

The image shows a power plant with several tall, red and white striped chimneys in the background. In the foreground, there is a lush field of green crops, likely sorghum, with some yellow flowers at the bottom. The sky is clear and blue.

SIEMENS

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Securing sustainability in tomorrow's energy age
with products for cleaner fossil power generation

Answers for energy.



Dr. Roland Fischer, CEO,
Energy Sector, Fossil Power Generation

“The future of power generation will see a diverse mix of energy resources. Renewable sources are gaining in importance, but fossil fuels will continue to be the mainstay. Therefore, the demand for cleaner fossil power will become more challenging. We have the technology to answer this challenge already today.”







How can we ensure that we'll have enough energy for everyone – even in the year 2030?

With fossil power generation as the mainstay for tomorrow's well-balanced energy mix

The future will see a broad mix of energy resources. Renewable sources are gaining in importance, of course. But fossil fuels will continue to be the mainstay, ensuring grid stability as well as reliable energy supply – anytime, anywhere.

Stable basis: fossil fuels

Fossil fuels are at the top of the global energy mix, making up 67 percent. And they will continue to be just as important in the future as electricity generated from coal and gas will still account for the bulk: According to present-day expectations, their share will still be more than 50 percent in 2030. Within fossil energy sources, the weight is shifting toward natural gas for reasons such as stable prices and greater flexibility. Gas-fired power plants perform both base- and peak-load tasks. Their share of fossil power generation will increase and thus allow for a better CO₂ balance within the entire energy mix.

Hand-in-hand with renewable sources

There is no doubt that renewable energy sources will also play a vital role in the energy mix of tomorrow. Energy generated from the sun, wind, biomass, and geothermal sources ensures sustainability, protects the environment, and saves dwindling natural resources. This makes it even more important to create a stable foundation for these energy sources – with solutions that are cost-effective, permanently available, and highly efficient. Solutions that balance economy and ecology: products for cleaner fossil power generation.

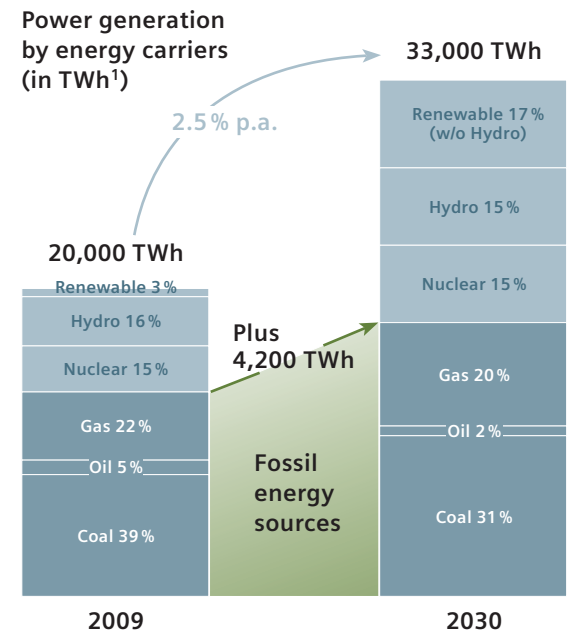


Greater efficiency and less environmental impact

A key factor for cleaner fossil power generation is the reduction of greenhouse gases and harmful emissions. We will achieve this goal first of all by continuing to upgrade our power plants technologically, with innovative features such as flue gas cleaning. In addition, we are developing fossil power plants to new standards of efficiency and performance. Parallel to these developments, we are actively driving future technologies forward, for instance with the development of high efficiency steam turbine packages for large concentrated solar power (CSP) plants. Another future technology is carbon capture and storage (CCS): We are currently running a pilot facility, operated with flue gas from Unit 5 of the E.ON Staudinger power plant. In this project, we are gaining significant knowledge of the technology's behavior in real operating conditions as we prepare for large-scale carbon capture plants.

