Smart Energy &
Power Quality Solutions



# Energy Management Systems

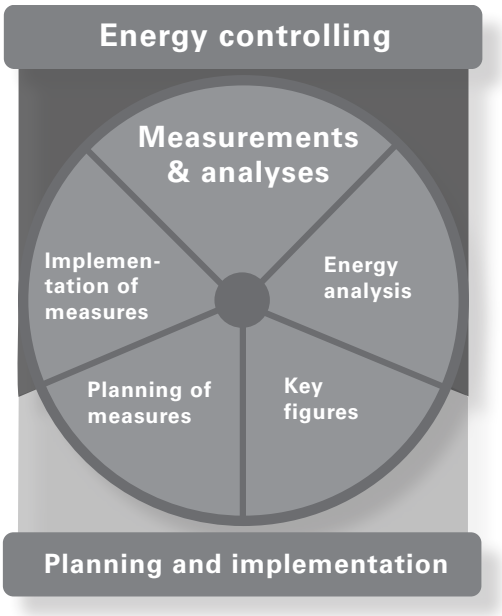
Janitza®

# Introduction
# Systematic energy saving

In the course of energy management, objectives relative to energy consumption, $CO_2$ emissions and energy costs are defined. With the new ISO 50001 standard, which replace the previuos EN 16001 standard from 24. April 2012, appropriate basic parameters have been specified for a corporate energy management system. The primary objective is to continuously reduce energy consumption and the associated energy costs! Based on concrete data and facts energy-saving measures are identified, developed and implemented. Objectives and the achievement of these objectives are continuously monitored and corrective measures are initiated as needed.

Energy management requires a systematic approach. It requires a holistic approach that is resolved on, driven and promoted by corporate management that is carried through the entire enterprise via all departments.

Financial aid programs on different levels, as well as tax benefits support the introduction of energy management systems in your company. Janitza solutions, software and hardware components, ensure the necessary transparency and documentation in the implementation of your energy management system.

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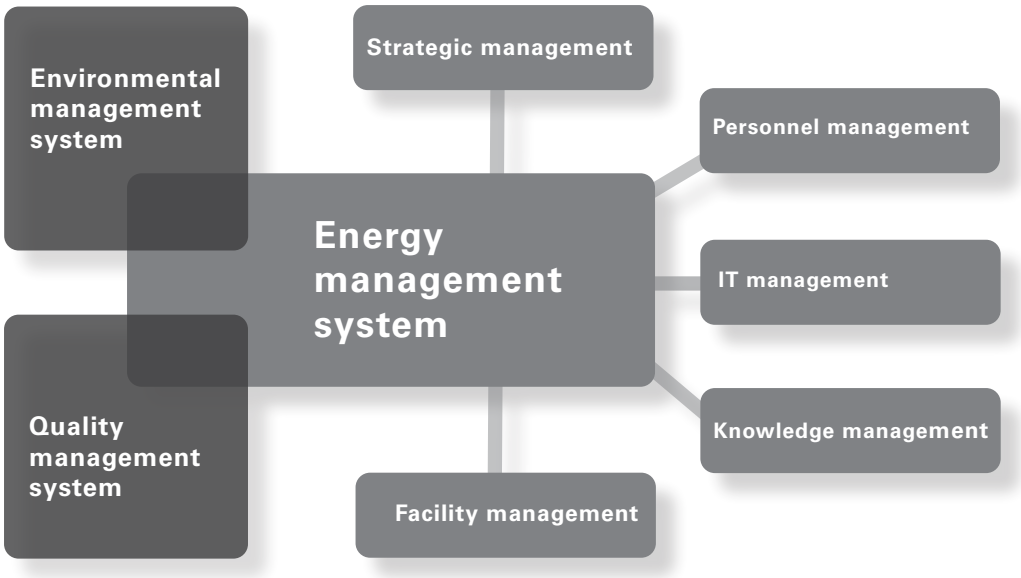
# Objectives and advantages of an Energy management system (EMS)

As a rule, energy management systems are integrated within existing management systems, such as quality management (ISO 9001) or environmental management (ISO 14001). This results in synergy effects because common operative elements, for example, are used. The overall expense can thus be reduced. The standard ISO 50001 (previuosly EN 16001) aims at supporting the development of corporate energy management systems.




