

Addressing the Energy Resource Crisis

A Practical Energy Program for Industry

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ABSTRACT

How much does your facility spend annually for purchased energy and utility equipment operations—\$4 million, \$8 million, \$16 million? Would reducing those costs by 5% or 10% interest you? This article offers proven ideas for engineering personnel to optimize energy usage and utility costs in these challenging economic times of limited resources and frozen budgets.

INTRODUCTION

Energy management is not new to American industry. The US has gone through energy supply shortages and price spikes several times since the 1970s. Many large companies have implemented energy programs and reduced their costs significantly. Yet, in the past 8-10 years, energy costs have again increased 30% to 60% (even more in some regions). Energy has become a major part of indirect operating expenses, compared to earlier times when it was only 5% to 8% of the budget. This trend is expected to continue, on average, at 2% to 3% yearly energy supply rate increases.

Environmental and energy advocates tell us that America must move away from carbon-based energy sources—coal, oil, and gas—to effectively manage budgets, to mitigate environmental challenges, and to sustain our standard of living. Yet, 45% of our energy is still provided by coal and 28% by oil and gas. These historically abundant natural resources all have their benefits and limitations. It may require 30 years to displace aging coal-fired utility power stations, which are the major source of CO₂, NO_x and

SO₂ pollution. All the while, OPEC continues to control energy prices by manipulating the worldwide oil supply. Consider the recent catastrophic BP oil spill crisis in the Gulf. As of this writing, new regulatory mandates are yet to be developed. The political “fall-out” may be tremendous for highway and rail transportation, the backbone of industrial plant materials procurement and product shipping. America simply must become more energy-independent and carbon-free. We are 4% of the world population consuming 26% of the energy—and growing more each year. Dependence on foreign oil must be resolved. America cannot continue to borrow money from China to purchase oil from Saudi Arabia.

For large manufacturing facilities that consume huge quantities of energy, management challenges would ease if we could rely on petroleum feedstock and energy price stability. However, for the interim, companies that cannot control supply costs may need to concentrate more on demand-side issues. Let your company’s policy makers and regulatory consultants handle these high profile supply-side issues. Meanwhile, operational efficiency improvements can produce significant demand-side savings. The Department of Energy (DOE) provides a wealth of information and support for manufacturing facilities to help optimize energy usage; however, consider the following simple plan.

ACCOUNTABILITY

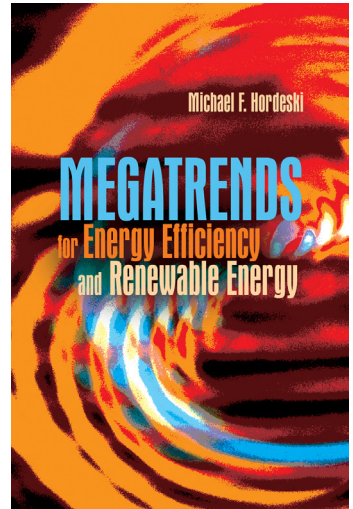
We submit that, for energy and utility systems, the issue is rather straightforward: The “manager in the corner office” must have demand-side energy conservation as one of ten measurable performance objectives, with the manager’s pay being partially based on a continued energy and environmental improvement program. If not, the organization has little incentive to commit scarce resources to these issues. Subordinates will tackle the challenges of the stated objectives. The chief operating officer or the board of directors will need to establish corporate sustainability guidelines.

Recently, energy and utility challenges have increased for many facilities, partly due to corporate short-term operational strategies, cost reduction programs, and reduction-in-force policies brought about by conflicting political, environmental, and monetary policies. High wages and benefits in America have caused the US to be less competitive in the world economy. To compensate, companies have automated and eliminated jobs or relocated

