Part One of a Two-part Series

Don't Even Say Energy Conservation— The Manufacturing Initiative

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ABSTRACT

The strategic energy related opportunities which sharply reduce production costs in manufacturing are often never identified. Even when identified, these low-risk investments, which provide very compelling financial returns, are often rejected when non-energy related investments are implemented which have a higher risk and less compelling financial results.

Starting from the plant manager's perspective, part one of this article will explore why these opportunities are missed and provide a different strategy, which has been proven to be more successful. Part Two will provide the analysis methodology supporting this different strategy.

The foundation of this approach is that industrial energy programs would be far more effective if energy conservation were not the emphasis. Energy conservation doesn't translate well in terms of manufacturing initiatives. Further, it limits the field of opportunity. The energy opportunities which will radically improve business results must be built upon manufacturing initiatives, not conservation.

It's not about energy savings. It is about optimizing energy as a factor of production.

SEEKING THE ENERGY EPIPHANY

We are seeking the "energy epiphany," when we see the same old facts in a surprising way which presents radical improvements. Of course, no such opportunities are evident in any of the reader's plants; if there ever were, such would have been implemented long ago. Yet with the different strategy to be presented, and the methodology that works within that strategy, such an energy epiphany is discovered at about one of five manufacturing plants.

The expectation is to increase production output per energy unit by 40 percent or more with a payback within two or three years at most. As with the example in Figure 1 (which increased energy productivity by over half), the process itself becomes easier, and reduces cycle time and increases output rates.

This is not about squeezing a 10 percent efficiency improvement out of the boiler room. Ironically, the primary goal is not efficiency improvements in general, as these complicate the process and only provide marginal improvements. There may be some valuable efficiency

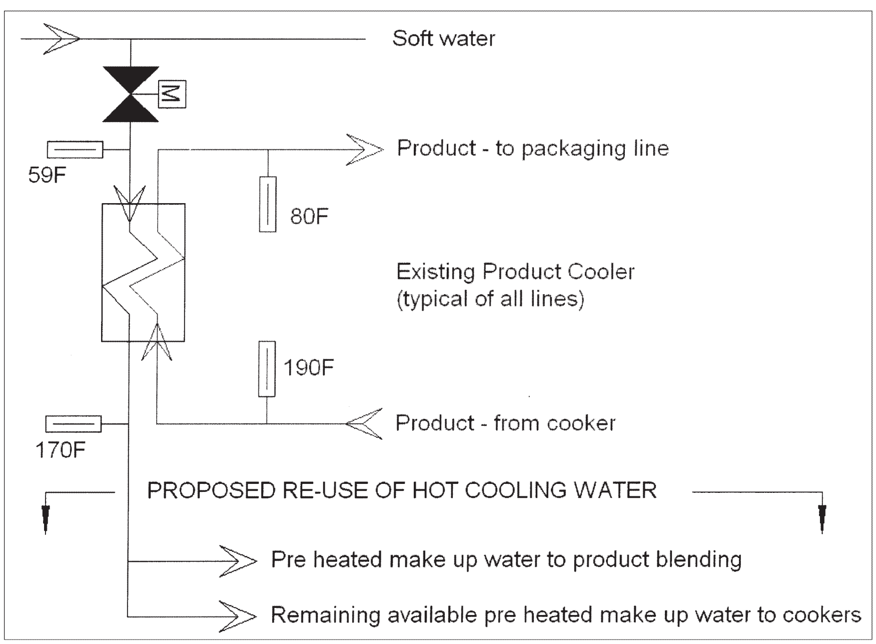

Figure 1

improvements to consider, but only after the fundamental process energy use strategies are developed and the non-value added energy waste is minimized. This avoids investment to more efficiently provide energy that's wasted anyway.

The energy epiphany requires a broader focus on product output per unit of energy. Since most products have no energy content, as the raw materials and finished product are both at ambient temperature, we must question why the thermal processes cannot just feed upon themselves.

Alfred Adler, a noted psychiatrist, once said, "Man knows far more than he understands." Could our vision be clouded by the great complexity of details? We need to prospect for opportunities in a new way that allows this complexity to show us a different perspective never before seen.

