



Energetic about energy: Michael Weinhold enthusiastically discusses new technologies with a group of university students.

Photo: Oliver Mark/Agentur Focus

Talking Tomorrow's Energy System

Four students from Berlin's Technical University met Siemens Energy's Chief Technology Officer, Michael Weinhold, to discuss the new electricity age, the future of our energy system. They plunged into a conversation about "green" visions – covering power from the Sahara, a grid with a brain, and an electric autobahn.

By Stefan Nicola



What's Your Vision?

Michael Weinhold, 45, CTO Siemens Energy

"My vision for Germany 2020 is that renewables will be able to satisfy peak load, that we will have smart grids and one million electric cars on the roads. On a global scale, the picture will look a bit different: In 2030, more than half of the global power mix still will be dominated by coal, gas and nuclear. But energy efficiency and carbon capture and storage (CCS) will be very important. Renewables will have made a big jump from currently 3 percent to then 17 percent. But let's talk 2050, because that's a very different story. By then, 60 to 80 percent of the power generation in Europe may come from renewables, with nuclear and CO₂-free fossil fuel accounting for the rest."

Christine Kölling, 24, student of Industrial Engineering specializing in energy management, TU Berlin

"I strongly believe in wind and photovoltaic. They have great potential. But what I want to stress is that the energy mix of the future has to be looked at from a global perspective. We can't ignore fast-growing economies such as India and China. One of our biggest tasks will be to convince these countries that they can attain economic prosperity with renewables."

Alexander von Leliwa, 25, student of Industrial Engineering specializing in energy technology, TU Berlin

"I think that a 30 percent share for renewables is possible in the long term, but on a global scale, coal and gas still will

dominate for quite some time. I don't believe in photovoltaic because it is too expensive, but I think wind, if it finally goes offshore, has great potential. I am also in favor of keeping nuclear power in the mix, because it's a CO₂-free technology."

Kilian Veer, 25, student of Industrial Engineering specializing in energy systems, TU Berlin

"Until 2020 coal will remain important, especially in Germany, because so much of it is readily available. That's why I hope that CCS technology becomes economic before 2020, although this might sound a bit too optimistic. I do think renewables will take over eventually: wind has a strong potential, and photovoltaic is nearing grid parity, even in Germany, as thin-film cells are becoming cheaper and more efficient."

Henryk Wolisz, 24, student of Industrial Engineering specializing in energy systems, TU Berlin

"I think diversification is key to tomorrow's energy mix. Wind and solar energy will prosper. Photovoltaic is good for decentralized power generation, but I see more potential with solar thermal power, because it's linked to proven technologies such as steam turbines. I am critical of coal, even with CCS. Why ditch highly developed, CO₂-free nuclear power and invest huge sums in CCS, which is undeveloped and could bring new risks and insecurities? Key to the future mix will be smart grids that harmonize fluctuating energy sources."

"Siemens depends on new ideas. We want to question the status quo; we want to learn."

Michael Weinhold, Chief Technology Officer
Siemens Energy

It is January, and thick snow blankets Berlin. Towering above the city's Charlottenburg district, not far from the Victory Column, is the Technical University (TU) Berlin – one of Germany's leading lights in energy studies. Weinhold, wearing a navy-blue tweed suit, chats with four students in the university's presidential reception room, a high-ceiling space with paintings and steel busts of former university presidents and famous alumni. Henryk Wolisz, Alexander von Leliwa, Christine Kölling and Kilian Veer are studying Industrial Engineering at the TU with a focus on energy management and technology. They are nearing graduation and they are eager to grill Weinhold about all sorts of visionary issues.

The 45-year-old electrical engineer turned Siemens top manager looks delighted, because energy visions are just his cup of tea. In 16 years of working at Siemens, he has had a hand in some 130 patents and in 1997 was named Siemens Inventor of the Year. Two years ago he became Chief Technology Officer of Siemens Energy, a unit with 85,000 employees and yearly revenues of around 25 billion euros.

Nobody knows better than Weinhold that as an innovation-driven company, Siemens depends on new ideas. "We

want to question the status quo; we want to learn." New ideas have shaped his work focus, he tells the students, which has changed from mere technical improvements to ones of greater social responsibility. "We engineers," he says, "need to make the energy system sustainable, so that the world can avert catastrophic climate change."

Recent events in Denmark did not help this. Copenhagen's UN Climate Conference in December 2009 was intended to blaze a trail into a new age of energy. Unfortunately, it failed utterly, says Kilian Veer, who had hoped that CO₂-generating giants such as the USA and China would commit to concrete emissions reductions. Weinhold is disappointed, too. "I would have liked an agreement that goes beyond what emerged in Copenhagen," he says. "But that doesn't mean we innovators are burying our heads in the sand. We will keep pushing for a sustainable energy system."

Kilian, a 25-year-old native of Germany's coal-producing stronghold North-Rhine Westphalia, cheers him on. "Would it not be possible," he asks, "for large companies such as Siemens to take matters into their own hands, to press politicians to take more action on climate change?" Weinhold nods: "Siemens already is showing politicians what's possible," he says, mentioning products such as a free-floating, offshore wind turbine, the world's largest gas turbine in the combined-cycle process with a record-setting 60 percent efficiency and a new high-voltage, direct-current power line in China that shifts 5 GW of CO₂-free hydropower across 1,400 kilometers at about 95 percent efficiency.

Back and forth, round and round: Bold thoughts are tossed about in a lively, five-way interchange.





Quo vadis? Topics discussed include post-Kyoto policy, carbon capture and storage, smart grids and solar thermal power plants in Africa's Sahara Desert.

