Energy Efficiency and the Impact of EU Legislation

The European IED (Industrial Emissions Directive) was published in January 2011. This replaces the former IPPC (Integrated Pollution Prevention Control) Directive.

Directive 2010/75/EU, concerning Industrial Emissions (IED), merges the existing Directive 2008/1/EC of the European Parliament concerning IPPC, with six industrial-sector specific directives, into a single Directive for the clarification and simplification of existing provisions.

The Directive establishes a general framework for the control of principal industrial activities with a view to controlling emissions arising from industrial installations into air, water and soil. A key element of the Directive rules that installations should operate only if they hold a permit or, in certain cases, if they are registered. IED follows the concept of **Best Available Techniques** (or **BAT**).

Completing the link between Energy Efficiency and Carbon Emissions saw the announcement on 22nd June 2011 of the proposed EU directive on Energy Efficiency. This will now go into a consultation period. However, its proposals are wide ranging from the power generation and distribution industry through retail customers, energy efficient buildings to industrial energy consumers. The drive behind this Directive is that, on current performance, the EU is unlikely to reach its previously announced 20-20-20 targets (a reduction in EU greenhouse gas emissions of at least 20% below 1990 levels, 20% of EU energy consumption to come from renewable resources and a 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency, all by 2020).

Clearly while many BATs will be sector specific, the common strand throughout will be the adoption of a Systematic Approach to Energy Management. This is a universal concept and likely to be the back-bone of any permit to operate. The proposed Energy Efficiency Directive specifically mentions the adoption of Energy Management Systems for SMEs and regular Energy Auditing of large Industrial Complexes. This paper looks at the implications and requirements and in particular how modern measurement and control technology play a key role in being able to achieve the aspirations of the BATs.

What the Directives Mean to the Site Operator
Individual EU Member States will develop their own permit and license to operate systems within the aims of the Directives. However, given the diversity of industrial sectors and the prominence given in the BATs, Energy Management Systems will become the framework under the license to operate. In an analogous way to Quality Management, they provide an auditable structure for both compliance and improvement, defining what is the appropriate process for managing “energy” for the site/ installation in question.

The drivers behind Energy Performance are many and varied – in most cases there is no single issue or cause which can be tackled in isolation. Thus the topic is ideally suited to a systems management approach which drives a culture of management responsibility, process measurement, problem identification, corrective action and improvement. This can be seen in the International and European standards for Energy Management, (BS) ISO 50001.

Thus high quality process measurement, data management, control and reporting form the foundation for any successful Systematic Energy Management. Many aspects will be cross-discipline – maintenance (asset management) as well as operational (process control and optimisation). Energy Efficiency is affected by phenomena on many time frames – long term equipment efficiency as well as real-time minute-by-minute plant performance. Thus the growth of modern plant systems, with integrated cross-site and multi-level databases, provides the ideal foundation for the development of solutions to such a multi-level problem.

The Key BAT

The important BAT is the EU reference document ENE. Its purpose "is to provide general indications about energy efficiency techniques that can be considered as the appropriate reference point to assist the determination of a BAT-based permit...."

The document, some 400 pages long, is a comprehensive resume of Good Practice, covering steam systems, electricity, combustions, compressed air, HVAC and many other important areas of common operation.

However, right from the start, the Executive Summary stresses the importance of a formal systematic management approach to energy efficiency and its applicability to all types of installation. In its summary it specifically mentions:

- Benchmarking.
- Checking performance and taking corrective action, paying particular attention to monitoring and measurement.
- Appropriate use of energy models, databases and balances.
- Establishing and reviewing energy efficiency objectives and indicators.

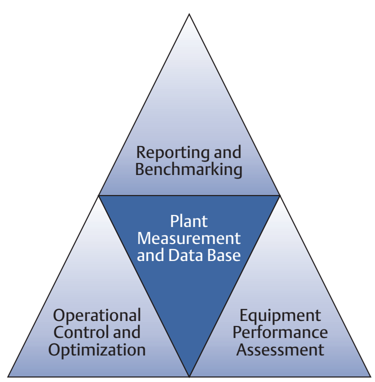
Thus there is a clear steer that measurement, monitoring and control have a key role to play in achieving BAT for Energy Efficiency. Accurate energy data and performance metrics, on a variety of timescales, provide the foundation for any improvement system.

The Integrated Measurement and Control Approach

By looking in more detail, the different roles that measurement and control play in effective energy management can be seen.

