Accounting and Accountability: the Clean Energy Trade-off

Electricity generators have a crucial role in mitigating climate change by reducing emissions with "clean energy" technology. But, as RWE Chief Commercial Officer Leonhard Birnbaum explains, this requires not only heavy investment, but also a trade-off between spending and results to show developing countries that investment in clean energy is worthwhile.

By Gerald Ashton

Leonhard Birnbaum, you're the chief commercial officer of one of Europe's top electricity generators. How do you define clean energy?
BIRNBAUM: The meaning of the term "clean energy" has undergone several metamorphoses over the last decades – and its meanings vary depending on where you live. In Africa, you are likely to be concerned with having access to any kind of commercial energy – which is clean, since it replaces the unhealthy burning of wood, dung or old tires in your dwelling. If you are living in an emerging industrial nation, you will be concerned about having enough energy for your growing economy and avoiding fallout from power plants in your neighborhood – sulfur, nitrogen oxides or dust. Europe is following the latest meaning of "clean energy", i.e., "low-carbon energy". Obviously, low-carbon energy is emerging as a powerful global paradigm that ought to be the blueprint for emerging and developing nations too, if climate protection is taken seriously.

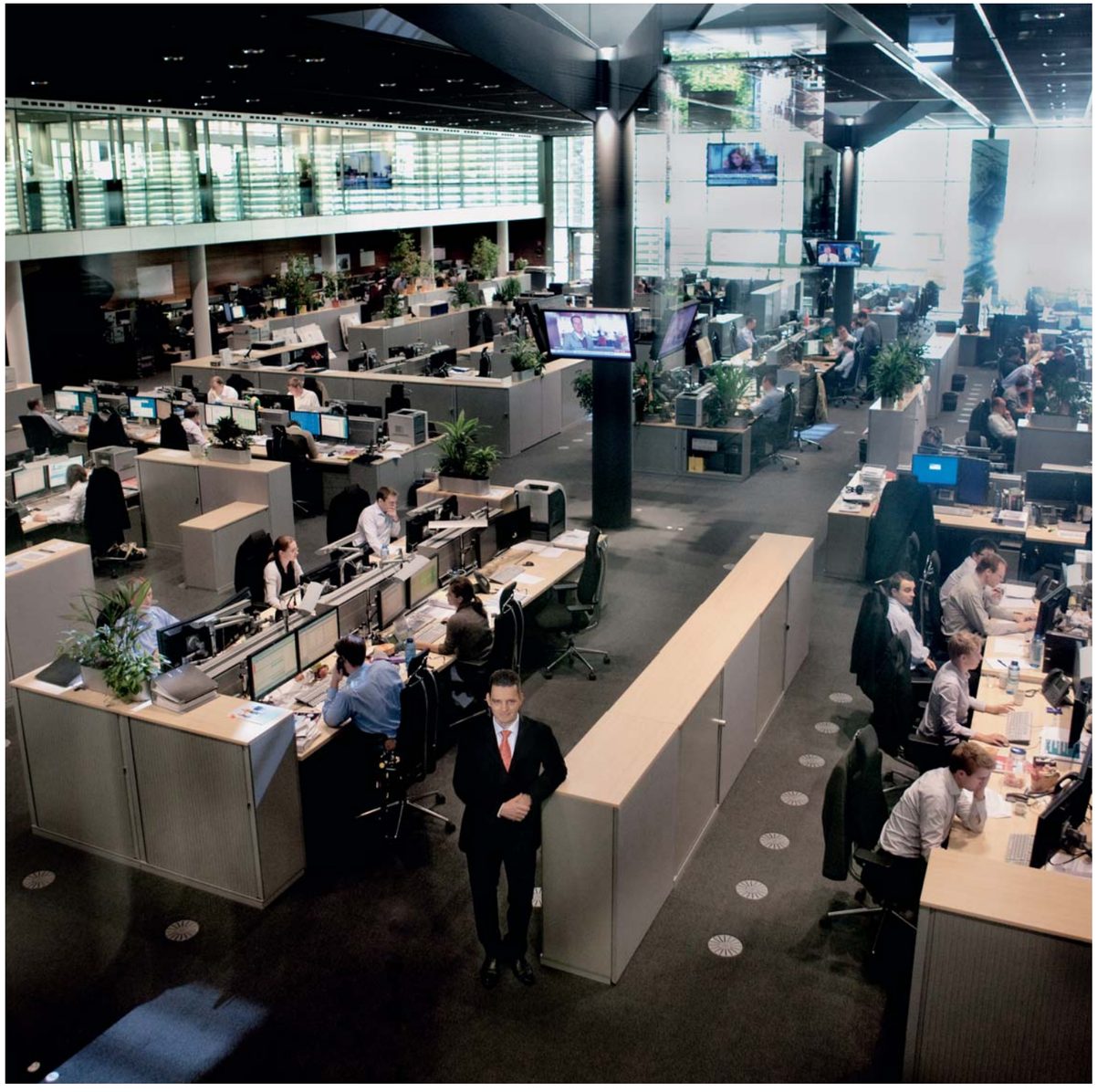
So how do you see the role of clean energy growing?
BIRNBAUM: The role of clean energy will grow with massive investment. Priorities are different in different regions of the world: providing more clean basic supply in developing countries; transforming outdated energy infrastructure in emerging markets and investing in additional capacities to accommodate rapid growth; transforming carbon-heavy infrastructure into a low-carbon market in industrial countries. Investment is required in all parts of the world. The global quest for clean energy will create massive competition for capital. The International Energy Agency (IEA) projects that building up a global clean energy infrastructure will require US$47 trillion until 2035. That is 15 times the US government's annual budget.

