

Energy monitoring results in huge saving potentials for plastics processing companies



With soaring energy prices, the energy cost has become an important factor in the total cost of the final product. After raw materials and direct labor, energy generally is the third largest variable cost in plastics processing, representing on average 3 to 5% of the company's turnover.

Today it is no longer sufficient to optimize output, quality and production planning, also energy consumption is a very important factor in the operating cost of a plastics plant. A sudden increase in the energy consumption of a production run can push an order easily in the red figures. With ever rising energy prices and increasing environmental legislation, efficient energy management has become a very critical success factor to run a profitable business in today's global economy.

In order to help plastics processing companies with these new challenges, BMS-BarcoVision has extended its PlantMaster MES applications with an ENERGYMASTER module. Following the principle of Monitoring and Targeting (M&T), it maps the different energy consumptions (electricity, gas, compressed air, water, steam, effluent, CO₂ emission) for further analysis and optimization. The integration of these energy parameters with the other MES applications, such as scheduling, machine and process monitoring provides a perfect insight in the relation between energy consumption and production.

Which objectives are targeted with EnergyMaster?

By monitoring the energy consumption, the company gets answers on important questions such as:

- Which machines or departments are the largest energy users?
- What is causing our peak consumption?
- What about the power factor (cos phi) of our company?
- What about the energy consumption fluctuation of a machine or department over time?
- What is the energy consumption by production order and product?
- What is the remnant energy consumption when production is shut down (base load)?
- What abnormal consumptions occur and when?

Automatic alerts to managers on exceptional energy consumption via e-mail or text messages, allows for quick reaction and to realize immediate savings. The use of energy monitoring creates an "energy awareness culture" within the company for all employees. ENERGYMASTER is the perfect tool for a company to achieve its Energy Efficiency Plan goals.

Measuring energy consumption

In order to achieve energy management, consumption meters need to be installed. In some departments meters can be placed in the power switch panel to measure the consumption of a group of machines, but in case a detailed follow up is required, the individual machines should be equipped with meters.

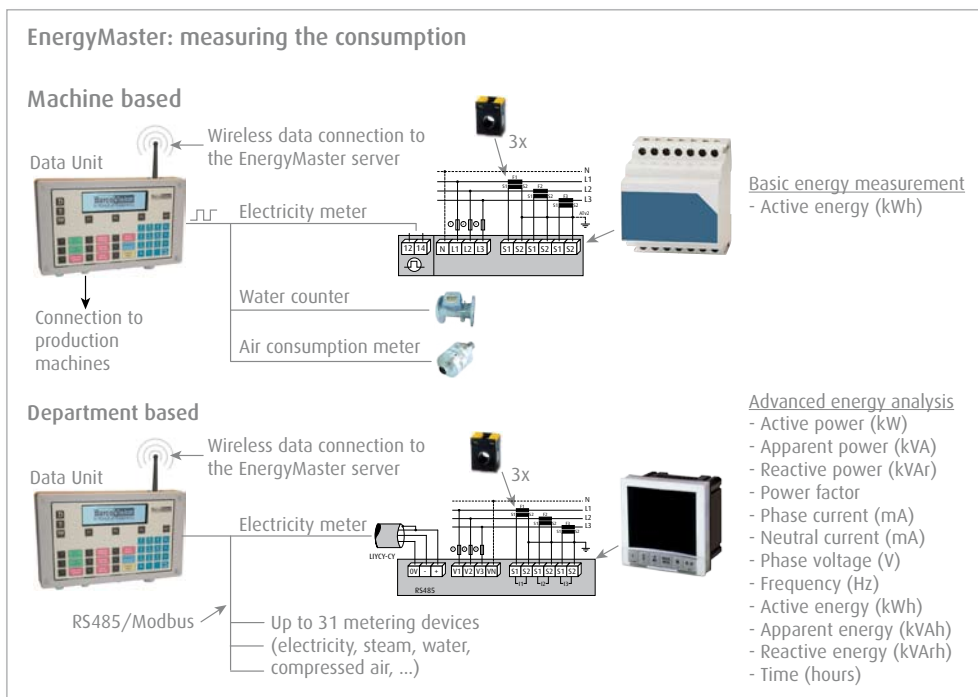
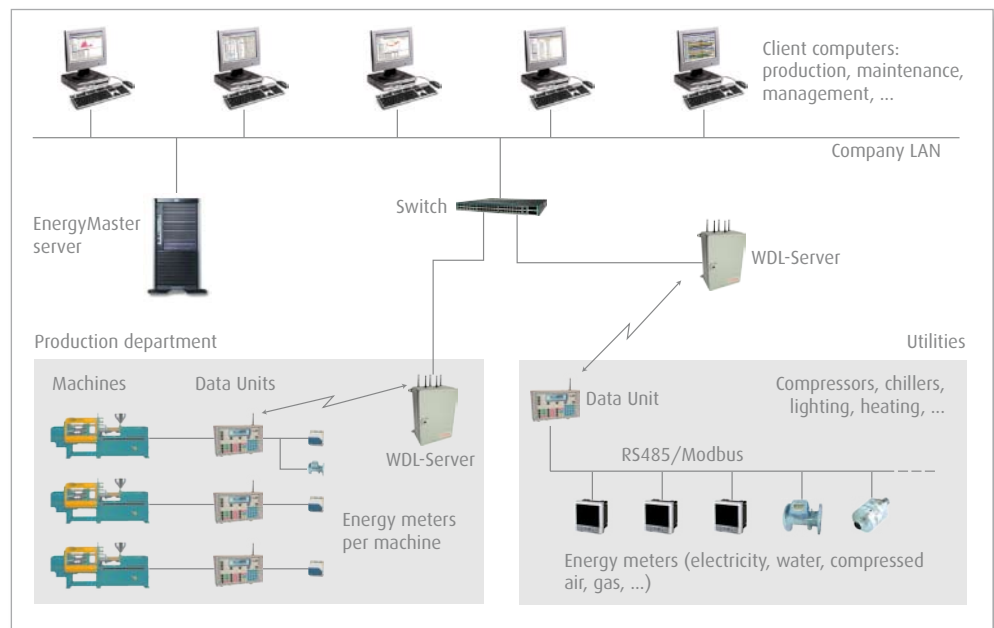
These simple meters allow measuring the active energy consumption. Such a meter typically consists of three coils, one per phase, connected to the electrical wires. The meter then converts the signals of the three coils into consumption pulses. These pulses are counted by the BarcoVision Data Units and passed on in real time to the MES system, exactly like stop times and production and quality data are transmitted.

