World Energy Council head Christoph Frei is also an Adjunct Professor and Advisor to the President of the Swiss Federal Institute of Technology, Lausanne (EPFL), Switzerland, where he earned his PhD in energy policy and sustainable development in 2001.

"There Is a Lot of Work to Do Everywhere"

Christoph Frei, Secretary General of the World Energy Council and former Senior Director of Energy Industries & Strategy at the World Economic Forum, spoke exclusively to *Living Energy* on the future of energy.

Interview by Craig Morris

What is the World Energy Council's forecast for energy consumption?
FREI: There will be great regional differences. In our scenarios, we expect energy demand in the developing world to continue to grow strongly, but the developed world should actually be able to meet a large share of its slightly growing energy demand from increased efficiency – and meet possibly up to 40 or 50 percent of the current Kyoto targets through efficiency measures.

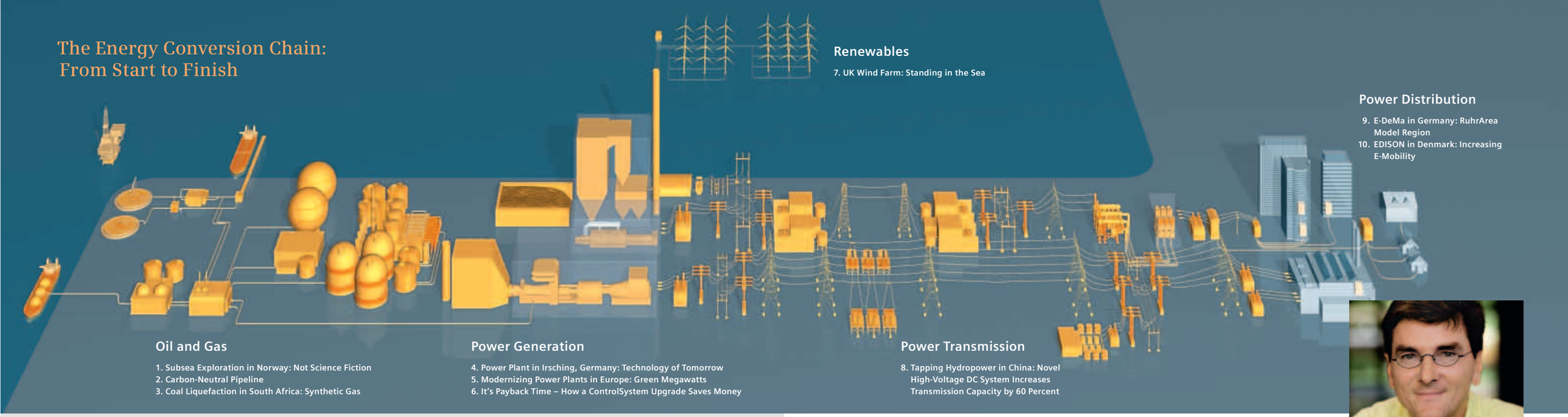
That is the demand side – will production be able to keep up?
FREI: You are referring to the idea of peak oil. The overall trend is rising prices as we run out of easy oil, and prices will rise even further when we get an international carbon price. As prices rise, of course, demand and emissions drop. But this is the goal. If we return to the question of the scarcity of resources, you have to look at each source of energy on its own. If we talk about oil and gas, it is clear that easy oil is becoming scarcer, but at the same time, unconventional sources are gradually becoming profitable and will partly counteract that trend.

Will the drop in energy demand slow down economic growth?
FREI: Most economists now agree that energy consumption and economic growth are increasingly decoupled in industrialized countries. I don't think we have too much to worry about here. Lower energy consumption does not mean a lower standard of living.

Where are we going to get all this efficiency from?
FREI: There are a lot of areas. To take one example, we have tremendous potential in buildings, where a large chunk of our energy is consumed – and where little attention has traditionally been paid to energy efficiency. Mobility is another growing area of interest. And roughly 50 percent of our electricity is consumed in electric motors, which generally do not run optimally, so the potential here is great. In the production industry, a lot of systems are quite old and need to be modernized. So there is really a lot of work to do everywhere.

Do you think people are willing to become more efficient?
FREI: Mobility is an interesting field

Photo: Ruud Baan



in this respect. The question of whether people are willing to drive cars with smaller, thriftier engines is an emotional one. We do know, however, that when prices rise, people are willing to switch to more efficient systems. For instance, when the price of a barrel of oil recently rose to more than 140 dollars, sales of SUVs plummeted. Gasoline prices dropped shortly thereafter and have since been rising again, but we can clearly see that a small step was made in the right direction.
If we take a look at how far we need to go in the field of mobility, we see some astonishing figures. For instance, we currently have some 800 million cars on the road, but that number is set to rise to 2,000 million by 2030 – that's a 2.5-fold increase. If we wanted to keep our emissions at the current level, we would have to become 2.5 times more efficient in the sector of mobility – just to maintain the status quo. So each vehicle is going to have to become 2.5 times more efficient, and that is not going to be possible simply by changing people's behavior, not even with the kind of price increases that occurred last year.