Your advantage: solutions that are a perfect fit

Our portfolio is made up of innovative products and solutions for cleaner fossil power generation: gas and steam turbines, generators, instrumentation & control systems, and power plant solutions. Our expertise includes key technologies such as solutions for pre- and post-combustion carbon capture and storage and combined-cycle power plants with integrated coal gasification (IGCC). After all, our goal is to significantly boost the efficiency of power generation from coal and gas – thus reducing harmful emissions. We are achieving this with innovative technologies for low-CO₂ power generation – with products for cleaner fossil power generation.



1) Terawatt hours
 Source: Siemens AG



How can we sensibly balance business economics and ecology?

By being one step ahead with products for cleaner fossil power generation, ...

Siemens offers the broadest spectrum of future-ready technologies, providing an outstanding basis for sustainable success. Our strength lies in our perfectly coordinated solutions that lead to fewer emissions and less consumption of natural resources. You can rely on quality products that have already received numerous environmental awards!

... meaning greater efficiency

Growing demands to further reduce CO₂ emissions in power generation with fossil fuels will require a substantial increase in efficiency. With Siemens, you can rely on a comprehensive portfolio of highly efficient products and solutions: gas and steam turbines, generators, turbine packages, and even complete power plant solutions. For example, our innovative steam power plant solutions achieve world-class efficiency levels of more than 46 percent. Our combined-cycle power plant solutions with the latest gas turbine technology will even perform at efficiency levels of more than 60 percent. To increase efficiency and to help you produce environmentally compatible electricity, we also offer a wide range of modernization options for existing power plants. In short, we bundle everything for a sustainable future with cleaner fossil power generation.

... meaning fewer emissions

As early as 2002, our Mainz-Wiesbaden combined-cycle power plant (CCPP) literally set a world record with an efficiency level of 58 percent and CO₂ emissions of only about 345 grams per kilowatt hour. And we are continually optimizing this performance level: The Irsching 5 CCPP, connected to the grid in May 2010, pushed efficiency levels to more than 59.5 percent, thus achieving the lowest CO₂ emissions, while our latest burner technology keeps emissions at a very low level. During acceptance testing in 2011, the Irsching 4 CCPP achieved the world record efficiency of 60.75% at 578 MW output, meaning 43,000 metric tons of CO₂ less per year. This corresponds to the annual emission of more than 10,000 mid-size cars traveling 20,000 kilometers each.



... meaning flexibility

Utilities must be flexible – and able to respond to fluctuating power demands with short notice. The days in which combined-cycle power plants primarily served as base load power plants are coming to an end. Up to 90 percent of these types of power plants are scheduled to be replaced or modernized in the next five to ten years – with flexible fast-cycling power plants. The advantage: short start-up times and thus a high degree of flexibility. Where regular combined-cycle power plants require nearly two hours for a “plant hot start up”, Siemens solutions based on FACY (fast-cycling) are operational in about 30 minutes. This not only saves valuable time, but also reduces resource consumption and thus lowers costs. Another benefit that also ensures your maximum flexibility is our intelligent maintenance service: in many cases we don’t need to dismantle the turbines or generators in your power plant to look inside – so you enjoy maximum flexibility and reliability.

... meaning cost savings

State-of-the-art power plant technology not only saves natural resources and reduces emissions, it also lowers costs for fuel, operation, and maintenance. For example, Florida Power & Light, a leading U.S. utility, will reduce its demand for fossil fuels considerably by converting its existing power plants into modern combined-cycle power plants based on latest Siemens H-Class technology. Calculated over the entire lifetime, our customers will gain a five to eight percent higher return on investment compared to state-of-the-art F-Class technology. On average, combined-cycle power plants in the U.S. currently operate at 45 percent efficiency. Equipping all U.S. combined-cycle power plants with Siemens H-Class turbines would yield as much additional power as almost 20 million Americans consume in one year – without increasing CO₂ emissions. This additional power would have a retail value of up to \$30 billion.

