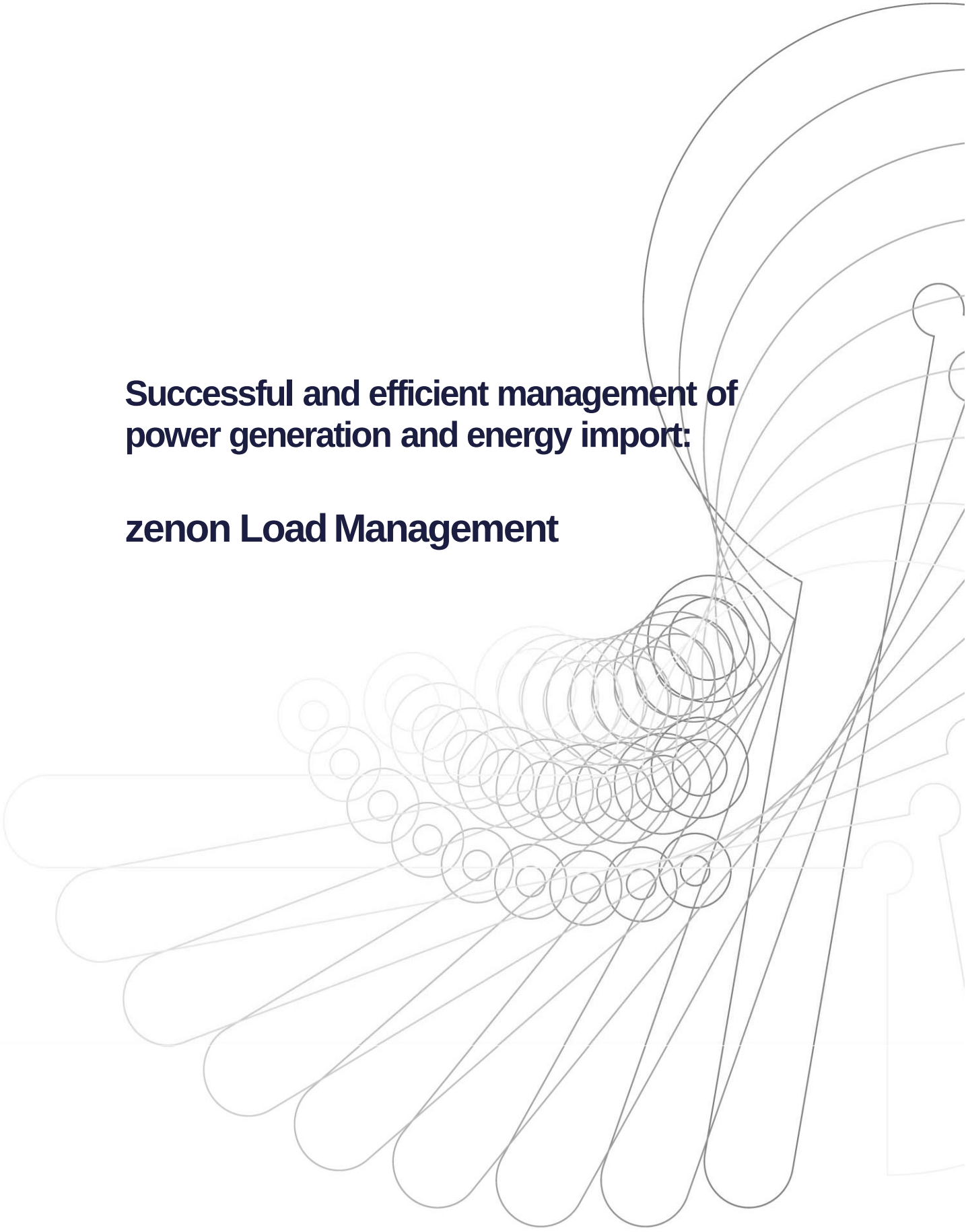
Successful and efficient management of power generation and energy import:

zenon Load Management



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The successful and efficient management of power generation and energy import; zenon LOAD Management

Energy is a very high value commodity; electricity and gas are important resources for manufacturing companies. Energy supply companies and industrial plants must be able to manage the import of electricity and gas in the best possible way. As a rule, supply contracts work on the basis of predetermined energy consumption levels. If the agreed levels are exceeded, the charge for the additional amounts are significantly greater. At the same time energy must be used as efficiently as possible.

