White paper

Efficiency is so last year

Advancing technologies and a more holistic view of industrial systems are driving process improvement with multiple benefits. This is the evolution of efficiency.

The concept of energy efficiency has established itself in the public consciousness and energy consumers of all sizes have at least a basic understanding of what it means. However, to this point the discussion around efficiency has centered mostly on saving money and reducing environmental impacts by using less energy to run a given device or system, or gaining more productivity from the same amount of energy.

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The question we should be asking now is: what more can we be doing?

What are we missing out on? The concept of efficiency ought to extend well beyond electricity and fuel savings, as essential as they are. One way to think about efficiency is in terms of better use of resources. The logic is similar to that of energy efficiency: by using less of something, but doing more with it, the consumer reduces costs and environmental impacts at the same time. The next section illustrates this idea with examples of resource efficiency solutions in use today.

More with less

The pulp and paper industry uses a considerable amount of water, which itself costs money, but also makes less water available for other uses, which can be controversial in water-stressed areas. One major pulp producer reduced its water usage dramatically by using a bio-treatment process combined with filter presses that together extract more water from the end product. The water saved in this process is re-used, reducing the amount needed to produce the same volume of pulp by 50 percent.

The power industry uses water for cooling, and while many plants utilize a closed-loop system where steam is condensed back into water and re-circulated, there are still opportunities for savings. One nuclear generation plant is using variable-speed drives to gain more precise control over the pumps that circulate the water in the cooling system, which in turn enables better control over the transition from steam to water. For the system to work properly, the transition from steam to water and back to steam must be carefully regulated. If not, the steam can condense into water in the wrong place, reducing cooling effectiveness. The water must also be drained. With better control over the pumping system, less water must be drained from the parts of the loop where steam should be, and as a result, less “make-up water” has to be added to the system.

The economic impact of reduced water usage as described in these examples may not be enough to support the business case, but today the ideas of corporate social responsibility, environmental stewardship and a “license to operate” are often equally if not more compelling. However, there are many examples where economic and environmental concerns converge.

Many industries use large amounts of commodities like copper or steel, the prices of which are set in global markets rather than being negotiated with suppliers, making costs harder to control. Such businesses, then, are very keen to control the costs that they can, and often this means making better use of input materials.

Most steel production in the US, for example, comes not from raw ore but from re-manufacturing scrap metal. The process is extremely energy-intensive. One plant realized both energy savings and greater yield by using electromagnetic fields – instead of mechanical means – to stir the melt. The optimized stirring function in turn allowed the chemical reactions taking place during the melt process to work more effectively, maximizing the amount of useful steel and minimizing impurities. Better mixing also ensured that each batch retained more heat throughout the process, which reduced the need for subsequent re-heating steps.

Efficiency's tangled web

This example highlights an important aspect in a more holistic view of what "efficiency" includes: the fact that in any multi-step process, an improvement in one stage often creates benefits in another.

To see this effect in action on a smaller scale, one need look no further than the laundry room. Front-loading washing machines have gained in popularity in the US, and are often marketed as more efficient in terms of how much water they use. Indeed, they require less water than upright machines, but their design also allows them to spin faster as well. This drives more water out of the clothes and reduces the amount of time and energy needed in the drying process. The tumbling action also causes less wear on material compared to the back-and-forth movement of an upright agitator, and that extends clothing life. So, a consumer looking to save money will enjoy added environmental benefits just as an eco-conscious shopper will enjoy the cost savings of their new washer.

Similar examples can be found in just about any industry, though the relationships between components and processes can be difficult to quantify. It's easy to make a business case for a more efficient motor, for example, but what are the downstream effects of choosing that motor, or implementing some other technology or changing a process?

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Thanks to the falling cost of sensors and the rise in the power of analytics, answers to questions like these are becoming easier to find. This is perhaps one of the most compelling aspects of the Internet of Things, which can be describe as the convergence of connectivity, communications and analytic capability.

The preceding steel plant example is only the beginning, and instances of inter-related benefits are not limited to physical manufacturing environments. In power transmission systems, for example, power electronics devices known as FACTS are often installed at key locations on the grid to provide voltage stability and improve the system's resistance to disturbances. However, they also allow more power to be transmitted on existing lines by making it possible to operate them closer to their physical limits. The result is that large capital investments in line upgrades or new power plants can be deferred or eliminated altogether.

Next-level efficiency

As we broaden our understanding of what it means to be "efficient," it's natural to begin looking for other opportunities to realize add-on benefits that support the business case for process and technology improvement. Often these lie in reducing environmental impacts.

For decades, industry has sought to reduce not only the risk of a release of toxic materials into the environment, but to eliminate toxic materials entirely. To take another example from the power industry, transformers historically have used mineral oil as an insulating material thanks to its dielectric properties. However,

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as a petroleum-based product, transformer oil is harmful and is strictly regulated at the federal and state levels. Even the smallest of spills must be reported and managed to exacting standards.

ABB, in cooperation with 3M, developed a vegetable-based oil that is non-toxic and as such does not come with the substantial compliance risks associated with traditional alternatives. But in addition to presenting less environmental risk, this new oil also performs better at its assigned task. It has a higher flash point than mineral oil, and it can even absorb moisture, which degrades the transformer and shortens its life if left unchecked.

So, a product designed to address one problem (toxicity) delivers additional benefits both in its immediate application but also in reduced equipment maintenance costs over the long term.

While massive and important initial gains have been and are being made through energy efficiency directly, the advent of the Internet of Things is creating a “multiplier effect,” uncovering new opportunities for efficiency improvements across a wider swath of industrial processes. As analytic capabilities continue to grow and operational data becomes more ubiquitous, we will see a proliferation of cases where, through better understanding of the relationships among components, processes and inputs, multiple benefits can be realized.

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