... meaning trust

To be a perfect fit is essential for all our products for cleaner fossil power generation. In close cooperation with our customers, we have been continually developing products that precisely meet the technical and economical requirements our clients face in their markets. This includes designing our products in accordance with internationally recognized codes, standards, and regulations such as ASME, ISO and IEC standards, as well as harmonized European EN standards. And we do more than just follow standards – we design the highest quality and maximum service life into our products and solutions. You can depend on reliability – right from the start.



How do our products foster sustainability even before going into operation?

We walk the talk – by minimizing our own carbon footprint

We not only offer innovative solutions to our customers. We also utilize them ourselves – so that we can deliver products that really stand for sustainability. Our processes are shaped by numerous environmentally relevant criteria, from development to assembly, and all the way to commissioning. That's because, for us, maximum protection of natural resources and the environment starts long before installing or even producing our products worldwide.

Thinking clean – at locations around the world

In 2009 alone, innovative solutions from Siemens Environmental Portfolio helped our customers cut more than 210 million metric tons of CO₂ emissions. We also think it is important that our facilities work with an optimized energy balance, and have set ambitious goals for ourselves: By 2011, we plan to reduce our CO₂ emissions by 20 percent – compared to 2006 and relative to revenues. We will achieve this goal by continually optimizing our energy balance and using fuels, paper, and water sparingly. And, wherever possible, we utilize local sourcing to avoid long transports and the associated CO₂ emissions. The following are but a few examples of our progress toward a lower carbon footprint from around 15 locations worldwide where we develop, produce, and upgrade our products for cleaner fossil power generation.

Budapest, Hungary 20 percent less gas and water

This goal was achieved through an energy saving project, applying innovative measures at our Budapest site, where we produce blades and bearings. Improvements such as roof and facade insulation, new windows, and a new water pipe system led to considerable energy savings. In addition, the site minimizes its water consumption by using its own water retreatment system. The energy generated during production in Budapest is used effectively – for example to heat rooms or the water in the employees' showers – without releasing additional CO₂ emissions!



Cilegon, Indonesia
50 percent less gas

At this plant, built in 1989, we produce condensers for turbines and turbine parts. Our Cilegon production site consumes only half as much gas since we installed highly efficient heat treatment furnaces. In the course of renovations, the roofs were equipped with skylights to reduce electricity demand by 20 percent. Double-glazed windows save an additional five percent in energy. In addition, the newly installed assembly unit for low-pressure turbine sections in Cilegon has halved land and sea transport and thus reduced corresponding emissions.

Orlando, USA
Almost 5 percent less energy costs

Orlando is the Americas' headquarters for Siemens Energy, Inc., with a special focus on engineering and sales. Between 2007 and 2009 alone, the Orlando site reduced its energy costs by almost 5 percent. By using a smart energy concept, a new air-conditioning system, and energy-saving lamps throughout the entire campus, the site succeeded in significantly reducing CO₂ emissions. For instance, the sensor-controlled lights in rooms automatically turn off if nobody is present. Orlando also set a good example as one of three main sponsors of Earth Day 2010, a global campaign for environmental and climate protection.

Berlin/Mülheim a. d. R., Germany
25 percent lower energy consumption

Due to outstanding energy efficient operation, our plants in Berlin and Mülheim an der Ruhr are certified with the "Green Building" label. In our turbine blade production at Berlin, for example, we release only one fourth of the CO₂ emissions normally associated with the process. The energy consumption of this manufacturing facility is 25 percent lower than statutory requirements, resulting in an annual CO₂ savings of 1,775 metric tons. In Mülheim an der Ruhr, we avoided using thermal bridges, replaced a boiler with a condensing boiler, and created a thermal buffer using a "HAST battery". In combination with a geothermal system, these measures reduced energy consumption by more than 25 percent in the concerning administration and factory building.



