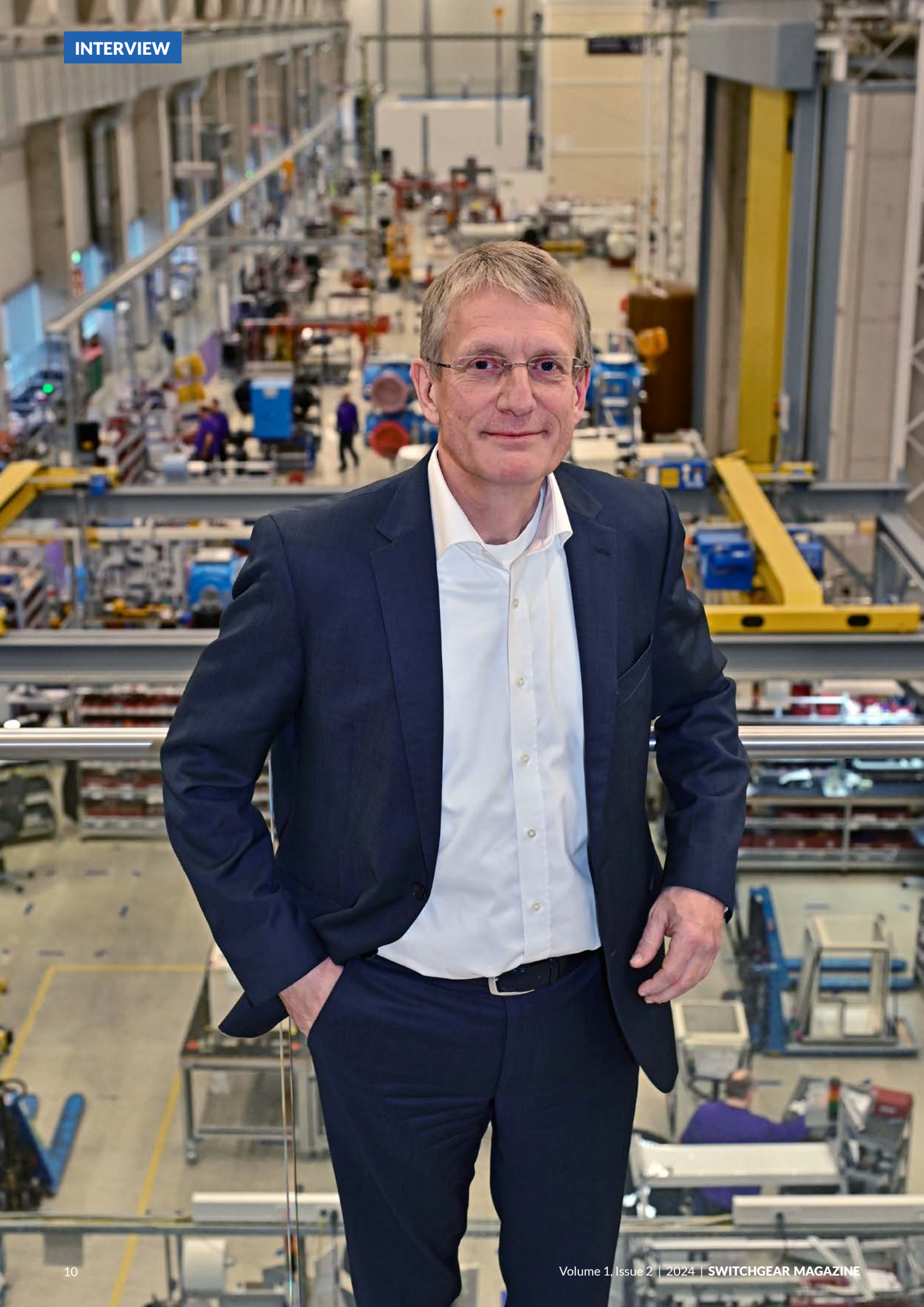


Dr. Ulf Katschinski

Working on the Blue Portfolio

Relevant for society: A conversation with Dr. Ulf Katschinski, Vice President of Product Management, Grid Technologies, Siemens Energy, on how his company's SF6-free 'Blue' products help with challenges for the power grid, how they were developed and are now being manufactured in a new plant in Berlin.

If you could name one driver shaping the future of power grids, which one would it be?

Dr. Katschinski: Simple: Decarbonization. As the share of renewables rises, energy generation is widely distributed, often far from urban and industrial centres. The grid must expand to cope with this development, and stability must be ensured. At the same time, decarbonization also involves reducing the carbon footprint of grid infrastructure including its supply chains.

And another factor?

Dr. Katschinski: Rising energy demand. It's mainly due to the electrification of the economy, namely electric vehicles, heat pumps, and data centres. In Ireland, for example, the share of data centres' electricity consumption could rise over 30% very soon.

