# A Guide to Energy Efficiency

## *Reduce energy consumption in your manufacturing operation with simple and practical ideas.*

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Companies continue to search for ways to combat the high price of utilities, which, for most in the food-processing industry, is the second-largest direct conversion cost behind only the cost of labor. Becoming more energy efficient is possible for every organization, and doing so can save money in more areas than just your utility bill. In order to help your organization as well as the environment, we've written this guide to show you how to become more energy efficient by outlining the opportunities available, identifying target areas, setting goals, taking action and monitoring progress.

In the last few decades, deregulation in energy markets has opened up many opportunities to save money by managing your procurement processes. Deregulation along with technological advancements, incentives and attention to global warming has also made alternative energy sources such as combined heat and power (CHP), fuel cells and renewables more economical. Although creative energy-sourcing strategies can be effective methods to reduce energy costs, those initiatives usually require major human and capital investment. Instead, this article will focus on reducing energy consumption in your manufacturing operation with simple, practical and even no-cost ideas that maximize your energy efficiency.

### THE OPPORTUNITIES

As in any business venture, it is important to decide if the opportunities are worth pursuing before simply diving in. The same is true with energy conservation. The first step is to collect general data and identify the billing structure as well as the delivery and metering of your utilities. Next, figure out the amount of money spent and the amount of the utilities used (Figure 1). This would include looking in a general perspective as well as identifying costs and consumption on a per-unit basis. To do this, start with the utility bill and utilize the interval data (more about this later). Then you can identify how consumption varies across different spectrums such as by time or by product. You must also ask how utilities are currently managed: are they treated as a fixed cost, or are they considered controllable? There ➤

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are other opportunities related to energy conservation that are often overlooked.

Energy efficiency and overall production efficiency are closely related, thus a focus on energy efficiency has residual effects on costs beyond the direct energy-savings benefits. Energy is a variable direct cost, which means the amount of energy consumed is directly related to the volume of product produced. In that sense, it can be treated as a raw material. If dump-to-pack ratios work (i.e., the final output volume per unit of input materials), consider an energy "yield" measure.

For some organizations, the impact of energy efficiency can be better appreciated in terms of waste reduction rather than the reduction of costs. Waste reduction is a plank in a company's corporate social responsibility platform. Reducing energy consumption of course reduces your carbon footprint and increases overall sustainability. Going green is a great way for your organization to save money without having to lay off employees. In these ways, the benefits of energy efficiency outweigh the costs.

How much does energy actually cost, though? For most food processors energy is typically second behind labor as the largest conversion cost. With current money-saving green technology, if an organization is not managing energy use, they may be spending as much as 50 percent more than necessary.

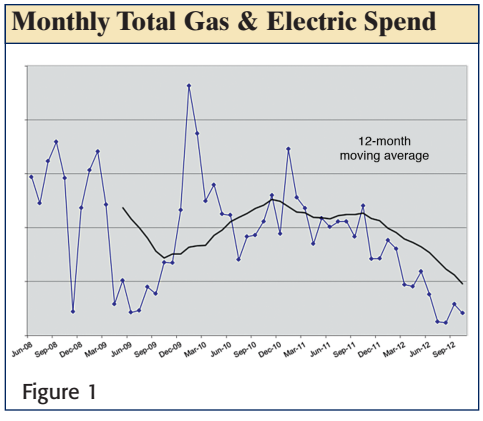

Figure 1

Energy-efficiency initiatives also have soft benefits that lead to greater overall performance. Employees today have to understand the processes in which they are involved in order to make decisions, rather than repeating the same simple task over and over again. Employee education is vital and energy efficiency is a great way to engage employees. Not only does education help engage the whole workforce, but the more the average worker understands how energy is used, the more that worker will understand the manufacturing process. Some manufacturers have found that engaged employees paying closer attention to energy consumption has led to residual improvements in safety, quality and productivity. Beyond that, energy-efficient practices and tools learned at work can be directly transferred to the home to save money there, too.

