OPTIMIZING THE SUCCESS OF INDUSTRIAL ENERGY EFFICIENCY IMPROVEMENT PROGRAMS BY DRIVING CULTURE CHANGE: LESSONS LEARNED AT DUPONT

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ABSTRACT
Many companies have recently begun to adopt energy reduction strategies, be it to lower costs through increased energy efficiency, to align with tightened government regulation or to respond to calls from the consumer to lower corporate carbon footprints. Achieving sustainable reductions in energy consumption in a cost-effective manner, though, can often prove challenging, as it requires a clear vision, a comprehensive assessment and a viable implementation strategy. When executed properly, however, such reductions can lead to substantial savings. This paper discusses the methodology of adopting an effective energy culture, as well as modes of reducing energy use through improved energy management.

INTRODUCTION

Many industrial companies today are beginning or accelerating programs designed to reduce their energy usage. These efforts are being driven by a number of factors, one of which is the impact of the volatility of energy prices on industrial operations. As this paper is being written, energy prices sit near all time highs, driving up manufacturing costs and eroding margins. But even during periods of moderate prices, energy costs can be highly volatile. For executive decision makers in organizations for whom the price of energy constitutes any but the smallest portion of manufacturing costs, the energy price "wild card" is a chief impediment to the effective forecasting that is vital to initiating new business strategies and growth initiatives. For this reason, many business leaders are coming to the conclusion that, above and beyond pure cost savings, working to tame the impact of energy cost fluctuations by reducing energy use is a key strategy for corporate growth.

For many organizations, another key driver for improving energy efficiency is the impact on their operations of governmental regulations, especially in those cases where energy use is such that greenhouse gas emissions are high[1]. In many areas there is currently significant uncertainty over the carbon markets, and the impact that they will have on profitability and the efficacy of operations. Over time, the clear trend is for government regulation to continue to increase, again pointing to tighter control over energy usage as an effective business strategy.

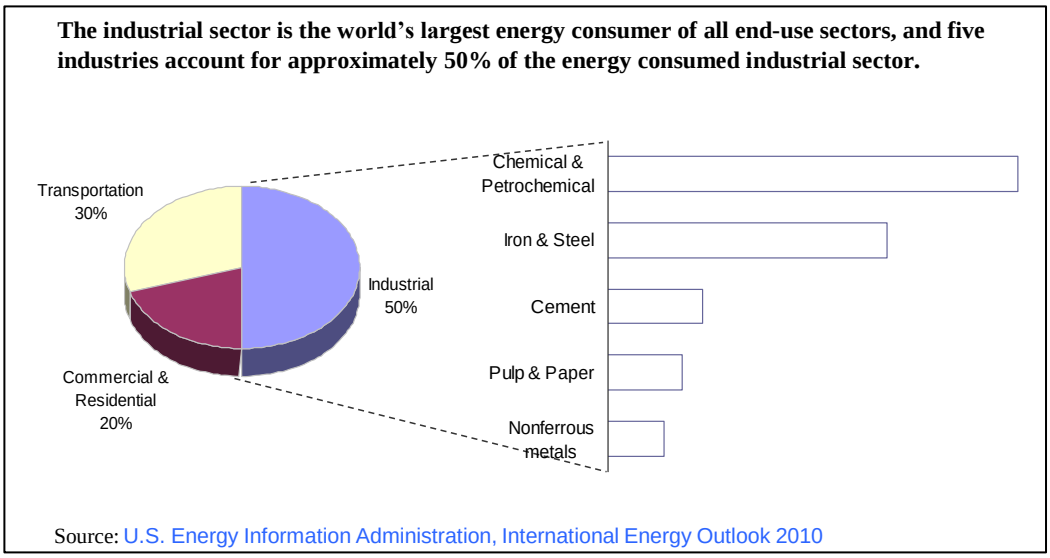

Figure 1: Global Energy Consumption for the Industrial Sector

Yet another macro trend being witnessed is the increase in public and stakeholder accountability, and more wide-ranging concerns over corporate footprints, which DuPont defines as *all* injuries, illnesses, incidents, waste, emissions, use of water and depletable forms of raw materials and energy. The investment community is increasingly putting pressure on companies to improve energy efficiency within their corporate borders because of the increased public scrutiny and the financial risks associated with poor performance, as well as conversely, benefits to be gained from perceived positive

[1] Energy use does not always drive greenhouse gas emissions; for more details see CO2 Emissions (http://www.iea.org/co2highlights/co2highlights.pdf)

performance. Further, this trend is likely to escalate as we get closer and closer to the publication of ISO 50001, the standard that will likely raise awareness of energy efficiency efforts in the same way as ISO 9001 has for quality management efforts, and ISO 14001 has for environmental management efforts.

