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An interview with Dr Markus Schwaderlapp

Solutions-oriented research for the powertrain systems of tomorrow

15.04.2024 // Dr. Markus Schwaderlapp, Senior Vice President Research & Development at DEUTZ AG, recently became the new Chairman of the FVV. In an interview with Richard Backhaus, he explains how FVV is accelerating the defossilisation of industry and the road transport sector and discusses the role that hydrogen can play in this as an alternative energy carrier.

You have taken up the role of President at FVV for the 2024/2025 term. What excites you about working for FVV, and which goals will you pursue over the next two years?

<u>FVV has undergone a sweeping transformation over the last few years and now stands for all powertrain solutions and energy conversion systems of the future</u>. I see it as my task to continue working in this direction. Whilst the situation of the turbomachinery sector remains relatively stable despite the current challenges being faced by the aviation industry and the energy system itself, suppliers and manufacturers of vehicle powertrains continue to encounter major international obstacles. Companies are increasingly considering retaining combustion engines for longer than was originally envisaged and contrary to their original planning, and are also working on concepts that use alternative carbon-neutral fuels. <u>In this context, I believe it is necessary to move towards a solutions-oriented approach and greater technology neutrality</u>. <u>FVV is a key player in this process, laying the groundwork for the development of future powertrain solutions through pre-competitive research projects</u>.

Your employer, DEUTZ, is active in the field of vehicle powertrains and mobile work machines, but is not an OEM in the true sense of the word. In which areas does this broader positioning present opportunities for the future development of FVV?

I have a lot of respect for automotive manufacturers whose in-depth approach enables them to offer perfected products. The technical aspects of these products are often infused with emotional elements to resonate directly with their target customers. As a tier-one supplier, DEUTZ cannot sell its products based on emotions, but must instead rely on quality and attributes such as power density, consumption and emissions. <u>Our diverse customer base requires a whole host of powertrain solutions tailored to meet the respective applications to enable our customers to maintain profitability</u>. Because of this, it was already clear to us five years ago that the future cannot solely rely on battery electric powertrains. Whereas it is easy to electrify a forklift, for example, the process is not as simple for a heavy tractor whose sustained high power demands would require an extremely large, heavy and, above all, expensive battery for the required energy.

At DEUTZ, a technology-neutral approach to cater to a broad range of sectors makes up our DNA. And this is mirrored in FVV's core narrative. After all, there is no one single golden solution, but rather multiple routes to the same goal involving combustion engines, fuel cells and battery electric powertrains to best meet diverse requirements.

DEUTZ has a wealth of experience with hydrogen combustion engines. In your view, where do the opportunities lie for off-highway applications, commercial vehicles and cars?

We started developing hydrogen engines in 2020 and kicked off series development in 2021. For commercial vehicles, the hydrogen engine offers a solution to the all too familiar chicken-and-egg dilemma in terms of the availability of hydrogen powertrains and the construction of the requisite infrastructure. In contrast to the fuel cell, hydrogen engines can enter series production quickly and are affordable. The infrastructure can then be re-used for fuel cells later on. In the off-highway segment, a large number of applications are obvious candidates, including stationary applications such as generators or heat pumps. For these, remote applications that encompass the entire ecosystem would also be feasible. Electricity can be generated using wind power or photovoltaics, and surplus electricity converted to hydrogen using electrolysis to run a generator during periods of low wind or sun. The rail transport sector also presents interesting opportunities, with fuel cells still remaining incredibly complex to handle in such applications. For passenger cars, the viability of hydrogen engines is closely tied to infrastructure availability and, in particular, to governmental regulations.

Is the concept of hydrogen engines even economically viable?

For it to pay off, the price of hydrogen needs to drop to four or five euros per kilogramme. But with the current price of hydrogen exceeding 10 euros, it doesn't make economic sense at the moment. Success hinges on producing electricity for electrolysis at an affordable price. But this would require an energy sector in which electricity is generated in the windy and sunny regions of the world and converted locally to produce energy carriers such as hydrogen or ammonia. These energy carriers could then be transported to Europe by pipelines or ship and, if necessary, processed further to prepare it for use.

So you believe that Germany cannot be energy self-sufficient?

It is neither physically nor economically sensible to erect wind turbines in Germany and extract hydrogen from the generated energy when investing in the same wind turbine in Patagonia would yield four times as much electricity and thus four times as much hydrogen. This is not to say that Germany shouldn't use wind turbines to cover its domestic electricity demands, but the concept is not efficient for hydrogen production. The same also applies to photovoltaics. The higher yield factors possible in sunny and windy world regions offset all conversion losses. Therefore, the frequently voiced criticism that repeat energy conversions result in excessive losses is inaccurate. Whilst there are inherent conversion losses for purely physical reasons, they are practically negligible. The best solution is to generate electricity in Germany using wind power or photovoltaics and feed it directly into the grid. But this is only the smaller part of an overall solution. In Germany, electrical power accounts for 20% of the final energy demand, of which we currently produce approximately 50% sustainably. Yet this accounts for just 10% of the overall demand, a fact that regrettably receives too little public attention.

Where should large quantities of renewably generated hydrogen come from?