*Integration of the energy management system in other management systems (e.g.: ISO 9001 or ISO 14001)*

Energy management systems help companies to optimize the use of energy systematically, economically and ecologically - from purchase to energy consumption. Energy management helps improve the energy efficiency of processes, equipment and devices, and to reduce costs, energy consumption and $CO_2$ emissions. In addition to direct energy costs there are additional advantages for your company, such as:

- **In many countries tax benefits (e.g. Germany)**
- **Fulfilment of legal framework directives**
- **Transparency of energy consumptions in the individual departments**
- **Increasing supply security**
- **Environmental protection, image cultivation (ecological thinking)**
- **Use of an optimised energy mix, optimisation of energy contracts**
- **Increasing employee awareness relative to energy efficiency and climate protection**
- **Cost-centre management: Causer-based allocation and billing of energy costs**
- **Early detection and correction of significant changes through continuous monitoring**

# From the actual status to the energy-efficiency measure

Energy analysis on the basis of concrete energy-consumption measurement data supplies the basis for determination of the corporate objectives relative to energy consumption, energy costs or reduction of energy consumption.

Through the corporate energy analysis you obtain the overview and transparency of the energy supply and energy consumption structures, as well as an overview of the specific energy influences. The human factor should not be underestimated - employees and responsible parties should be made aware of possible cost savings through rational energy use.

The first step is the recording of available data. For example, this includes invoices from public utilities for electricity, gas, water district heating, listing the significant energy consumers, etc.
Reading out existing measuring points and consumption meters at fixed intervals, monthly for example, follows.

In the second step detailed and continuous data acquisition of energy consumption is undertaken.

This measurement is executed beyond the various network levels, extending to low voltage, and should at least include the main supply lines and essential underconsumption groups. Typically a measurement system with automatic data readout must be retrofitted to do this.

The third step involves the analysis and valuation of the data acquired.

Because the absolute energy use is insufficient for evaluation of trends, efficiency or for comparisons based on different conditions (e.g. revenue fluctuations or changes in ambient temperature), the formation and evaluation of energy coefficients has proven to be extremely effective, e.g. kWh/m², energy costs/sales or energy consumption/ production volume. Suitable reference values must be defined individually for every company.

With coefficients benchmarks can also be easily executed, e.g. comparison of the energy consumption in the hotels of a worldwide chain with absolutely different climatic conditions.


*Fig: UMG 96RM energy meter*

To keep the complexity of a corporate energy analysis within reasonable limits, not all consumption areas or devices can be examined with the same depth of detail. An initial rough analysis includes taking stock of the enterprise from the perspective of energetic considerations. First, the areas and scope of the examinations will be selected. This includes equipment and areas in which the greatest energy consumption is presumed, such as heating and ventilation equipment, large compressors, production equipment, etc. or areas that hold the greatest promise for fast savings.

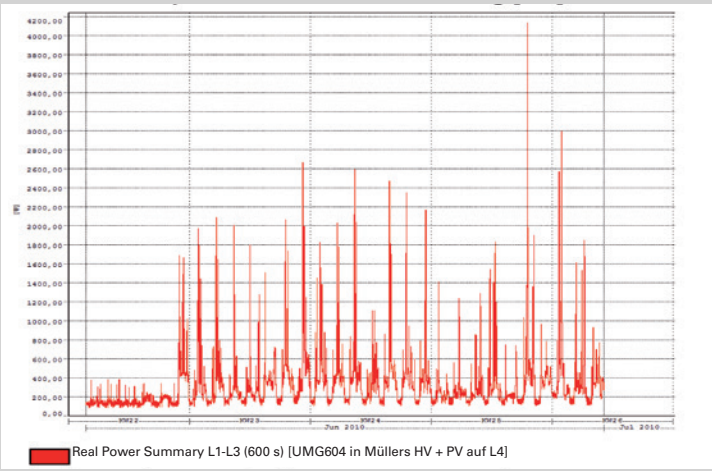
*"The appropriate energy-efficiency measures can only be derived with the necessary transparency of the individual energy consumptions."*

*Dr. Schmidtbauer-Huber (Power & More)*

## Necessary information:

- Annual energy consumption and energy costs
- Energy and load profile and its development in recent years
- Connection and power data (nominal power, maximum power, reactive power, etc.) of the main loads
- Purchase contracts and tariffs of all energy types
- Situation of energy acquisition data in the company (number and location of the meters and measurement devices for electrical power, natural gas, heat, water, etc.)
- Consideration as to whether data concerning power quality will also be recorded

Load profile, June 2010: Active power (kW)




*Load profile over four weeks: Via the load profile, for example, the electrical power is compared with the work times in the company and excessive consumptions are identified.*

The energy-efficiency potential that is worked out through the rough analysis is examined in more detail in the next step. The goal is to obtain differentiated data in order to work out possible optimisation potential in detail and to appropriately prioritise energy-efficiency measures.