With all of these potential impacts—high energy costs, wild price swings, escalating government regulation and increasing stakeholder scrutiny, it's no wonder then that energy efficiency, as well as safety, environmental and other aspects of sustainability performance, has become an increasingly strategic issue in an accelerating number of organizations.

DOES IMPROVING ENERGY EFFICIENCY MEAN INVESTING BIG CAPITAL?

No matter what the drivers, many companies believe that an effective energy efficiency improvement program can only be implemented through a significant outlay of capital. Although these types of investments are an important part of an energy strategy, they are not the only, or even the first items that should be considered when designing an energy reduction and cost saving transformation. In fact, this erroneous belief hamstrings many efforts before they even get started, since, in the queue for scarce capital, energy improvement projects are often quickly superseded by those related to increasing capacity or otherwise fueling corporate growth initiatives. In addition, the scrutiny for energy efficiency projects can often be severe, with those presenting anything other than the fastest of paybacks often ruthlessly knocked down in the pecking order.

There is no doubt that many energy efficiency goals can only be met through the investment of capital. But DuPont's experience as owner/operators of more than 150 diverse production facilities worldwide suggests that a highly significant portion—in fact, upwards of 40% of the total energy efficiency improvement opportunity—is achievable through relatively minor, low cost/no cost continuous improvement energy projects rooted in culture change.

Over the course of its 200-year hands-on production history, DuPont has developed and maintained a compilation of best practices in energy management that are utilized across its global operations. These best practices represent an extensive, proprietary collection of technical and management guidelines and performance criteria for operating, controlling and maintaining energy-intensive plant systems at top efficiency. As an operator that utilizes more than US$1.1 billion worth of energy every year, these methodologies have been a key to DuPont's success.

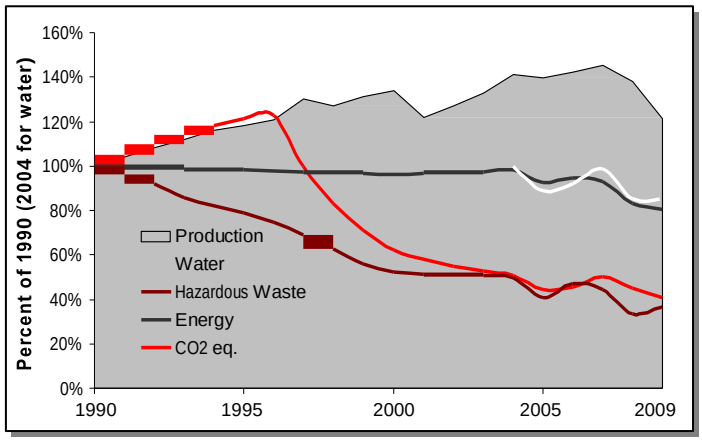

Figure 2: DuPont Energy and Environmental Performance

Since 1990, when DuPont's then CEO Edgar Woolard committed the organization to a set of environmental and energy management goals that went well beyond compliance, DuPont has *increased* its production of goods by 21%. Yet, in the face of that growth, the company's total energy usage has *decreased* 19%, and its greenhouse gas emissions have *decreased* 60%[2]. According to William F. Bailey, principal consultant, DuPont Engineering, and leader of the DuPont Energy Center of Competency—and DuPont's energy "guru"—the company's energy efficiency work has enabled it to avoid more than US*$5 billion* in energy purchases in that period. Mr. Bailey's current overview is that, even on top of these improvements, DuPont is still able to identify and reclaim at least US$45 million in energy savings out of its operations every year with efforts that require minimal out of pocket spending, and that is the basic goal we often set for companies who choose to work with DuPont's consulting practices to achieve similar results.

