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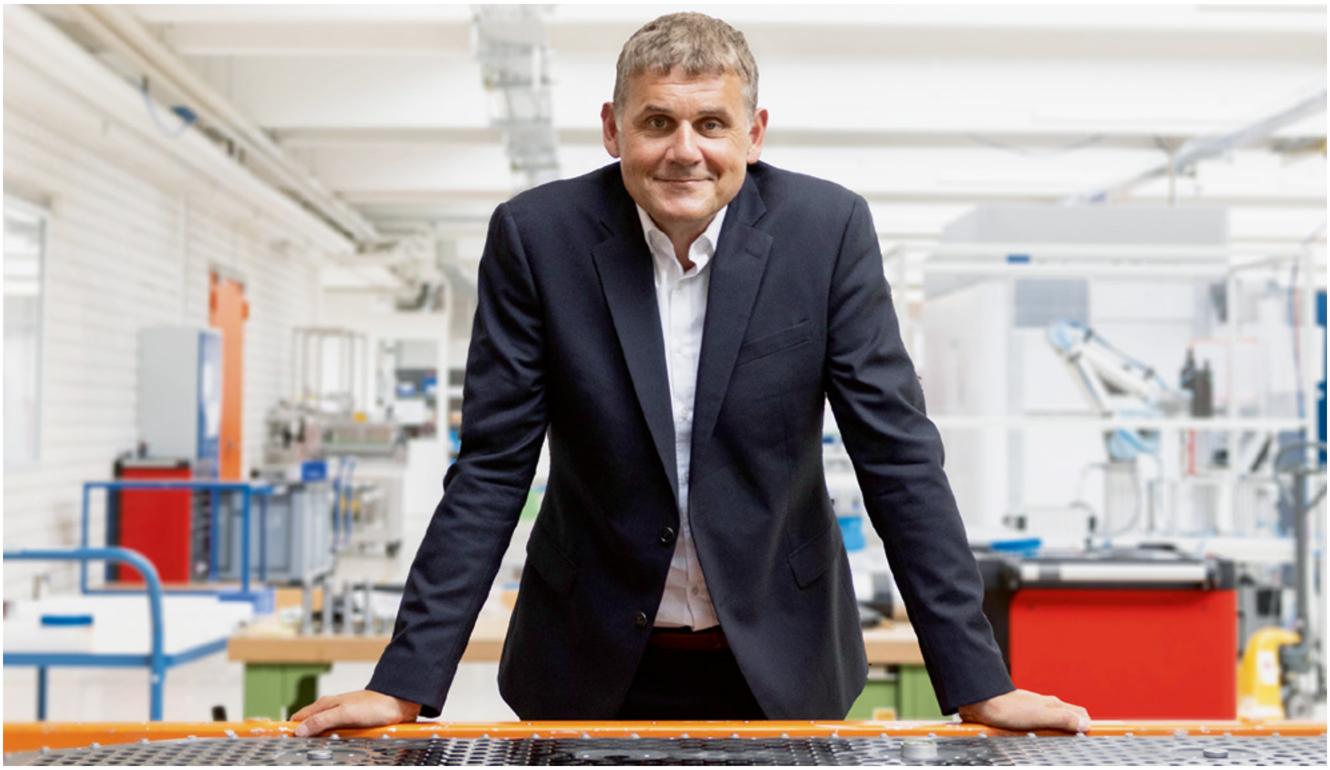
„The number of different cell chemistries will continue to rise“

/// **INTERVIEW** Dr. Stefan Bergold (Farasis Energy Europe)



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"The number of different cell chemistries will continue to rise"

Battery development is progressing at great speed, and the energy density and performance of the storage devices are constantly increasing. However, most of the value creation has so far been in Asia and there are also controversial discussions about the materials required and the recycling of the batteries. Dr. Stefan Bergold, General Manager of Farasis Energy Europe, explains how batteries for BEVs can be further improved and how the aforementioned challenges can be met.

MTZ _ The cost of the battery makes up a large proportion of the overall price of a BEV. Do you expect that to change in the foreseeable future?