How can such huge amounts of capital be mobilized without endangering wealth?
BIRNBAUM: Basic macroeconomic textbooks teach that you can either invest or consume. Hence, if you want to bring the world on a track toward clean energy, you must allocate scarce capital as efficiently as possible, or risk constraining consumption too much. That is the key challenge we face! Markets deliver the most efficient allocation of scarce resources. Any effort to design a post-Kyoto agreement must approach a global carbon market with stable conditions for investment. Otherwise, future global growth in energy consumption will either not be "clean" or endanger global wealth. Global carbon trading will channel capital toward the most productive and cost-efficient clean energy uses. And it can orchestrate efficient transfers of technology from industrial countries to emerging and developing nations. However, the experience of the 2009 UN Climate Change Conference in Copenhagen makes me question whether the world will make fast progress toward a fair and market-based post-Kyoto agreement. Therefore, policy makers would be wise to support the further use of flexible project-based mechanisms such as the Joint Implementation/Clean Development Mechanism.

Competition means losers and winners in the global combat for capital and clean energy?
BIRNBAUM: In a fair market, the winners will be the most entrepreneurial and most sophisticated players, whether they be nations or companies. There is much entrepreneurial spirit, especially in Asia's emerging countries. Europe may bet on its superior know-how in clean energy technology. If

Photo: Harald Hoffmann, Ruhr Museum

"The way to a low-carbon future is already mapped out." Leonhard Birnbaum, RWE Chief Commercial Officer.



The future of the energy business: At RWE's Supply and Trading Center, energy generation and sales are optimized daily to achieve an ideal balance between supply and demand for global markets.

Photo: Harald Hoffmann

you have a global "level playing field", clean energy may be a win-win story. But that's a big "if"! Not only do we see global anticompetitive behavior – e.g., the Chinese government securing strategic resources or the US Federal Reserve flooding the US economy with cheap money. European governments are badgering the players who may be the frontrunners of clean energy sophistication: power generators or the energy-intensive industry. There is no sense in siphoning their cash flows with punitive taxes or choking them off with overambitious and unilateral caps on CO_2.

Does "clean energy" mean "renewables"?

BIRNBAUM: Clean energy means electricity. Electricity has a vast potential as a substitute for "dirty" energies in transport and heating. Indeed, most Germans and many Europeans think that clean electricity must come exclusively from renewables. But even in the most green scenarios for the future, the IEA's experts expect that about two-thirds of the world's additional supplies of electricity will come from fossil fuels. China's plans alone call for one large new coal-fired power station a week – adding the equivalent of Germany's entire coal power capacity every two years. If we don't find clean ways of using fossil fuels, the battle against climate change will be lost from the start. Europe has a great deal of technological sophistication at its disposal and may be the pacemaker for clean conversion of global energy. But policy makers should not narrow the scope of technology to renewables, while the rest of the world demands high-efficiency fossil power plants and nuclear power stations. The way to a low-carbon future is already mapped out. The question isn't whether we will go down this path, but how, and how fast. Renewables are only one obvious way among others.

Leonhard Birnbaum was born in 1967 in Ludwigshafen in southern Germany. Appropriately for someone from the hometown of chemicals giant BASF, he studied chemical engineering at the University of Karlsruhe, going on to take a doctorate. The bulk of his career was spent as a consultant at McKinsey, including a year in Houston. Birnbaum rose to become a senior partner and member of the firm's global management team for the energy sector. In April 2008, he moved to RWE as head of corporate strategy and business development, followed soon after by promotion to the five-member executive board. In January 2009, Leonhard Birnbaum was named RWE's Chief Commercial Officer.