Christoph Frei

Born in Switzerland in 1969, ***Christoph Frei*** became Secretary General at the World Energy Council in April 2009. He also has an assignment as Adjunct Professor and Advisor to the President of the Swiss Federal Institute of Technology, Lausanne (EPFL). From 2001 to 2009, Frei was Senior Director of Energy Industries & Strategy at the World Economic Forum and a member of the Forum's Executive Council. He holds an electrical engineering degree, an econometrics degree, a master in energy systems and a master in applied ethics and received his PhD from the Swiss Federal Institute of Technology, Lausanne, in 2001. Frei has led projects on energy security, energy poverty, sustainable biofuels, and innovation in cities.

E-mobility will play an important role in this context. However, there are a number of unknowns there as well: The electricity supply will have to deliver on the demand surge, and we will not only need tremendous amounts of lithium for the batteries once their cost comes down, but also an industry capable of effective recycling.

What do we have to do in Copenhagen to reach these efficiency goals?
FREI: The main thing is to get an international carbonprice mechanism. Anything less would simply not properly contribute to greater efficiency and energy security. The goal in Copenhagen – and in subsequent policies, to the extent that this goal is not reached in December – has to be a strong international price for carbon.

Is the developing world going to have to pay the same price for a ton of carbon as the developed world does?
FREI: No, that is neither politically feasible, nor fair. There will have to be quotas that allow the developing world to continue its economic development in the years to come.

*For our author **Craig Morris,** the most interesting part of the tour was "seeing things in person and not just reading about them." He was also especially interested in demand management, "which I have been following for years."*

Innovative Projects throughout the Energy Conversion Chain

Energy innovation – this catchphrase is on everyone's lips in the globalized world of energy. Siemens Energy Sector is the world's leading supplier of a complete spectrum for the generation, transmission and distribution of power and for the extraction, conversion and transport of oil and gas. *Living Energy* invites you to take a look at ten of the most innovative projects along the entire energy chain, which our journalist researched or visited in person – projects that soon may come to a power socket near you.

By Craig Morris

Photo: haraldhoffmann.com, Graphic: Rainer Schubert

If we walk through Siemens' energy sector, we could start where the electricity supply chain traditionally begins: coal, oil and gas, and nuclear. In recent decades, renewable energy sources – in particular, solar power and wind – have also increasingly become significant players. Siemens is a major technology supplier in each of these

sectors, and in June of this year, the company announced how various stimulus packages across the globe would affect it. Over the next three years, the firm expects to sign 21 billion US dollars worth of new contracts, nearly 8 billion of which will be devoted to renewables and energy efficiency.
The next stage in the electricity supply chain is the transmission system. Here, large central power stations hook up to the high-voltage power grid, which later connects via transformers to the medium-voltage distribution system, to which smaller generators are often connected – wind turbines, for instance. From there, the grid branches off into the low-voltage level that serves individual buildings.
At each of these stages, Siemens is working to improve energy efficiency and diversify energy production. In the following pages, we invite you to accompany me on a visit to some of the most innovative projects that Siemens is working on. At midstream in the value chain, Siemens has developed a novel all-electric system to liquefy natural gas, thereby boosting its efficiency by as much as 50 percent. A global leader in steam turbines, Siemens has retrofitted nuclear power plants to produce as much as 10 percent more energy without any other modernization of the plant. And in the field of gas, Siemens is now putting into operation the world's largest combined-cycle gas turbine in Bavaria. In the field of coal liquefaction, Siemens has provided the world's largest air separation compressors to a South African plant. And Siemens may soon be providing an electric compressor for a Norwegian subsea oil platform that has to run maintenance-free at a depth of 3,000 meters underwater.
In all of these areas, efficiency is crucial. After all, fossil and nuclear plants will continue to be our main sources of electricity for some time to come, so efficient use of these resources will both extend the range of these energy sources and reduce the environmental impact.

In some projects, the positive environmental impact is considerable, though it is not apparent at first glance. For instance, a new high-voltage DC transmission system that Siemens will complete in China in 2010 allows the country to tap more hydropower instead of adding new coal plants. The CO_2 emissions offset amount to a whopping 33 million tons at the Yunnan-Guangdong project alone.
In other projects, the positive environmental impact is obvious. As mentioned above, Siemens is a global leader in steam turbine generators, so it comes as no surprise that Siemens is a leader in the steam turbine generator sets for concentrated solar power (CSP).
But fewer people may be aware that Siemens may have the longest history in offshore wind, having taken over Bonus, the firm behind Vindeby, one of the first offshore wind projects in the world back in 1991. And in a more spectacular development, Siemens has come up with a solution to allow wind turbines to be put up outside of shallow offshore areas – the technology sounds like it could never work when you try to describe it, but since it does, we will do our best to tell you how.