WHY UNRAVEL THE BEST DEAL GOING?

Energy has a powerful (please excuse the pun) role in modern industry, as is evident from macroeconomic progress in modern history. Productivity in advanced civilizations almost doubled in the 2,000 years preceding the industrial revolution, to a per capita GDP in 1820 of about $1,149, which is slightly better than the current standard of living in Afghanistan. But since 1820, it increased 17-fold to $19,990 (see Figure 2). (1)

This spectacular growth in the past two centuries was nearly all due, directly or indirectly, to learning how to use energy to create economic wealth. A few decades after 1796 when James Waft invented the first viable steam engine, energy opened a multitude of compounding developments of fundamental value to our lives today. Energy made modern industry possible. It became a factor of production.

In most industries, energy is only 2-5 percent of production costs; far less than labor, materials, or capital. Hence, energy is not managed as aggressively as these other three factors of production. Manufacturing managers don't need to worry about it much, as their business leadership skills are challenged with many other more demanding and volatile competitive factors. Energy is less expensive and more reliable than the other demanding complexities in a competitive manufacturing operation.

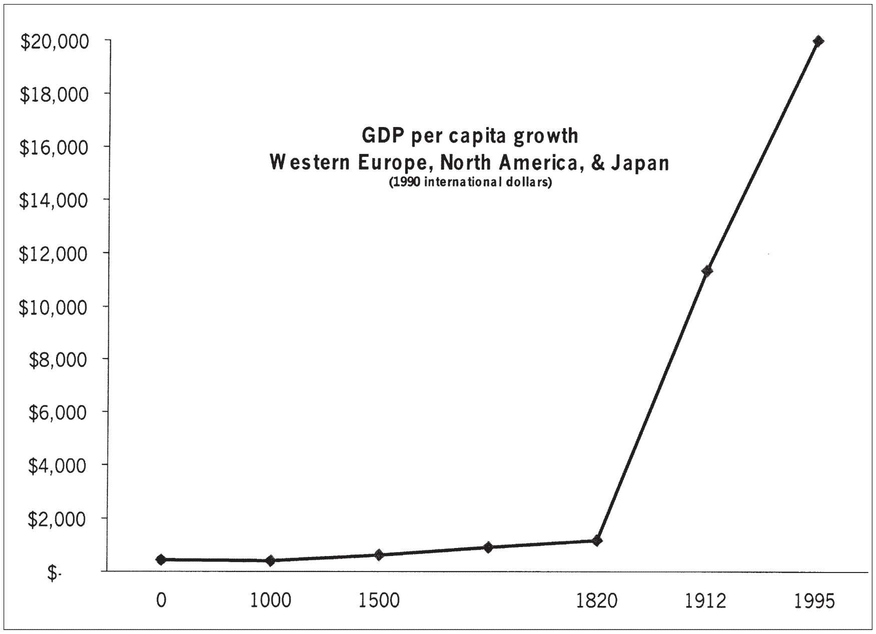

Figure 2

Today's plant manager has a great challenge sustaining a viable operation in the global market. "Meeting the numbers" (production schedules, operating cost, capital, and work-in-process inventory budgets, etc.) and ever-increasing demands in quality, safety, and environmental issues require great leadership and vision. The plant process (the golden goose itself) wanders out of control on occasion, with variations in product quality and/or yield that occur for indeterminate causes. Imperceptible changes in unknown variables cause great impact. The recipe for consistent success is elusive.

Energy is not on the long list of issues that absolutely demand management's attention. Any focus on conservation seeks to limit the part of the manufacturing equation that consistently works well. Its nature anticipates compromises, being less comfortable, giving up things, and running systems closer to the edge of failure. But compromise is not the strategy which will increase our competitive ability. Since energy has a spectacular yield in production results (the 17-fold increase in productivity), why risk it?

Government engagement in energy conservation initiatives accelerated in the late 1970s with the formation of the Department of Energy, mandatory usage reporting requirements, and the Emergency Building Temperature Restrictions program. Government regulation added to production costs, making the ever-increasing challenge of global competition even more difficult to meet. Many companies handle energy and environmental compliance programs within the same department, because energy management is at least partially regarded as a regulatory driven program. Energy conservation is viewed, at least subconsciously, as related to government programs. But a valuable energy management program must stand tall on its own merits; it isn't about government regulation. It is about competitive business.