MEGATRENDS FOR ENERGY EFFICIENCY & RENEWABLE ENERGY

Michael F. Hordeski

What are the major developments and trends which are emerging and evolving to set the course for meeting the growing energy needs of the modern world? This comprehensive book explores this compelling and complex topic, examining the driving and often competing forces which come into play as we move forward. Currently 85% of the world's energy systems are powered by coal, oil and other fossil fuels. However, as growing concern for the climate crisis and carbon emissions move to the forefront, while simultaneously it becomes clear that the end of cheap oil is in sight, the need for increased emphasis on both energy efficiency and alternative sources of energy can no longer be ignored. The author provides an overview of the ongoing energy mix evolution, current technology and alternative fuel developments, sustainable building trends, evolving energy efficiency practices, and more. The technical and economic tradeoffs of renewables, as well as planning, siting installation, operation, and safety considerations are covered. A full chapter is devoted to alternative fuel sources and fueling methods. Also examined are grid integration and transmission issues as they relate to alternative energy sources. The influence of energy and environmental policy, greenhouse gas restrictions, and the role of the business community are fully discussed.



ISBN: 0-88173-632-5

6 x 9, Illus., 302 pp.

Hardcover

\$125

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Also, in order to address the interests and needs of the large number of U.S. government professionals who traditionally attend WEEC, AEE will again offer a section of the program known as **FEMWorks 2011**. First introduced as part of the 2006 WEEC agenda, this special multi-track portion of the WEEC conference will include a comprehensive series of workshops for federal energy managers.

them offshore. Engineering and maintenance positions are generally some of the first to be affected. As a result, utilities and key process equipment in numerous mature plants and factories have become less efficient and in need of rebuild or upgrade.

The DOE Industrial Technology Program (ITP) reports that declining maintenance services, poor equipment reliability, and the need for employee training are among the most frequently identified energy-wasting issues in industrial facilities. Are you keeping abreast of technological changes, new products, and controls in the energy industry, as well as the operational integrity of your equipment?

WHAT IS YOUR COMPANY POLICY

The number of companies selling energy conservation products and services these days is staggering. Every month we hear another energy strategy buzzword from the media and the marketers—carbon footprint, sustainability, green buildings, LEED, stimulus funds, buy vs. save, etc. Cap and trade has recently become the latest “excelsior” (surely not another technical-political Ponzi scheme). The environmentalists and the oil companies have completely divergent priorities. Meanwhile, our political leaders continue to debate centrist issues as the clock continues to tick. But reality would seem to indicate that American industry and transportation must look inward, become more efficient, and reduce its carbon-based energy appetite rather than accept market manipulation, OPEC extortion, and the federal government’s inability or unwillingness to enact an energy policy. Moreover, government programs often come with untold delays and unending paperwork.

Be cautious about committing resource time to package sound energy conservation opportunities into a new, more palatable “concept” that the boss will accept. Educate your Vice President or Site Manager; this isn’t rocket science. Get back to the basics. Energy conservation is a well-established industry; energy programs have been around since the early 1980s. Google is full with ideas. The DOE has a list of the 100 most often identified energy conservation measures on its EERE website. For mature operating facilities, it just takes a trained eye to review some energy data, check over the DOE list, and conduct a brief audit. Then prioritize and get busy.

The new carbon-free technologies (wind, solar, ice storage, geothermal, etc.) will not pass economic muster in most for-profit companies

over the near term. Be careful when considering huge, third-party energy projects—buy vs. sell, budget or no budget, shared savings, break even analysis, the cost of money, government stimulus funds, etc. Do not waste valuable resources on “think-tank” proposals that can consume a mountain of personnel time and may have a very long ROI, with increased maintenance costs. Seek independent advice on these issues.

In these slow economic times, big capital projects are few and far between. Moreover, any facility constructed after year 2000, with new ASHRAE/DOE building codes, should be fairly well energy efficient. Many of the new conservation measures (i.e., efficient motors, re-insulation, and controls upgrade) probably will not meet your internal “hurdle” rate.

