Smart is clever

Sustainability, secure supply, and efficiency are the goals of good power management. The increasing decentralization of electricity generation, not least through the boom in renewable energy, however, confronts electrical transmission and distribution with new challenges.

The solution is Smart Grid: this intelligent grid regulates fluctuating energy feeds – and offers large-scale industrial consumers attractive optimization potentials.

It happened in broad daylight. For some 50 million people in eastern North America, on August 14, 2003, at 4:10 p.m., the lights literally went out: a gigantic area from Toronto to Detroit and all the way to New York City experienced the biggest blackout in history. Computer screens went dark, trains stopped moving, emergency power sets rattled at high speed in hospitals, Wall Street switched on the emergency lighting. It took 48 hours for electricity to be restored – hours in which the most significant economic regions in the world came to a standstill. European grid operators promptly issued reassurances that a disaster like that was unlikely because of the combined system on the old continent. But only two weeks later, the Greater London area faced the same fate. Twenty percent of the generation output went off the grid, followed by a breakdown in the transport system. Four weeks later it was the turn of southern Sweden and Denmark, and five days later it happened in Italy, leaving 50 million residents unsupplied. Three years later, in November of 2006, a subsequent power failure plunged almost all of Western Europe into darkness.

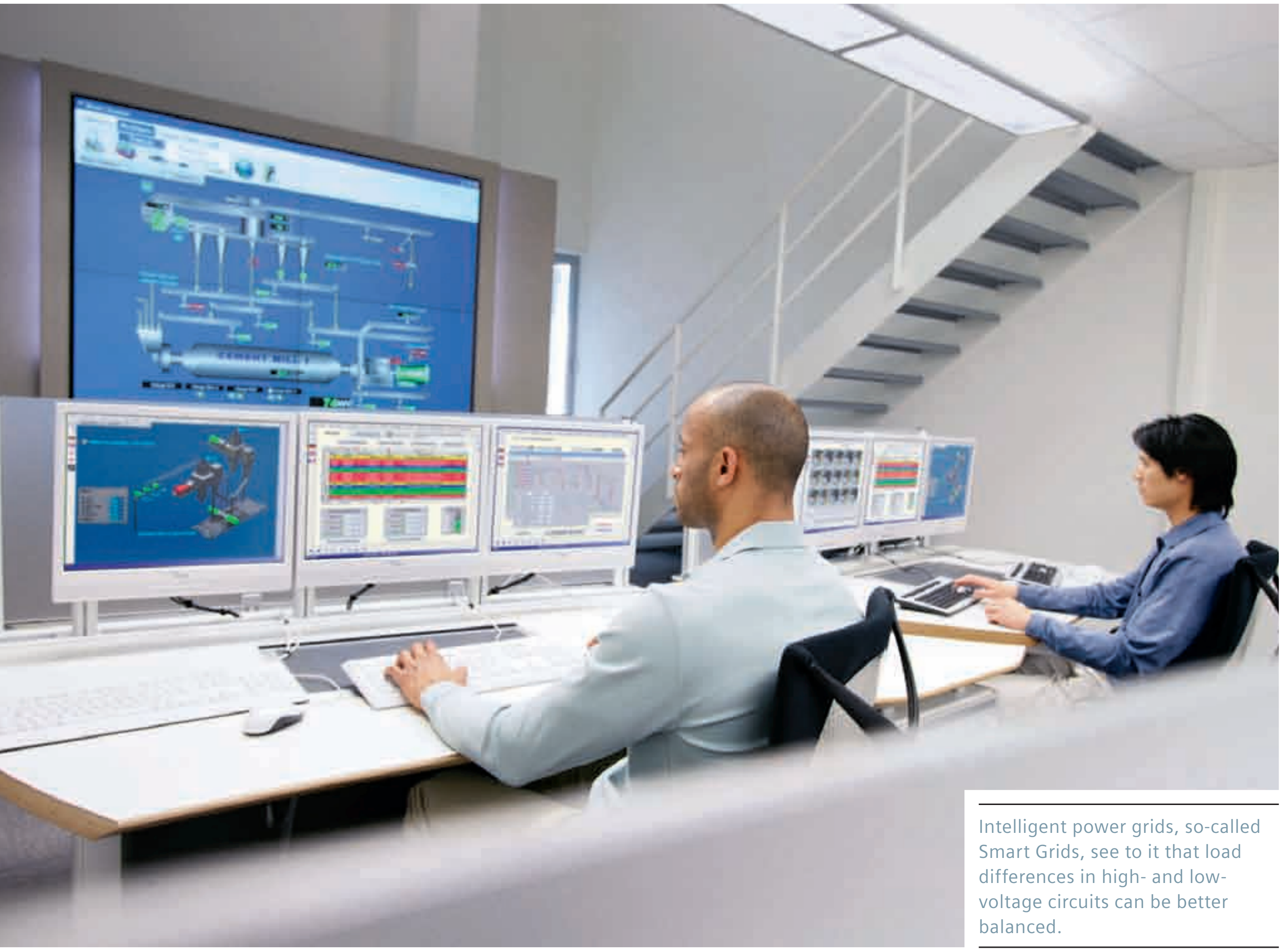
Following a blackout in August of 2003 in New York, power and the economy needed 48 hours to resume operation.

