



Instant Guide to managing energy in steam boiler and burner applications



ABB Instrumentation



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The era of cheap fuel is over. Improved energy efficiency is the best way to mitigate rising prices, but it can be difficult to know where to start. ABB offers advice on the best ways to optimise the efficiency of your steam boilers and burners.

The Carbon Trust stresses that companies need to use a range of monitoring and targeting techniques to identify and implement energy saving measures. The Trust estimates that basic housekeeping enables many no- and low-cost savings, which can add up to 5% or more of an industrial energy bill, while more formal energy management schemes can achieve savings of 20 to 30% or more, depending on which industrial sector a company operates in.



A site survey from a reputable manufacturer such as ABB is a recommended first step to manage energy use. It is a good way to identify wasteful processes that are easily rectified and offers advice and selection of products tailored for the particular application. [Service and maintenance packages](#) are also available to ensure the process is running at optimum efficiency.

However sophisticated a company's planned energy management strategy might be, it starts with one essential realisation, you can't manage what you can't measure. For example, steam provides a popular and efficient form of heating throughout industry, as well as in building services, but how can operators be certain that their steam systems are working as efficiently as possible?

Combustion efficiency

Efforts must start in the boiler itself, where operators need to aim for the best possible combustion efficiency.

Most waste heat is lost in the stack gases leaving the furnace. Creating conditions that generate the smallest quantity of flue gas at the lowest possible temperature will boost efficiency. This is because channeling extra air through the process simply carries more heat away in the flue gas. Obviously, hotter flue gas also 'steals' more energy than cooler gas, so that a 22°C drop in stack temperature can often boost boiler efficiency by 1%.

On the other hand, supplying insufficient air will result in incomplete combustion of the fuel. This leads to fouling of heat transfer surfaces and emissions of soot, smoke and carbon monoxide. So getting the air supply right is a fine balancing act. The optimum combustion process provides just enough excess air to completely burn the fuel. The right level of excess air depends on the fuel, but it ranges from between 5-10% for gas and 10-15% for fuel oil, all the way to 20-30% for stoked coal. Using instruments such as an [ABB zirconia oxygen system](#) and a [temperature probe](#) in the flue stack

(see diagram) can ensure the plant is burning fuel optimally. Furthermore, if the oxygen level rises in the stack-gas over time, it can also indicate the need for minor adjustments or repairs, while a rising stack-gas temperature can indicate the need for tube cleaning, since fouling may be hampering heat transfer.

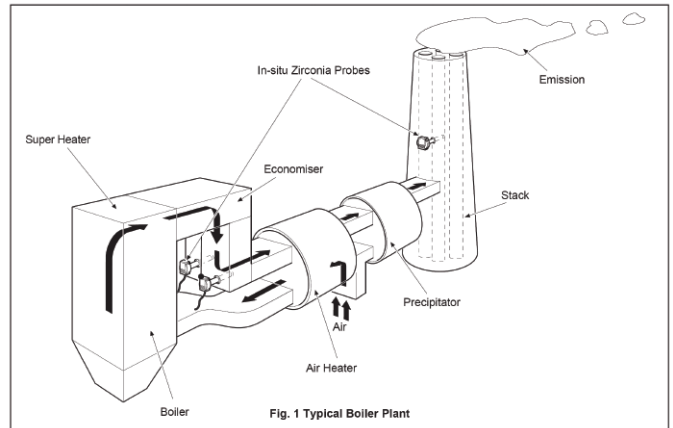


Fig. 1 Typical Boiler Plant

Animation

Rapid heat transfer

Heat transfer surfaces must be clean in order to conduct heat efficiently, but fouling can also be a problem on the 'wet' side of the boiler. Water quality is the key here, since any solid contaminants can cause a build up of scale, which effectively act as unwanted insulation.

The two main sources of contamination are the feed make-up water and the returning condensate. Condensate returns to the boiler from the condenser, having been cooled using locally sourced, lower quality water. Condensers are notoriously prone to leaks however, so cross contamination is common. Feed water on the other hand, is normally de-ionised, pre-heated, deaerated and chemically treated before it makes it to the boiler. A failure in any one of these processes can lead to contamination problems.

Regular boiler blowdown is the obvious way to control contamination, although dosing the feed with chemicals such as ammonia or hydrazine also stops some chemicals getting that far. Careful, continuous monitoring also plays a vital role in ensuring good long-term boiler chemistry. So what should you look for?

Typical parameters include: [conductivity](#), [pH](#), [dissolved oxygen](#), [sodium](#), [silica](#), [hydrazine](#), [phosphate](#), [ammonia](#) and [chloride](#).



