

Fueling the Future: Hydrogen in the Automotive Industry

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Fueling the Future: Hydrogen in the Automotive Industry

Dr. Dieter Zetsche, Daimler AG, Germany

1 A Brief Word of Thanks for the IPHE Award

Thank you very much, Dr. Steinle.

I think I can speak on behalf of all the “H2 Mobility” partners when I say that we view this award not so much as a symbol of recognition for what we’ve already accomplished, but more as an incentive to tackle the challenges ahead. And there’s lots to do.

Receiving this honor at such an early stage of our work can also be a burden — Barack Obama’s Nobel Peace Prize immediately comes to mind here. Now, it’s not my intention to compare our activities with the job of the President of the United States. Nevertheless, attempting to bring peace to the world does have one thing in common with the endeavor to establish a hydrogen economy: Both of them require a great deal of patience. One thing I can promise you is that we have enough patience. So with that in mind, I would like to express my heartfelt thanks to the IPHE for this award!

2 Introduction

Ladies and gentlemen,

- Our world has changed remarkably since the last WHEC was held in June 2008.
- First, we saw many banks fail, one after the other.
- Then many banks were nationalized.
- And now, several countries are threatened with bankruptcy.

Here in Europe, for example, we have the problem that while Iceland is plagued by too much volcanic ash, Greece has too little cash. (Basically, all of us are affected in both cases.)

Although a lot has happened in the last 24 months, practically no other industry is experiencing the kind of transformation that is currently affecting the automotive sector. Sooner or later, we will overcome the impact of the recession on the automobile markets. However, one fundamental process of change will continue: the paradigm shift regarding drive system technology. It’s inevitable that oil will become scarcer and more expensive, emission standards more restrictive, and customers more environmentally conscious. Taken together, all of this means that vehicles will have to become more electric.

Public attention is currently more or less focused on battery-electric mobility. However, I am convinced that the chances of success for electric vehicles equipped with fuel cells have never looked as good as they do now. The fact is that fuel cell technology is now ready to hit the market. What we have to find out is whether the market is ready for fuel cells. And that’s exactly the question I’d like to address today.

Let's imagine that this exhibition center is a dealership showroom. I'm the salesman and all of you are potential customers interested in buying a car with a fuel cell drive. As customers, you wouldn't be very interested in the math describing the chemical reaction of oxygen and hydrogen. You also wouldn't really care much whether the platinum-free membrane actually works or is just a PR gag. As experts, you'll be looking into these issues and many others over the next few days here in Essen.

For now, I'd like to come up with answers to three very simple questions that you as customers would probably ask:

- First: What can a fuel cell vehicle do?
- Second: How much does a fuel cell vehicle cost?
- And third: Where do you refuel a fuel cell car?
(Anyone I've already won over at this point is, of course, welcome to pre-order a fuel cell vehicle from me.)

So let's look at question number one: What can a fuel cell vehicle do?

3 What Can a Fuel Cell Vehicle Do?

There's no way to answer this question without comparing fuel cell technology with the current "top dog" of drive system technology: the combustion engine. We know that the only way to keep our industry in the black over the long term is with green cars. However, customers believe that a new car must always be a better car as well — and environmental compatibility is only one aspect here. Individual mobility also needs to remain safe, comfortable, and flexible. With regard to these and other aspects, the combustion engine has been the measure of all things for more than 120 years now. So that's what we've got to beat.

There's no "miracle cure" in sight here. That's why efficient combustion engines will remain the most important lever for the time being when it comes to reducing CO₂ emissions. Over the long term, we at Daimler are looking at a mix of different drive system alternatives. Specifically, these alternatives are partial electrification with hybrid drives, battery-electric vehicles, and, of course, electric cars equipped with fuel cells. I'm convinced that this combination represents the best response to the varied mobility requirements of our customers.