BERGOLD _ Battery costs will continue to fall and electric vehicles will become more and more competitive compared to traditional internal combustion engines. This trend is now irreversible and the end of the internal combustion engine is in sight – with the exception of some niche applications. How quickly this transformation takes places will depend on several factors, such as material developments for the cathode and anode and access to and the cost of raw materials. Production costs are also a factor.

Will the average capacity of BEV batteries fall if charging rates are significantly increased, or how else can cheaper individual mobility be achieved with BEVs?

Individual mobility and the related costs will always depend on the needs of the individual traveler. Not every driver wants to have maximum range, but would like to take breaks at regular intervals and recharge the battery during this time. This does not require the biggest possible battery, but a high charging capacity with a continued high energy density. Other drivers might prefer to have the maximum range and be able to travel 1000 km, for example, without recharging. For this, you need a large battery with the highest energy density. There are also drivers who travel short and medium distances and need neither maximum range nor fast charging ca-

Dr. Stefan Bergold studied and earned his doctorate in electrical engineering at the Rhineland-Palatinate Technical University of Kaiserslautern-Landau and began his career as a development engineer at Siemens, subsequently heading the dSpace project center in Munich. In 2008, he joined AVL Deutschland GmbH, where he headed the Measurement and Instrumentation business unit and took over the position of Director Territory Sales, Marketing and Product Business in 2015. Further positions took Bergold to the Kistler Group in 2016 as Global Head of Customer Service and to Akasol in 2018, first as Head of Global Sales and later as Vice President Global Sales. In 2021, he became Head of Sales and Marketing EU and US at Farasis Energy and was appointed General Manager Europe in January 2022. He also took on the role as Member of the Board of the joint venture Siro Energy.

pability. For drivers like these, a normal charging rate and a medium-sized battery would be sufficient. We expect that maximum range will become less important than a fast charging capability in the future. In that case, batteries will have to be increasingly designed to meet all requirements in terms of performance and cost. With its Ultra High Power variant as an expansion of its Generation 4 battery cells, Farasis in fact meets both of these requirements: a long range and fast charging. An energy density of 330 Wh/kg makes it possible to achieve a range of around 1000 km. Customers who place more value on fast charging capability will benefit from a battery with an adapted cell design. This may have an impact on the energy density, but it enables the battery to be recharged from 10 to 80 % in just 15 min in fast charging mode.

What trends do you see in battery development?

We can recognize various trends in battery development. Firstly, there will be different chemistries for different applications, due to the fact that some raw materials are scarce and expensive. In Europe, lithium-ion batteries with a nickel, manganese, and cobalt (NMC) cathode are widespread. These batteries provide a high energy density and fast charging rates. But they contain critical raw materials. Lithium ferrophosphate (LFP) batteries do not have these critical raw materials, but they cannot compete with NMC batteries when it comes to range and charging performance. On the other hand, these batteries are cheaper. There is also a trend towards sodium-ion batteries and these are already being tested in China. Farasis Energy is also rolling out its first project. Instead of lithium, sodium is used in the electrode, and this is an uncritical and widely available raw material. The energy density – according to the current state of technology – is lower than that of lithium nickel batteries or lithium ferro-phosphate batteries. The fact is that the number of different cell chemistries will continue to rise and that several variants will co-exist side by side in the future, simply in order to meet the high demand. A further trend is the optimization of the design, with the aim of reducing the amount of superfluous material in the battery. This will include, for example, cables, connecting elements, plastic parts, and other components. Instead, attempts are being made to put more energy-storing active materials into the battery, because the higher the energy density, the greater the range. There are various approaches here such as "cell-to-pack" or "cell-to-chassis". In the cell-to-pack arrangement, the basic three-part structure is replaced by a two-part one. The three-part structure consists of cells that are combined to form modules, which in turn are put together to form packs. In the two-part structure, the intermediate module step can be eliminated by integrating the battery cells directly into the pack housing. This approach results in an increase in both the gravimetric and the volumetric energy density of batteries and can improve efficiency by up to 20 %. This allows a faster market launch while at the same time reducing the number of components required. Among other things, Farasis Energy is a partner in the government funded PEAk-Bat project, which is aimed at carrying out research into innovative approaches like these towards the virtual validation of battery systems. A third trend is an increase in voltage to provide a higher power output. Most electric cars have a 400 V system. However, if we want to achieve higher performance, faster charging, better acceleration, etc., we need 800 V. Some OEMs are already implementing this – but this trend needs to be reflected across a broad mass of vehicles. Recycling is absolutely essential, but this means that there will have to be enough batteries and production scrap available for recycling. This trend will probably be implemented on a broad basis in ten years' time when the first cars have reached the end of their life cycle.

