At Lausward, part of the Düsseldorf harbor area, a landmark is taking shape. "The building will be visible from many places in the city, so it deserves a special design, one that creates a distinctive identity," says Gerhard Wittfeld, Managing Director of kadawittfeld-architektur, the architecture firm responsible for the project. "And that led to the idea of giving the building a sort of rhythm, which is generated by its steel frames and the gaps between them."

If this sounds like one of those faceless office towers that cities are famous for, it’s not. Instead of carpeted offices or lofts, this one-of-a-kind structure will house a combined cycle gas turbine power plant (CCGT). To be more precise, it will house the world’s most efficient and thus most environmentally-friendly power plant of its kind, and it will be built by Siemens.

The plant’s glass-enclosed power section will open up to the city. “We want our architecture to make people aware of the sources of energy that are driving our city,” says Wittfeld. The client is the utility company Stadtwerke Düsseldorf (SWD), which wants to use the plant as a reliable energy source for the city and, considering its prominent location in the middle of Düsseldorf, to also create a new urban statement.

"In contrast to many other regions in Germany, the population here is continuing to grow," says SWD Lead Project Manager Rainer Tröger. "Together with the high demand for power and heat from the regional economy, that means a growing need in the future, and the new power plant addresses that demand. At the same time, we want to get the most out of our fuel.”

The power plant is designed with precisely that goal in mind. Due to beginning supplying electricity and heat in 2016, the plant will be outfitted with a combination of a gas turbine, a steam turbine, and additional waste heat recovery — and it will try to break three world records at once. Here’s how:

1. At the heart of the plant will be the latest Siemens turbine generation: the SGT-800. Its output is equivalent to that of 22 jumbo jet engines, and it weighs as much as an Airbus A380 with full fuel tanks. In combination with a downstream steam turbine (Siemens SSTS-5000i), the Düsseldorf power plant will provide an electrical output of approximately 595 megawatts (MW) in a single block, which is a first.

2. In another first, the electrical efficiency of the power plant will be over 61 percent — exceeding the previous record of 60.75 percent attained by the Siemens-built “Ulrich Hartmann” CCGT plant in the Bavarian town of Ingolstadt (see Pictures of the Future, Fall 2011, p. 96).

3. In an additional process, the plant’s waste heat energy will be used to supply district heating for the city of Düsseldorf. The 300 MW of thermal energy that will be extracted for this purpose will set a worldwide record for the amount of power harvested by a single gas turbine generating unit.

Full-Load Output in 30 Minutes. When it goes online, the “Block Fortuna” plant, as it has been christened by Stadtwerke Düsseldorf, will burn its natural gas fuel with an overall efficiency rate of 85 percent. Every year, the plant will therefore emit approximately 700,000 fewer metric tons of CO₂ than the worldwide average for electricity generation plants. That corresponds to the amount of CO₂ produced by approximately 350,000 passenger cars, each driving 15,000 kilometers a year. Top class features like these are enough to get both experienced engineers and laymen excited.

However, by themselves, these achievements will not be enough for the plant to operate cost-effectively. In order to supply energy profitably, it will have to operate at full capacity. To understand why, it is important to bear the following in mind: From a technical point of view, efficient gas-fired power plants like this one represent the ideal technology for an economy that is using a steadily growing share of renewables to meet its energy needs, which is what Germany plans to do while shifting to a sustainable energy supply. After all, fluctuations in power generation as a result of changing winds or cloud cover must be quickly compensated for, and the Block Fortuna power plant will be a true champion in this department. It will be able to reach full generating capacity within just 30 minutes of starting up.

Unfortunately, however, electricity from CCGT plants is hardly cost-effective in Germany, because of current market conditions. At the moment, in fact, despite Germany’s plans for greener energy production, because of low raw material costs and the extremely low prices for CO₂ emission certificates, coal, rather than natural gas, is the most common fuel now being used to generate electricity. “In Germany, many gas-fired power plants therefore produce electricity only 1,000 to 2,000 hours per year. But to operate cost-effectively, at least 3,000 hours are normally needed,” explains Olaf Kreyenberg, head of European power plant sales at Siemens Energy, who is responsible for sales activities at the Lausward project.

How can the Lausward power plant escape the fate of other similar plants? “To operate a CCGT plant profitably in Germany, you need more than just electricity production,” Kreyenberg continues. “You need guaranteed purchases of the process heat to boost the operating hours into an economical range. And that’s precisely what you have in Düsseldorf, thanks to one of the largest district heating systems in Germany. As a result, the plant is expected to reach a utilization rate of approximately 5,000 hours per year.”

Adds Tröger: “We have the perfect conditions here. The plant is being built on a site that has been used for power generation since the 1950s — so a large part of the infrastructure we need is already present, such as the district heating system and a direct connection to a 110-kilovolt grid owned by SWD. Heat supply in particular will continue to play an important role here in the future.”

District Heating Makes the Difference. Despite the economic efficiency that is expected to drive Block Fortuna’s success, the plant is by no means a blueprint for the CCGT market in Germany as a whole. “A power plant of this kind with reliable customers for both heat and electricity, with a large installed district heating system, is possible only at a few locations in Germany,” says Kreyenberg.

Nevertheless, the Lausward example illustrates that CCGT power plants can, under certain circumstances, be operated profitably even in the current regulatory environment. And to ensure that the plant will deliver profitable and record-breaking performance for as long as possible, Siemens and Stadtwerke Düsseldorf have decided to continue their partnership after SWD takes charge of the plant. “In years to come, we want to help our partners in Düsseldorf always get the best out of their plant — for example, by raising its efficiency even further through innovations,” says Kreyenberg.

The Lausward power plant will thus be a system that can respond flexibly to the requirements of the energy market in the future. And that’s a characteristic that architect Gerhard Wittfeld and his firm keep coming back to. “Regardless of the angle from which people will look at this building, they will always have a sense of flexibility, of the rhythm of the power plant,” he says. But despite the plant’s name, the architect, the plant operator, and Stadtwerke Düsseldorf’s Managing Director promise to be Lady Luck. Thanks to top technology, they expect it to be a showpiece of a power plant — in more ways than one. ■ Sebastian Webel