## GETTING STARTED

### Management Sponsor

With all of these potential energy- and money-saving ideas, you might be asking yourself where to start. One great way is to enlist a management sponsor. Ideally, this would be a senior manager. The sponsor should have the authority to set priorities and assign resources, so it is important to communicate to him or her the energy interests and priorities of the organization. Encourage the sponsor to get engaged and make sure that he includes time in his agenda for his sponsor responsibilities.

### Energy Policy

Next, write an energy policy. This is a statement that will define the organization's commitment to energy efficiency. The ➤

energy policy should set goals and define the company's mission for their energy-efficiency initiatives and overall objectives. The policy should be signed by the senior management and communicated throughout your organization.

In order to track improvements there must first be a baseline. Obtain this by measuring utility usage; all energy consumption is metered somewhere. The baseline will allow your organization to target specific areas where you can cut back. Two vehicles to do this are via monthly utility bills and utility interval meters. If you track consumption with monthly bills you will soon find that they do not have the timeliness or granularity necessary to give you good information. That's where interval meters come in. An interval meter is generally different for each utility so contact your utility provider to set it up. Most commonly, gas is measured daily, if it is available, whereas electricity is measured in 15-minute intervals. Water is often not on an interval meter at all.

Data from the interval meter is then made available on the web. Keep in mind that interval data from the utility provider is usually 24 to 72 hours behind consumption, and it is sometimes not available online. We have found that subscribing to a demand response program from the utility provider provides for better interval data reporting. It is usually more timely and more granular than the utility usage information. Demand response encompasses changes in electric usage by customers from their normal consumption patterns in response to changes in the price of electricity over time. Once you have the interval data, you can then correlate energy consumption to operational metrics.

## Energy Team

A great way to promote energy efficiency across the entire workforce is to start an energy team. This allows employees to get involved and gives everyone an opportunity to make a difference in energy savings. Build the team and assign roles to promote team efficiency and effectiveness. Your team should set goals that the organization can strive to achieve. Goal setting is a great tool to use to define your mission and help with a successful reduction in energy consumption. Goals can vary in many ways, and it can be hard to figure out where to set your benchmark. A guide to setting goals is to set SMART goals: *specific, measurable, achievable, results-based* and *time-constrained*. In other words, set goals that are challenging but reachable and make sure you have a way to know when you've reached them. Some examples follow:

- Reduce consumption of gas, electric and water per pound by 5 percent by the end of the fiscal year.
- Establish a process for recording energy metrics and comparing them to their targets by September.
- Conduct one kaizen (continuous improvement) event every three months focused on energy waste reduction by July.
- Add energy waste reduction to all department meeting agendas by June.
- Develop meaningful incentives to reward energy savings and implement them by October.

In order to make these goals successful, make it worthwhile for your whole organization to accomplish them. And celebrate your success, whether it is with a reward, recognition or simply personal satisfaction; it is easier to get people to make the effort if they get something out of it as well. ➤

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## Assessments

With the energy team in place and functional, you can start doing assessments of your energy efficiency. There are multiple ways to conduct uniform assessments of utility use. The EPA created the Energy Star Assessment Matrix, which is a spreadsheet to help compare energy-management practices to the best practices outlined in the EPA's Energy Star Guidelines. Your organization can also track improvements against itself by comparing your current results to past results. Another available tool is the ISO 50001, which is an energy-management system that provides a framework to develop an energy policy, set goals, make data-based energy decisions and review results of energy improvements.

Energy audits are another way to assess energy usage. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) provides uniform audit guidelines for three levels of monitoring, which become increasingly thorough from the level I walk-through audit to the level III investment-grade audit, which is a long-term study that involves a computer simulation of the plant. ASHRAE audits are typically conducted by a consultant and are usually subsidized by a rebate from your utility company. There are also a number of organizations that provide various other utility bill audits.