A specialized energy management system enables the largest possible amount of energy to be procured from the supplier at the lowest possible price. Most significantly, it is the avoidance of costly power peaks that is the key to these savings. There are a number of ways to avoid these peaks, the loading can be reduced by switching off consumers, in-house energy generation can be introduced or increased or energy can be brought in from other reserves. To this end the average power for a measuring period must be predicted using the most accurate forecasting tool available. In this way, if the defined limit for imported power is at risk of being exceeded, the problem can be recognized in good time and the appropriate action can be taken.

The energy trend calculations that form part of the zenon Load Management are important tools for calculating the best and most efficient use of energy. The Load Management allows the importation (i.e. that which is externally supplied) of energy to be optimized automatically. Although the electricity and gas industries operate in a similar way, in terms of forecasting and optimization there is a considerable difference between the calculations for the importation of electricity or gas; energy management systems must cater for both of these energy sources.

Electricity suppliers' contractual conditions reflect the fact that it is not possible from a technical point of view to store electricity in significant quantities. With gas, on the other hand, not only must the contractual conditions be complied with, but steps must also be taken for storing the energy in a sensible way.

Electricity

With electricity the tariff usually takes into account the supplier's investments, e.g. construction costs, as well as the costs incurred in generating the energy and maintaining the network.

Liberalized electricity markets bring a profusion of tariffs in which the power components play an ever greater role. Energy suppliers appreciate accurate loading forecasts, as these make so-called "timetabled supplies" and thus reliable planning possible. Customers who manage to adhere exactly to their own personal loading profiles are able to benefit from extremely favorable tariffs. If, on the other hand, they deviate from the timetable, they can expect hefty charges for the extra unplanned energy consumption. Intelligent load management systems like zenon enable accurate planning and correct timetabling.

The power price is calculated using the highest consumption figures that arose during the previous year. The average consumption or charging period usually has a duration of 15 or 30 minutes. During this period the average imported power measured at the transfer points – also referred to as load – respectively the equivalent amount of energy is calculated and billed. The demand rate is usually dictated by the three highest values that have occurred in different months during the measurement period. In addition, the consumed energy is charged per kWh or MWh. The supply contracts are then finalized on this basis.

The average power readings that are applied when calculating the power price can be reduced if load peaks are reduced by specific optimization actions. The most important opportunities for short-term import optimization are:

- Load shedding of switchable consumers
- Increased in-house energy generation from CHP or other means

However, the avoidance at all costs of exceeding the contractually defined or target energy consumption (target power consumption or power consumption limit) within a measurement period is not the sole aim of optimizing the importation of energy. If the power requirement is correspondingly high, then the supply should only be a little below the target in order to obtain as much as possible of the energy paid for at the beneficial contract rate. For this purpose a trend calculation is used for short-term forecasting. The measured values captured in the working interval – generally 30, 60 or 180 seconds – are used to carry out trend analysis, the trend is calculated ahead up to the end of the period.

Gas

With gas, a variety of measures can be employed to compensate for load peaks: retrieving gas from storage or taking advantage of the storage capacity in the gas network through pressure adjustment or load shedding through the switching of consumers. This is achieved by storing gas in a storage facility or in the network and retrieving it as required. It is also sometimes possible to purchase gas known as spot gas from the supplier; this is gas that the supplier makes available outside of the terms of the contract.

With gas the measurement period for calculating the energy price is usually one hour or one day. As with electricity when the agreed energy limits are exceeded the energy price is increased considerably. The consequences of exceeding an agreed limit are, however, controlled in a much more specific way than they are in the electricity industry. In principle every possible effort is made in gas networks, as in electricity, to ensure that the agreed limit on imported energy is not exceeded. The following actions may be carried out:

- Load shedding of switchable consumers
- In-house production of gas in liquid gas plants
- Switching heating furnaces over to other fuels where ‘dual-fuel’ furnaces exist
- Obtaining gas from storage facilities.
  This must be carefully thought through, there may be only small amounts available, and these may need to be available at peak times. Irrespective of the amount stored a strategy *must* be defined for restoring the consumed gas for short or longer periods.

How can loads be spread out?

