White Paper

Process Energy Efficiency:

Measure, monitor – then improve

EMERSON
Process Management

Process Energy Efficiency: Measure, monitor—then improve

An effective approach to energy efficiency relies on a continuous stream of measurement information to verify that energy is being produced, transported, and consumed as efficiently as possible.

Amidst growing global concerns around energy and the environment, industrial plants are feeling the pressure to take a closer look at their operations. Nearly one-third of all energy consumed in the United States is consumed by industrial facilities. An astonishing one-ninth of the nation's total energy use is attributable to steam systems alone.[(1)]

Despite frequent "ups and downs," energy costs consistently remain one of the biggest items in the operating budget of a typical industrial plant. According to the U.S. Department of Energy, approximately 30 percent of an operating budget is typically spent on energy.[(1)] Even when energy costs are relatively low, an average mid-size plant can face a $10 million energy bill annually.

Yet pinpointing where energy is being consumed, and where it could be saved, remains a challenge for many plant managers. Energy use within industrial facilities is extremely complex. There are thousands of manufacturing processes in operation, and no two are exactly the same, even within the same organization. Subsequently, each plant will have a unique path to improved efficiency.

The good news? It doesn't take a major plant overhaul to see measurable results: For example, research shows companies can often reduce the overall energy costs of running a typical industrial steam system by 10-15 percent through simple operational improvements.[(1)]

"It's only one little steam leak..."

The cost of seemingly small process inefficiencies increases exponentially. In just one hour, a blowing steam trap at 300 pounds per square inch (psi) with an orifice diameter of 3/16 inch will waste 267 pounds of steam. Using an average cost of steam at $10 per 1,000 pounds, one blowing steam trap will waste $64 per day—which adds up to $23,426 per year in avoidable energy cost. And that's just one trap: About 20 percent of steam traps fail in a typical year.

1. *U.S. Department of Energy, Energy Efficiency, and Renewable Energy. (January 2006) Best Practices: Steam, Save Energy Now in Your Steam Systems. DOE/GO-102006-2275. Retrieved from http://www1.eere.energy.gov/manufacturing.*

Process energy efficiency—what is it?

In manufacturing, energy efficiency is defined as the effectiveness with which energy resources are converted into usable work, meaning the end product or a product ingredient. Inefficiencies, anywhere energy is lost before it is converted to usable work, result from hundreds of big and small problems throughout the process.

Some problems, such as major steam system leaks, are fairly easy to recognize during occasional inspections. More often, conditions that are wasting energy are extremely difficult to detect in a timely manner without some sort of measurement providing constant insight into what's happening inside the process.

For example:

- Fouling or corrosion within heat exchangers increases the energy input that's required to produce the desired amount of process heating.
- Poor combustion control, especially when fuel heat content changes, wastes energy by causing excessive stack losses.
- Leaking compressed air systems waste the electricity that was consumed to create the compressed air. Losses in air pressure further drive up energy waste.
- Steam trap failures cause energy loss, reduced heating efficiency, and increased risk of water hammer events.

These are just a few of the conditions that can be detected almost immediately when the right devices—measuring temperature, pressure, flow, and other key quantities—are installed in the appropriate places. And while an individual problem or isolated incident may seem insignificant, the cumulative effect of all process inefficiencies can be surprising.

Research shows that within any plant, about 32 percent of the energy that's being input is lost before reaching its intended purpose.[1] One hundred percent "perfect" process efficiency is impossible, of course. But studies indicate that a significant amount of energy is being wasted unnecessarily.

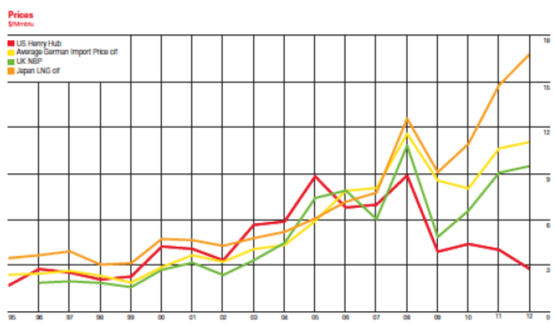
1. *U.S. Department of Energy, Energy Efficiency, and Renewable Energy. (January 2006) Best Practices: Steam, Save Energy Now in Your Steam Systems. DOE/GO-102006-2275. Retrieved from http://www1.eere.energy.gov/manufacturing.*

Managing what's manageable

Unpredictability is often the only constant when it comes to energy management. Costs fluctuate widely. Consumption varies within processes. The challenges are even bigger for global companies: Energy resource availability and prices vary significantly from one business region to the next. No wonder it can seem virtually impossible to operate within a set energy budget.

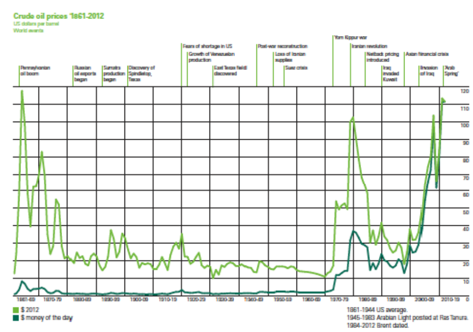
Regional variation

Global price history for natural gas



Price volatility

History of crude oil prices in the U.S.



Source: BP Statistical Review of World Energy 2013 (June 2013)

The fact is, energy should not be viewed as a fixed overhead cost. Treating it as an inflexible budgetary line item incurs financial risk. However, plants can gain greater control over energy spending by implementing an ongoing and proactive energy management program.