What does cleaner fossil power generation look like in practice?

Unprecedented power plant performance all over the world

We demonstrate this not only with references from around the world, but also with outstanding products that are leading the way in this area. Steam turbines for cleaner power from coal and gas turbines lead to unparalleled efficiency levels – products like these form the basis for tomorrow's energy age. Here are but two of our many references from around the world that emphasize this.

Waigaoqiao: world-class in clean coal

Clean coal – impossible? No. Coal-based power generation is one of the fields where Siemens technology can substantially reduce the emission of gases that are harmful to the environment. For example, in China: The Chinese economy's growing need for energy – experts predict an annual increase of up to 20 percent by 2020 – makes action imperative, since China currently obtains some 70 percent of its energy from coal. This results in tremendous emissions of harmful CO₂. Today, China burns 2.1 billion tons of coal a year, more than the U.S., the EU, and Japan combined. New solutions are therefore urgently needed. Conserving energy and raw materials as well as protecting the environment are priority issues for the government and energy suppliers.

In 2004, China set new standards with the Waigaoqiao II coal-fired power plant in Shanghai, equipped with innovative steam turbine technology from Siemens. Thanks to its advanced power plant technology, based on so-called supercritical steam parameters, Waigaoqiao II is cutting CO₂ emission by 1.1 million tons a year. With Waigaoqiao III, also equipped with turbines and generators from Siemens, our customer even saves 900,000 metric tons of raw coal and reduces CO₂ output by 1.9 million metric tons annually compared to an average Chinese coal-fired power plant. The plant achieves an efficiency of up to 46 percent, making it the most efficient coal-fired plant in the world. That's one reason why Siemens Energy and the Waigaoqiao III Power Generation Company Shenergy won the Asia Power Gold Award for Best Environmental Power Plant of the Year.



Efficient, eco-friendly, extraordinary: SGT-8000H Series

With an efficiency level of more than 60 percent in the combined-cycle operation, the SGT-8000H Series is the world's most efficient gas turbine. We are entering a new dimension of sustainable power generation with our "H-Class". The SGT-8000H Series gas turbines and the SCC-8000H Series combined-cycle power plants feature best-in-class technology based on further evolution of our proven product lines. Tested in actual operation at the Irsching 4 power plant, the SGT5-8000H, our solution for the 50-Hz class, has already proven that it is a masterpiece of excellent engineering: So far the engine has accumulated more than 8,000 equivalent operating hours and more than 200 starts, during gas turbine field testing and combined-cycle commissioning.

As of January 2011, the SGT5-8000H at the Irsching 4 power plant of utility E.ON Kraftwerke has been running in combined-cycle operation. The rated output for SGT5-8000H under ISO conditions is 375 MW in simple-cycle and 570 MW in combined-cycle operation. Compared to state-of-the-art advanced combined-cycle power plants, this new gas turbine contributes to reducing annual CO₂ emissions by approximately 43,000 metric tons. That is equivalent to the annual CO₂ emissions of more than 10,000 mid-size cars traveling 20,000 km a year. With a hot plant start-up time of only about 40 minutes, it will maximize the operator's efficiency, performance, and flexibility. In February 2010, this one-of-a-kind performance was even awarded the Innovation Prize for Climate and Environment by Germany's Ministry of the Environment. For the world's most efficient gas turbine, Siemens Energy placed first in the "Green products and services" category.

Crossing the pond for new destinations

The SGT-8000H technology is available for both 50 Hz and 60 Hz applications. Florida Power & Light (FPL) already selected our next generation H-Class turbine technology for two plant modernization projects in Florida. The modernized plants will become Florida's cleanest: With more than 60 percent efficiency, previous emission levels will be halved and costs cut significantly. By implementing Siemens modern H-Class turbines, our customers will realize a five to eight percent higher return on investment compared to state-of-the-art F-Class engines. Another example of what Siemens is delivering with its products for cleaner fossil power generation: Sustainability through balancing business economics and ecology.