However, if the objectives are zero-emission travel over long distances and short refueling times, there's only one alternative to gasoline or diesel — and that's hydrogen. The market is in fact demanding solutions for long-distance driving. For example, according to surveys, almost 75 percent of all Germans believe that electric vehicles already have a minimum range of 300 kilometers or will achieve such a range in the near future. I'm basically an optimistic kind of guy, but as things stand today, a range like that isn't possible with a battery-electric system. Even the nominal energy content of lithium-ion batteries is still below 120 watt-hours per kilogram for automotive applications. That corresponds to only a fraction of the energy density of liquid fuels. To be exact, it's only one percent. In practice, this translates into a range of less than 200 kilometers.

The situation is completely different with hydrogen. Thanks to 700-bar technology, the Mercedes-Benz B-Class F-Cell can now drive nonstop for well over 400 kilometers. I also believe we'll break the 600-kilometer mark — without having to sacrifice any cargo space volume. Fuel cell technology is also absolutely competitive when it comes to the refueling time. It takes just three minutes to fill a tank these days, so there's no reason to spend the night at a refueling station if you've got a fuel cell.

We've also made tremendous advances in the past few years in terms of the durability of fuel cell stacks. One way of increasing a fuel cell's service life is to combine the unit with a "buffering battery." That cushions peak loads, which means that cell membranes last longer. Our fuel cell systems for buses can now operate for six years, and the technology we use is practically maintenance-free. At the moment, we expect fuel cell stacks for passenger cars to last for more than 110,000 kilometers, and this figure will probably increase to 250,000 kilometers in ten years.

By the way, fuel cells have nothing to be ashamed of when it comes to driving pleasure. When we let journalists drive the B-Class F-Cell, we often hear the following comment — and I quote: "This car is awesome." All I can say to that is: "You're right."

My main message so far is therefore that if the fuel cell is going to be successful on the market, it will have to outperform the combustion engine. In my opinion, we're on track to achieving this goal. This may be a little over the top, but I can't resist saying that the fuel cell can do almost anything — except produce emissions.

4 How Much Does a Fuel Cell Vehicle Cost?

After hearing about what fuel cells can do, customers will want to know how much all of this is going to cost them. So let's not pull any punches: It's going to cost a lot — at least for the time being. A kilogram of hydrogen sells for only eight euros and will allow you to travel around 100 kilometers. That roughly corresponds to the price range of gasoline or diesel fuel. Moreover, just by using the hydrogen produced as a waste product in the chemical industry we could power 750,000 vehicles. So the problem is not the fuel price but the hardware — by which I mean the cost of the fuel cell system. On the other hand, 120 years ago the first automobiles were also much more expensive than horse-drawn carriages, in terms of both procurement and upkeep. That's why cars didn't dominate the mobility market until they were mass-produced. Similarly, the cost of a fuel cell will decline not only as a result of technological advances but, more importantly, through the achievement of economies of scale.

That's why I'm so pleased to see other automakers besides Daimler moving ahead with fuel cell technology. I'm also optimistic that the list of such manufacturers will soon grow longer. After all, fuel cell vehicles in particular have the potential to achieve a critical mass in the near future. That's because the vehicle isn't just suitable for urban applications; it's an all-rounder. And it can be used to power large passenger cars, vans, and buses. The potential fuel cell market is therefore larger than the market for battery-electric vehicles. At Daimler, we believe we can reduce the price of fuel cell passenger cars to the hybrid level in the medium term, starting from an annual production volume of 100,000 units.