RWE AG holds 25 percent of Germany's power market and is the fifth-largest electricity producer in Europe (2009). It generates electricity using lignite and hard coal, nuclear power, and gas as well as some energy from renewable sources and pumped storage. In 2009, RWE sold 282 billion kWh Europe-wide, especially in the core markets of Germany, the UK, Hungary and Austria. As part of its CO_2 reduction strategy, the company is modernizing its power plant portfolio and invests more than €1 billion per year in its renewables business.

How much of your current generating capacity can be defined as "clean"? And what are your plans to expand?

BIRNBAUM: In 2009, about 18 percent of our own electricity production came from nuclear power stations; another 4 percent from renewables. Gas accounted for a further 16 percent. So with lignite at about 38 percent and hard coal at around 24 percent, about two-thirds of our electricity were generated from traditional sources. That's pretty representative of the picture globally.

We currently have a €28 billion capital expenditure program to 2013. About 14 percent of the total is being invested in upstream oil activities, and almost one-third will be spent on annual maintenance of power stations and grids. About half of the total will be directed towards investments in renewables and in new gas- and coal-fired plants. Coming onstream now are approximately 4 GW of gas-generated electricity capacity in the UK, and more than 2 GW in Germany and the Benelux. Add to that Turkey, and the total is above 7 GW. Such modern gas-fired plants are a crucial part of our investment program. But don't forget what we're doing in coal. In Germany, we're building pioneering lignite power stations, totaling about 2.2 GW, to replace no less than 12 older and much smaller 150-MW plants. And we're building two hard coal plants with a combined capacity of 3 GW in Germany and the Netherlands.

The new lignite blocks will have a thermal efficiency of about 43 percent, compared with 33–35 percent for their predecessors. That means they will burn 3 million tons less lignite each year for the same power output. That's the fastest CO_2 reduction you can have – by modernizing or replacing old power stations!

Has RWE already done its share?

BIRNBAUM: Our program to reduce our CO_2 exposure is under way and progressing rapidly. On the lignite and hard coal side, we're constantly modernizing our generating base and increasing the efficiency. A further promising area in the future is gas, considering the performance and potential of combined-cycle gas turbines. Our goal is that 75 percent of our installed capacity should be either CO_2-free, or at least low-carbon generators by 2025. On average, we aim to cut our CO_2 intensity radically from around 800 grams per kWh to 450 grams by 2020.

How have you experienced Siemens as a supplier of clean energy technology?

BIRNBAUM: We have been strategic partners along the entire value chain and hope to continue to work together in the future for a new age of sustainable power. Siemens has positioned itself successfully as a world leader in green technology. We at RWE are happy that this also includes high-class fossil power technology. Siemens should be proud of that, too.

Mr. Birnbaum, thank you very much for this interview.

__Gerald Ashton__ is a freelance business journalist who writes for several major international publications.

Clean Energy and a Changing Mix

In a world transformed by steep economic and demographic growth as well as climate change, new solutions for global energy supply are required. Siemens offers a broad portfolio for clean energy solutions. The following overview lists some examples of recent developments advancing the state of the art in sustainable power supply.

By Stefan Nicola

Focus on Sustainability

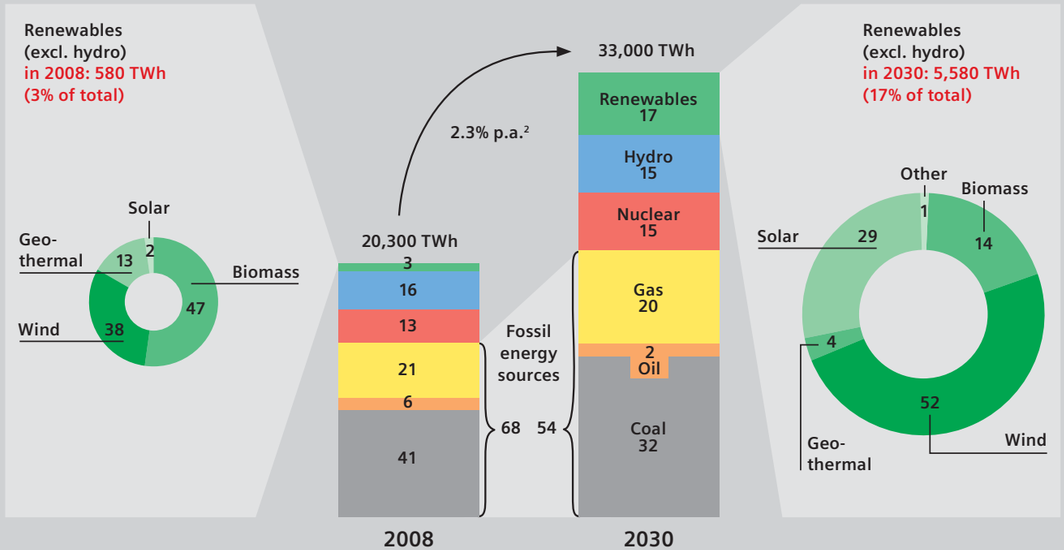
These clean energy highlights from the Siemens portfolio are showcased on the following pages:

- Electric solutions oil & gas
- Highly efficient combined-cycle power plants
- Highly efficient steam power plants
- Carbon capture and storage
- Postcombustion carbon capture
- Precombustion IGCC
- Conventional island for nuclear power plants
- Combined heat and power plants
- Modernization of power plants
- Process optimization software solutions
- Onshore wind power
- Offshore wind power
- Solar thermal power
- Photovoltaic
- Marine energy
- HVDC/UHV DC
- Integrating offshore wind power
- Gas-insulated lines
- Gas-insulated switchgear
- Smart grids

Graphic: Siemens

The global energy mix is at the crossroads: "At the beginning of the 21st century, we face the question of how we can put our energy system on a sustainable foundation," says Wolfgang Dehen, the CEO of Siemens Energy. It's clear that there's no easy answer. The world's population is growing, and with it the demand for energy. At the same time, fossil fuel resources are dwindling, and the potentially catastrophic effects of climate change force nations to rethink the way they produce, transmit and consume energy.
Western industrialized countries might rely to a significant degree on renewable energy sources – wind, solar, biomass and hydropower – for their future energy mix. Emerging countries with largely untapped fossil fuel resources, however, might mainly exploit those on their growth path. For some of the world's poorest nations, the answer is much more fundamental: An estimated 1.4 billion people still lack access to electricity, and for them, being able to turn the light on at night would make all the difference. In the end, each country will decide on its own how to shape its energy mix. Experts agree that despite the rapidly growing importance of renewable energy sources, fossil fuels – gas, oil, coal – and nuclear will still be around for decades. So for the new electricity age to become sustainable, the entire energy chain has to be optimized. Fossil fuel energy generation must become cleaner and renewable energy sources need to become more cost-efficient so they can be introduced even in poorer countries. At the same time, aging national grids have to be replaced by smart ones that are internationally linked so that the fluctuating renewables can be integrated efficiently. With its Clean Energy portfolio, Siemens is well prepared to shape that transition. Group CEO Peter Löscher told *Bloomberg Business Week* in late September that Siemens is the "only company that has a fully integrated energy value chain – from energy generation, transmission and distribution to consumption."

Power Generation (in TWh[1])



Source: Siemens Energy Sector [1] Terawatt-hours [2] Primary energy consumption grows by 1.6% per year.
Values in percent

Scenario: Fossil energy sources remain dominant, but renewable energy becomes more important.

Oil and Gas Go Electric

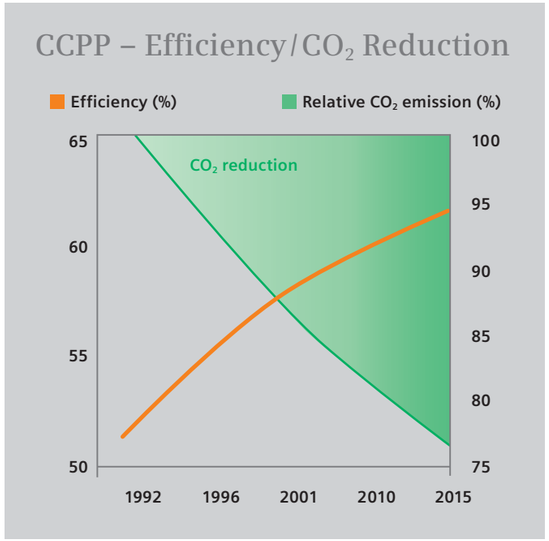
Yes, fossil fuels will still be around for decades. But the undeniable truth is that resources are dwindling and the days of easily accessible oil and gas fields are over. An increasing amount of energy has to be invested to extract, process and transport oil and gas – in fact, the oil and gas industry is the most energy-intensive in the world. This is pressuring companies to increase efficiency levels across the entire oil and gas value chain. Siemens Energy advocates market requirements for a cleaner environment in oil and gas by putting more focus on **electric solutions**. Conventional facilities use compressors driven by mechanical gas turbines to extract, transport and process oil and gas. If these turbines were replaced with modern electrical motors, the efficiency of the entire process could be boosted from 20 percent to more than 50 percent, saving significant resources, Siemens says. The electricity would ideally come from a combined-cycle power plant – one of the cleanest and most efficient fossil fuel plants around.