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Fossil Power Generation Division
Order No. E50001-W210-A159-V3-4A00 |
Printed in Germany | Dispo 34802 |
c4bs No. 7430, 7448, 7449, 7478 |
TH 214-110775 | BR | 430167 | WS | 08113.0

Printed on elementary chlorine-free bleached paper.

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descriptions of the technical options available, which
may not apply in all cases. The required technical
options should therefore be specified in the contract.



The image features the Siemens logo in a white box at the top. Below it, a photograph shows a power plant with several tall, red-and-white striped smokestacks. The foreground is filled with green plants and yellow flowers, suggesting a natural setting. The sky is clear and blue.

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Facts and Figures

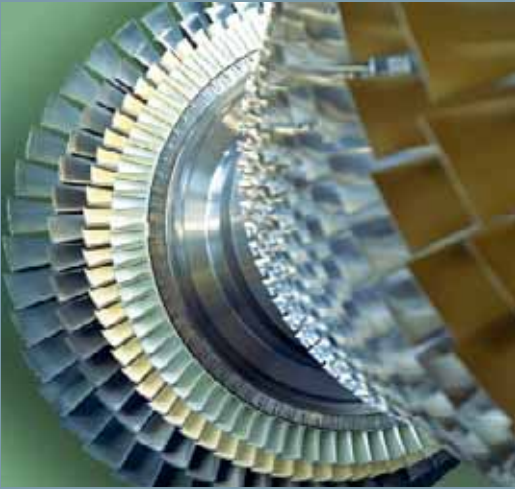
Answers for energy.



Gas turbines

- Output from 113 MW up to 375 MW
- Highest combined-cycle efficiency = up to more than 60 percent
- Advanced burner technology helps keeping emissions at very low levels
- Short start-up times
- Development and manufacturing in line with internationally recognized codes and regulations such as ISO, DIN, ASME as well as harmonized European EN standards
- More than 1,000 gas turbine units installed worldwide (SCPP and CCPP)

Read more about the leading gas turbine technology from Siemens on the following pages.



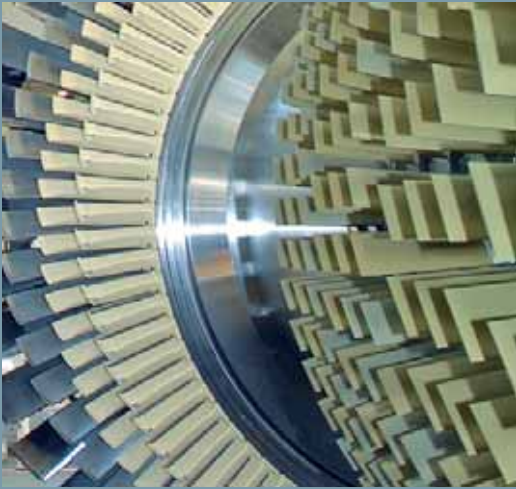
SGT-4000F Series

Output	50 Hz: 292 MW
Efficiency	Most advanced F-Class gas turbine technology leading to efficiency levels of more than 59.5 percent in CCPP
Emissions	The ceramic heat shields for the combustion chambers reduce the turbine's cooling air consumption and thus the output of nitrous oxides. This innovation was awarded the Berlin-Brandenburg Innovation Prize.
Flexibility	Fast hot-start: Only 30 minutes to combined-cycle base load (> 420 MW)
References	More than 200 units installed worldwide, including in Irsching 5 (Germany), Hamm-Uentrop (Germany), Al Taweelah (UAE), Panglima (Malaysia)