Modularization is a key lever that will help us to rapidly achieve high production volumes and thus lower prices. We're already showing how this can be done with our BlueZERO label, which encompasses three different models that are based on the platform used for the A-Class and B-Class. The models are: the battery-electric BlueZERO "E-Cell," the BlueZERO "E-Cell Plus" with a range extender, and the BlueZERO "Fuel-Cell." This year the F800 Style also demonstrated that a fuel cell package can now be fitted into the vehicle architecture of a traditional sedan without the need for a sandwich floor. If you ask me, the F800 Style is the most attractive fuel cell packaging to date. Alongside modularization, the technical side of the equation also has huge potential for cost reductions. For example, it may be possible to lower the platinum content in fuel cells from 0.9 grams per kilowatt to 0.2 grams by 2020. That would correspond to the platinum content of a state-of-the-art diesel catalytic converter. Of course, I'm not the first person to predict a major breakthrough for fuel cells in the automotive industry. Many experts have predicted the same thing at past WHEC events. I therefore want to state very clearly that it will take some time before fuel cell vehicles can be manufactured in large volumes and offered at competitive prices.

If this is to happen sooner rather than later, governments will have to firmly commit themselves to a hydrogen economy. The electric mobility summit held by Chancellor Angela Merkel here in Germany two weeks ago sent out a positive signal. But this summit must be followed by actions. I think there are three key points to be considered here. First, research must be supported in a targeted manner — not just by providing more money but also by improving the links between existing programs. Secondly, the market must be given a boost — for example, the public sector could purchase more fuel cell buses. Finally, we need to have mandatory standards, especially for the fueling station infrastructure.

Which brings me to my final question: Where do you refuel a fuel cell car?

5 Where Can I Refuel My Fuel Cell Vehicle?

There's a good anecdote in relation to this question — one that you probably already know. A little girl asks her grandfather, "Hey, grandpa, did you have computers when you were young?" The grandfather replies, "No, we didn't have computers." The girl then asks, "So how did you get on the Internet?" This story reminds us that many innovations require certain preconditions. Without computers, there's no Internet — and without a hydrogen infrastructure there will be no fuel cell cars. Only about 200 hydrogen fueling stations are currently in operation worldwide. Thirty of these are in Germany — but only seven are accessible to the public. However, customers will only accept fuel cell cars if there is a comprehensive refueling network. If there isn't, a zero-emission hydrogen car will be as much fun as an iPod without any iTunes.

One thing is clear: This "chicken-and-egg" debate will get us nowhere. That's exactly why we launched the "H2-Mobility" initiative last year in conjunction with the German Ministry of Transport and partners from the energy industry. Our goal is to establish a nationwide hydrogen fueling station network in Germany in three phases. The first phase began in 2009 with the construction of fueling stations in large cities. In 2012 we will begin establishing a network of stations on the roads that connect major metropolitan areas. A gradual further

expansion will then be initiated in 2013. Eventually there will be 1,000 hydrogen stations throughout the country. I'm sure Professor Reitzle will have plenty more to tell you about the hydrogen infrastructure later on. For now, let me just say that we expect the undertaking to cost €1.7 billion. That's a lot of money, there's no doubt about it. But it's also money well spent. Moreover, raising such a large amount of money won't be a major problem if the right partners from government and industry get together. That's why I'm feeling more and more optimistic about the infrastructure issue. In addition, every fueling station built will make hydrogen more attractive to car buyers.

6 Conclusion

When you get right down to it, there are many reasons for believing that the time is right for fuel cell vehicles. Technologically speaking, we're now able to offer customers effective solutions. In terms of costs, we're making tremendous progress, and we're also finally starting to move ahead with the infrastructure.

So in my view, the question is no longer whether the fuel cell will offer an acceptable alternative to the combustion engine; the question is when this will happen. In any case, Daimler plans to continue driving developments in this field. There's a great quote from Thomas Edison that really fits in well here. Edison said, "Failure is just an interim result. Those who keep trying can't avoid being successful eventually." I think we've had our share of such "interim results" in pursuit of our goal of establishing a hydrogen economy. However, I'm also convinced that we will be successful in the end and that many of us will eventually be driving with hydrogen.

You, ladies and gentlemen, are driving this development. And it is your work and your ideas that will make the difference. You are playing a major role in shaping the future of the automobile. That's why I hope that you — and all of us — will have enough patience. For now, however, I wish all of you an interesting and successful World Hydrogen Energy Conference 2010.

Thank you very much!