Finally, there is my personal favorite: smart grids. Siemens is working on two projects in Germany and Denmark that will allow electricity consumption to be better tailored to production – rather than the other way around, which has been the case up to now.

Exploring New Territory in Fossil Fuels

Oil and gas have been in the news a lot lately. With prices fluctuating wildly at the pump, consumers are perhaps more aware of changes in the crude oil market than they are of any other source of energy.

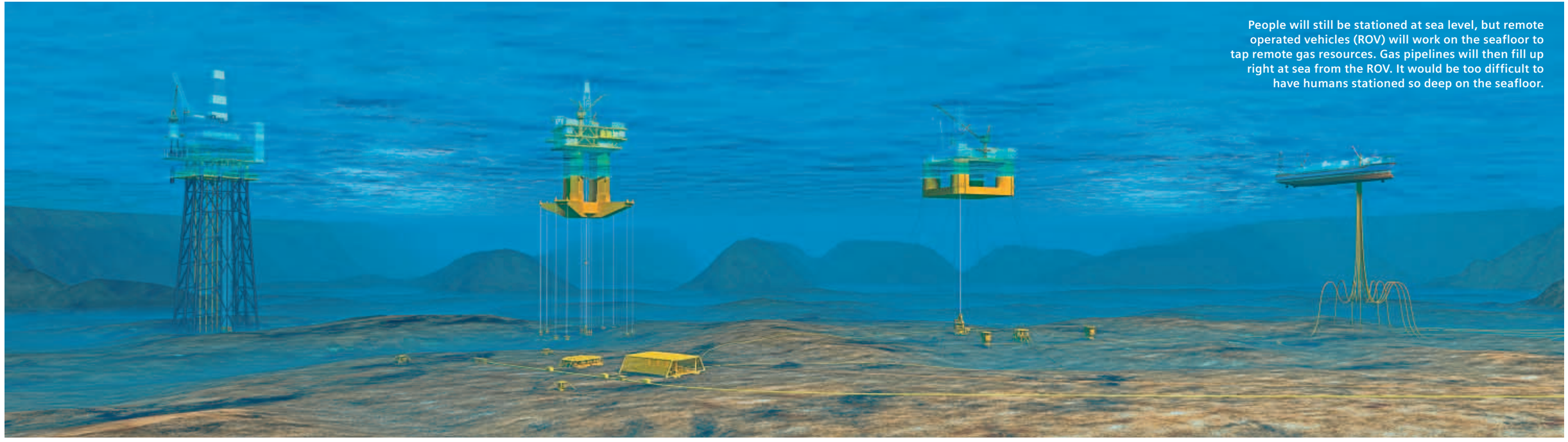
Siemens products are used in all stages of this sector: onshore and offshore drilling, the use of electric drives for natural gas liquefaction, the coal-to-liquid process, pipelines, and terminal management.

Take a walk with us through three novel sites where Siemens is either increasing the efficiency of the overall process or allowing previously inaccessible resources to be tapped.

1. Subsea Exploration in Norway: Not Science Fiction

You may have heard of the recent best seller *The Swarm* by German novelist Frank Schätzing. The fully automated subsea oil exploration described in the book is not fiction, however. Siemens is developing a compressor with an integrated electric motor that may be used at this futuristic station. As easily exploitable oil and gas fields become rarer, engineers are working to reach less accessible ones. One approach is to move further out to sea. But at depths of 3,000 meters below sea level, water pressure is a considerable challenge. It is also impractical at such depths to have people manning the station. The solution is to have robots operate independently. For several years, Siemens has tested a prototype of its electric-driven compressor in an onshore application in Holland. It will provide maintenance-free operation at the required depths.

Illustration: Siemens



People will still be stationed at sea level, but remote operated vehicles (ROV) will work on the seafloor to tap remote gas resources. Gas pipelines will then fill up right at sea from the ROV. It would be too difficult to have humans stationed so deep on the seafloor.

2. Carbon-Neutral Pipeline

In some respects, the Ruby Pipeline is nothing extraordinary. When it opens in early 2011, the 1,000-kilometer-long, 1-meter-diameter tube will transport natural gas from the wilds of the US state of Wyoming to other western states: Oregon, California, Idaho, Nevada and Washington. It will have a huge capacity – hauling some 40 million cubic meters of gas per day – but even that is not special in the USA, the world's largest energy user. What sets off the Ruby from the rest are its shoes. Size zero, to be precise. Thanks to Siemens, the carbon footprint of the pipeline will be null. This is because the three STC-SV (08-5-A) pipeline compressors, three 17-MW electric motors, and three Perfect Harmony drives that Siemens supplies – the ones pumping the gas – will be powered by greenhouse-gas-free energy. Their electricity mix will consist of renewable fuels plus conventional fuels offset by carbon credits.
"A carbon-neutral pipeline is a first," says CEO Tom Blades of the Siemens Oil & Gas Division. "And that is where we want to be in the oil and gas business."