## Data acquisition methods

Data acquisition of the energy consumption data is possible in two ways:
The consumption data, operating data, and cost data is manually entered by qualified employees, however this is extremely time-intensive and is not possible if there are multiple measurement devices, i.e. inaccuracies occur!

Alternatively, automatic acquisition of energy consumptions can be executed via appropriate measurement devices with interface and communication equipment (e.g. Modbus-Fieldbus or Ethernet).

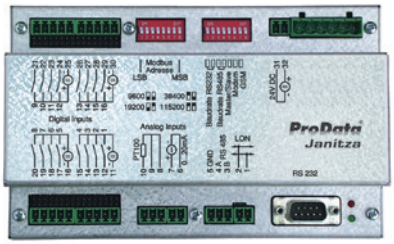
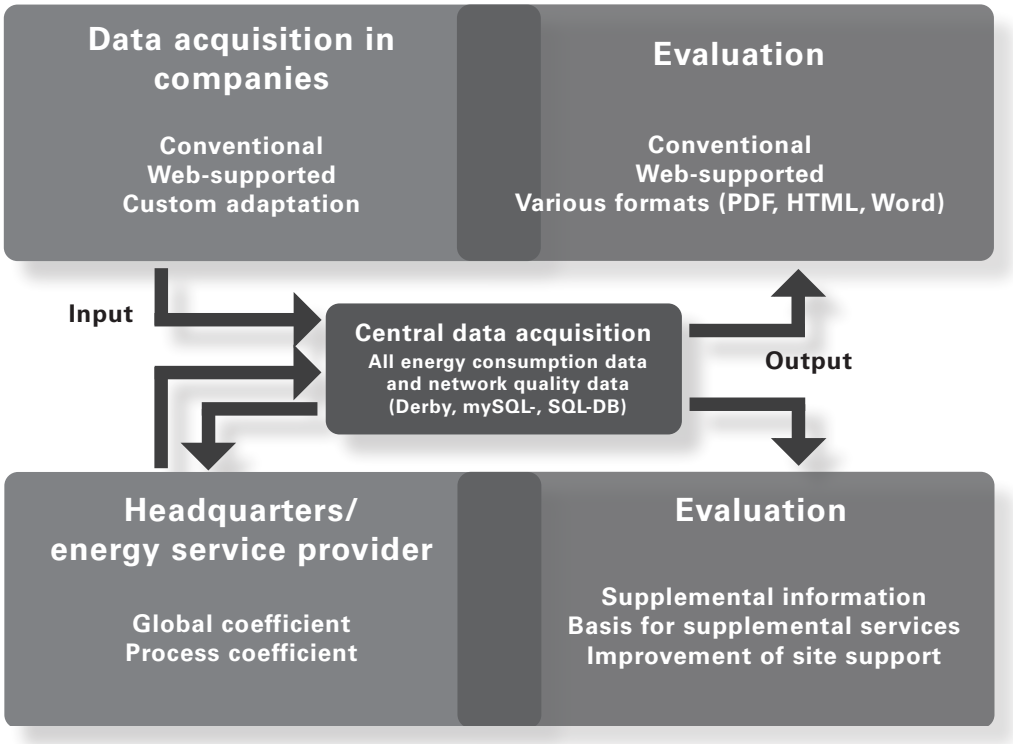



*Fig.: ProData data logger*




### Note!

For medium-size and larger energy management systems, professional SQL databases are required due to the high data volumes. Moreover with regard to performance and data security, the use of a professional data server is also recommended.

