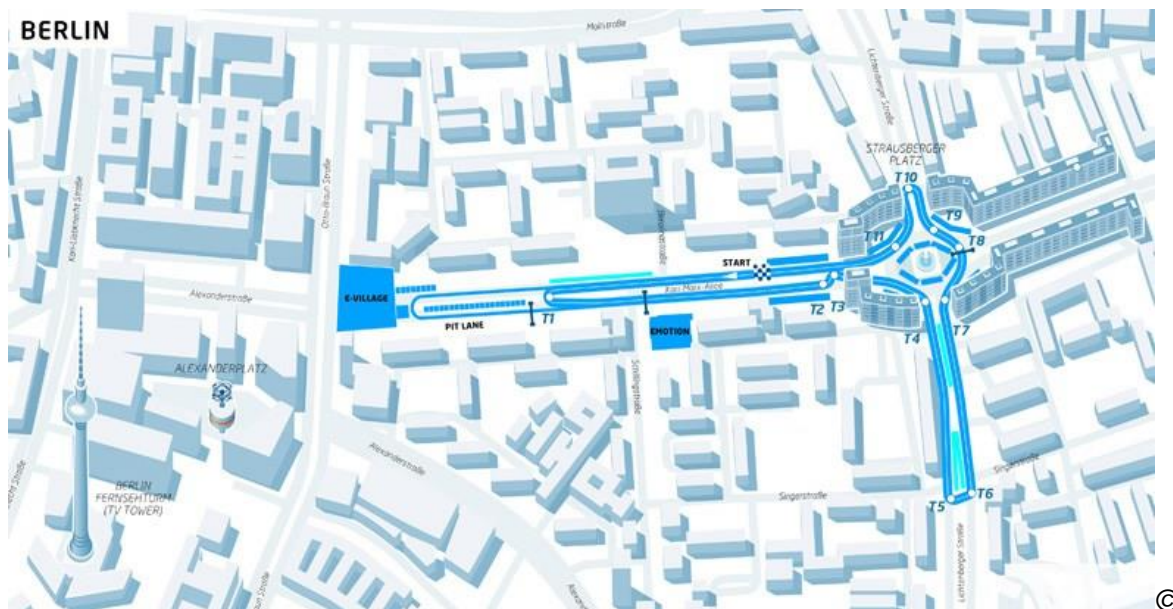
– 0.3% of the quota in 2018

– 0.5% of the quota in 2019

compared to the reference value of 83.8 kgCO<sub>2</sub>eq/GJ.

3. Systems for the generation of electricity-based fuels should be categorized as systems pursuant to section 64 of the Renewable Energy Act if they can supply the grid. These system should also be exempt from electricity tax and grid fees in case of grid supply.

## Formular E in the Midst of Berlin



*FIA Formula E*

The next Formula E race in Germany won't play out on the Tempelhof Field – as originally planned – but in former East Berlin. As the area that used to be the city's airport was repurposed this year, the organizers agreed on a May 21 race track exactly on the border between the districts Central Berlin and Friedrichshain. The over two-kilometer long Berlin ePrix starts at the Alexanderplatz and continues on to

the Karl-Marx-Allee and to the Strausberger Platz. “Having the race in the heart of Berlin is like a dream come true. The fans will love the race and the Formula E,” Formula E driver Daniel Abt said. Cornelia Yzer, Berlin’s senator for economic affairs, technology and research, said: “This a big event linking innovative solutions to greater environmental benefits in transportation.”

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## Blue Hamster Falls into Deep Slumber



*Blue Hamster in 2014, © H2FC*

German Mossau Energy, which closed down its business at the end of 2015, had not had any luck in finding either a successor to the company or an investor for its Blue Hamster idea. Helmut Janßen said to Ostfriesische Nachrichten: “Mossau Energy is no more. That has nothing to do with insolvency.” Eighty-one-year-old Günter Mossau, who founded the company, just didn’t have any luck in finding a successor, leading to the liquidation of the company at the end of December 2015. Whereas Janßen was able to find someone who would rent the company premises, he is still looking for someone to invest in Blue Hamster.

Mossau had already presented the storage energy solution in 2013 during the Hanover trade show (see HZwei issue from July 2013) and again in 2015 during the Intersolar. A demonstration unit consisting of a 100 kW solar system, a 41 kWh battery, a 2.3 kW electrolysis system, a 20,000 L hydrogen pressure tank and a 2.3 kW fuel cell has been in use at Kerafol since 2014. The latest news was that mass production had been planned for the end of 2015 and investors from the Middle East were ready to support the project, although the system had not yet been economically feasible. In March 2013, the German Ministry for Economic Affairs had awarded the company – whose origins can be traced back to the solar industry – with the Federal Prize for Outstanding Innovative Achievements in the Trades.



## Energy Storage Europe Continues to Grow



*Canadian ambassador to Germany, Marie Gervais-Vidricaire, with Philipp Andres, president of Next Hydrogen*

Expectations exceeded – this best sums up the three days from March 15 to 17 in Düsseldorf, Germany. In its fifth year, the Energy Storage Europe (ESE) and the four events taking place at the same time were able to attract an even greater number of participants: around 50% more exhibitors and 60% more attendees from the industry compared to the previous year. The mood in the Congress Center Düsseldorf right next to the Rhine was cheerful – and rightly so.

The trade show and its 142 exhibits (2015: 93) were well frequented; the hallways were often bustling with activity even during conference sessions. The organizers did expect some kind of an increase (see [ESE and IRES Become One](#)), but could hardly foresee such growth in numbers: All in all, the trade show attracted 3,000 attendees from 54 countries (2015: 1,800 visitors from 48 countries). And this although it didn't even offer any eccentric designs or spectacular presentations. The focus of the ESE was on dialogue and networking.