The energy transition is playing out differently worldwide, though.

Dr. Katschinski: Yes. In Europe, for example, there is an emphasis on replacing existing infrastructure and integrating renewables. In North America, modernization is currently a priority. Other regions are active as well. For example, in the Near and Middle East, there's Saudi Arabia's NEOM megacity project, to which Siemens Energy contributes energy infrastructure. Other markets, such as China and Southeast Asia, are also adapting their grid to renewables and rising energy demand.

Siemens Energy is a major player worldwide. What are some of your main products that support restructuring the energy grid?

Dr. Katschinski: We have a wide range of products and services to help decarbonize energy generation and the grid. Just to name a few: HVDC offerings for long-distance power transmission; energy storage, such as Battery Energy Storage Systems (BESS) to stabilize the grid; or our Flexible AC Transmission Systems (FACTS), which enhances the reliability of AC grids by improving power quality and transmission efficiency. Another example I would name is digitalization with the reliability-centred and data-driven dynamic substation asset and overhead line rating. Lastly, our clean air Blue Portfolio with switchgear solutions supports the energy transition towards net zero.

Let's talk about that. The 'Blue Portfolio,' as you call it, consists of…

Dr. Katschinski: … high voltage switchgears, namely live- and dead-tank breakers (Air-Insulated Switchgear, or "AIS") as well as Gas-Insulated Switchgear (GIS), that use vacuum switching technology and clean air insulation. The primary focus is eliminating SF6, the insulation gas of choice for decades, but with a Global Warming Potential (GWP) of 24,300. That´s no longer tenable. We have sold nearly 6,000 Blue products, and more 1,600 units successfully operate worldwide. In terms of CO2 footprint, SF6 plays a major role (around 80%), if the entire life cycle footprint is considered. Our ambition is to reduce the CO2 footprint even more. Therefore, we have started to decarbonize our supply chains, for

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example by using green steel and green aluminium.

How did it come about?

Dr. Katschinski: We started working on alternatives to SF6 around 2008. We couldn't ignore its GWP; there was growing customer interest, and fluorinated gases (F-gas) regulations were being discussed within the EU. So, we got to work; back then, we were still part of Siemens AG. We developed the prototypes based on our expertise at a Siemens factory for medium-voltage circuit breakers based on vacuum interrupter switching technology in Berlin. We intensified this work in 2014. That was also the year the EU outlawed SF6 for most applications, except for the power sector, due to a lack of alternatives. But even then, it was clear that this exception would be only temporary. So, we focused on making our first commercial clean air switchgear and vacuum circuit breakers available – and we accomplished that by 2017. As expected, in March of 2024, the EU's revised F-gas regulation for phasing out F-gases with GWP > 1 came into force.

Was it clear that clean air and vacuum would be the way to go?

Dr. Katschinski: Yes. Clean air with GWP = 0 produces no new emissions



8VN1 Blue GIS™ for voltages up to 145 kV

during its life cycle, is easy and safe to handle, and poses no health risks to workers or environmental harm. That's also why it's not surprising we're witnessing a high demand for our Blue Portfolio.

So, would you consider yourself a pioneer in the industry?

Dr. Katschinski: Well – while we started looking into SF6 alternatives early, other competitors also quickly realized the need to move away from SF6. The more important question is which solution to use – natural-origin or fluorinated gases with a reduced GWP. For all live- and dead-tank circuit breakers as well as for GIS of 145 kV and below natural-origin gases are the clear favourite. Only a few OEMs are still using PFAS–gases (PFAS = Per- and polyfluoroalkyl substances) as an alternative to SF6 in GIS of higher rated voltages. We are confident that natural-origin gases will also prevail here as PFAS restrictions are being discussed globally and even are already prohibited in some regions of the world.

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What was your strategy for developing the Blue Portfolio?

Dr. Katschinski: It was bottom-up—first developing switchgear for lower high-voltage ratings, means for rated voltages of 72.5 kV and 145 kV voltage, then moving on to higher voltages. Our approach also allows the market to accept this new technology gradually and see its efficiency and overall low lifecycle costs.