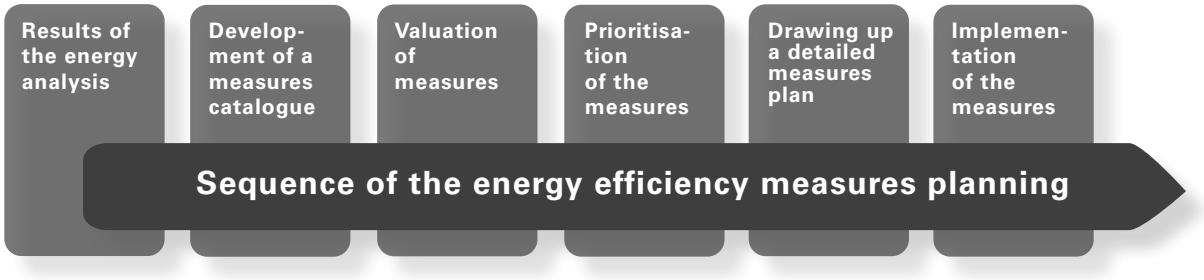
If the data from numerous consumption points, (main transformer feeders, infeeds of LV distribution panels, server cabinets, el. major loads, cost centres, etc.) should be recorded, automatic measurement device readout is actually indispensable.
All automatically and manually acquired data is brought together into a central database for further processing. This data forms the basis for later evaluations with appropriate software packages and tools for cost-centre reports with detailed consumption allocation, documentation, online monitoring with alarm management in order to react quickly to changes, etc.

*"Through the introduction of an energy management system we were able to realize an annual energy cost savings of 18% within two years!"*

*Dr. Schmidtbauer-Huber (Power & More)*

# The energy-efficiency measure: The key to success

The results of the energy analysis are the basis for the planning of energy-efficiency measures for reducing power consumption and power costs. Two types of measures are differentiated. These are **technical measures**, for which higher or lower levels of investment are necessary, but also **organisational measures**, which integrate more-efficient use of energy in the daily operation of the company. Both types of measures offer considerable savings potential and should be pursued with equal priority. Working out a measures catalogue on the basis of an ABC analysis of the electrical loads is effective (the initial data is the measurement data of the energy analysis). The energy-efficiency measures should be valuated in the measures plan and sorted according to priority - which measure offers the greatest benefit at the lowest expense.




## Note!

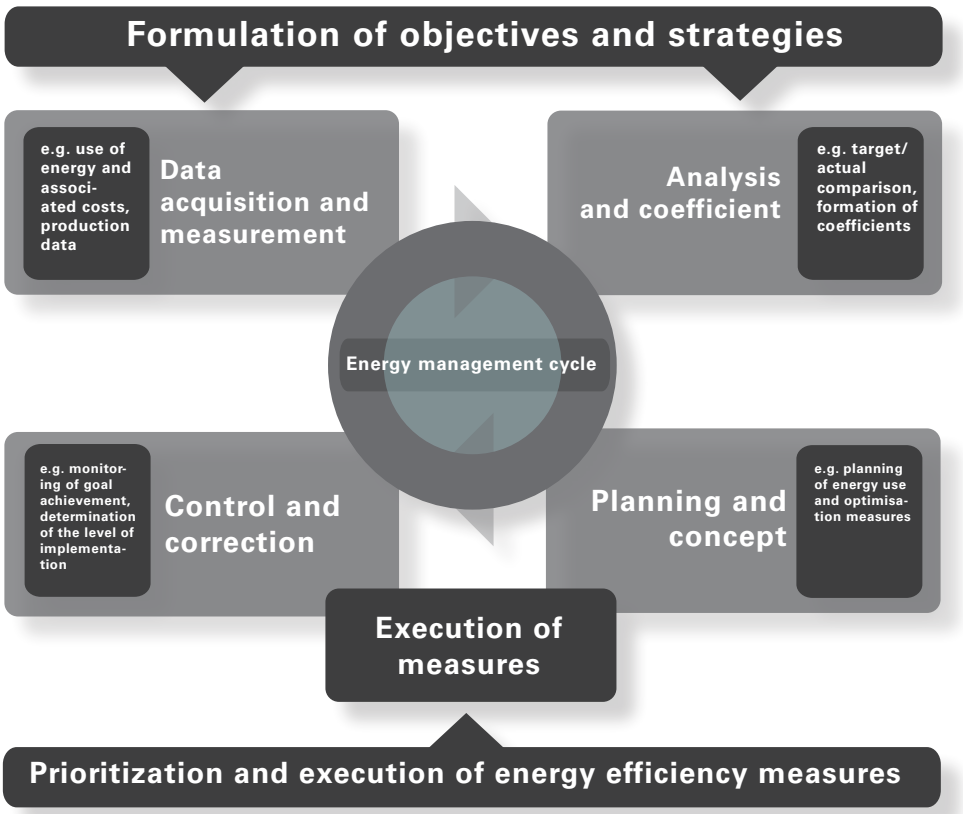
Energy-efficiency measures are not always associated with costly new investments. Many measures can also be implemented with a small budget.