"The end of the internal combustion engine is in sight"

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For future battery generations, the plan is to use silicon instead of graphite for the anodes. What are the advantages of this anode material?
Pure silicon anodes are still a long way off. Work is currently being carried out on a mixture of silicon and graphite. Silicon has a higher specific capacity and can therefore store more energy than graphite. The higher energy density results in a longer battery life cycle. Another advantage of silicon anodes is their high conductivity, which improves the efficiency of the battery. In addition, silicon is relatively cheap and is easily available. On the other hand, silicon can expand and contract over the course of charging and discharging cycles, which means that an adapted battery design is required. Farasis offers suitable solutions for this.

Will other new cathode materials become available in the foreseeable future?
There are certainly various developments taking place. Farasis Energy recently received a $2.6 million order from the United States Advanced Battery Consortium LLC (USABC) to develop battery technologies that go beyond lithium-ion. The potential of this technology has not yet been fully exhausted and still offers development opportunities for the next few years – but this too will come up against a certain limit. The aim of the program is therefore to develop a lithium metal-based anode with a cathode containing nickel and liquid electrolyte battery technology for electric vehicle applications.

Is there a physical limit for the energy density of batteries?
The physical limit for the energy density of batteries is determined by the specific properties of the materials and technologies that are used. These can maintain a high energy density without becoming unstable or causing safety risks.

Your project for battery production in Germany is currently on hold. What are the prospects for its resumption?
The decision on a production location depends on our customers and the markets. Due to new partnerships and increased demand, we are still working on adapting our localization strategy for Europe, of course in close consultation with our customers. The question is which products we intend to produce where in the future. We announced our collaboration with Togg some time ago. The resulting joint venture called Siro already manufactures modules and packs and will produce battery cells in the future.

What proportion of added value is actually attributable to cell production in Germany? Can we assume that the battery chemistry and some individual elements will continue to be imported?
The European battery industry is reliant on importing certain raw materials because they are not available in sufficient quantities. A significant proportion of the added value can be attributed to the processing of raw materials

"Several variants will co-exist side by side in the future"

and cell production itself, as both of these processes are complex and technology-intensive. In many cases, the further processing of cells to produce modules and batteries is already standard practice in Germany and Europe today. Customers from all areas expect their solutions to be manufactured locally, as this is also a requirement in the context of sustainability. This can cut costs, for example because it eliminates transportation distances and customs duties, and reduces our dependence on the Far East.

How do you assess the potential and chances of implementing solid-state batteries?
We still see a lot of potential in using the high-nickel battery technology that is available today. Nevertheless, this chemistry also has its limits. Solid-state batteries benefit from the higher energy density because no liquid electrolyte is used. The technology that will ultimately prevail will certainly depend on various factors, such as the application, the requirements to be met by the battery, the availability of raw materials, and so on.

Battery recycling is a real challenge. Will we have fully recyclable batteries in the foreseeable future? And what are the greatest challenges?
The principles of recycling are known. It now needs to be put into practice. This requires a sufficient mass of used batteries in order to fully utilize the capacity of large-scale plants. This is currently not the case, but it is likely to be common practice in a few years' time. Our assumption is that more than 95 % of the battery can be recycled. Farasis Energy has also developed a corresponding solution for this in the form of its Direct Recycling Process. This can be implemented quickly and inexpensively, enabling the valuable active cathode material to be recovered and recycled.

Stefan Bergold, thank you for this interesting interview.

INTERVIEW: Marc Ziegler

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Special Edition 2023 in cooperation with schoesslers GmbH, Max-Planck-Straße 7/9 | 97082 Würzburg; Springer Fachmedien Wiesbaden GmbH, Postfach 1546, 65173 Wiesbaden, Amtsgericht Wiesbaden, HRB 9754, USt-IdNr. DE81148419

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