The exponential growth shows that energy storage is an interestingly enough topic in its own right. But in some areas, the jovial mood just couldn't make up for missed opportunities. The environment minister from North-Rhine Westphalia, Johannes Remmel, explained during his opening speech: "I see it as an urgent task for the



federal government to do more for energy storage.” Stefan G. Reindl, spokesperson for the management board of Thüringer Energie, expressed his disenchantment with the current situation: “We don’t see any way for pumped storage plants to become economically viable. Power-to-Gas isn’t much better off in terms of feasibility.”

The Energy Storage Europe took place in conjunction with the 10th International Renewable Energy Storage Conference (IRES 2016) by Eurosolar and the Finance Track by VDE Institut. Side events were the 5th Conference Power-to-Gas by OTTI and the 9th Storage Day of SolarAllianz.

Practically as a consequence of the existing lack of public support, the participants of the tradeshow issued the so-called Düsseldorf Declaration on the third day of the trade show. It calls on federal and state authorities to continue the energy transformation of the country and the storage expansion necessary to achieve it. In the words of the declaration: “Storage systems are neither consumers, nor producers. They should be included as a fourth independent pillar of the energy infrastructure besides generation, transportation and consumption. The miscategorization of storage systems as end consumers and the resulting fees and taxes need to be repealed.” Urban Windelen, CEO of the German Energy Storage Association, said: “Energy storage solutions are market-ready. Only the framework is lagging behind and still impedes a sensible market introduction of grid-appropriate storage systems. Here, I agree wholeheartedly with minister Remmel’s statement during the conference to – finally – revise the legal framework.”

### **More growth in 2017**

Thanks to the great interest in this year’s trade show, Hans Werner Reinhard, CEO of Messe Düsseldorf, is thinking about providing “additional exhibition space at next year’s Energy Storage Europe, which will take place from March 14 to 16, 2017. The next chair after Eicke R. Weber, who as BVEW president and head of Fraunhofer ISE was one of the founders of the Energy Storage Europe Conference, will be Andreas Hauer, head of the Energy Storage department at ZAE Bayern.

### **25 Years of Intersolar**

The importance energy storage has gained throughout the industry will no doubt become clear during the ees Europe, which will take place on the tradeshow premises in Munich, Germany, from June 22 to 24. The conference will be all about different types of storage as well as electric transportation and renewable energies. The ees Europe – which, by its own account, is the “largest industry trade show for batteries and energy storage systems in Europe” – will run at the same time as the world’s leading trade show for the solar industry, Intersolar Europe, which celebrates its 25th anniversary this year. The starting events on June 21 and 22 in the International Congress Center Munich are going to be the second ees Europe Conference as well as the Intersolar Europe Conference. Compared to last year, attendees can look forward to 30% more exhibition space: The 380 organizations expected to participate in the ees Europe will have 12,000 m<sup>2</sup> to present their solutions. As always, H2-international readers will receive free ticket vouchers (also for the Intersolar).

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## Events

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- May 12th, 2016, **The National Fuel Cell Symposium (NFCS)**, at the University of California, Irvine, California, USA, [www.nfcrc.uci.edu](http://www.nfcrc.uci.edu)
- May 25th to 26th, 2016, **Fuel Cell & Hydrogen Technical Conference**, in Birmingham, United Kingdom, [www.birmingham.ac.uk](http://www.birmingham.ac.uk)
- May 30<sup>th</sup> to 31<sup>th</sup>, 2016, **The Future of Electric Vehicles**, in Frankfurt am Main, Germany, [www.claridenglobal.com](http://www.claridenglobal.com)
- June 13<sup>th</sup> to 16<sup>th</sup>, 2016, **World Hydrogen Energy Conference 2016**, in Zaragoza, Spain, [www.whyec2016.com](http://www.whyec2016.com)
- June 15<sup>th</sup> to 17<sup>th</sup>, 2016, **16th Advanced Automotive Battery Conference**, in Detroit, MI, USA, [www.advancedautobat.com](http://www.advancedautobat.com)
- July 5<sup>th</sup> to 8<sup>th</sup>, 2016, **European SOFC & SOE-Forum**, in Lucerne, Switzerland, [www.efcf.com](http://www.efcf.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)



- **European Fuel Cell Forum**, Obgardihalde 2, 6043 Luzern-Adligenswil, Switzerland, Phone +41-4-45865644, Fax 35080622, [forum@efcf.com](mailto:forum@efcf.com), [www.efcf.com](http://www.efcf.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)

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- **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, [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, [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, [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**

- **FUMATECH BWT GmbH**, 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)



- **Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie**  
**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**  
German Aerospace Center  
Institute of Engineering Thermodynamics

- **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**

- **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)

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- **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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- **OMB Saleri SpA**, Via Rose di Sotto 38/c – 25126 Brescia, Italy, [hydrogen@omb-saleri.it](mailto:hydrogen@omb-saleri.it), [www.omb-saleri.it](http://www.omb-saleri.it)

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# Free Book about Hydrogen and Fuel Cells

Both the author [Arno A. Evers](#) and the publishing house [Hydrogeit Verlag](#) decided to donate the book

## The Hydrogen Society – More Than Just a Vision?

to the worldwide H<sub>2</sub>-community.

This book written by Arno A. Evers was published in April 2010 on the annual Hanover Fair where the author had established a global meeting point for companies and interested people from commerce and politics as well as science and media who are involved in the implementation of hydrogen and fuel cells since 1995.

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*written by Arno A. Evers*

*published by Hydrogeit Verlag*

*Oberkraemer, April 2010*

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