Fossil Fuels to Stick Around

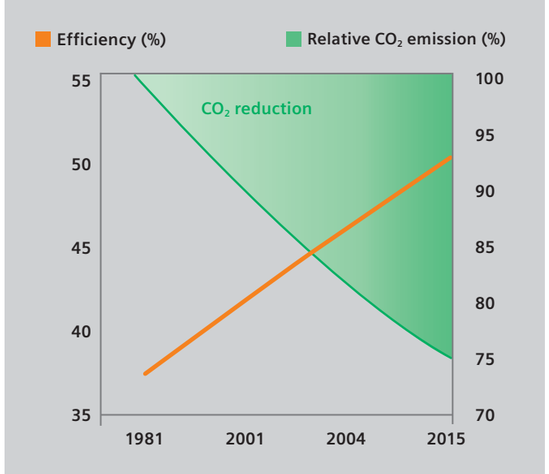
Citing the growth of world population and the rapid development of emerging economies, the International Energy Agency (IEA) predicts that global energy consumption by 2030 will be 40 percent above 2007 levels. Fossil fuels will account for three-quarters of that growth, the IEA says. "Even in 2030, over 60 percent of our worldwide electricity" will be generated with gas, coal, oil and nuclear, as Michael Suess, the head of Siemens Energy's Fossil Power Generation Division, said at the World Energy Congress this September in Montreal,

Graphic, Photo: Siemens

Advanced turbines deliver unprecedented performance and produce cleaner fossil power at exemplary levels of efficiency.



Siemens technology raises competitiveness by reducing CO_2 emissions in gas-fired plants and increasing efficiency by 10 percentage points over 20 years.



Siemens technology for steam-fired power plants produces a continuous increase of 10 percentage points in efficiency over 20 years.

Canada. That means fossils will dominate for quite some time. Yet, if nations want to limit global warming to no more than 2 °C – a threshold scientists say is crucial for averting the most catastrophic effects – then the world must roughly halve its CO_2 emissions by 2050. That's why "we must make fossil fuel power generation as clean as possible," Suess said.

Cleaner Gas

No wonder experts predict that the role of gas will rise substantially over the next decades: It is one of the cleanest fossil fuels and can back up the fluctuating renewables by stabilizing the grid with rapid start-up times, high load ramps, and frequency support capability. A sustainable way to turn gas into energy is through a **combined-cycle power plant (CCPP),** which uses the exhaust heat from its gas turbine to produce steam for the generation of additional electricity by a steam turbine. Modern CCPPs produce power at roughly 340 grams CO_2 per kWh. That's well below the 500-gram average observers say needs to be reached to limit global warming to no more than 2 °C. CCPPs will play a key role in tomorrow's energy mix. Not only are they relatively cheap and quick to build, their operational flexibility also enables them to balance out growing feed-ins of fluctuating wind and solar power, thus relieving strains on the grid.
The innovative Siemens gas turbine SGT5-8000H, tested at Irsching 4 power plant in Bavaria, will run in combined cycle from the first half of 2011 at a world-record efficiency level of more than 60 percent. Compared to even the most modern CCPP, Irsching 4, to be operated by utility E.ON, will avert around 45,000 tons of CO_2 per year – equivalent to more than 10,000 midsized cars driving for 20,000 kilometers.