An underlying issue with deploying a Load Management is which elements or devices can be effectively influenced either directly or indirectly. Naturally these will be different for electricity and for gas.

Options for load influencing with electricity

With electricity several options are available for reducing loads for short periods thereby adhering to the agreed import limit.

- **Directly switchable consumers** such as industrial furnaces, pumps for water tanks, etc., may be switched off for short periods without interrupting production processes.
- **Direct heaters** can often be interrupted for short periods with no significant reduction in supply quality due to their stored heat. Such heaters include those in hot water tanks, electric floor heating systems, etc.

- **Monovalent heat** pumps are usually operated as direct heaters. The temperature-dependent proportion is more pronounced and increases when the outside temperature is falling, e.g. with heat producing pumps, as well as when the outside temperature is rising, as with air-conditioning units.
- **Bivalent heat pumps** can choose between the fuels used, and below a certain temperature they will be switched over to a different energy source either by their own controller or by the optimization facility. As far as the consumer units are concerned this does not result in any supply restriction. This type of switchover to a different source should not be taking place constantly, components are only switched over on a long term and controlled basis.
- **Night-storage heaters** are supplied with energy according to a timed schedule during low-tariff periods. At other times they remain switched off.
- **Peak-load units and emergency generating sets** can be switched on and off as necessary. In some cases these units can be controlled.
- **Voltage reduction** is possible only in certain networks. This is achieved by setting the mid-range voltage transformers to a lower level.

Options for load management with gas

The following are the main options for avoiding import limits being exceeded with gas:

- **Directly switchable consumers** that can be switched off without any disruption or interruption to the production process.
- **Heating furnaces and district heating plants** can, if their design allows, be switched to a different fuel, e.g. from gas to oil.
- Different companies have different **gas storage capabilities**. Sometimes the pipe network has enough capacity to be used as a storage facility otherwise standard gas storage might be available. Gas can then be taken from these facilities to smooth out the peaks.

Consumer unit load characteristics

Before a Load Management is configured detailed planning should be carried out to decide which energy sources are to be included in the Load Management and which ones do not readily fit into such a system. Devices whose energy consumption often fluctuates are as a rule not suitable for Load Management. For the load characteristics of the switched-off components, models are used that can be assigned to different classes:

Constant power: When a unit (pump, furnace, …) is switched on it starts up with a specific power consumption. When it is switched off the power consumption is reduced by the same amount.

Direct temperature dependency: Temperature-dependent consumers depend directly on weather conditions and their consumption increases roughly proportionally to the negative gradient of the outside temperature.

Charge time model: Here the temperature makes itself felt firstly in the level of making capacity and secondly though the length of the subsequent charge time until the power drops when all the heat stores are loaded.

Relationship to switch-off time: Depending on the preceding switch-off time that results from the cooling or warming that have taken place in the meantime, either more or less consumer units are switched on, and are then switched off again after a short time.

Relationship to the production process: In the industrial sector, production processes can bring about behavior that does not conform to any behavior pattern or relationships and which is only determined by the production schedules.

Load Management methods

COPA-DATA provides a Load Management that is directly integrated with zenon. This is based on a time-series analysis in which the future power consumption pattern is extrapolated from an analysis of the measured consumption pattern. The forecasting horizon for the Load Management corresponds to the remaining time in the current measuring period.

The short-term forecasting model

The zenon Load Management is based on power (consumption) and hours, and performs its calculations internally without units. The units in which the values are supplied and interpreted are therefore of no significance as long as the values are obtained on the same basis. The base units are configurable either as KW or MW. For gas the standard m^3 can be used as the energy quantities in the calculations.

In order to calculate the current power pattern a mathematical model is used to estimate the anticipated power value at the end of the period.

Reduction of the import limit

Even with the best mathematical model, the load trend can never be predicted with complete accuracy. There can also be deviations from assumed values for the switchable loads. For safety reasons the value should be kept slightly below the actual import target.

Energy importation is generally controlled in a closed-loop system. In this, the results of forecasts form the basis for consumers being switched on and off. When the zenon Load Management module is used, the direct switches on the devices concerned should not be used for this purpose. The user can decide whether direct switches are to be enabled for operation by zenon, or whether such actions should depend on final approval from the user.