### Examples of organisational energy-efficiency measures:

- Life-cycle costs are in the forefront: Energy-efficiency as decision-making criterion
- Training and instruction of employees
- Adjustment of work processes in production
- Adapt power delivery contracts to requirements
- Time-delayed start-up of processes to avoid expensive demand peaks
- Optimisation of process parameters (also with regard to energy consumption)

### Examples of technical energy-efficiency measures:

- Use of motors with greater energy-efficiency class IE2 (approx. 95% of the life-cycle costs of an electric motor are caused by energy costs)
- Use of modern drives (e.g. frequency converters instead of mechanical throttle valve for fans)
- Load management - peak demand optimisation
- Optimal dimensioning of motors and operating materials (the efficiency level of a motor drops significantly when operated below the nominal power)
- Leakage reduction in the compressed air network
- Use of heat recovery




*Energy management is a closed control loop with the goal of continuous improvement.*

*"Frequently cost-effective measures, and in some cases no-charge measures, that result in significant energy savings can be implemented through the conscientious analysis of energy consumers."*

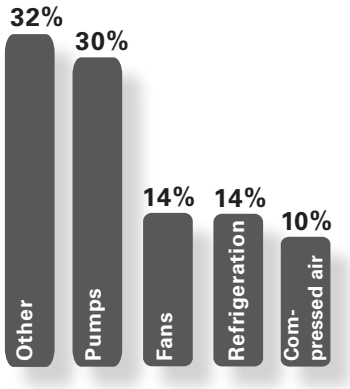
# The HVAC example


*Fig: UMG 508 power analyzer*

Electrical motor systems are responsible for two thirds of industrial power consumption. In Germany, in 2005 that was approx. 160 TWh! A majority of this consumption can be assigned to the following consumer groups:

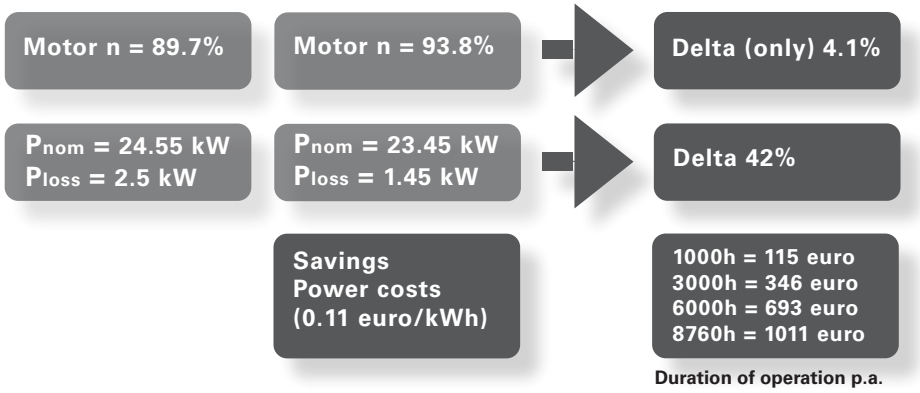
1. Compressed air systems
2. Refrigeration systems
3. Pump systems
4. Ventilator systems
5. Electrical drive systems

*Distribution of power consumption Motor-powered systems in the EU*




## Energy-efficiency measures in this area:

- Continuous monitoring of energy consumption
- Timely detection of malfunctions and energy squandering
- Use of more energy-efficient class IE2 motors
- Process optimisation
- Use of frequency converters instead of conventional mechanical control systems
- Operation of drives in the nominal operating point
- Benchmark of plants, plant sections and processes



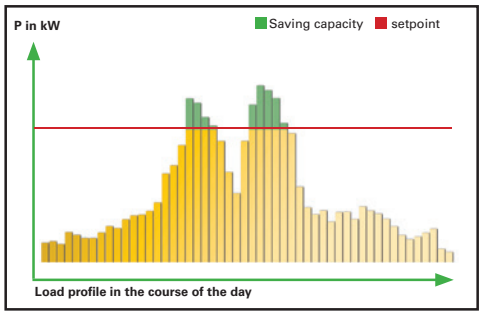

*Conversion to a class IE2 motor with correspondingly higher efficiency reduces losses by 42%. Depending on the annual duration of operation, short amortisation times are ensured.*

*"95% of the life-cycle costs of an electric motor occur through energy costs!"*

# Load management - peak demand management

A particular measure is demand management. Optimisation of the load profile does not result in energy savings, however depending on the power delivery contract it can result in considerable cost savings.