Cleaner Coal

Coal remains the world's primary energy source. India and China sit atop significant domestic resources they have vowed to exploit, and even in Germany, famous for its renewable energy industry, coal still accounts for around 40 percent of the power mix – the same share as coal has in the global production mix. However, coal-fired power generation involves significant CO_2 emissions. Siemens says coal can and must be made a lot cleaner.
China's unparalleled rise to the economic powerhouse of the world came fast, and it was fueled by coal, the country's most abundant domestic fossil resource. Coal accounted for two-thirds of China's electricity in 2009. With Beijing eager to reduce the CO_2 footprint of its plant park, highly modern coal-fired plants such as those designed by Siemens Energy can make a real difference. The 1-GW Waigaoqiao III **steam power plant** in Shanghai, equipped with a Siemens SST5-6000 steam turbine, is such a plant: Operating at far higher temperatures and pressures than a conventional plant, it produces electricity at an efficiency level of around 46 percent – already far above the global average efficiency of 28 percent, making it world-class in coal and an example for state-of-the-art, ultra-supercritical technology. Siemens engineers are confident that this value can be boosted to over 50 percent by 2020.
Of course, there is only so much you can do when it comes to efficiency. Experts instead hope for **carbon capture and storage (CCS)** technologies to reduce coal's CO_2 footprint significantly. In existing or new plants, around 90 percent of the CO_2 can be separated from the flue gas after combustion – the so-called **postcombustion carbon capture** process. The CCS demonstration projects currently planned in several countries typically capture around 1 to 2 million tons of CO_2 per year that would otherwise be released to the atmosphere. Large-scale European demonstration projects are expected to start operation in 2015. In the USA, a pilot plant using Siemens' PostCap carbon capture technology is expected to start operations three years earlier. Siemens has been chosen to install a pilot unit at Tampa Electric's coal-fired Big Bend power plant in Florida, funded by the US Department of Energy. The plan is to treat 10,000 Nm^3 of flue gas per hour and capture 90 percent of its CO_2, i.e., up to 17,000 tons of CO_2 per year.
In the **precombustion IGCC** (integrated gasification combined cycle) process, gasification power plants transform coal into a synthetic fuel gas, from which around 90 percent of the CO_2 can then be extracted before combustion. The leftover hydrogen-rich gas fuels a gas turbine, while the CO_2 can be stored underground and/or used for enhanced oil recovery. Precombustion capture solutions are applicable to new units or for retrofits at syngas-ready combined-cycle plants. (For more information about precombustion IGCC in Texas, see Rachel Walker's article on page 36.) Precombustion capture test facilities using a slipstream of the produced syngas have recently been commissioned in Europe at the Buggenum (Netherlands) and Puertollano (Spain) IGCC power plants, where Siemens combined-cycle units have been operating on syngas since the mid-1990s. The first full-scale precombustion carbon capture plants in conjunction with new IGCC power plants are expected to be operational after 2015.

Equipping the Nuclear Revival

Because it is cost-effective and almost CO_2-free, **nuclear power** is undergoing a worldwide revival. Construction of more than 300 new plants is planned by 2030. Siemens is one of the top suppliers of **conventional islands** and the operating control technology.

Oldie But Goldie

Combined heat and power (CHP) has been around for decades, but is in demand more than ever because it can cut costs, primary energy consumption, and greenhouse gas emissions. For more on the Siemens Energy CHP portfolio, check out Eric Johnson's story on page 22.

Improving What's There

Remember when you turned 20? You were young and full of energy. For power plants, 20 is the perfect age for first **modernizations**. Siemens can retrofit aging fossil fuel power plants so that they produce more power at greater efficiency.
In Singapore, the combined-cycle gas-fired power plant at Senoko has received a complete makeover. Siemens recoated the entire compressor and upgraded the combustion system, boosting the plant's power output by around 11 MW. A coal plant in Farge, Bremen, was retrofitted with the latest technology, its capacity increased from 318 to 345 MW, with CO_2 emissions reduced by up to 100,000 tons per year. "The payback in such projects – the euro per MW – is surprisingly great," says Norbert Henkel, Director Steam Plant Modernization Region Europe, Asia, Middle East. For more on the effects of efficient operation and maintenance, see Justus Krüger's article on the Philippines (page 30).

Computer-Driven Efficiency

In the new electricity age, power plants must be operated under conditions for which they were never intended. To help run these plants efficiently, a family of **process optimization software solutions** has been devised. They require no changes to the critical mechanical equipment, but the potential savings for the operators are on a significant scale; efficiency improvements of up to 0.5 percent and more are within reach. With the aid of SPPA-P3000 process optimization solutions, Siemens is looking at the entire power plant, trying to optimize all actuating variables to improve overall plant efficiency while maintaining maximum availability.

Graphics: independent

Clean Energy

Renewables – It Doesn't Get Cleaner than This

Follow the money! If you believe in this evergreen business strategy (and virtually every expert agrees you should), you might want to think about the renewable energy industry. Despite the recession, some US$162 billion were invested globally in the sector in 2009. Siemens predicts that by 2020, more than half of global power plants investments will go into developing renewables. Considering that Siemens in the past regularly revised its in-house forecast for the share of renewables in the 2030 energy mix – from 3 percent in 2010 to 17 percent in 2030 – there is room for even further financial and relevance growth.

The best thing about wind, solar and hydroenergy plants is that they produce power without emitting CO_2, which is key to reducing global greenhouse gas emissions. Siemens Energy's Renewable Energy Division is part of the Siemens Environmental Portfolio, a set of group-wide products and solutions that in 2009 helped Siemens customers reduce their CO_2 emissions by 210 million tons – more than Argentina spews into the atmosphere in a year.

Challenges remain: Experts agree that the world's aging power grids have to be modernized – made "smart" – to be able to take in more and more green power. Transnational grid plans are already under way. And while renewables on average are still more expensive than fossil fuel sources, this is about to change, with costs for wind and solar power generation tumbling.