[2] Note this figure was even higher, 72%, prior to the divestiture of Invista, DuPont's fibers and textiles operation.

It is our experience that these efforts can and should be initiated *early* in any energy efficiency effort, before any capital programs are undertaken, or at least in tandem *as* they are undertaken. They are easier to do, easier to get approved and add up to significant savings, and DuPont experience shows that they are synergistic and "pave the way" for any subsequent capital projects. For example, we have learned that capital projects will frequently achieve more effective utilization and faster payback if the energy culture that impacts and surrounds them is first optimized. In fact, DuPont has learned the hard lesson that often, if you just write the check and bring in the technology and you don't do the culture ground work, if the right roles and responsibilities aren't in place and people don't fully understand what is trying to be achieved with the new capital investment, the expected energy efficiency gains will likely not materialize.

In addition, DuPont has seen instances where the program can become fully or nearly fully self-funding, actually generating a large portion of its own capital, with the "small" energy efficiency savings racked up—US$850,000 there, US$90,000 there, US$400,000 there—collected and re-invested to fuel even greater results. In fact, in a recent two year period, these projects generated an internal rate of return (IRR) of about 75% for DuPont, really making them a "no brainer" to pursue, once, of course the culture of the organization is geared toward identifying and bringing to the forefront the enterprise-wide opportunities available. Through experience, it has become clear to DuPont that developing a culture of energy efficiency can release a significant amount of capital to fund energy efficiency efforts, or fund other corporate initiatives as business leaders see fit.

DRIVING CULTURE CHANGE THROUGH A COMPREHENSIVE ENERGY MANAGEMENT SYSTEM

One core strength of DuPont has always been the ability to manage change, to drive it deep into an organization, and to make sure that it becomes engrained. This is not accomplished in a piecemeal or a "seat of the pants" fashion, but through use of a comprehensive system, in this case, a comprehensive energy management system that provides a clear view of the current state of the organization, realistic and measureable goals, and a clear path and direction for forward motion.

The creation of the Energy Management System (EMS) begins with assessment and benchmarking, and, obviously, is different for every organization. However, in very general terms, actions can be placed into three distinct categories as shown in Figure 3: 1) the responsibilities of top management, 2) changes to organizational structure and 3) tactics that are people and process related.

Designing the EMS, frankly, is the easy part; the chasm between the creation of the EMS and its acceptance and successful implementation enterprise-wide is where many organizations fall flat. Drawing upon extensive—and irreplaceable—real world experience as owner/operators, DuPont, throughout its global operations as well as at client operations, has been very successful at driving immediate results, as well as creating a culture and setting it in motion to continuously drive energy efficiency improvements over time.

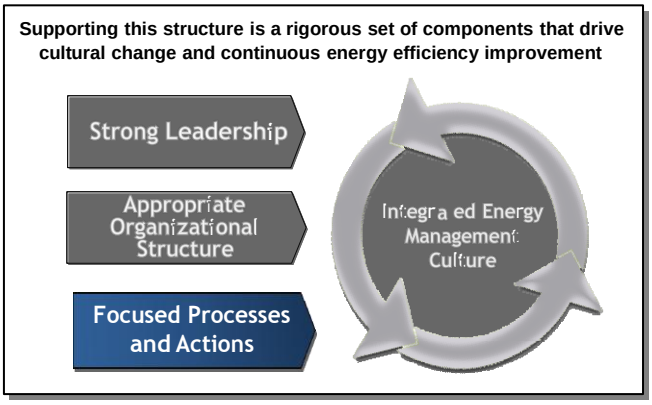

Figure 3: Energy Management System

ELEMENTS OF AN EFFECTIVE ENERGY MANAGEMENT SYSTEM

A sustainable energy efficiency culture is one that grows in effectiveness over time, as opposed to one which, perhaps, starts off strong but quickly peters out. In DuPont's experience, the elements that characterize the successful creation of such a culture often include, but are not limited to, many of the following.