The analyses of these blackouts revealed a number of different causes: from human error over bottlenecks in the transmission grid all the way to an incorrectly installed network relay in the case of the London blackout. The consequences in each case were severe: industrial production and communication came to a total standstill. The North American blackouts in particular were precisely documented and examined. The macroeconomic costs of the power breakdown in August of 2003 can be estimated at between seven and ten million dollars. In the case of Europe, a study conducted at the Technical University in Vienna placed the cost of a power breakdown in the service and industrial fields at five to thirty-five euros per non-delivered kilowatt-hour of electricity.

All these incidents – even the one in America – happened under conditions that aggravated the vulnerability of power grids over the past decades: an extreme increase in electricity trading and a concurrent increase in the grid workload, even in normal operations. In the American blackout, an above-average connection of often timeworn air conditioners added to the problem. A dilemma that doesn't just exist in America: right in the low-voltage area – in the customer's grid – there is often a shortage of necessary sensitivity for energy efficiency. An important role is also played here by the growing number of producers of renewable energies. Wind and solar generators – unlike biogas power plants – number among the so-called fluctuating producers: sometimes they feed a lot, sometimes a little, and occasionally no electricity at all into the grid. The wide distribution and expansion of regulation zones may provide a certain continuation of solar and wind power. The core of the problem, however, remains. Fluctuating generation places heavy demands on a flexible grid management.

In addition to this, energy production is being largely decentralized: smallscale power plants at the municipal level, biogas plants on farms, or photovoltaic plants on the roofs of private homes or industrial facilities are assuming an ever larger proportion of power generation. This is forcing, more and more, the central control of our power grids on all voltage levels up against the limits. A Siemens study confirms the growing proportion of decentralized production capacities up to the year 2020. These must somehow be integrated into the power grid.

The answer to these challenges is Smart Grid – the intelligent grid. This is a sustainable energy system that independently controls fluctuating energy feeds. This also includes the intermediate storage of generated energy, storing extra



Intelligent power grids, so-called Smart Grids, see to it that load differences in high- and low-voltage circuits can be better balanced.

power generated during high-production or low-demand periods.

To measure, check, and control the generation, transmission, and consumption of electrical energy in grids on all voltage levels, Siemens experts are not only driving forward the development of effective communication and information technologies for the build-up of intelligent power supply networks, solutions are already being applied right now on various products. Examples of these are control systems for the realization of virtual power plants, intelligent consumer data acquisition systems, and smart distribution management systems.