In addition to contracting an outside organization, there are possibilities for self-analysis. One of note is energy mapping (Figure 2). This is a tool with which your organization can make a visual representation of how energy flows throughout the plant to various processes. An energy map can make it much easier for everyone to identify areas to target energy savings.

**Cost of Compressed-Air Leaks**

| Leak Size | Cost of 10 Leaks |
|---|---|
| 1/16 inch | $4,540 |
| 1/8 inch | $20,005 |
| 1/4 inch | $80,020 |

Figure 3

**Define Energy Demand**

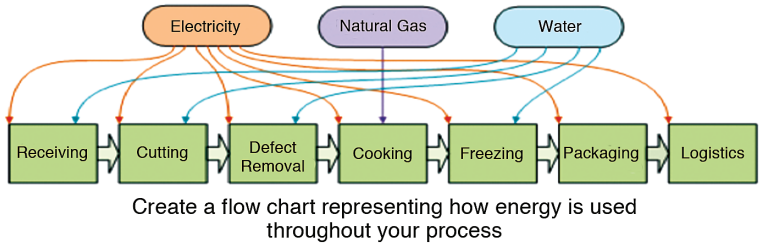


Figure 2 ©Strategic Energy Group

## TAKING ACTION

Now that you've identified areas to work on and established goals for those areas, it's time to take action. Whether the action is company-wide or more specific, your effort should be focused. One course of action would be to coordinate activities such as treasure hunts, which increase awareness and can engage the entire workforce. Compressed air is invariably a source of energy-saving opportunities. Identify and fix leaks. Fixing 10 leaks of one-sixteenth of an inch can save as much as $4,500 per year (Figure 3). A zero-cost measure is to lower the system pressure. Lower the pressure just one PSI every two weeks until someone complains. Another idea is to make sure your water-treatment systems are effectively eliminating bioslime and scale, which can inhibit heat transfer. Every little bit can go a long way.

The lighting industry has taken great strides in making new green technology with T5 or T8 fluorescent lights or LEDs. By replacing large 400-watt pendant HID or halogen lamps, your organization can save a fortune. Just four of these 400-watt bulbs create the heat of a typical residential oven. This can add up quickly—a warehouse that utilizes 50 of these bulbs is generating the heat of more than 13 residential ovens. Replacing the high-wattage ➤

lights will also reduce the air-conditioning load, which compounds the energy savings. This is an example of combined savings, where making a change in one area can save money in multiple areas. Most lighting improvements are eligible for utility rebates as well.

The area of water chilling and air conditioning has many opportunities for energy savings, too. Because of its harmful ozone-depletion effects, the common refrigerant R-22 is in the middle of its phase-out program. As of January 1 of this year, the Montreal Protocol requires the United States to reduce its consumption of hydrochlorofluorocarbons (HCFCs) to below 90 percent of the U.S. baseline, and by 2020 the production of new HCFCs to service existing air-conditioning systems will be completely banned. These caps are causing the price of increasingly scarce R-22 to rise and that trend is bound to continue. The need to replace outdated air-conditioning systems provides an opportunity for organizations to consider upgrading to higher-efficiency systems. Rather than replacing an old air-conditioning unit or chiller with a similarly sized one, which would have a similar or slightly lower energy efficiency due to the lower effectiveness of the new refrigerant used, consider consolidating units into a central system with higher efficiency. To get the same chilling capacity, replacement of an R-22 unit would require more space for a bigger compressor, which is just another reason to consider consolidation.

## FOLLOW-UP

You've already taken the big step to incorporate energy-saving methods into your process; now measure how efficient the new processes actually are. Again, it is best to start with the utility interval data or, better yet, demand response data. Monitor your changes, track them on some sort of chart and report your findings. One way to track your organization's progress is to make a bar chart of the overall energy intensity, or Btu, per unit produced. Don't forget that producing greater volume for the same amount of energy is saving energy. Another option is to utilize a multivariable linear regression model, which shows general energy-consumption trends. The CUSUM, or cumulative sum control chart (Figure 4), is a method to detect when a change is made. This tool not only quantifies the savings but identifies the exact date that the savings began.