In many cases, these Data Units are already present at the machine to detect and transmit production and quality data to the PlantMaster MES system. As such, energy data can be transmitted via the existing network (wired or wireless) to the PC server of the PlantMaster system.

As in plastics processing, the production machines consume between 60 and 75% of the total energy of the plant, it is strongly advised to equip each individual machine with an energy metering device.

Departmental meters are often installed to follow up on energy consumption of utilities, such as the compressor room, chillers, material drying equipment, ...

► Fig. 1: EnergyMaster concept



◀ Fig. 2: A Data Unit can be extended with an energy meter. The production and quality data of the machine are passed on together with the energy consumption data to the BarcoVision MES system.

Reporting

The ENERGYMASTER system includes a set of predefined reports, such as:

Counter reports

These are graphs which map the meter data. The consumption measured per meter is charted in a graphical way. With such a report the main meter of the plant or a department can be monitored (Fig. 3). These reports can be used to trace abnormal peak consumption, to eliminate abnormal consumption and for example to evaluate if reduced night or weekend shifts makes sense, considering the higher energy consumption per unit of production.

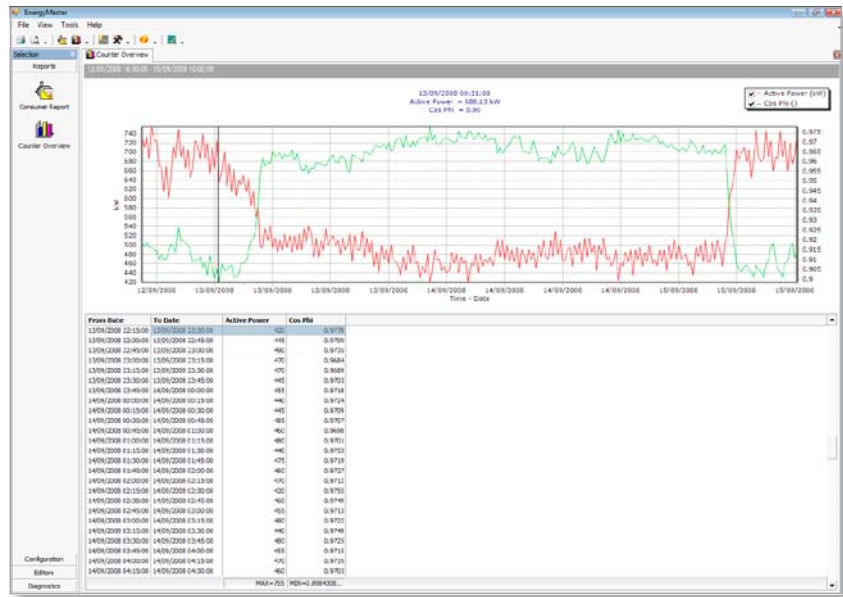
Consumer reports

Show the consumption of a specific energy or utility resource by department, work center or machine over a certain time period. These reports allow to quickly identify the "top consumers" for a selected energy resource

► Fig. 3: Counter report of the main meter of the plant. The electricity consumption (active power) and the according power factor (cos phi) are reported every 15 minute interval. During the weekend fewer machines are in production and as a result the active power decreases and the power factor improves. The graph shows that the power factor always remains above 0.9, which indicates an acceptable situation. This graph also allows to evaluate the functioning of the condenser battery for improvement of the power factor.

History reports

This set of reports shows the energy consumption for a specific machine, for a machine type, for a product, for a department or for the whole plant over a longer time period. These reports allow evaluating the energy component in the overall production cost of each product. Does the energy consumption remain constant when a certain product is produced or is there large fluctuations, which require further analysis?



Energy monitoring standards

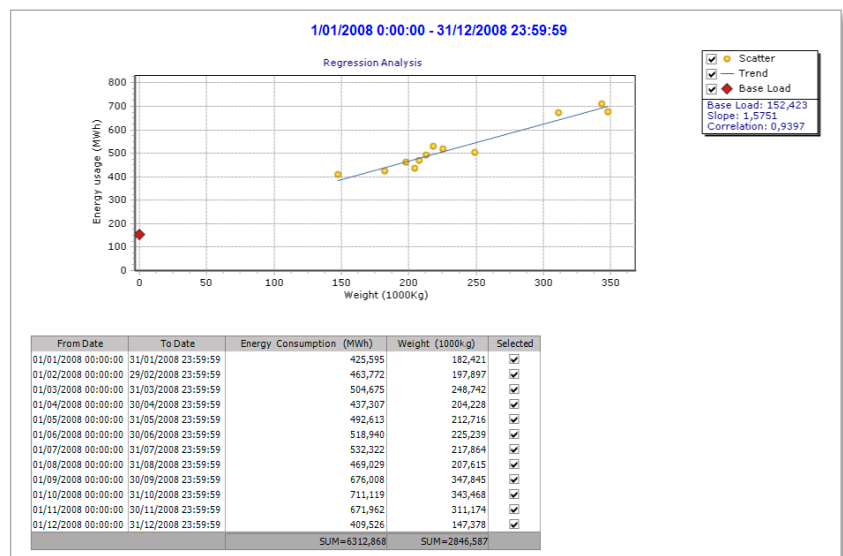
The reporting for energy consumption is well documented by the industry in many countries. For example in the UK, companies receive government subsidies if the installed energy monitoring software package includes a well defined

set of reports. The BarcoVision ENERGYMASTER reporting package includes these industry standard reports, such as the PCL, SEC and CUSUM charts.

Performance Characteristic Line (PCL)

The PCL is the result of a regression analysis between energy consumption and production output, as registered by the monitoring system. In plastics processing, the PCL is commonly expressed as kWh per kg of processed material. The PCL can be plotted for a machine, machine group or a complete department or plant and for energy resource monitored by the system. Based on this regression analysis, the base load is calculated, which is the energy consumption when there is no production at all. The slope of the line indicates the amount of energy needed to produce one unit of product. The PCL can also be used for targeting future energy consumptions based on production budgets.

▼ Fig. 4: Performance Characteristic Line (PCL) for an injection molding plant, showing a base load of 152 MWh/month and a process load of 1.5 kW per kg of processed material. Extrusion lines for example, will have a process load which is less than half of that in injection molding.