Energy consumption varies quite considerably over a 24-hour cycle:

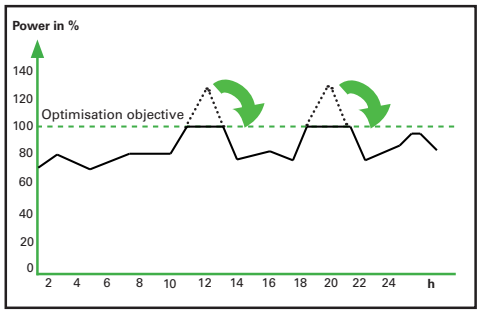



This results in massive loading of generating and distributing equipment, it also requires expensive peak load coverage e.g. in the form of pumped-storage power stations.

To compensate these active power peaks, the energy providers have introduced corresponding power price tariffs. According to the tariffs of the energy companies, when assessing power costs the highest peak power value measured over a quarter of an hour in the month or year is charged. Then based on these peak values the grid provisioncosts and the monthly power price will be billed. If this peak value is lowered, power costs are reduced.

An optimal adaptation of load distribution profiles to the delivery conditions of the energy suppliers must be ensured.

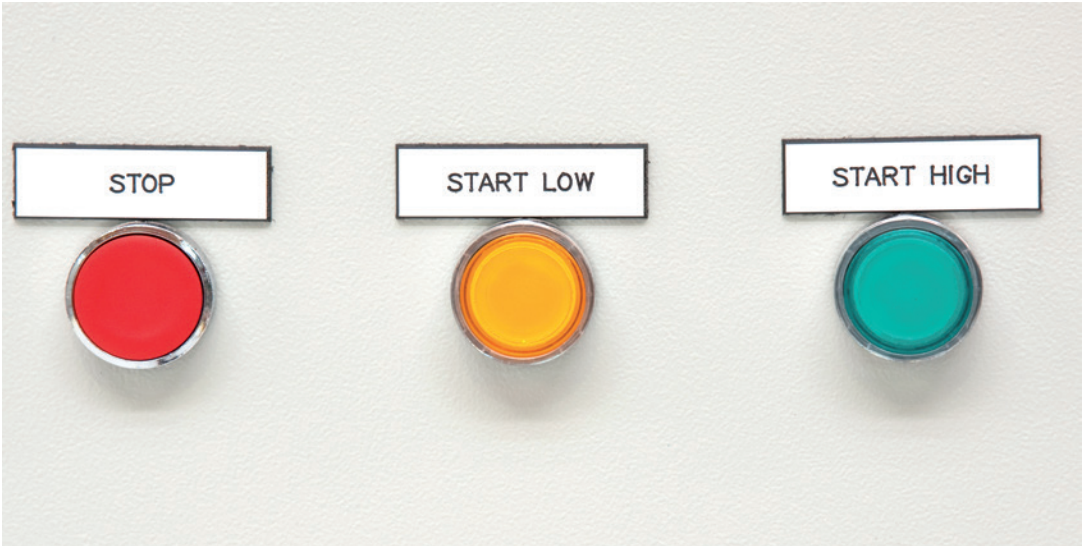
Peak demand optimisation systems reduce through complex control algorithms, the power of non-critical loads (e.g. thermal loads) defined by the user, or switch them off for a short period of time temporarily according to programming provided particularly for this purpose.




*Avoid power peaks via demand management*

## Note!

Peak demand management is a proven means of significantly lowering electrical energy costs.



# Janitza's complete solution for your energy management system

### Extensive portfolio of measurement devices

Janitza offers one of the most extensive product portfolios in the area of energy measurement technology. The matching software and hardware components permit a solution that is custom-tailored for the specific customer requirement.

### Automatic measurement data readout and storage

Uncomplicated system integration (energy management system, PLC, SCADA, BMS) is assured through numerous interfaces and protocols. The UMG scope of delivery includes the GridVis software, which is the basis for energy management systems and power quality examinations. Via fast communication equipment the measurement data is automatically read out of the measurement devices and stored in a central database.