ABB's new [Navigator 600 silica analyser](#)

Tracking consumption

Steam metering throughout the entire distribution system is crucial for good energy management. Proper metering allows operators to see exactly what's going on. For example, meters can track the consumption of individual user processes across a site. This enables energy managers to encourage efficiency by introducing separate billing, or target energy saving measures where they will have the most effect. Trend information also enables operators to spot malfunctioning equipment or other problems as they develop.



Offering high accuracy and low maintenance, ABB's [swirl meters](#) are ideal for steam metering applications

Accurate metering is the key. Operators need to know the mass of steam moving around the plant, since this equates to the energy flow. Traditional differential pressure meters such as orifice plates require peripheral paraphernalia including differential pressure transmitters and a flow computer to produce mass readings for steam, all of which adds up to a high-maintenance headache.

In contrast, [swirl meters](#) have lower maintenance requirements and deliver greater accuracy - especially in applications where the steam flow varies over a significant range. Rather than an accuracy of two percent of the upper flow range, which is the best an orifice plate can provide, swirl meters offer better than one percent accuracy over the entire flow range. Furthermore, the turndown is up to five times greater than that of an orifice plate. Swirl meters rely on static veins at the entrance to the meter to force the fluid into rotation. The meter then measures the frequency of a helical secondary rotation that automatically develops within this pattern.

The frequency of the secondary rotation is directly proportional to the volumetric flowrate of the fluid, without any need to compensate for changes in pressure, temperature or density. The meters only need to know the temperature of the steam to calculate the mass flow.

Where companies are looking to retrofit meters on existing steam systems, swirl meters offer the added advantage of being able to fit almost anywhere. Most flow meters need to receive undisturbed flow to deliver accurate results. So they need to be positioned a good distance downstream from pipe bends, valves or other components that might interfere with the

readings. Instead of requiring straight inlet and outlet runs of 15 pipe diameters and 5 pipe diameters respectively, which is typical of vortex meters, swirl meters need just three and two diameters in most applications.

With rising fuel costs and changing environmental legislation, the pressure to optimise the operation of combustion plant can only increase. The right monitoring schemes can improve combustion efficiency, reduce pollution, extend the life of equipment and reduce the frequency of unplanned stoppages. In short, UK companies need to embrace energy monitoring and targeting schemes if they hope to remain competitive.

The Glenfiddich Distillery® controls energy use with ABB's swirl meters

Accurate flow data delivered by eleven ABB swirl meters is enabling whisky distiller William Grant to identify areas for potential energy savings at its Glenfiddich distillery in Dufftown Scotland. William Grant uses steam in its distillation process to heat the fermented liquid to boiling point.

Measuring mass flow rather than volume, the meters are accurate to within +/-0.5% of reading, with a turndown up to ten times greater than that of an orifice plate.

With the installation of the meters, energy consumption can now be pinpointed to exact departments and processes, enabling William Grant to achieve its aim of cutting energy waste, limiting environmental impact and cutting costs. Information from the meters can be used to find and address problems such as poor lagging or steam leaks leading to steam wastage.

[Tell me more](#)



Measure, Optimise, Prove and Save

Instrumentation can form a vital front line in the drive to become more energy efficient. When used to its full potential, an instrument can provide you with a full indication of what's happening within your process, enabling you to make more informed decisions about potential improvements.

The following are some tips for deploying instruments to help you get the best levels of efficiency from your boiler:

Measure:

- Make sure you are only generating what you need. Measure the demand and compare it with what the boiler is generating. This will ensure you're not wasting steam heating up your factory instead of your process, for example
- If you measure steam or gas, measure the mass flow, not the volume flow. It takes ten times the energy to create 1m³ of steam at 10 bar than at 1 bar, yet the volume is the same

Optimise:

- Optimise the combustion process by monitoring the [flue gases](#). Only careful monitoring allows operators to strike a balance between supplying too much air, which carries heat away up the flue, and insufficient air, resulting in incomplete combustion
- Make sure that boiler duty is at optimum efficiency. For example, don't use two boilers at 30% output if you can run one at 60 - 70% output
- Check your instrumentation is up to scratch. Modern instruments are typically more robust and more accurate. They are also easier to [maintain](#), and are less prone to problems such as drift

Prove:

The ability to readily access energy consumption data for a given period or piece of equipment is a key first step in helping to create an effective energy management strategy.

[Videographic data recorders](#) offer an ideal tool for collecting and retrieving data as part of an energy management programme. Benefits include: immediacy of data, with operators able to quickly gain access to years of data; the ability to tie in associated data such as the date and time that an event occurred with specific information on that actual event; ease of use, with ABB's recorders using a simple Windows™ interface and simple scrolling menus; and lower cost of ownership.