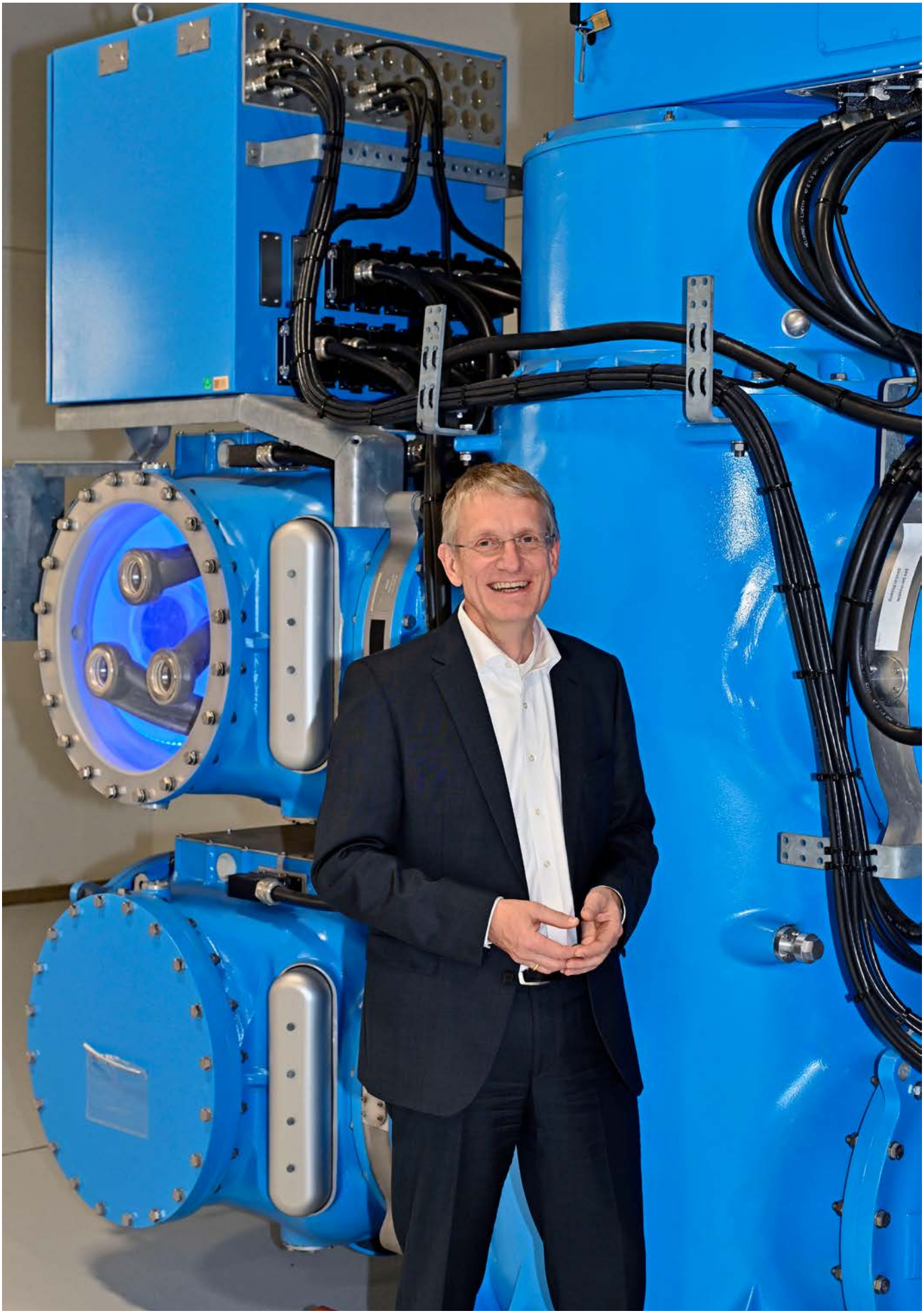
For product development, how important is public funding, e.g., from the EU?

Dr. Katschinski: Very important. With the EU, we're currently part of two programs concerning switchgear and phasing out SF6. One such initiative is the 'Mission' project, an Innovation Action project co-funded by the European Union through Horizon Europe, with €11 million in funding. It addresses critical technology gaps for AC and DC grids in medium and high voltage. Under this program, using pressurized clean air, we're developing and piloting a 420 kV HVAC live-tank AIS vacuum circuit breaker and a 550 kV HVDC clean air GIS. Another project is an EU project to develop clean air 420 kV GIS under the 'Programme for the Environment and Climate Action' (LIFE). The main success factor to be selected was that we are in line with the restriction proposal on PFAS-F-Gases in switchgears in Europe, which is currently in the evaluation and discussion process.

You are investing €60 million in your Vacuum Interrupter factory in Berlin.

Dr. Katschinski: Yes, we exclusively produce all vacuum interrupters of our Blue Portfolio at this site using the latest state-of-the art precision manufacturing. That's especially important when you aim for high-voltage vacuum interrupters. The physics for higher voltage is the same as for lower-voltage applications, but quality requirements increase. It's comparable to manufacturing microchips. In addition, Berlin helps secure our supply chain having our biggest switchgear

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Dr. Katschinski in front of an 8VN1 Blue GIS™

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factory and all related R&D facilities there. And since the plant uses 100% renewable energy, it also increases sustainability. With this factory we are very well prepared for the higher market demand for Blue switchgears worldwide.