3. Coal Liquefaction in South Africa: Synthetic Gas

Along with the USA and China, South Africa has considerable coal reserves. It also has a special history: During the years of apartheid, an embargo was imposed on the country, which then had to resort to coal liquefaction as a way of producing fuel domestically. These days, South Africa can, of course, buy oil on the global market, but its prices have risen enough that liquefied coal is an economic option. Siemens has provided the country with the world's largest compressor for air separation. "The trend is toward larger facilities," says Jochen Domas, a Sales Director with Siemens. "Customers prefer to have one large plant rather than two smaller ones." This approach lowers overall project costs without reducing efficiency.
In the coal-to-liquid process, high concentrations of oxygen are needed to produce "syngas" (synthetic gas). As air is cooled down to minus 180 degrees Celsius, the various components become fluid, allowing them to be captured separately. Nearly pure oxygen can thus be used for the combustion process.

At Sasol's coal-to-liquid plant in Secunda, South Africa, a series of chemical processes convert coal into synthetic fuels.

Power Plants for the Future

Central power plants are our main source of electricity, and while distributed power is becoming more common, central coal and nuclear plants can be expected to continue to provide a large share of our electricity for some time to come. In addition, since the 1980s, gas turbines have been very popular as a way of quickly reacting to rising power demand. Siemens has helped a number of plant operators tweak their processes to provide immediate efficiency gains almost overnight. Indeed, in one project, Siemens' engineers helped an operator in the Netherlands to add 35 MW of generating capacity in the short space of only 35 days.
The efficiency gains are even greater in northern Bavaria, where Siemens is testing the world's largest gas turbine. Siemens and EON chose the site because the gas lines were in place, but the plant was partly already out of operation. Its now unprofitable conventional gas-fired boilers once replaced the oil-fired boilers that had themselves become unprofitable during the oil crises in the 1970s. In a way, this gigantic turbine is the third generation at the plant in Irsching – one that may soon set the industry standard.

4. Power Plant in Irsching, Germany: Technology of Tomorrow

Author Craig Morris visits the world's largest gas turbine in an open-cycle power plant. The turbine is already installed and is currently waiting for the steam turbine and balance of plant to be added downstream.

Photos: Siemens, Kurt Paulus

In Irsching, Bavaria, Siemens is putting the world's largest gas turbine into operation in a combined-cycle unit in cooperation with EON. As Siemens Program Manager Willibald Fischer explains, the prototype of this turbine – the H series – was built in Berlin in 2007 and has since been tested on site in Irsching. Fischer says, "Not only is this turbine extra large, it also is extra efficient – thanks to reduced losses – and this brings overall operating costs down."
The firing temperature has been increased by about 100 K, "which places even greater challenges on the nickel-based alloys that stand directly in the hot-gas path." The gas turbine itself has an efficiency of around 40 percent, and the downstream steam turbine, which will operate at around 600° C, adds on another 20 percentage points. "The 600° C water steam cycle with HRSG squeezes more out of the exhaust gas. Temperature of the residual exhaust is then only around 85° C," Fischer explains.
While Siemens' F series gas turbines currently makes up roughly two-thirds of the firm's gas turbine sales, Fischer says, "The H series is the technology of tomorrow. A lot of our customers are very interested in this project, and we receive a lot of visitors in Irsching."

Two of Siemens' staff get almost directly to grips with the world's largest gas turbine, located at Siemens' test facility in Irsching, Germany.

Photo: Kurt Paulus

The installation of a modern steam turbine can improve plant efficiency considerably.

Photo: Siemens

5. Modernizing Power Plants in Europe: Green Megawatts

Often, aging power plants can be modernized to produce more power. For instance, Siemens can retrofit the rotor section of steam turbines used both in coal-fired and nuclear power plants by applying novel blading and sealing technologies. “I can think of a lot of examples where we have done that – at plants with outputs ranging from 200 to 1,200 MW,” says Norbert Henkel, Director Steam Plant Modernization Region Europe, Asia, Middle East. One such project is the Borssele nuclear plant in the Netherlands, where an additional 35 MW were added on in a mere 35 days. “The payback in such projects – the euro per megawatt – is surprisingly great,” Henkel explains. The new components extend the service life of the power plants, which are generally at least 20 years old when modernized, and they improve efficiency.