The Generation Game

Then there are projects like Desertec, a multi-billion-euro project aimed at powering homes with electricity generated from the African sun and wind, eventually also including European houses. Siemens helped found the initiative, which would be based around huge solar thermal power plants in the Sahara. "Only a few years ago," Weinhold says, "this project would have been labeled a passing craze."

The students find Desertec exciting. Still, Henryk Wolisz warns of potential risks when generating a large portion of Europe's power in potentially unstable countries, or with infrastructure that poses an easy target for terrorist attacks. And how about this: "We are talking a lot about Europe's energy dependence on Russia, but wouldn't Desertec create a new dependence?" Henryk asks.

Weinhold replies that there will always be a broad alternative-fuel mix: offshore wind power in the North Sea, solar photovoltaic from Italy and

Spain, biomass and onshore wind in Germany, not to mention nuclear and CCS, both poised to play a key future role. So, too, will Desertec, says Weinhold: "We can realize it, and we will realize it."

Kilian Veer and Christine Kölling, a fifth-year student from Saxony-Anhalt who plans to become a consultant to the energy industry, contend that Desertec makes sense only if the European power grid network is overhauled completely. Massive amounts of power from the Sahara would simply overburden the current, outdated network. "You're right," Weinhold says. "The European grid is unable to transport large amounts of power over a long distance. This has to change." And it will. Nine European countries, including Germany, Britain and France, are planning to build a massive, trans-border power grid to integrate renewable electricity better. The countries also aim to raise billions of euros for a high-voltage grid under the North Sea. Its direct-current lines would connect British and German offshore

wind farms to hydro storage in Norway, wave-powered generators off the Belgian and Danish coasts and large wind and solar farms in mainland Europe.

Power Grid with a Brain

Future grids must not only become more powerful, they will also have to develop a brain. Kilian is fascinated by plans for a European smart grid. He has studied the issue, and he is thinking about doing his thesis on smart meters "that could help balance the grid, so that more renewables can be integrated." Via smart meters in homes, utilities could tell their customers when power is cheap (at night, when wind power is abundant, for example), so that appliances can be run accordingly. This is classic win-win: Utilities balance supply and demand to avoid bottlenecks, while customers save on their energy bills.

Making the grid smart is essential, if it is to be integrated with Henryk's passion: electric cars. After working with the German Car and Transport

Teaming up for Innovation

The Center of Knowledge Interchange (CKI) is a strategic alliance between Siemens and the TU Berlin aimed at sparking innovation in several technology sectors. In operation since 1998, it is about furthering research, recognizing and supporting young talents and strengthening the exchange between academia and industry. Joint conferences and workshops, Siemens-funded research projects and a regular personal interchange foster open innovation and benefit students as well as Siemens employees. The CKI relationship, established at top universities around the world, reflects the high level of cooperation between Siemens and academia. The TU Berlin, located in the heart of Berlin, is an important technical university in Germany, with 28,000 students and a strong focus on practice-oriented research.

Engineering Society, or IAV, one of the leading engineering service providers to the automotive industry, he has high hopes that the autobahn will turn electric.

Weinhold is eager to electrify a sector currently dominated by liquid fuels. He believes that by 2020, one million electric cars will cruise German roads. If connected to a smart grid, the cars' batteries could then serve as a giant power storage system. At night, people could plug in their electric cars to load their batteries with wind-generated power. Then, during daytime peak demands, the parked car (when not being used) could feed excess power back into the grid. Of course electric cars' success is all about social acceptance, notes Alexander von Leliwa, a fifth-year student who also wants to work as an energy consultant. Drivable distance per charge is still pretty low (around 100 kilometers for a fully electric car), so people might switch to other green alternatives, such as extended-range hybrids.

Alexander saves a difficult question for last. He knows Siemens from the inside; he has worked there part-time for two years as a student. Now he wants to know why Siemens includes

coal and gas in its portfolio of environmental technologies. Weinhold clarifies: Siemens products, such as gasifiers for coal plants, or highly efficient gas turbines, make coal and gas generation less polluting than it otherwise would be.

Whether it's clean coal, efficient gas, nuclear, biomass, wind or solar energy – there is no doubt that environmental concerns are driving the power sector. "We live in an age of transformation, in a time in which visionary ideas are entering their realization phase," Weinhold says. "And you are about to graduate right into the middle of that. Things are happening now, and you can take advantage of them."

The students nod. They look ready.

Stefan Nicola, a politics and energy journalist based in Berlin, is working for United Press International (UPI) as its Europe correspondent. He also writes for the European Energy Review, an energy publication for decision makers.

Further Information

www.siemens.com/energy

Glossary

■ **Smart Grid:** A smart grid is an integrated system combining the electricity supply with IT technology for an intelligent delivery from producers to consumers and the other way around. The system is smart in that it uses digital technologies to optimize efficiency, save energy and costs and to provide increased reliability and transparency. Customers, for example, can see when power is cheapest and run their appliances accordingly. Smart grids are being promoted in many areas to address energy, environmental and reliability issues for electric power.

■ **Solar Thermal Power:** This CO₂-free generation technology uses a field of mirrors to focus solar rays on an absorber pipe with an integrated heat carrier. The carrier transfers the heat to a central power-generating unit, producing steam that drives a turbine. Solar thermal power plants operate mainly in southern Europe and the USA.

■ **High-Voltage Direct-Current (HVDC) Transmission:** HVDC lines are able to send large amounts of power over long distances with very little losses – key to the transmission of renewable power, often generated far from where it's needed most.

■ **Carbon Capture and Storage (CCS):** CCS technology captures CO₂ from a coal- or gas-fired power plant and then stores it in underground reservoirs. The technology has been demonstrated in small scale. It is foreseen full-scale plants will go commercial by 2020.

For further glossary terms see: www.siemens.com/glossary