René Umlauft, CEO of the Renewable Energy Division at Siemens Energy, is convinced that the green energy sources can continue this trend: "The change toward a more sustainable and CO_2-neutral global energy mix is under way."

Wind, the Established Green Player

Wind turbines are now towering in 75 countries around the world. Every 30 minutes, a new one is erected. Apart from hydropower, wind power is the most widely used, cost-efficient renewable source around. Having sold some 9,000 turbines with a total capacity of 11 GW, Siemens is one of the most successful companies in this sector.

Siemens offers **onshore wind** turbines – an established, reliable technology – for all wind conditions. While Europe remains a stable market for onshore wind, much of the future onshore growth is predicted to take place in the USA, Brazil, India and China. A total of 18 GW wind power could be installed in Asia this year, nearly double the amount in Europe, the Global Wind Energy Council predicts.

This year, Siemens Wind Energy launched its first-ever direct-drive turbine, hailed by analysts as a major market breakthrough. The turbine has half the parts and weighs less than standard machines, reducing the need for maintenance and the overall cost of wind power. Engineers are racing to upscale the direct-drive machine to supply the **offshore wind** market, which is set to grow massively over the coming years.

Virtually every European country with a shoreline is considering offshore wind as a sustainable and affordable long-term source of energy that can reduce dependency on fossils. The German government has for many years attracted wind developers with a long-term feed-in tariff, and the UK has made available significant government subsidies to launch the construction of several giant wind farms

Situated 24 kilometers off the British coast, the London Array will generate 1,000 MW of green power when completed.

It is to become the world's biggest wind farm: The London Array, under construction in the waters of the Thames Estuary near London, could eventually provide electricity to one-quarter of the total population of the Greater London Urban Area. Siemens is delivering 175 eco-friendly offshore turbines and will connect the farm to the grid.

Photo: Siemens, Graphic: independent

off its coasts, where environmental conditions are often ideal. Siemens is well equipped to handle that boom: It's the world's leading maker of offshore turbines.

Sunny Outlook for Solar Energy

Solar energy could account for up to one-quarter of the world's electricity by 2050, the IEA predicted this year. This would cut CO_2 emissions by almost 6 billion tons.
For large-scale solar energy generation, Siemens is banking on **solar thermal power,** a technology that uses mirrors to focus the sun's rays on a receiver, which then heats a special thermal oil or molten salt to drive a steam turbine.
On the site of a former cotton plantation near Seville in Spain, Siemens is constructing the 50-MW Lebrija 1 plant, which banks on more than 170,000 mirrors installed on 6,048 parabolic troughs. Due to come online in early 2011, the plant will produce power for some 50,000 households.
In the **photovoltaic (PV)** sector, Siemens offers turnkey solutions including power grid connections, service, monitoring and maintenance for utility-scale PV installations.
In June, Siemens Energy scored its first large-scale order for six PV plants with a combined capacity of 30 MW, to be built in Les Mées in the province of Alpes-de-Haute-Provence. They're scheduled to go online next summer and supply some 12,000 households.

Oceans of Energy

The potential for the young **marine energy** sector is huge: Some 71 percent of the earth are covered by oceans, and they harbor huge amounts of energy in the form of waves, tides, salinity and thermal differences. Siemens earlier took a stake of close to 10 percent in the UK's Marine Current Turbines, which has a 1.2-MW tidal power plant running off the Northern Irish coast. The firm's SeaGen tidal technology works much like an underwater windmill, its rotor blades driven by the tidal currents (see page 42).

The parabolic troughs at Lebrija, placed side by side, would extend 60 kilometers. Larger plants could operate even more efficiently by making better use of the power plant unit.

Photo: Siemens

Dii International Consortium

Siemens is a founding member of the Dii international consortium, a business venture aimed at powering North Africa's and Europe's homes with green electricity generated in deserts in Africa and the Middle East. Dii focuses on solar thermal and PV installations, while also integrating wind farms, biomass plants and hydropower. The companies involved say Dii could supply up to 15 percent of Europe's electricity by 2050.

Bulk Power Energy Highways

Today, grids must perform like never before. This is due to growing power consumption, widely distributed generation and an increasing share of fluctuating renewable sources. Experts have long called for a modernization of existing grids – which often date back well into the past century – and for the construction of new, more powerful and flexible networks.