Data recorders from ABB Limited are helping a major food producer to identify areas for potential energy savings at one of its [UK sites](#). Following a site survey by ABB, flow meters and data recorders were installed as part of a site energy monitoring and targeting programme.

The company uses steam at around 6 bar and 120 °C to heat hydrostatic cookers, retorts and jacketed pans used in food



production. Previously, the company used a series of primary flow meters to measure the site's steam, gas and water consumption. However, it was not possible to easily use the measurement data to pinpoint the amount of energy being consumed by specific parts of the plant.

The information from flow meters is fed into [ABB's SM3000 videographic data recorders](#), enabling the operator to monitor steam consumption for specific lines, which allows waste to be easily spotted and provides better matching of energy consumption against the steam flow rate.

The recorders allow precise variations in process data to be recorded and displayed as required. They also offer a range of possibilities for presentation, including the ability to stipulate data for specific time periods and create and print graphs and reports. Events can be automatically recorded together with the actual time they occurred, unlike paper chart recorders, which rely on additional details being manually added to the chart by the operator.

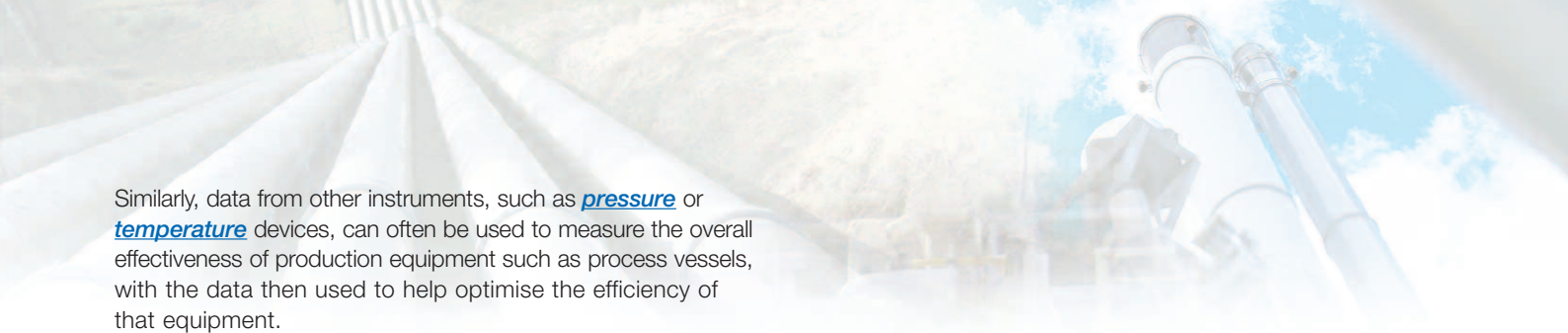
A key requirement set by the customer was the ability to feed the information from the SM3000 recorders into its energy management and targeting software system. To accommodate this, ABB created a driver program to export consumption data and enable the customer to use the data from the instruments as it wished. Now the instruments used throughout the plant are connected via an Ethernet system from the SM3000 recorders, which then relays the real-time data and trend information to the customer's system.

Since installing ABB's instruments, the customer has already been able to identify ways to better control the steam flow to the cookers. They also saw that general steam demand was higher than expected and are taking steps to reduce this demand and improve efficiency.

Save:

Instrumentation, by itself, will not directly save you energy. What it will do, however, is help you to identify the areas where measures can be taken that will help you to optimise your energy consumption.

For example, data from a flow meter on a steam or process line can often be used as a preliminary measure when assessing whether to use a [variable speed drive](#), which are proven to drastically [reduce energy consumption](#).



Similarly, data from other instruments, such as [pressure](#) or [temperature](#) devices, can often be used to measure the overall effectiveness of production equipment such as process vessels, with the data then used to help optimise the efficiency of that equipment.

What ABB can offer

For more information on how ABB's instrumentation equipment can be used to help you better manage your energy consumption, call 0870 600 6122 or email moreinstrumentation@gb.abb.com ref. 'Energy management'.

Recommended reading:

Technical articles:

['A measured approach to energy management'](#)

['Putting the squeeze on compressed air costs'](#)

['The benefits of using zirconia oxygen probes to monitor flue gas'](#)

['A new era in data recording'](#)

['Saving energy with pumps and fans'](#)

Online tools:

[Energy saving calculator \(for Variable Speed Drives\)](#)

[Carbon Footprinting - getting the measure of your organisation's emissions](#)

Wallcharts:

['Swirl and Vortex flow meter selection wallchart'](#)

['The ABB application guide to thermal mass flow measurement'](#)



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