### Flexible and scalable system architectures

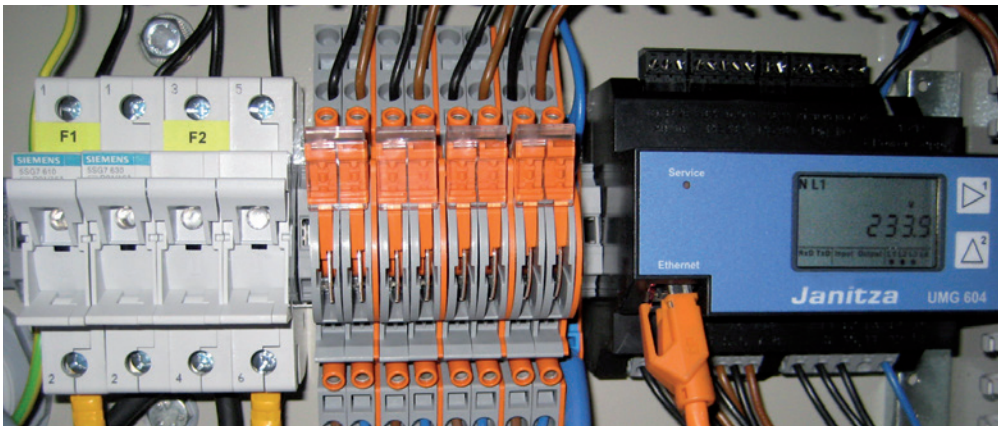
- Easy integration of meters that are not capable of communication via digital inputs
- Acquisition of power, gas, water and steam consumption
- Use of existing infrastructure
- Scalable, easy-to-extend system architectures
- Cost-optimised systems through the master/slave concept

### GridVis system software and its tools

The GridVis system software includes extensive tools, such as automatic measurement data readout with freely definable time schedules that enable automatic execution of cost-centre reports or power quality reports in accordance with freely configurable time schedules, graph sets, online topology view with limit-value monitoring and much more.

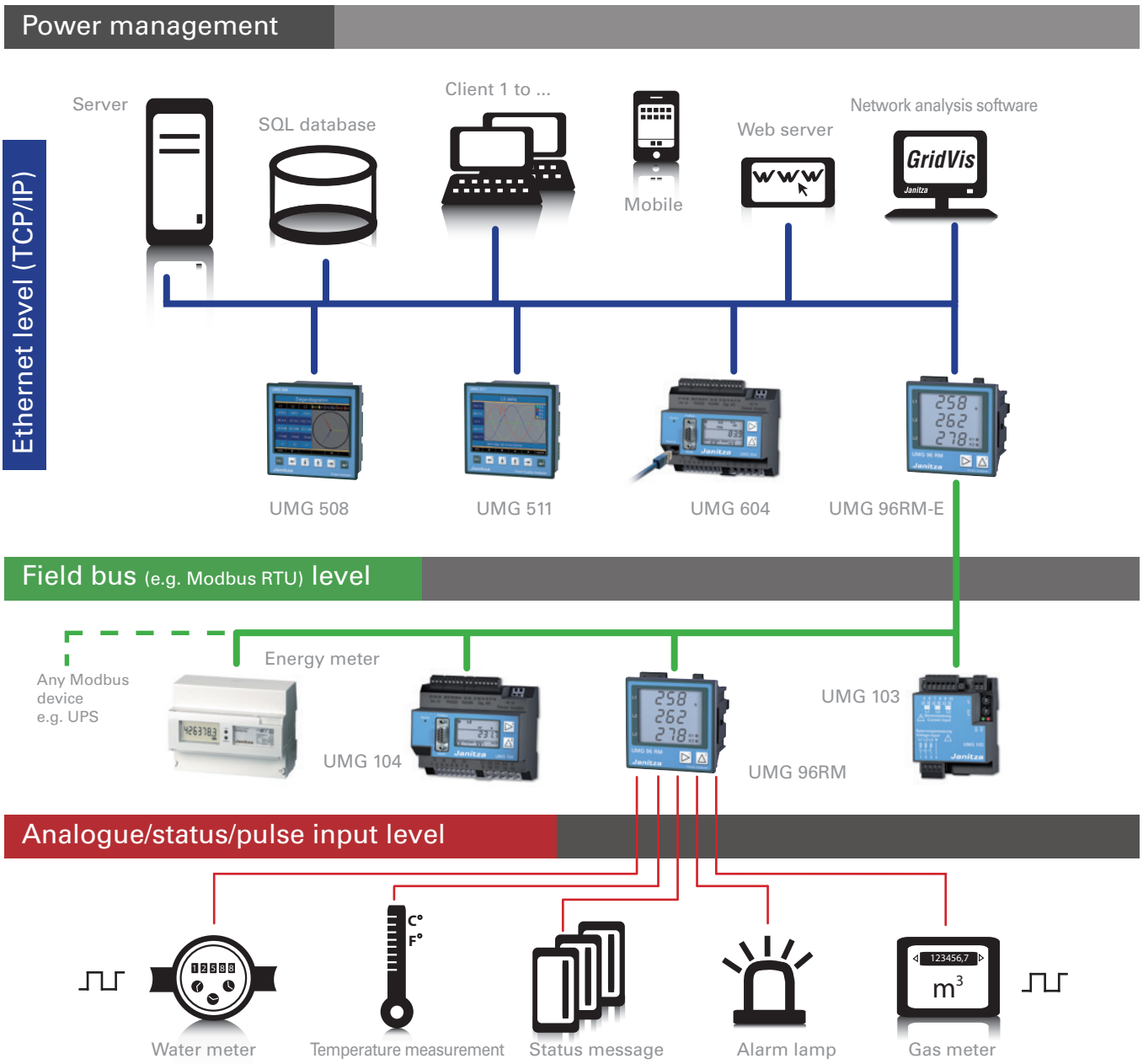
### Best-possible power quality and secure supply