Isn't it expensive to produce in Germany?

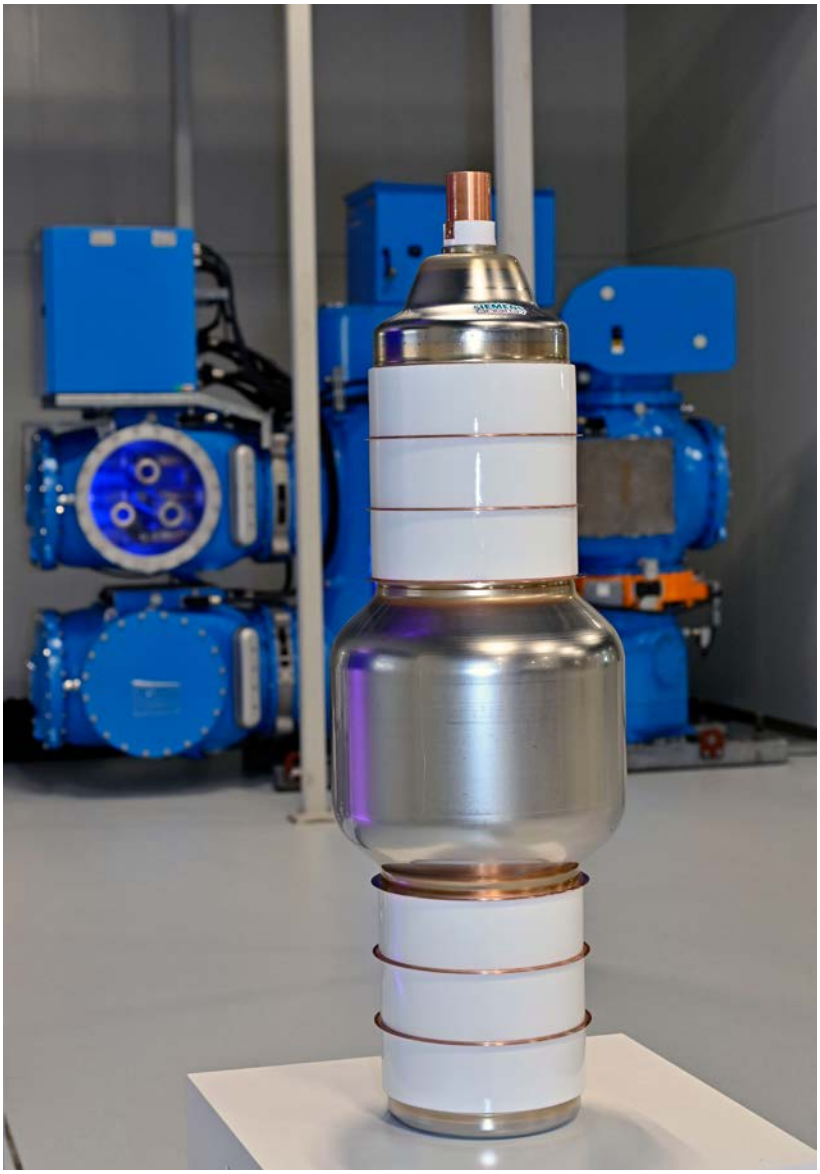
Dr. Katschinski: Labor may be cheaper elsewhere, but the manufacturing processes are highly automated. Also, despite a scarcity of qualified workers, university graduates and skilled workers enjoy working on products like the Blue Portfolio, as it's technically attractive and entails doing relevant work for society. Furthermore, Siemens Energy also has a good reputation as an employer. We recently increased our workforce in R&D and manufacturing and had no problem filling positions.

What are the anticipated outcomes of the newly established VI facility and the enhanced research and development activities in Berlin over the coming years?

Dr. Katschinski: We will continue to speed up our Blue development work, where some projects are co-funded by the EU mentioned earlier. In particular, we are working on starting pilot applications for 420 kV AIS life tank and GIS in 2026. In parallel, other Blue developments are ongoing; we aim to have the entire Blue portfolio based on clean air with GWP = 0 available for the world markets by 2030.

Transforming switchgear: A new factory in Berlin

In July 2024, Siemens Energy opened a new, state-of-the-art vacuum interrupter factory in Berlin's historic Siemensstadt district. Built in 1916/17, the site has long been a hotbed of innovation, developing and manufacturing devices for high-voltage systems that supply the world with electricity. With an investment of about €60 million, it manufactures vacuum interrupters for the company's clean-air Blue switchgear. The 6,200 m² production hall will achieve a production capacity of up to 30,000 vacuum interrupters within the next decade. The highly automated, entirely digitally connected production plant is also powered by 100% renewable energy, and with more than 100 people working on-site, it also boosts the Berlin economy.



High-voltage vacuum interrupter for 245 kV