It is very important to determine the power consumption of each consumer to be able to calculate the anticipated effect of switching the consumer on or off accurately. It is not always possible to get the actual measured value of the consumer as it might be switched off. zenon offers the user two alternative methods of specifying the consumption of a consumer. Either a fixed value can be applied through parameters or by measuring the actual current value.

zenon can very easily query measured values directly. zenon is an extremely powerful SCADA and HMI system that can use more than 300 communication protocols to directly integrate with many different devices. The integrated SCADA logic, straton, communicates directly with the hardware IO.

The decision about which consumers are switched on or off depends on a number of factors. The primarily factors are the amount of energy required and the availability of the consumer. The aim is to manage the import of energy with the smallest possible number of switching actions. This keeps the power network operation steady and maintains the availability for consumers.

Fully integrated – zenon Load Management

Optimizing the import of energy and sticking precisely to timetables can only be successfully achieved with the support of a Load Management. It is not only a matter of remaining within limits but comprehensive analysis, accurate forecasting, and optimization based on this information also have an important part to play. It is also *essential* for these systems to work in conjunction with the process control system. This is why pure hardware solutions can only control part of the task. They may be capable of responding to trigger values but they do not have the ability to calculate useful average values and to use them to operate in a predictive way or even to integrate other components of the process.

zenon complies with IEC 60870 and 61850 energy standards. This means that it is extremely easy to integrate with all manner of devices. zenon offers an excellent combination of a Load Management and SCADA/HMI system with an extensive means of communication with many different devices.

All of the data is organized in a system database and can be accessed by all modules. straton, which forms an integral part of zenon, can also access the data in its capacity as soft PLC and SCADA logic module. Measured results are therefore available from a central location and switching actions can be performed with the highest degree of confidence. Switch actions carried out in the Load Management that affect the SCADA system are carried out and checked simultaneously in the SCADA system and vice versa. When a command affects other components or parts of the system they can be seen immediately and can be clearly assigned.

zenon is developed by COPA-DATA and, along with the Load Management, has been tailored for use in the energy sector. For further information on zenon and Load Management, please contact: energy@copadata.com

About COPA-DATA

COPA-DATA is a European automation company and a leading innovator in the field of SCADA/HMI software. For more than 20 years its successful process control system, zenon, has been used for automating, controlling and the visualization of production processes and distribution of resources in companies from the widest imaginable range of sectors that include automotive engineering, mechanical engineering, pharmaceuticals, energy, and food and beverage. COPA-DATA is an independent company that works in a quick, flexible way, constantly creating new standards of functionality and ease of operation, thus leading the way in its field. The COPA-DATA sales network includes subsidiaries in Germany, Italy, France, the Middle East, UK and USA as well as partners in many other countries around the world. COPA-DATA currently employs more than 130 people, and its list of customers features numerous internationally successful companies including Festo, Swarovski, BMW and Audi.

About zenon®

zenon is the easy-to-operate, powerful software for industrial automation from COPA-DATA the leading European player in the SCADA/HMI field. It is used by many companies around the world for process visualization, as a human/machine interface (HMI) and as a process control system (SCADA). zenon's main strengths lie in its simple object-oriented configuration, its comprehensive extensibility from terminal to control room, and its high level of security. Its openness makes it possible to make rapid and efficient connections with any hardware or software, e.g. ERP systems. zenon delivers first-class performance to industrial PCs running any of the latest Windows operating systems, as well as to any other hardware operating with Windows CE. Companies from many different sectors including mechanical engineering, automotive, food manufacturing, process engineering, building control systems or power supply reap the benefits of zenon.

About straton®

As a hard PLC, soft PLC and bus terminal controller, straton enables industrial plants to be configured quickly and safely. straton is fully IEC 61131-3 compliant and runs on all current Windows operating systems including Windows 2000, XP, XP embedded, Server 2003 and CE. The programming interface supports all the common Fieldbus systems and all five languages defined in IEC. These languages are: AWL (=IL, instruction list), ST (structured text), KOP (=LD, ladder diagram), FUP (FBD, function block diagram)/CFC (continuous function chart) and AS (=SL, sequence language). When straton's development environment is fully integrated with the zenon SCADA system, the resulting interface features simple variable handling, universal support of complex data types and object-oriented configuration.