UMG measurement devices provide indispensable information about sub-standard power quality and thus enable measures to be undertaken to resolve network problems. This results in the prevention of production downtimes, significantly longer service life for capital equipment and thus improved sustainability of the associated investment.



# Typical architecture of an EMS

Use of an automated energy measurement system with measurement devices placed over the various network levels (multi-level) is recommended. Ethernet (TCP/IP) is increasingly used as the backbone for data communication. Measurement devices with Ethernet/Modbus gateways and master/slave architectures ensure efficient systems with high transparency.

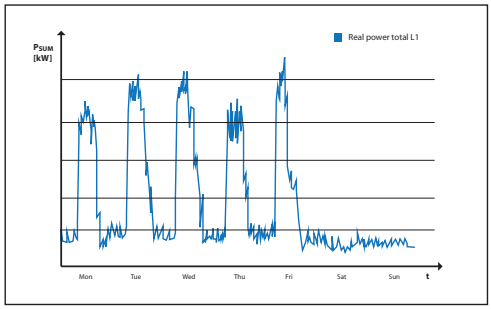



*UMG 508/UMG 604 = Janitza power analyser*
*UMG 511/UMG 605 = Janitza power quality analyser*
*UMG 103/UMG 96RM/UMG 104 = Janitza universal measurement devices*

# GridVis energy management software

GridVis Software included in the content of delivery of all UMG measurement devices is used for Energy Management Systems and Power Quality Solutions. GridVis provides historical values, e.g. load profiles, which allow a trend analysis as well as online measurement values for monitoring the actual load scenario and much more.

GridVis is a powerful tool for automatic collection of measurement data, for analyzing and visualizing the measurement results, e.g. the topology-view provides a quick overview of an actual online situation.
Automatically generated reports for most common Power Quality Standards as well as reports for energy consumption can be freely scheduled by the user.


| | January | February | March | April | December | Total |
|---|---|---|---|---|---|---|
| HKA Water Boiler Heating | 2480<br>12 kWh | 1240<br>6 kWh | 160<br>0,8 kWh | 380<br>1,9 kWh | 240<br>1,2 kWh | **4500** €<br>**21,9 kWh** |
| HKA Water Total | 737<br>3,7 m³ | 386<br>1,9 m³ | 790<br>3,9 m³ | 506<br>2,5 m³ | 454<br>2,3 m³ | **2873** €<br>**14,3 m³** |
| Hall 1 Final assembly | 166<br>831 kWh | 155<br>776 kWh | 183<br>920 kWh | 174<br>871 kWh | 171<br>856 kWh | **849** €<br>**4254 kWh** |
| Hall 2 Painting | 155<br>776 kWh | 171<br>856 kWh | 166<br>831 kWh | 195<br>980 kWh | 191<br>956 kWh | **878** €<br>**4399 kWh** |
| **Total** | **3538** € | **1952** € | **1299** € | **1255** € | **1056** € | **9100** € |

- System and UMG device configuration
- Measurement device management
- Topology view
- Automatic measurement data readout
- Report generator (costs and power quality)
- Graphic programming
- Alarm management
- Central database access for all clients
- Database management
- Display and evaluate real-time and historical data
- Unlimited number of measurement devices and clients
- **Included in the UMG measurement device scope of delivery**

(For >6 devices SQL DB driver license is required)

Smart Energy &
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