THE CONCEPT

Mature facilities may need to get back to the basics; i.e., process operational reliability, operator training, and evaluation of some of the new products with excellent returns, such as lighting upgrades. An approach that was used successfully in the 1970s is to require staff personnel to have one issue of every ten on their project “to-do” list be an energy conservation item, even if it is a small one. In today’s environment, two of every ten active items may be a better plan. Commit to continuous improvement. *Demand-side energy conservation is everyone’s job.* We have to modify our wasteful habits that were developed in the ‘60s and ‘70s in a “throw-away” society with bountiful and cheap energy. The rapidly developing economies in China and India could significantly impact world energy supplies within 3-5 years. American industry needs to be prepared; contingency plans may be appropriate. Do you leave the lights and TV on at home when you go away? The same conservative logic should apply to all personnel throughout your organization.

Tackle this job rationally! Staff personnel should key in on the priorities of the boss. Remember, cost control is number one. Learn to turn Btus into dollars that he understands. There are usually a few “low-hanging-fruit” energy savings and utility improvement items that can be implemented without the need for project managers, consultants, and major capital initiatives. A few successful small projects will gain you some experience and creditability. With 10¢/kWh power and \$7.00 fuel, there are several issues around your facility that should have less than a two year return-on-investment (ROI), such as boiler efficiency, insulation work, leak repairs,

and new controls. Hello! These are some of the same generic items from the 80s. The difference now is that engineering and maintenance guys are no longer available to handle many of these routine improvements. We've downsized, and operational reliability has begun to slip. Left unattended, equipment and systems will degrade in performance. Recent retirements in your organization could be an issue; you may need to identify some experienced help.

It is well established that production process improvement (often impacted by utility systems) is the best energy and cost reduction program of all. Consider identifying a third-party contractor that specializes in energy and process systems improvements. Someone in your organization will need to coordinate the work. Also appreciate that possibly one in ten employees may be web-surfing an hour per day. Can you effectively tap into that resource?

THE TEAM

Communicate with your employees. Share energy data and costs. Ask for their assistance. Get them involved. Organize an informal energy awareness "Tiger Team." Let them meet at lunch and generate some ideas. Award any outstanding contribution with tickets to a community activity, or a US Savings Bond. There are surely a few environmentally conscious employees in your organization. Some may even have noticed an excessive number of steam or compressed air leaks and office/shop lights on at lunchtime or during back shift. A few employees may volunteer to be on a Tiger Team if you will make a firm commitment and pay for the sandwiches and chips. It can be a win-win situation! Yet, keep in prospective that we cannot "eat an elephant in one sitting." Small and continuous progress will sustain employee interest, produce good results, and please the management team. It may take 3-5 years to produce a step change in performance, but be persistent. For those larger projects, a lack of technical resources should not be reason to do nothing. Consider identifying some technical help to lead the program, if needed.

Proven energy projects and utility equipment optimization can bring more profit to the bottom line than selling an equal amount of your company products. Moreover, process efficiency improvement may well occur. Your challenge is to identify these opportunities. The extent of resource commitment can be estimated.

THE GOAL

Energy and utility costs are summarized in the financial department’s monthly closing statement. It takes only a few minutes to compare energy costs to total manufacturing costs. Energy may be 60% to 80% of the maintenance and utilities budget; it may also be 25% to 40% of the site’s overall operating budget. If you establish these benchmark comparisons, it is easy to determine potential savings and extrapolate a reasonable level of resource commitment.

Use the chart in Figure 1 to estimate your facility’s potential savings.

Annual Energy Savings Guideline Chart				
Age of your facility	Formal Energy Program	Formal Maintenance Program	Annual Energy Spending	Annual Savings Potential
Years	Y or N	Y or N	\$\$\$	\$\$\$
< 5			< \$1 Million	\$ 25 K to \$ 50 K
< 5			< \$5 Million	4 % to 6 %
< 10			< \$1 Million	\$ 50 K to \$ 75 K
< 10			< \$ 5 Million	4 % to 8 %
< 20			< \$1 Million	\$ 75 K to \$ 100 K
< 20			< \$ 5 Million	4 % to 10 %
20 +			< \$ 5 Million	5 % to 15 %
20 +			> \$ 5 Million	5 % to 20 %
Note: Formal Energy & Maintenance Programs directly affect savings results				

Figure 1

It is not unusual to experience a 3 to 5% process efficiency improvement along with utility systems up-grades. For smaller converting plants, \$50,000 to \$100,000 savings can justify a limited resource commitment. For larger facilities, \$500,000 to \$1,000,000 of annual savings would be a major success. Again, the boss in the corner office must be committed, ask employees to include energy awareness in their daily activities, and reward the few having exceptional ideas. Recognize that a 5% employee participation rate is typical in most facilities. Understand that many employees are quite busy with the pace and stress of American family life.