For the ecosystem I've just described, the respective large quantity of hydrogen and energy carriers for producing hydrogen must come from the Middle East, Africa and South America. The question is whether we will switch to carbon or nitrogen-based renewable fuels in the future. The advantage of ammonia is that the required nitrogen is universally readily available. Conversely, methanol synthesis offers a much higher energy density, which is a point in its favour. The use of e-fuels in mobile applications offers major advantages. To accelerate the energy transition, politicians should set and prioritise their goal of rapid decarbonisation and leave the technical design of the ecosystem to industry and market forces.

What do robust and efficient electrification solutions for mobile work machinery look like?

The technology used is similar to that of a car and commercial vehicle powertrains, both in terms of the motors and batteries used, as well as the voltage level of 400 volts to over 800 volts in the future. System development for mobile machinery is therefore based on ISO 26262 for the functional safety of vehicles. Resilient components, notably batteries, and high mechanical durability are crucial, particularly for applications exposed to extreme conditions such as on construction sites or in forestry. The software must also work reliably.

Which devices can be electrified easily, and which ones pose more of a challenge?

The feasibility of electrifying mobile machinery depends on two factors: the energy demand and the proximity to a power grid connection. Electrifying forklifts up to outputs of 50 kilowatts is already viable today, as is the case for airport baggage transporters or mini excavators. However, difficulties arise when dealing with large machinery with high power demands and heavy-duty usage. In such cases, the battery size, space requirements and costs increase disproportionately. As a rule of thumb, electrification is straightforward for outputs of up to 100 kilowatts. But beyond this threshold, it becomes technically more complex and thus less economically viable.

Today's environmental problems require joint and global solutions. How can FVV further expand the global connectivity between research activities?

The area of research and development has seen increasing internationalisation over the last few decades. The same also applies to FVV, which is attracting ever more members from both European countries and beyond. In my view, one pioneering initiative lies in the collaboration with the Japanese research association AICE, a consortium of Japanese OEMs, suppliers and scientific institutions founded in 2014 and based on the FVV model. FVV collaborates with AICE extensively. This ranges from knowledge sharing, such as via lectures held by Japanese speakers at German conferences and vice versa, right through to joint projects in collaboration with German and Japanese scientists. This serves as a blueprint for collaborations across other countries and regions. There is potential for expansion not only in Asia and Europe, but also notably in America, for instance. As a globally influential market with programmes such as the Inflation Reduction Act, the USA presents a growth opportunity for FVV and its members.

Meta-studies, such as life-cycle analyses in the European mobility sector and the fuel studies that build upon these, are a further important instrument for FVV. Through these efforts FVV's members gain direction and insights into activities across the world – including into areas that have often remained overlooked.

The future standing of Germany's industrial landscape is currently the topic of intense discussion. Is the standing of Germany's research landscape also under threat?

I hope it's not as serious as that, but we are clearly already being challenged in certain areas by other countries such as China or the United States. Part of the reason why Germany is being overtaken by other regions in some fields may lie in our certain hesitance to explore new scientific avenues and technologies. This hesitance can limit research work and therefore slow the pace of technological progress. For example, few young people today are willing to pursue engineering degrees with a focus on combustion engines, as this field has fallen out of favour. We experienced the same phenomenon with nuclear research several decades ago. As a result, we are damaging the Germany's research landscape and its standing. The aftermath of the Dieselgate scandal has further exacerbated this effect by tarnishing the reputation of combustion technology worldwide – but particularly in Germany – compared to alternative system solutions. Nonetheless, a key strength of Germany's research landscape lies in the long-standing close ties between industry and academia, with FVV being a perfect example of this. In my view, we remain the global benchmark in this regard.

Has the scientific exchange between experts changed in recent years?

When the traditional combustion engine was the focus of research and development, this exchange occurred at events such as conferences and congresses and primarily centred on optimising specific details. These interactions sparked discussions and broadened technical horizons. Pre-competitive research often yielded results that delivered important stimuli others could leverage when developing their own solutions. In recent few years, we have talked a lot about future concepts, be they powertrains, energy carriers or entire ecosystems. This was important, as we need to think in terms of systems to be able to navigate the era of transformation. However, it is essential that we maintain a sharp focus on detailed solutions. Only then can we achieve the level of development in alternative powertrains that we see today for spark-ignition and diesel engines. FVV plays an indispensable role in this regard as a platform where market competitors can work together under the umbrella of competition law to research the optimisation of powertrain components.

How can FVV counter the problem of a lack of young engineers, and what initiatives is DEUTZ undertaking in this respect?

DEUTZ takes a pro-active approach by starting the search for and nurturing young talent as early as during their school years, including via work experience placements for school pupils or vocational training opportunities. We are currently introducing dual study programmes to strengthen our ties to universities and universities of applied sciences, enabling us to engage with and support students early on. What's more, they can write their master's and bachelor's thesis in-house at our company.

FVV actively promotes young talent by fostering connections between companies and academic institutions. Involving young graduates and students in collaborative projects with industry experts offers them insights into industry approaches to scientific questions and connects them with relevant working groups and global specialists. Their skill sets also benefit from tasks that originate from the industry, thus making them inherently relevant for the sector. As such, FVV creates substantial added value for the German industry and society at large. A fact which deserves greater attention from both the public and policymakers in my opinion.