The key word is "ongoing." Any effective energy initiative must be sustainable and focused on continuous improvement, with strong leadership support and dedicated staff and resources.

Methodology should address the three major barriers to improvement:

- Lack of visibility into energy use
- Excessive variability in energy consumption
- No plans or provisions to maintain the program's viability (sustainability)

Measure energy to manage energy

As the saying goes, "You can't manage what you don't measure." In order to make smart decisions on how to optimize and improve a plant's energy use, energy and plant managers need to know (by measuring) how much, and where, energy is being consumed on an ongoing basis.

It is critical to have enough measurement devices strategically located throughout the process, to detect anomalies wherever energy is being produced, transported or consumed. Temperature, pressure, and flow measurements provide immediate insight into sub-optimal process conditions that can inform maintenance and repair activities, and drive down energy use.

Measurement also provides data for energy benchmarking and other efficiency comparisons, such as how the efficiency of key energy-using equipment compares to the "boilerplate" or other performance standards. Measurement helps identify whether efficiency is trending toward improvement or away from efficiency targets.

And energy balancing—matching total energy production precisely against areas of consumption—requires granular data from measurement devices strategically located throughout a specific utility system.

Any effective energy management approach requires an accurate, ongoing stream of data from all plant utilities (fuel, air, water, and steam) feeding into an energy management information system (EMIS).

Information: the power to change

An EMIS provides a systemized approach for data storage, reporting, and running the calculations that are foundational for energy consumption analysis and informed decision-making.

An EMIS can take a variety of shapes and forms. Some companies' EMIS solutions consist of making physical "clipboard" rounds to collect data and then manually entering it into spreadsheets. An EMIS software solution, on the other hand, automates data capture and analysis, providing greater insight into energy use and improvement opportunities in a fraction of the time.

EMIS software solutions automate data collection and analytics. They typically provide energy use visibility in real-time as well as historical trending.

Key EMIS capabilities include:

- Visualization of energy consumption
- Interpretation of energy data
- Advanced modeling of key process units
- Notification/alerting of developing inefficiencies
- Information for decision support
- Integration with existing historian software applications
- Target-setting based on expected optimal energy use

For an EMIS to be truly effective, the placement of measurement technologies needs to be expanded into all process areas. New technologies, including wireless solutions, make it easier and more affordable to install and integrate new measurement devices into existing processes with little or no disruption to plant operations.

Additional benefit: improved reliability

Once an EMIS is in place, many plants gain an unexpected bonus benefit: fewer equipment breakdowns. That's because excessive energy consumption is often symptomatic of equipment that is running sub-optimally, or about to fail. By installing additional measurement points for energy optimization, the plant subsequently increases the amount of information that's available about the overall health of the manufacturing equipment. Plant and energy managers learn to recognize the performance clues that are embedded in the data, and proactively resolve emerging problems.

Best practices for steam header control are a good illustration of this phenomenon. When steps are taken to resolve cascading steam header issues that are drawing excess energy, the steam system ultimately runs more reliably, with fewer trips and reduced downtime.

Facing environmental challenges

Environmental regulations are increasing the pressure for process industries to implement energy efficiency best practices. The rules vary around the world. Yet, anywhere that process plants are facing environmental regulations, compliance almost universally requires the measurement and documentation of energy use and emissions.

In the United States, legislation varies from state to state. California has initiated energy efficiency standards with requirements that are dictated by state law. The Global Warming Solutions Act of 2006, or Assembly Bill (AB) 32, established a program to reduce greenhouse gas emissions from all sources down to 1990 levels by the year 2020. The law includes emission caps for major emissions producers.

EPA Greenhouse Gas Reporting Program (GHGRP)

Facilities that emit 25,000 metric tons or more per year of GHGs are required to submit annual reports to the EPA. The purpose of this rule, referred to as 40 CFR Part 98, is to collect timely and accurate data to inform future policy decisions.

At the national level, the U.S. Environmental Protection Agency (EPA) in 2009 initiated the Greenhouse Gas Reporting Program, establishing rules for the mandatory reporting of emissions from major sources. It continues to enforce the new and more-stringent national environmental legislation.

In the European Union, process plants must seek compliance with local regulations as legislated by the EU Energy Efficiency Directive 2011/172 (“The EED”). This initiative has encouraged the adoption of best-practice energy management methodologies by setting specific energy and environmental requirements that are to be met by the year 2020:

- Reduce greenhouse gas emissions by 20 percent
- Improve energy efficiency by 20 percent
- Increase the amount of energy derived from renewable resources to 20 percent

Global environmental policies will continue to evolve and move energy management ideals into practice in the years to come, making effective measurement even more critical.

Making it official

As mentioned earlier, any energy management program must be long-term and sustainable if companies want to realize meaningful gains. It requires a disciplined, information-based approach to making decisions and prioritizing activities and spending.

Some plants opt to pursue registration for ISO 50001 to introduce a level of formal commitment to continuous process improvement. The program instills accountability through external audits and process reviews.

That level of engagement may not be necessary to see a meaningful change in the way your plant manages energy use. What is necessary is a structured approach, organizational commitment, and defined goals and targets for improving energy and environmental performance.

Getting started

Like all new initiatives, it can be difficult to know how to begin reducing your plant's energy use. Process energy efficiency is full of complexity, but measurement almost always provides the insight you need to start—and sustain—an effective energy management program.

To learn more about measuring to manage energy use throughout your plant, visit www.EmersonProcess.com/Rosemount-energy

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