THE PLAN

Those tried and true energy projects of yesteryear are still good ideas for today; i.e., boiler efficiency, compressed air systems, pipe and duct insulation, steam and air leaks, electric demand control, efficient motors, VS drives, lighting upgrades, HVAC optimization, synthetic lubrication, belt drives, pumps and fans, and process optimization. Many of these will produce excellent results (less than 2 year ROI) with today's higher energy supply costs. In regions where power costs are 12¢ to 15¢/kWh, many electrical projects can produce an ROI of less than one year. For facilities with fuel costs of \$7 to \$9, boiler efficiency, process system burners, and insulation improvements produce an ROI of 12 to 24 months. Any process that operates above 250°F should have the insulation inspected annually. Use an inexpensive \$250 infrared gun to conduct a brief survey. If insulated surface temperatures exceed 130°F, then repairs are in order. Make a list and have an insulation contractor handle the work. *There should be NO poorly insulated steam or chilled water piping, valves, or fittings in your facility.* The same goes for gas- and electric-heated process system ducting and pressure blower piping. In air-conditioned converting bays, the savings can be doubled. Does your facility have a published plan for operation of HVAC systems and office equipment? These issues should be part of the company's basic sustainability mandate.

You should not need a comprehensive energy program full of charts, diagrams, and protocol in order to make improvements. Here is a brief outline for a simple but effective energy program:

Energy Policy:	Publish an energy plan with simple objectives.
Identified Sponsor:	Designate someone as the energy coordinator.
Energy Bills:	Have monthly utility bills reviewed by a technical person.
Accountability:	Hold the management team accountable.
On-going Repairs:	See that the facilities team has an effective repair program.
HVAC & Office Equipment:	Develop and publish an equipment operating policy.
Monitoring & Reporting:	Conduct regular data analysis (quarterly at a minimum).
Employee Involvement:	Ensure awareness and empowerment with rewards.

To get started, you will need some good old fashioned “legwork” and help from a trained eye to identify the viable opportunities. Consider the following:

RECENT INDUSTRIAL ENERGY REVIEW EXAMPLE PROJECTS

1. Lighting upgrades, EMS controlled thermostats, and better service for 150 DX air conditioning units at a historic office complex in the South, with documented energy savings exceeding 50%.
2. Several gas-fired boilers at a converting plant were being “trip tested” (while under load) at the start of every shift, and combustion control was poor. A couple of days of boiler service work and some operator training resulted in average savings of \$700 per day (\$250,000/year).
3. Insulating four large bellows-type expansion joints (480 sq. ft.) in the 700°F hot air ducts on a huge paper machine (using ceramic blanket material) produced an annual savings of \$105,000.
4. A steel fabrication plant was experiencing major problems with a compressed air system; the maintenance program needed TLC. A three-day review and a one-day training session with the maintenance personnel resulted in a plan that produced significant results (\$400,000/year).
5. Electric demand costs at a flooring plant were well above average, and a rate increase of 15% had just been announced by the local utility. A load-shed management plan resulted in power savings of \$30,000 per month.
6. Thermal insulation work at a large paper mill identified numerous sections of uninsulated main steam lines, dozens of uninsulated valves (8” to 16” size), many traps “open-blowing,” and three steam air-heater units in a major state of disrepair, leading to a savings of \$270,000 per year.
7. Modifications to a hood exhaust system on a 400 TPD flat paper machine increased production by 3% and reduced steam consumption by 2,000 PPH.