"You're being audited."

An "energy audit" is the typical terminology for a plant energy assessment. A worse terminology could not be imagined. People don't like being audited. They give no more information than clearly asked, and only do the essential minimum to get through it without problems.

Audits seek what's being done wrong. Conversely, this is opportunity prospecting, not auditing.

Energy conservation just doesn't push the right buttons within manufacturing leadership. It's incongruent with their primary initiatives. It has negative connotations, with respect to compromise, government regulation, and risk.

Energy conservation should be removed from the vocabulary of the industrial energy program. Instead, the optimum energy program must be built upon manufacturing initiatives, not conservation.

TO BUILD THE PROGRAM UPON MANUFACTURING INITIATIVES, A REVERSE PERSPECTIVE IS ESSENTIAL

Great energy engineering talent has already been applied at virtually all manufacturing plants. Efforts have been refocused repeatedly to implement every viable energy cost reduction. Many have deployed energy service companies with teams of specialists. Energy cost savings efforts are typically focused primarily on the energy supply side—the boilers, refrigeration equipment, air compressors, and related distribution systems. Review of the production processes is usually limited to efficiently providing and controlling the necessary utilities.

The engineering resources are career experts in these energy supply systems, so this is comfortable technology for them which they have deployed with good results. Attractive savings have resulted, but this method is substantially played out. This approach is self-limiting. If the review is focused on supply side systems, the results will be limited to those sub-systems. But the valued energy use occurs in the process itself, not the supply side. Further, and most important, since a manufacturing company is not in business to have energy systems at all, the energy supply side focus is from an incongruent vantage point. From the supply side, energy is viewed by the energy analyst as a commodity to be minimized. This limits thinking to conservation projects only.

Further, minimizing the energy supply approach typically promotes reducing the capability of the system (such as compressed air or steam pressure) to the rocky edge of the minimum known needs of the plant. To manufacturing leadership, this threatens their capability to sustain increasing output and quality within the normally occurring process variations. It's a bit like most highways across the Mexican Yucatan, with no shoulders and rocks right up to the edge of the road. Driving on them is nerve wracking, but you can survive if all the drivers never err. (There are miniature churches constructed along the roadside here and there, in memorial for those who didn't make it.) While it is prudent to correct obviously excessive and inefficient over-design, such changes must be based on a meticulously complete inventory of the plant requirements and still include a safe contingency for process variation.

To build the program upon manufacturing initiatives, a reverse perspective is essential. The energy supply systems are not the first focus; they are last. Instead, a comprehensive understanding of how energy adds value in the production process itself is the foundation of the energy productivity prospecting process which will help us to discover the energy epiphany.

ENERGY PRODUCTIVITY IS THE FOCUS

It's not about energy savings. It is about optimizing energy as a factor of production. The best opportunities will improve the production rate, which may increase or decrease energy use. Opening up to this broader view seeking to optimize energy productivity, the opportunity shows itself through a three step analysis process:

- Each production process is evaluated to define how energy adds value in direct relation to the process parameters. This is summarized in a **value-added energy inventory**.

- The aggregate plant energy use is measured during normal production, during a production-ready (but no production) condition, and during a typical no production day. Some simple comparisons provide a **top-down value-added energy assessment**. This is used to cross check the value-added energy inventory and identify the aggregate non-value added energy waste. The aggregate energy use patterns may characterize the major causes of the non-value-added energy waste.

- Each major non-value-added energy waste is characterized by engineering estimates or measurements and summarized in a **non-value-added energy inventory** in an effort to break down the losses in relation to the total plant energy use.

The methodology is similar to an optimization study of manufacturing direct and indirect labor productivity, so it is more familiar to production management and easier for them to gain confidence in the results.

Since the analysis is grounded in the production process, which is of great interest to the management rather than the utilities supply system in which management has little interest, the conclusions will have enhanced credibility.