The Smart Grid concept is also a serviceable instrument on the low-voltage level in industrial plants. Here, the demand for system-overlapping communication is especially high, because this area consumes almost 50 percent of the electricity – and increasingly produces it on its own in photovoltaic plants, fuel cells, or combined heat and power plants. Until now, the superordinate level – network control – has been totally blind with regard to the low-voltage level. At present it can only retrace load profiles. This is like trying to drive a car with your eye focused on the rear-view mirror.

This is why both power producers and consumers should be able to communicate both with each other and with network control. This is the only way refrigeration units, air conditioners, process steam generation, or the preparation of process water can be used for grid stabilization, for instance, by intermediately storing excess wind power at a temporarily lower refrigeration temperature or in the provisioning of process water. To be able to carry out process optimizations like these, it is, first and foremost, necessary to improve the transparency of power flow in low-voltage energy distribution all the way to the individual consumers. This way, in combination with the manufacturing and consumption data of other media, such as gas, steam, or, in general terms, other process energies, energy-efficient production and manufacturing processes can be generated.The optimum tool for the creation of optimization strategies is the "powerrate" add-on for the Simatic PCS 7 process control system and the Simatic WinCC manufacturing automation system. Powerrate compiles detailed information on energy consumption and cost factors, and then processes it for energy efficiency analyses.

Among the challenges for an optimization strategy of this kind are the "hidden power gobblers." Fans, refrigeration units, or air conditioners, can, for example, be switched off from time to time without affecting the main process.

The load management function of powerrate can be used to combat the overconsumption of hidden power gobblers, for example by automatically turning off auxiliary processes should there be a danger of exceeding limits. This not only lowers energy costs, but also stabilizes the power grids overall, as it helps avoid the provision of peak load energy from the public grid or on-site generators.

Especially in energy-intensive industries with complex process technology, such as steel and aluminum production, paper mills, or in the chemical industry, the hidden power gobblers can offer great potential for more efficiently designing the entire process. The use of energy-saving motors can increase potentials considerably. Besides these measures, which can be carried out with an ROI in two short years, there are even ways of achieving initial optimizations without investment.

By comparing different units or shift crews, power gobblers can be identified when considerable consumption differences appear. "We can, for instance, compare similar processes in production with one another: Why does the first shift carry out the same process with greater energy efficiency than the third?" says Bruno Opitsch, Sales Manager for Power Monitoring and Control, citing one example. New in application here is the Sentron PAC3200 Power Monitoring device, which precisely measures the power consumption of individual consumers of manufacturing units and sends on the data to the process control or manufacturing automation system. "This makes it possible to analyze energy flows and, beyond this, allocate them to specific cost positions with precise causality, thus supporting the improvement of cost-saving potentials," says Opitsch.

The aforementioned solutions also serve analysis in conjunction with a comprehensive service Siemens now supplies to its customers. A so-called EnergyHealthCheck is used to examine the entire operation for energy optimization potentials from stem to stern, all the way to an energy optimization service, which especially examines electric drive systems.

Power management systems are supporting here in the examination of the relevant energy processes. This way, the most efficient procedure can be determined for each individual step in the manufacture of products. Beyond this, auxiliary processes during periods of lower energy consumption can also be used to reduce acquisition peaks.

With the energy optimization service and powerrate as energy management, not only can energy costs in plants be typically reduced by up to 20 percent, but they also make a major contribution to grid stability. They help to avoid energy peaks, while, under certain conditions, also ascertain grid pollution, such as with the Sentron PAC4200, which measures harmonics. "These lead to the unnecessary heating of motors and increased grid losses," Opitsch explains, "caused by rpm-regulated drives, computer power supplies, or induction furnaces in one's own facility." Here, as well, Siemens supplies the appropriate solutions, from condensers to filters and all the way to dynamic voltage regulation to stabilize the grid.

Energy-intensive manufacturing industries like the chemical industry can use such tools such as load management to lower their power costs – and thus contribute to higher grid stability.