8. At a government site, ducting 160⁰F hot air from the drive motor of a process adjacent to the ID Fan on a 40,000 PPH gas-fired boiler reduced fuel consumption by 1.5%.
9. A steel mill retrofitted three oversized, 300-hp cooling water pumps, which were being manually throttled to eliminate start-up overload, to produce a power savings exceeding \$90,000/year.
10. A 90,000 PPH, oil-fired boiler reported 4.5% to 5.5% excess O₂ at $\frac{3}{4}$ load. Casing deterioration was extensive, rear and sidewall furnace insulation was in need of rebuild, and the ends of both steam drum zones had no insulation. Radiation losses were calculated to be 4% rather than the normal 1%. Air infiltration was a big issue. Fuel savings easily achievable: \$165,000.

GETTING YOUR ENERGY PROGRAM STARTED

- A. Develop a simple one- or two-page energy plan as outlined above.
- B. Obtain management approval to delineate energy and utility costs.
- C. Quantify those costs as compared to site total operating costs.
- D. Assume that a 10% annual savings is possible.
- E. Get your employees involved and developing some ideas.
- F. Separately identify and prioritize electrical and thermal opportunities.
- G. Tackle the four or five best projects and validate the results.

Within a few months, improvement should begin to occur and you will be pleasantly surprised.

A formal energy program (as published by the DOE) can be implemented after the economy recovers. This would include mission statement, benchmark data, project development and implementation, performance monitoring, carbon credits, etc. Meanwhile, this more casual approach should get your employees involved and produce some excellent results.

CONCLUSIONS

If your plant or factory has recently experienced a degradation of process and utility equipment performance and increased energy costs,

it is essential that you conduct a basic assessment. If you do not have the time or resources, then get some help. Don't allow a lack of resources to be cause for inaction. There may well be a savings opportunity of \$200,000 to \$2,000,000 per year, as well as significant environmental recognition. Oversight of energy costs and environmental stewardship activities are major responsibilities for every facilities manager. A simply structured plan, as outlined above, should allow you to make significant progress in the midst of these hectic times.

TWO "HEADS-UP" ITEMS

1. Become sensitive to "turf" issues with those in your organization who are currently responsible for facility systems and the energy program. A good approach may be offering to help economically justify some of their backlogged energy projects.
2. The government stimulus programs have drawn a few "nefarious" characters into the green energy movement. Some of these folks were selling automobiles and real estate just last year. Check the fine print about performance guarantees before buying their products.

References

1. US DOE Energy Star Program; <http://www.energystar.gov/PortfolioManager>
2. US DOE Industrial Technologies Program; <http://www.eere.energy.gov/industry>
3. US DOE Energy Information Administration (EIA); <http://www.eia.doe.gov>
4. US DOE Energy Efficiency & Renewable Energy Program (EERE); www.eere.energy.gov
5. ASHRAE Building Energy Standards: ASHRAE Standard 90.1; <http://www.ashrae.org>

ABOUT THE AUTHOR

Gary W. Wamsley is a mechanical engineer with 40 years of technical management and operational experience in plant and staff engineering at large and small facilities for the tire, aerospace, and tissue/paper industries. He is a registered Professional Engineer in four states, a Certified Energy Manager with AEE, a Certified Plant Engineering Manager, and an ASME member since 1965.

Recently he served as a technical consultant for a Fortune 100 com-

pany, coordinating its corporate energy program. He has developed and presents training programs for boiler operations, water and steam treatment, combustion systems, compressed air systems, centrifugal pump systems, industrial energy management, and thermal process systems energy optimization. His industrial boiler system experience is extensive, ranging from small fire-tube units to 1500 PSIG coal-fired cogeneration plants. Currently, Mr. Wamsley is president of JoGar Energy & Utility Services, Inc., located in Alpharetta, GA and offering on-site energy reviews, boiler efficiency testing services, technical assessments of specific utility systems, and training seminars. Mr. Wamsley can be reached at www.jogarenergy.com or by cell at 678-977-1508.