The primary emphasis is on heating and cooling processes. To avoid wasting time in areas not likely to produce major opportunities, electrical systems (drives, lighting, etc.) should usually be omitted from this analysis, as electrical systems have comparatively small waste energy flows and are well controlled.

However, compressed air systems are an exception, since their energy productivity is so horribly low, typically at 10 percent or less (see Figure 3). Unlike any other utility, compressed air doesn't make a mess or a hazard. It is the most widely wasted and poorly managed utility, which makes prospecting for large and fast return energy productivity opportunities relatively easy. It is poorly understood by many users, as it is a confusing field where industry standards for quantifying performance are not consistently used. This leads to misunderstood or even low bid supplier misrepresented equipment selections resulting in very inefficient overall system performance and poor air quality, which impedes production results.

"Free" steam, from cogeneration, thermal destruction of VOCs, or other specialized chemical process is also of special interest. It's free, but it may have great value for thermal and/or mechanical power applications. "Free" steam sites often have huge potential for energy productivity gains.

Throughout this effort, we are simply seeking easier ways to get valuable things done and to minimize non-value-added waste.

CONCLUSION

The energy opportunities which will radically improve business results must be built upon manufacturing initiatives, not conservation. Energy productivity is the focus. It's not about energy savings. It is about optimizing energy as a factor of production. The best opportunities will improve the production rate, which may increase or decrease energy use.

With the conventional, less effective, energy conservation methods,

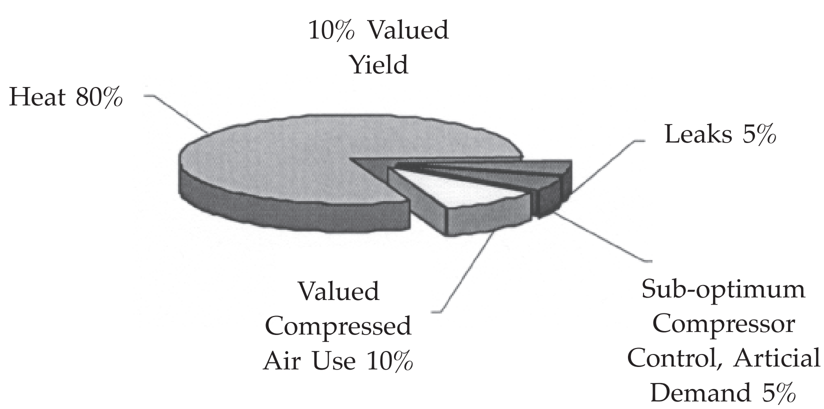

Figure 3

the "energy auditor" (a word we shouldn't use) looks for which of the usual energy saving technologies "fit" at a plant. This is like a solution seeking a problem, and often leads only to superficial improvements. It is far more effective to find the root opportunities first.

In Part Two of this series, a unique analysis methodology will be presented which is effective in discovering energy productivity opportunities within the manufacturing initiatives-based strategy. With the energy productivity approach, we aren't looking for anything in particular; **the manner in which we gather unbiased facts about the plant energy processes will simply show us the fundamentally valuable opportunities**. It is backwards from the conventional methods.

ABOUT THE AUTHOR

Oliver L. Clarke, CEM, is president of Synergy America, Inc., an engineering consulting firm specializing in the development of innovative energy productivity opportunities in manufacturing. Clients include both manufacturing companies and large energy service companies who are serving manufacturing clients. Core capabilities include steam systems optimization, heat recovery, compressed air, and refrigeration.

The foundation of Oliver's capabilities is 20 years experience in mid- to top-level engineering, utilities, and maintenance management at two massive manufacturing plants. He knows the manufacturing client's heart and conscience because he lived there, holding the line responsibility for their same concerns. This common experience builds the strong relationship and trust at the project site which is essential to developing the optimum solutions.

Oliver is a graduate of Georgia Institute of Technology with a degree in mechanical engineering, and has completed post-graduate education in business administration, finance, risk management, business law, total quality management (TQM), predictive maintenance, and innumerable energy subjects.

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Reference

1. "Poor Until 1820," by Angus Maddison, published by *The Wall Street Journal*, January 11, 1999.