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## THE CHALLENGES

There are many challenges your organization might encounter in your pursuit of increased energy efficiency. One of these is the competition for manpower. It is important to remember the priority of the organization and know that you and your team are responsible for more than just energy savings. We have to think realistically. Energy efficiency must be put on the back burner sometimes because at the end of the day your organization still has to reach its production goals and fulfill sales obligations.

Another challenge is the competition for capital. Not all projects can be funded

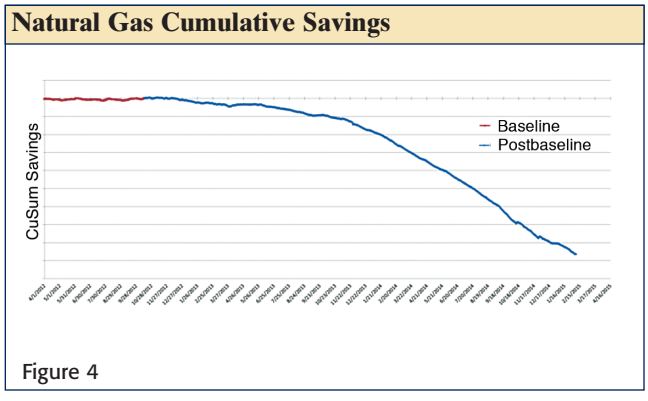


Figure 4

***Becoming more energy efficient can seem daunting, but no one has to fight alone. Knowing where to turn for help will be pivotal for any organization as they try to improve their energy policies.***

because an organization simply does not have the capital to do so. For this reason, it is best to focus on no-cost and high-return projects that predict fast payback and a high return on investment. But don't forget the nonenergy benefits of some of the previously mentioned actions. These must also be counted towards your return on investment. Utility rebates and even government incentives are available to help fund capital improvements.

## RESOURCES

Becoming more energy efficient can seem daunting, but no one has to fight alone. Knowing where to turn for help will be pivotal for any organization as they try to improve their energy policies. The National Institute of Standards and Technology, or NIST, offers manufacturing extension programs that provide consultants and can assist with training and finding funding sources. These programs are designed to promote manufacturing improvements in much the same manner as agricultural extensions do. Utility companies offer incentive programs that help cover capital funds. The rebates they offer can be prescriptive or custom. A prescriptive rebate gives a specific rebate reward to organizations that preform specific upgrades, such as lighting upgrades or a variable frequency drive (VFD) installation. Custom rebates give rebate awards to organizations that achieve a specific level of energy savings, regardless of methods used. Utility companies themselves will commonly offer consulting services to their clients.

There are even more national programs that can assist in energy savings (Figure 5). The Department of Energy offers advice through their Better Plants Program. The EPA Energy Star Program offers energy strategies for buildings and plants, recognition programs and benchmarking along with other energy-efficiency services. The previously mentioned ISO 50001 provides a framework for continuous energy-efficiency improvement and it also offers Energy Management certification. Lastly, LEED, or Leadership in Energy and Environmental Design, offers another helpful place to turn for energy consulting.

**National Energy-Savings Programs**

Department of Energy Better Plants Program
http://energy.gov/eere/amo/better-plants

EPA Energy Star
http://www.energystar.gov
- Energy Strategies for Buildings and Plants
- Recognition programs
- Benchmarking
- EE Services

ISO 50001
- Energy Management Certification
- Provides framework for EE continuous improvement

LEED
- Leadership in Energy and Environmental Design

Figure 5

## CONCLUSION

You now have the tools to become more energy efficient. Make the case for increasing efficiency and sell it to your boss. Set up demand response to get access to your data and make your initial findings on which specific areas to target. Measure usage, track results and report them. Use your energy team to set goals and execute plans as well as to build awareness. Reach out to your available resources; there are plenty of people who want to help you reach your goals. The bottom line is that it doesn't matter what you do to save energy; what matters is that you do something to save energy. □

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