Another example is the coal plant in Farge near Bremen, Germany. Here, the plant’s total capacity was increased from 318 to 345 MW, with CO_2 emissions being reduced by up to 100,000 tons per annum. In the process, the plant’s service life was extended by 15 years. “We speak of this added generation as ‘green megawatts,’” Henkel says.

6. It’s Payback Time – How a Control-System Upgrade Saves Money

About 100 kilometers west of Phoenix, Arizona (USA), the mountainous desert is the home of New Harquahala Generating Company (NHGC), a combined-cycle, 1,080-MW gas-fired generating plant that sells “merchant” power. Unlike conventional utilities, merchant power plants, like NHGC, are privately owned and sell power directly to wholesale buyers at competitive rates in unregulated power markets. When it comes to justifying any new capital investment, NHGC’s owner is extra hawkeyed on return on investment and on improving competitiveness in the merchant power playfield. Both the owner and the plant saw the opportunity of achieving their business objectives by upgrading the plant control system to Siemens’ fourth-generation controls technology SPPA-T3000 in fall of 2007. They immediately jumped into action. They were not disappointed by the returns. The plant saw intangible benefits from various areas: system operability and flexibility, plant security, as well as employee morale right after project completion. Tangible savings totaled up to more than half a million dollars per year. Around two-thirds of it came from improved reliability and availability by significantly reduced control system trips, which kept the plant in closer alignment to its long-term service agreements. The rest came from savings of time and effort in administration. Numbers talk and they all speak an important word: PROFIT.

Renewables: Offshore Wind and Large-Scale Solar

Since last fall, Siemens has a Solar Power Business with two focal points: large-scale rooftop and ground-mounted crystalline photovoltaic arrays, and concentrated solar power (CSP). As part of its intention to drive technology in solar thermal power plants, Siemens in March 2009 bought a significant stake in Italy’s Archimede Solar Energy. The company has innovated in CSP: Instead of using oil as the heat transfer fluid in parabolic troughs, with the heat being passed on to the molten salt in the boiler via a heat exchanger, the molten salt runs through the glass tubes atop the parabolic troughs. This approach allows salt to be stored so the plant can run at night plus enables higher temperatures, and thereby greater power production. Siemens has a 90 percent share of the parabolic CSP market with its steam turbines. Siemens is also focusing on a sector that has proven quite exciting offshore. The energy potential per turbine is much greater at sea, where wind velocities are higher and steadier than on land, making wind a more reliable source of electricity. At least in theory. In practice, offshore wind turbines must withstand harsher weather conditions than onshore turbines do. Siemens is well positioned to offer the most robust turbines on the market. The world’s first offshore wind farm went up in 1991 off the coast of Denmark. Siemens later acquired the company behind that project: Bonus Energy. As a result, Siemens has nearly two decades of experience in the fledgling offshore wind market – more than any other company worldwide.

Off the shelf: Siemens has the right-sized turbines, ready today for commercial installation and operation.

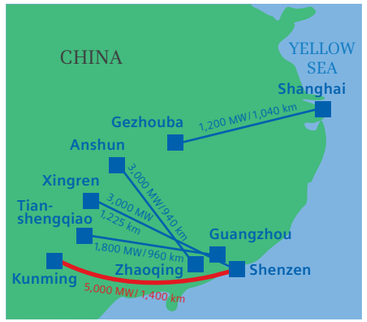
7. UK Wind Farm: Standing in the Sea

At the Lynn and Inner Dowsing Offshore Wind Farms some 5 kilometers off the shore of Lincolnshire, UK, Siemens has supplied 54 of its SWT-3.6-107 turbines for an overall capacity of 194 MW, making these two adjacent projects the largest collective wind farm in the world. (A year later they will be surpassed by Greater Gabbard's 504 MW – see p. 36.)
But the waters around these two projects off the coast of Skegness are relatively shallow, with a maximum depth of around 13 meters. Siemens is going further to find ways of installing turbines at much greater depths. You may be familiar with the slogan, "Weebles wobble, but they don't fall down." Siemens is using the basic idea behind these toys for "floating" wind turbines: The bottom is weighted so that the turbine always stands upright. There are three anchors on the seafloor to which the turbine is flexibly attached; these anchors prevent the turbine from drifting across the sea. The challenge here is to provide enough weight at the bottom to keep the turbine standing without sinking it. The problem becomes even more difficult when we realize that the turbine's nacelle – the round casing for the generator at the top of the tower – is filled with heavy equipment.

Power Transmission – Enabling Large-Scale Clean Energy

Around a century ago, one of the first standardization struggles in industrial history took place between George Westinghouse and Thomas Edison. In what has become known as the "Battle of Currents," Westinghouse and his colleague Nikola Tesla succeeded in getting alternating current used to transport electricity from Niagara Falls to Buffalo, New York, by demonstrating that AC was more efficient than DC in power transmission.
For most of the 20th century, direct current was therefore mainly used to supply power directly to power consumers. But in an interesting reversal, direct current has begun making a comeback for transmission with the latest technology. Indeed, most talk about "super grids" revolves around high-voltage direct-current (HVDC) transmission. Siemens is a forerunner in this field.