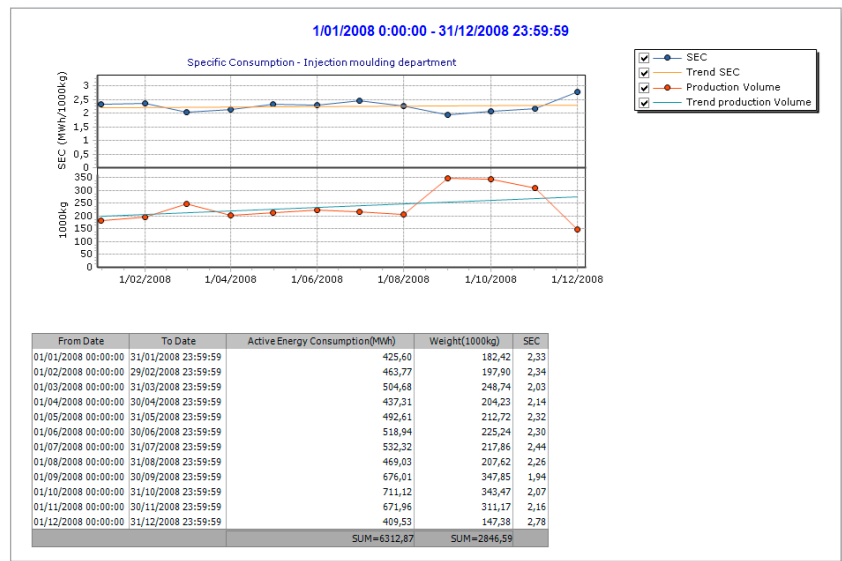


Specific Energy Consumption (SEC)

A next graph of importance is the SEC, which stands for Specific Energy Consumption in terms of kWh per unit of production. A typical graph is the monthly evolution of the SEC, which

allows to define whether the plant is gaining or losing energy efficiency.

► Fig. 5: Evolution of the Specific Energy Consumption (SEC) in combination with the production output. Decreasing SEC does not necessarily mean that the plant is operating more energy efficient; it can also be the result of a higher production volume, resulting the base load to be divided over a higher output volume.

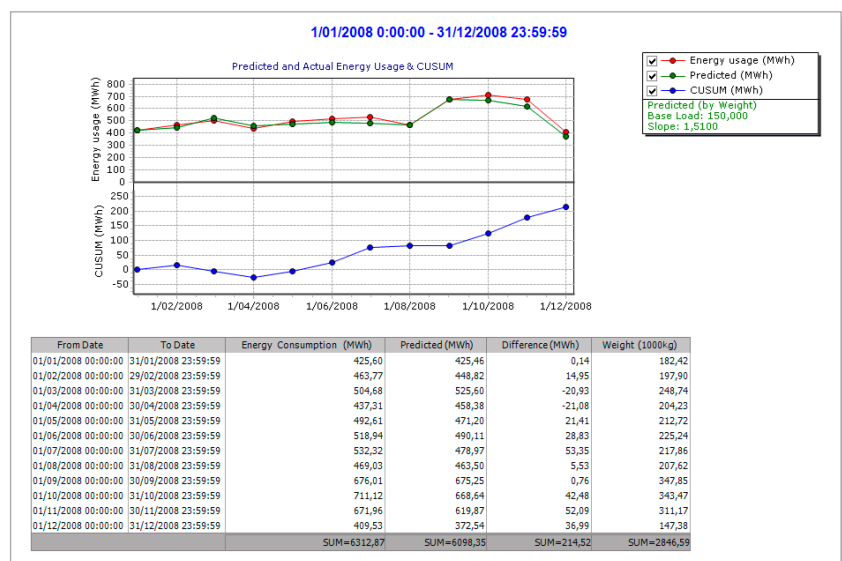


CUSUM (Cumulative Sum of deviations)

A special type report is the CUSUM trend. This report allows comparing the real consumption versus budget. The gradient line in the trend graph allows immediate detection of a rising

or decreasing trend in energy consumption. Such reports really help promote the energy awareness culture.

► Fig. 6: Cumulative Sum chart (CUSUM) with actual and target consumption. In case actual consumption is in line with target, the cumulative deviations should be scattered around zero. Deviations from target result in rising (actual consumption than target) or falling (actual consumption lower than target) CUSUM charts.



Conclusion

With the addition of the ENERGYMASTER module, the BarcoVision PlantMaster systems are extended with the monitoring of an important cost factor. By taking advantage of the already present data collection network, data base and server configuration, the investment cost can be kept to the minimum while the monthly energy bill savings can be substantial by using the ENERGYMASTER module.

By defining an Energy Efficiency plan with clear objectives, significant energy savings can be realized. ENERGYMASTER is the right software package to provide analysis and decision support for quick energy saving actions.