HVDC/UHV DC

Hydropower plants in the Alps, wind farms off the thinly populated European coastline and solar thermal power plants in Africa's deserts have one thing in common: They're far away from where the power is needed most. Sending it through conventional alternating current (AC) lines, however, would waste considerable amounts of energy.
The solution lies in **high-voltage and ultra-high-voltage direct current lines (HVDC, UHV DC)**, which can transmit electric power over long distances at very little losses.
In China, an 800-kV UHV DC transmission line built by Siemens transmits 5 GW of renewable power over a distance of 1,400 kilometers – the most powerful direct current system ever

The Siemens Environmental Portfolio

Environmentally friendly products carry a triple benefit: They benefit customers, who save on their energy bills; they benefit future generations by protecting the environment; and they benefit Siemens, which can expand its presence in attractive markets due to its cutting-edge technologies. This is not new to Siemens: The company developed a technology to eliminate ash from factory emissions as early as 1873. Today, the Siemens Environmental Portfolio is showcasing the latest in eco-friendly technologies. It includes products such as combined-cycle power plants, energy-savings lamps, renewable energy systems and technologies for cleaner water and air. In fiscal 2010, Siemens customers using products and solutions from the portfolio were able to reduce their CO_2 emissions by 270 million tons – the equivalent of the combined total output of Hong Kong, London, New York, Tokyo, Delhi and Singapore. For Siemens, the sector in 2010 generated €28 billion in revenue. Pursuing sustainability pays off – and not only on the revenue sheet. For several years, Siemens has been included in the prestigious Dow Jones Sustainability Index (DJSI) and the Carbon Disclosure Leadership Index (CDLI). The latter, which ranks companies according to the range and depth of their carbon disclosure, awarded Siemens as the best industrial company globally in 2010, citing the firm's comprehensive reporting about greenhouse gas emissions, climate protection strategy and measures. Dow Jones analysts in September 2010 placed Siemens in the DJSI for the 11th time in a row. This year's overall score of 87 out of 100 is the best Siemens has ever achieved.

www.siemens.com/sustainability

built. A bit closer to home, an HVDC link under construction could make Europe a better-connected place. Built by the national grid operators from the UK and the Netherlands, the 260-kilometer-long BritNed would be able to exchange 1 GW of power between the two countries. Siemens is supplying the converter stations for this ambitious project.
European companies have an excellent track record of **integrating offshore wind power** into the grids – Siemens connects more megawatts of offshore wind than any other company. The 504-MW Greater Gabbard wind farm under construction off the coast of England is not only made up of 140 Siemens turbines, the company also handles the grid connection that includes two topside offshore platform constructions. A brand-new trademark is Siemens Energy's Wind Power Offshore Substation (WIPOS™), which serves as an efficient interface between the turbines and the grid. WIPOS offers a self-lifting solution, a topside solution and a floating solution.
In a bid to increase the efficiency of energy transmission to big consumption centers, high-voltage transmission is moving closer to the end users. In areas with limited space, grids are often installed underground. Siemens Energy's **gas-insulated lines (GIL)** can transmit large amounts of power with low losses and negligible magnetic fields.
Once those HV transmission systems arrive in cities, they require transformer substations to feed the power into the local grid. Utilities are increasingly relying on solutions with space-saving **gas-insulated switchgear (GIS)**, which bank on latest Siemens Energy technology, design and safety standards for smooth integration in urban centers.
The most dramatic overhaul of all is the **smart grid**. This is essentially an intelligent management of load, enabled by IT-supported bidirectional communication between energy generation and consumption. The smart grid can integrate and balance a diverse and rapidly changing power mix – including distributed renewable energies – and help the consumer to use low-emission electricity in an efficient, cost-saving manner.
Best of all: Utilities balance supply and demand to avoid bottlenecks and increase the stability of their grids, while customers save on their energy bills without changing their consumption habits.

An engineer connects a ship to the onshore power plant.

SIHABOR

You may see more trucks and airplanes, but cargo ships are really supplying the world. Nearly 90 percent of global goods are traded via sea routes. While maritime transport has a CO_2 footprint similar to air travel, cargo vessels guzzling the dirty shipping diesel emit higher levels of sulfur, nitrogen oxides and particulate matter. This not only fuels global warming, it also puts pressure on local air quality when ships enter, leave or remain in port. Even in dock, these large ships burn diesel to produce electricity. Eager to reduce maritime emissions, the EU has reduced the sulfur emissions cap for docked vessels in harbors to 0.1 percent. It also wants port cities to link ships to the local electricity grid while anchoring. Siemens is offering its SIHABOR solution, a full-scale modular concept to power ships of all sizes from land. SIHABOR connects the ship via a cable feed system to cleaner onshore power plants. The system, which can accommodate all standard frequency and voltage needs, reduces CO_2 emissions by 35 percent, nitrogen oxides by 97 percent and particulate matter by 90 percent compared to shipping diesel.

At the 500-MW Greater Gabbard site off the coast of Suffolk, 140 Siemens wind turbines of 3.6 MW each will produce carbon-free electricity.

Photos: Siemens

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

Further Information

www.siemens.com/energy