8. Tapping Hydropower in China: Novel High-Voltage DC System Increases Transmission Capacity by 60 Percent

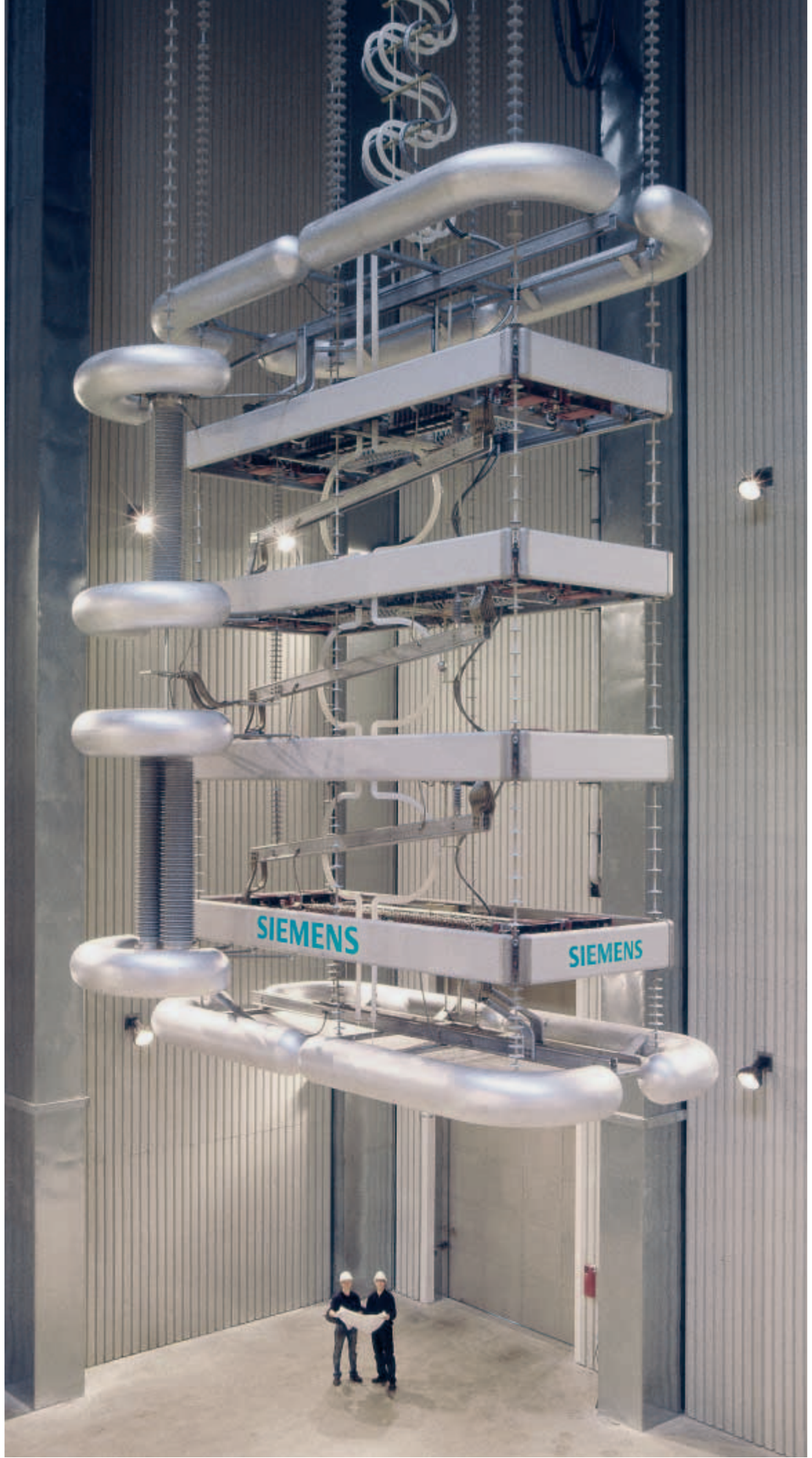


Sharing power in China: HVDC systems.