Clear commitment from top leaders

Demonstrated leadership commitment—and engagement—is vital to creating a culture that perceives value in implementing and maintaining energy efficiency improvements. Wherever applicable, this

commitment should be codified in core values and similar statements, and treated as a long term, strategic issue by the company, with management driving it as such, enterprise-wide. In other words, energy efficiency should weigh in management decisions with a similar priority as production, quality, and profitability related issues. While certainly not everyone needs to be focused on energy "100%" of the time, all levels of management from the CEO on down should in some measure be seen talking and walking the talk. That means taking opportunities to discuss energy efficiency priorities in speeches, presentations and interactions with colleagues and leading by example, that is, visibly demonstrating personal commitment to energy efficiency by providing resources, awarding staff and supporting initiatives. In addition, there should be one particular member of the senior staff who is recognized as "The Energy Champion" or "Energy Guru" in the organization. All this should be very visible throughout the organization.

Measurable goals metrics

Long and short term energy consumption and cost reduction goals need to be set, and a performance management process put in place to measure progress and drive performance improvement. Tracking energy efficacy metrics is vital to achieving continuous improvement, and these metrics need to be integrated with production metrics, financial metrics, quality metrics, safety metrics, cost metrics and all other metrics tracked by the organization. They fuel data-driven decisions to ensure appropriate priorities in selecting improvement opportunities and monitoring progress. Energy metrics should be developed such that every employee can relate to them and understand how their daily activities and decisions impact energy efficiency. Metrics should be easily accessible and easy to understand by all levels of an organization and updated continuously, helping to create a widespread "commitment to improvement" mindset.

Ownership by line management

In DuPont's experience, placing all responsibility for energy efficiency with an administrative or support "Energy" organization outside of every day production will not lead to success. While supporting organizations are important, an effective energy management system relies heavily on line responsibility. It is mandatory that the line leadership be actively engaged and committed to improving energy use in their units, and that they recognize efficiency as an essential part of running the operation. This tends to be one of the more challenging parts of the culture change. Getting senior management onboard is often easier, because the business case for energy efficiency can be so compelling. To the line manager, already challenged with the day-to-day responsibility to make product quotas and meet cost goals, adding in an additional responsibility can cause push back. DuPont finds that success in overcoming this challenge must come from creating a "trickle down" structure with a win-win scenario. When change is first strongly embraced by the executive suite, by the time line management is engaged, it is clear that the requirements are strategic directives and anything but arbitrary or "flavor of the month." And, of course, it is important for the organization to put money where its mouth is—when goals are met, line managers are rewarded, and energy efficiency performance should quickly be made a part of performance reviews, bonuses and incentive arrangements.

A Center of Competency (COC)

The CoC is a virtual organizational structure with the senior manager energy champion at the top and a clear path connecting all site energy coordinators and other energy subject matter experts throughout the organization. Through the CoC they are the owners of the corporate energy management system and the processes associated with it. The CoC is a vehicle to network and leverage and share learnings and best practices across the organization. It allows the senior managers to instantly assess the health of the effort at every location. Further, it ensures that local energy champions are never isolated and always have a conduit to specialized colleagues, however remote, as well as corporate executive assistance.

The culture of multi-disciplinary teams

This is where culture change meets technical competence. If a culture cannot tolerate any deviation from top performance, there needs to be a culture created where everyone is empowered to identify problems, bring them to the attention of others, and, as appropriate, work to solve them. We have found that in many organizations, even the more visible issues, while perhaps even being the subject of informal discussion among employees, tend to languish because there is no obvious methodology in place to analyze them. And, there is certainly little or no mechanism in place to delve deeper and

uncover opportunities for energy efficiency improvement that lie below the surface.

Most every industrial site has dozens of these opportunities, perhaps hundreds. At its sites, DuPont has a system in place to identify the highest savings/lowest cost opportunities, starting with the lowest hanging fruit, gathering input from the people who know these processes best. Basically, energy consumption is mapped to identify the areas of highest potential, workshops are conducted with a cross-functional team of stakeholders with intimate knowledge of the equipment, and ideas are generated, studied and prioritized. The top ones are selected and studies are done to test the changes and ensure that they can be incorporated safely and without consequence to product quality and production goals and don't cause any other unanticipated adverse event. Then processes are put in place to implement, execute, integrate and institutionalize what is changing the standard operating procedure for that piece of equipment.