SGT-5000F Series

Output	60 Hz: 208 MW
Efficiency	More than 57.5 percent in CCGT
Emissions	Latest burner technology in fleet operation leading to ultra low NO _x and CO ₂ emissions (<9 ppm)
Flexibility	<ul style="list-style-type: none">– Fast ramp-up/ramp-down (10 minute start-up capability to 150 MW)– High turn-down capability (single-digit emissions between 40 and 100 percent base load)– High starting reliability
References	More than 230 units installed worldwide, including in Elk River (USA), Evander Andrews (USA), Bartow (USA), Lakeside (USA)



SGT-8000H Series

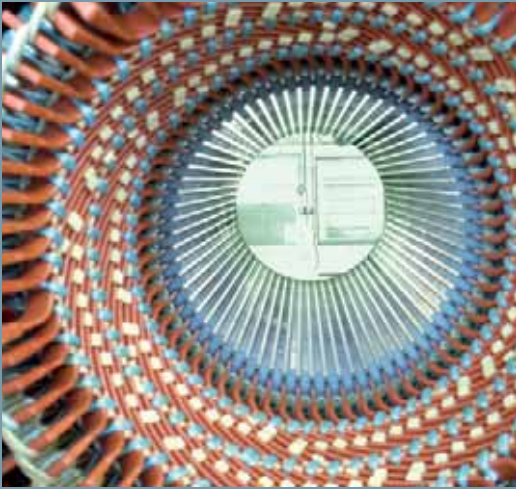
Output	<ul style="list-style-type: none"> – 50 Hz: 375 MW – 60 Hz: 274 MW
Efficiency	<ul style="list-style-type: none"> – 50/60 Hz = Highest efficiency in CCPP: More than 60 percent – Five to eight percent higher return on invest *
Emissions	Reduction of annual CO ₂ emissions by approx. 43,000 metric tons*
Flexibility	Fast hot-start: Only 40 minutes to base load
References	<ul style="list-style-type: none"> – Tested in actual operation at the Irsching 4 Power Plant in Germany – Winner of three international sustainability awards: <ul style="list-style-type: none"> ■ 2009 German Steel Innovation Award in the “Climate protection with steel” category ■ 2010 Innovation Prize for Climate and Environment awarded by Germany’s Federal Environment Ministry and the Federation of German Industries (BDI) ■ 2010 Bavarian Energy Prize – Finalist in EBAE (European Business Award for the Environment)

* compared to state-of-the-art
F-Class gas turbines/power plants



Steam turbines

- Output from 90 MW up to 1,900 MW
- Highest steam power plant efficiency = up to more than 46 percent
- Combined-cycle power plant efficiency = up to more than 60 percent
- Development and manufacturing in line with internationally recognized codes and regulations such as ISO, DIN, ASME as well as harmonized European EN standards
- Advanced FACY for fast start-ups, resulting in an 84 percent drop in fuel use compared to partial-load operation
- Steam turbines supporting carbon capture ready and storage available
- Steam turbines suitable for combined heat and power solutions
- Almost 1,000 steam turbine units installed worldwide (SPP and CCPP)



Generators

- Output from 25 MVA up to 2,200 MVA
- Highest efficiency = up to 99 percent
- Generators suitable for solar thermal power plants
- Generators with Micalastic® insulation system available, featuring high performance at highest operating temperatures and temperature changes
- Generators with Global Vacuum Pressure Impregnation (GVPI) available featuring extended service life and optimized reliability
- Development and manufacturing in line with internationally recognized codes and regulations such as ISO, DIN, ASME as well as harmonized European EN standards
- More than 1,200 generators installed worldwide



Ongoing development

Steam turbines

- Advanced materials for the highest steam capacities – to boost plant efficiency
- High-efficiency steam turbine series, optimized for large concentrated solar power plants

Gas turbines

- Continuous upgrading of components and systems for higher efficiency, lower emissions, and enhanced flexibility

Generators

- Optimized insulation system – MicalasticPlus
- High efficiency design, including high-temperature superconducting rotor windings

This flyer is part of publication
E50001-W210-A159-V3-4A00
TH 214-110775