By providing an 800-kV direct-current transmission system, Siemens allows China to connect a large hydropower plant to its quickly expanding grid instead of adding on additional coal plants. The remoteness of the site was the first problem. "We specially designed the actual transformer units to fit through the mountain tunnels by train," explains Marcus Häusler, Technical Director System & Equipment Engineering HVDC at Siemens. "The connector arms, the transformer bushings, as well as parts of the windings, were then installed on site." In total, 24 transformers with four different types are installed at each station with one spare for each type. "If one of the transformers needs to be replaced, it could take months to get a new one out here, so we chose to keep one for each type in reserve on site." Once assembled, the equipment is gigantic. "We increased the transmission capacity by over 60 percent from around 3 to 5 GW at one go, and we are working on 6.4 and 7.2 GW in other projects."
"But the air clearance grew by 100 percent in the process here," Häusler

Craig Morris (right) discusses the model of the HVDC station with Siemens Technical Director Marcus Häusler.

Photos: Siemens, Kurt Paulus, Graphic: independent Medien-Design



Two Siemens' staff look over an ultra-high-voltage (UHV) DC converter.

Behemoths in action – as this "snapshot" from UHV DC transformer shows, the equipment is the size of the entire building. Those are not ants in the pictures, they are people.

Photo: Siemens, 3-D Graphic: Siemens

explains. Some of the equipment therefore has to be twice as far from the ground – 10 meters instead of 5 meters up. "If you then consider that a single piece of equipment can weigh around 30 tons, and this region is prone to earthquakes, suspending it 10 meters up is a challenge." Where possible, Siemens suspended some equipment to allow it to move flexibly during earthquakes while retaining the required distance from the ground. Siemens' 800-kV DC transmission could, of course, be used in Europe or North America too, but as Director Technical Marketing & Innovations HVDC Dietmar Retzmann explains, "China's grids are incredibly dynamic. The European grid would first have to be expanded for this technology to be used properly."

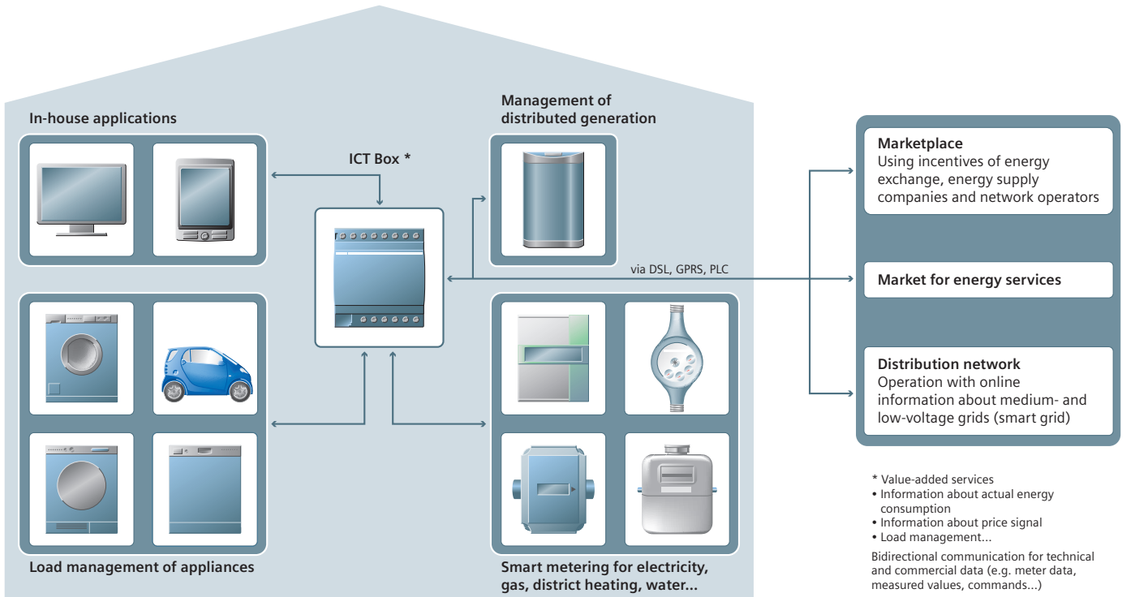
Changes in Demand Side Management

One level down from transmission comes the distribution grid. Here, power begins to be channeled to specific consumers. At this level, management of energy demand and central control of distributed power can lower peaks and raise valleys in demand, thereby lowering power costs overall and increasing power quality. With demand side management, power consumers can be switched on and off depending on the amount of power in the grid. For instance, heating and cooling loads are fairly easy to shift across the day. Air-conditioners can be switched off for 15 minutes without any noticeable rise in temperature in most buildings, but the relief for the grid would be clearly noticeable. Likewise, industrial freezing units can run full blast when electricity is plentiful and switch off for brief periods when power becomes scarce. As intermittent renewable energy provides an ever larger share of our electricity supply, such solutions will become indispensable. Within the next decades we will need to be able to shift part of our consumption to the hours when the wind is blowing and the sun is shining.

9. E-DeMa in Germany: Ruhr Area Model Region

Talking about E-DeMa – Michael Oltersdorf, Dieter König, Heike Kück and Prof. Dr. Michael Laskowski explain the concept to author Craig Morris (second from left).