Key to the success of this model—and it has been very successful for DuPont, instrumental in saving the company *billions*—is having the desire, the ability and the enthusiasm to form multi-disciplinary, cross-functional site teams to tackle these issues. This is not something that the energy expert or a lone engineer can tackle by themselves. Insight is needed from operators, from maintenance, from mechanics, from core process experts, from energy experts, from engineers and, of course, management supervision to help keep everyone focused, resources flowing and commitment high.

Hundreds of projects like these are underway throughout DuPont at any one time. For example, at one facility, a team determined that two on-line clarifiers could be operated with one less blower while still supplying the air required to control dissolved oxygen at target levels. The removal of that blower resulted in US$700,000 in energy savings every year, with no process impact. At another facility, a cross-functional team investigated an issue where the condensate stream from an amines area flash tank could not be returned to the powerhouse because flash steam bound up the pressure pumps. They determined that it would be possible to bypass the condensate pumps and return the condensate directly with the motive force from the flash tank. Their recommendation was quickly implemented, and not only provided US$300,000 in annual ongoing energy savings, it was even honored with an American Chemical Council Award.

Better training, better skills

Training and development efforts are a key part of implementing culture change, and take many forms in the creation of a sustainable culture where ongoing energy efficiency is organizationally valued. As one example, since many energy defects are not readily apparent, training technical people to "sniff out" opportunities for energy efficiency improvements, or, for that matter, improvements in environmental performance or process performance, are vital. General energy efficiency awareness training, such as learning how to calculate energy usage and associated cost, as well as specific training related to the equipment that they operate, should be included in the program.

Understanding your equipment better, in itself, opens up new opportunities for energy efficiency. For example, if you're operating a distillation column to produce fuel or a chemical, you have flexibility, within a range, of the operating parameters you choose to set, and the resulting reflux. The process is easier to control with high reflux, but takes more energy. Using less energy in the process lowers the reflux and makes it more challenging to control. So what is the mindset? To automatically do what is easiest to control, or to engrain a culture where the operator will optimize energy efficiency, even if it means more attention and skilled performance on their part? DuPont has found that training operators to better understand the variances and managing the processes more actively not only can save a significant amount of energy, it helps create a more involved and dedicated workforce as well.

These are only a handful of the components of a customized, comprehensive, well-integrated, enterprise-wide Energy Management System. Like many cultural changes, they focus upon using what you already have, but using it differently, as opposed to deploying capital to bring in "something else." To companies for whom implementing an energy efficiency program is becoming increasingly urgent, DuPont strongly suggests first turning attention to the cultural, rather than capital aspects of the change. Based on DuPont's own extensive field experience, implementing cultural change will not only synergize future capital changes you do make, it will help you realize upwards of 40% of the total energy efficiency opportunity, reducing your footprint and generating immediate cash savings, while positioning the organization for ongoing, sustainable success, whatever the future might bring. And, with a future that promises such advances as distributed generation, the convergence of smart grid, data

integration, demand response incentives and other next generation energy innovations, the organization with an enterprise-wide energy culture will be able to capitalize on these and other opportunities faster and more effectively than competitors for whom energy efficiency is merely an incidental interest, and not a true strategic directive.

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SUMMARY

As companies struggle to cope with the shifting energy context – high energy costs, wild price swings, escalating government regulation and increasing public scrutiny, energy efficiency is becoming a strategic priority on an ever more frequent basis. Many leaders, though, falsely believe that energy efficiency improvements are inherently capital-intensive. Such investments may prove efficacious, but they are not the only, or even the first items that should be considered when designing an energy reduction program.

Indeed, there is no doubt that many energy efficiency goals can only be met through the investment of capital. But DuPont's experience as owner/operators of more than 150 diverse production facilities worldwide suggests that a highly significant portion—in fact, upwards of 40% of the total energy efficiency improvement opportunity—is achievable through relatively minor, low cost/no cost continuous improvement energy projects rooted in culture change.

As it concerns energy, culture change must be accomplished within the context of a comprehensive Energy Management System (EMS), one that incorporates strong leadership, an appropriate organizational structure and includes focused processes and actions. The effective actualization of such a system is no easy matter, and must incorporate multiple confluent elements: clear commitment from senior management; measurable goals and metrics; ownership by line management; a well-developed center of competency; multi-disciplinary teams; and comprehensive training and skill-building programs. With this, companies have the potential to realize substantial energy savings at little to no cost.