Plant Measurement and Data Base

The cornerstone of all the activities is a reliable and accurate plant measurement system, feeding a modern database with seamless connectivity to broader business and engineering systems. Timely energy-related decisions need accurate plant measurements enhanced by density, pressure and temperature compensations when necessary (e.g. for critical steam flows). Traditional design standards



have not served energy monitoring well and adequate measurement point coverage on older units and also packaged units may be inadequate. However, modern wireless technology allows easy addition of new measurement points. Ideally, data base techniques such as plant-wide data reconciliation can improve the quality of the basic data.

Operational Control and Optimization

Inevitably plant energy performance tends to be a trade-off between the push for higher yields/margin and achieving desirable energy benchmarks. Thus it is a classic multi-constraint problem. Plant stability is key if the fine balance between these often competing priorities is to be achieved. Consequently modern control techniques such as multivariable model-based control, feed-forward and constraint pushing all play an important role in providing the stable plant platform.

Density and stoichiometric control of furnaces and boilers, improved anti-surge control of compressors, pressure minimization of distillation columns, furnace coil balancing, recycle minimization and heat recovery maximization by constraint pushing are all typical of the control techniques that should be standard for a modern energy-efficient plant.

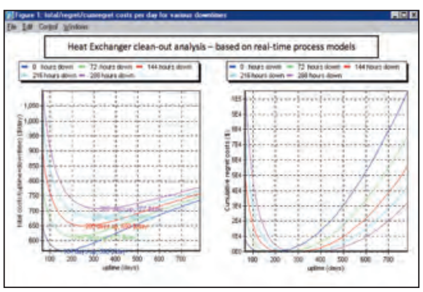
On top of the basic stabilization, there are ample benefits to be gained by model-based process optimization. Energy vectors need full credit and careful representation in process optimizers. Utility optimizers play an important role in drive selection (steam vs electricity) and the continual rebalancing of steam networks to ensure the best use of the most efficient generating equipment and minimizing unnecessary letdowns.

Equipment Performance Assessment

Equipment condition is a major factor in a sites energy performance – in particular the effects of fouling and degraded heat transfer. Fouling of heat exchangers, reduced turbine efficiencies, pump performance, flue gas recovery networks and other similar applications all require careful monitoring of their performance with a view to the optimal time to clean, taking out of service or other regular tasks (such as sootblowing of furnace ducts).

In the past, this was often done by a standard rotation approach (e.g. “clean every 30 days”) whereas a more modern approach is condition-based where the decision is based on the actual process measurements (and their performance over time) plus economic factors such as cost of downtime, cost of cleaning etc. Thus classical maintenance planning techniques can be brought into an almost real-time environment.

The availability of (historical) process data via PC links to maintenance staff brings vital information onto the desks of staff, who traditionally did not have easy access to control room measurements. Furthermore, the ability to seamlessly integrate historical process data with equipment data from the maintenance management system (e.g. SAP) allows even more intelligent applications, integrating maintenance records and current performance.



Reporting, Visualization and Benchmarking
Modern reporting and visualization techniques play an important role in enabling the systems needed to achieve BAT. Both from the perspective of managing the plethora of information into digestible forms, and also in providing improved insight – particularly important when analyzing causes and trends in energy performance against a wide range of (sometimes) conflicting drivers.

Historically, the energy report was a piece of paper that arrived on the Site Managers desk at the end of each month. It contained perhaps some simple metric – e.g. energy/feed and some rudimentary explanation for the previous month’s performance against a historical benchmark. A process of “explain away the difference” would be undertaken and that was it.

As has been discussed, energy performance is driven by many factors and, in analyzing performance data, it is important to be able to identify and distinguish “legitimate” drivers (e.g. production plan effects) from “poor performance”. Thus planning, scheduling and maintenance data is needed to separate out the different causes and isolate poor performance from a simple headline figure. Visualization techniques such as waterfall diagrams can be useful in preparing such reports.

The other key issue is presenting performance reports with data that is appropriate for the party handling it and their ability to utilize it. Thus the granularity and issues that may be presented in a daily performance report to the plant shift leader is very different to the monthly report to the Site Manager. The reports have to be consistent with the span of control of the intended recipient.

Fortunately drill-down and dashboarding techniques allow a single performance database (based on the Process Historian) to generate consistent reports which satisfy these requirements.

Conclusion
Energy Efficiency initiatives have been around for many years with varying degrees of success. They often fall between other more immediate operational demands. Sustainability is an issue. However in a climate of rising energy costs and increased environmental pressures, the EU is using energy efficiency as a key driver in the pursuit of lower carbon emissions – it is tangible and has clear benefits in reduced operating costs for the end user. Depending on the starting point, energy savings of 5-10% are achievable.

Achieving these goals in a sustainable manner against a dynamic operational background is clearly a management and control issue – therefore reliable and accurate measurement and control systems have a major role to play in meeting these requirements. Modern instrumentation is a vital enabling technology in realizing energy efficiency operation.

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