The overriding aim of the E-DeMa project is to link the fields of energy trading, energy management and information and communication technology (ICT). The E-DeMa (development and demonstration of locally networked energy systems to the e-energy marketplace of the future) research project is receiving financial support from the German Federal Ministry of Economics and Technology's framework program E-Energy. RWE Energy, Siemens AG, ef.Ruhr, Miele, SWK (Stadtwerke Krefeld-Gruppe) and ProSyst are the partners in this project. "Our goal is to reduce carbon emissions, increase energy efficiency, and ensure a reliable power supply," explains Prof. Dr. Michael Laskowski, who represents RWE in the project. "Besides the development of new technologies, creating standards that can be used everywhere is our focus," says Michael Oltersdorf, Deputy Manager of the project at Siemens. For instance, one goal is to find out which appliances could be centrally controlled by means of which technology. "We have to make sure that the cost benefits make the extra cost of whatever embedded systems we have to install worth the investment," explains Dieter König of the University of Dortmund.
Of course, Siemens is itself an appliance manufacturer, but Siemens Smart Grid Competence Manager Heike Kück says Miele was chosen as a project partner to ensure that the project would be spread more evenly across the industry. The E-DeMa project is currently in the specification phase and will be rolled out in 2011 and 2012.



Genie in a box – E-DeMa uses web-enabled smart metering and load management to work together to sink energy demand and carbon emissions while maintaining reliability.

10. EDISON in Denmark: Increasing E-Mobility

The EDISON Project (Electric vehicles in a Distributed and Integrated market using Sustainable energy and Open Networks) aims to ramp up electric mobility and to provide a way to store intermittent renewable electricity. Based in Denmark, the project focuses on "plug-in hybrids," which you can plug into a socket and charge. As an employee who handles marketing for e-cars at Siemens explains, Siemens is also investigating the idea of battery swapping, where the entire battery system can be removed in only a few minutes and replaced with fully charged batteries.
Siemens is also working to set up charging spots in public spaces. The car identifies itself via the cable connection controlled by the onboard unit. Only then will the charging spots release the power, Siemens says. Sven Holthusen, who represents Siemens in the EDISON project, says that, in addition to normal 3.7-kW household sockets, "We are also looking into ways of charging batteries faster via 11-kW, 22-kW, 44-kW and possibly even greater kilowatt connections." The car would then report its charging abilities to the charging spot, which would provide the fastest possible charge. Ultimately, the goal is to allow people to quickly recharge their cars during a coffee break or lunch so that drivers can continue for another 200 or 300 kilometers without having to wait hours to charge their cars.
The project was launched in March 2009 and is to be completed in December 2011.

__Craig Morris__ is a US journalist and translator based in Germany. He is the author of Energy Switch *(2006) and has acted as an energy consultant to the US National Renewables Energy Laboratory and the US Solar Electric Power Association. He publishes original work in the German and US press.*

Further Information

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Photo: haraldhoffmann.com, Graphics: Golden Section Graphics, Siemens

In the electricity supply of the future, various generators – including intermittent renewables – will provide power irrespective of demand, which will then partly have to be tailored to supply. Electric vehicles may be one practical way of storing excess power, since cars generally are in motion only 10 percent of the time. Our vehicles would then not only run on excess clean power, but also export power back to the grid in case of shortfalls. Consumers will also have consoles to control their systems.

Glossary

- **Combined Cycle:** A normal gas turbine has two parts waste heat for each part of electricity. In combined-cycle plants, this waste heat is used to drive a second, steam-generated turbine in order to increase overall efficiency.
- **Arc Distance:** When an electric discharge occurs, electricity travels through a medium that is normally not conductive – such as air. In welding, this event is used productively, but in transmission lines undesired electric discharges are generally prevented by making sure that the distance between discharging components is greater than the arc that would be created.
- **Peak Shaving:** Power generation capacity has to be able to meet peak demand, but demand generally only peaks twice a day for just a few minutes. The rest of the time, many of these generators run far below capacity or are switched off completely. Engineers are now working to spread some of that peak demand across the day more evenly.
- **Intelligent Meters:** Conventional power meters only record power consumption. More advanced power meters are able to indicate to households whether there is a shortfall or excess of electricity on the grid so that consumption can be tailored to power production.
- **Plug-In Hybrids:** Hybrid vehicles currently on the market have small battery systems to improve fuel efficiency. Future hybrids will have large batteries and small gasoline-powered engines to increase the range of the electric motor. These cars will then fully charge from wall sockets.
- **Concentrated Solar Power:** Solar heat can be used not only to heat buildings, but also to generate electricity. In this technology, which is to be used in the recently founded Desertec project, solar heat is used to drive a conventional steam turbine.

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