Case Study: Mariah Meat Packing Plant

With rising utility costs threatening the plant's existence, Holmes Energy steps in with an Opto 22-based energy monitoring system

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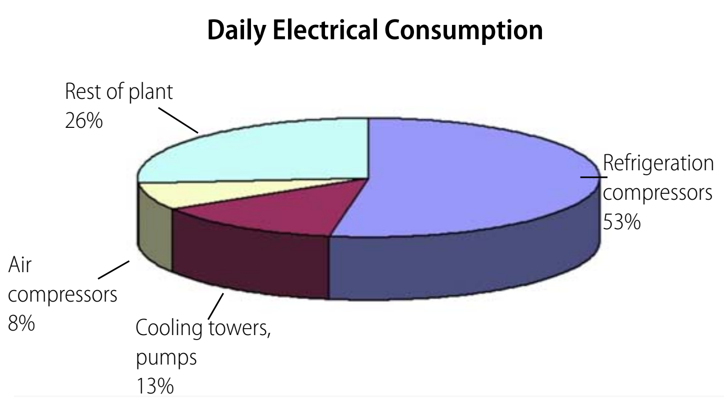
BACKGROUND

Meat packing plants all over the country were closing and many others were suffering financially. Mariah was no different. Utilities represented the plant's third largest expense (after raw product and personnel) and yet the company had little real knowledge of where those dollars were going.

In fact, expenditures had become so great that Mariah had sought a "no-cost" energy audit from the local electric utility. When plant management (including President John Stadler) read the utility's audit report and saw that its only suggestion for savings was a switch to more energy-efficient bulbs for the lighting system, they realized that the auditors had no clue about the complex systems in the Mariah facility.

With electricity accounting for two-thirds of the plant's total annual utility costs, it had become clear that the company needed to reduce its power bill if it wanted to remain in business.



To better understand and gain control of its energy bills, Mariah turned to Holmes Energy, experts in facility energy conservation, system operation, control, and maintenance. Holmes Energy determined that the first phase of the Mariah Meat Packing energy management project should be discovery. This included gathering equipment lists, system schematics, and copies of past utility records to provide a breakdown of electric, gas, water, and sewer costs.

Further examination and discussion revealed that when it came to electricity, the refrigeration compressors, cooling towers, air compressors, pumps, lights, and production equipment were all running for long periods and all were thought to be using a good deal of power. The question was, how was that power distributed?

MONITORING AND DATA COLLECTION

To answer this question, Holmes Energy designed and installed an AutoPilot Energy Information System to monitor, identify, manage, and eventually reduce Mariah's electrical costs.

The AutoPilot system, based on hardware from Opto 22, utilized multiple panels installed at key locations across the plant and included I/O connections to machinery and equipment, as well as the facility's electric meters. The connections to Mariah's individual machines and equipment provided the granularity needed to detect even small changes in power draw and the ability to precisely identify the heaviest energy consumers.

"Monitoring the meters alone would certainly show when every dollar was spent; but the rest of those Opto I/O points would prove even more beneficial in that they would track exactly where those dollars went within the plant," explained Holmes.

Because most of the major equipment systems at Mariah already had their own, independent control systems that functioned well and that plant operators were familiar and comfortable with, the AutoPilot system was designed strictly for monitoring and data acquisition purposes only—with no control functions.

The AutoPilot system hardware also utilized standard communications technologies, allowing Holmes to remotely access and review the energy data via a PC each day and provide ongoing analysis and recommendations.

The real-time and historical user interface screens provided by the system were representations of the actual plant and equipment, and because the information was presented in a graphical format, Mariah's operating and maintenance personnel found the system intuitive and easy to understand. Reports on equipment performance and consumption were made available not only in units of energy, but also in dollars and cents. Presentation of the data in this format allowed Stadler and others to understand how much each plant system was costing, every hour of every day.

The aggregated data would soon show that Mariah's refrigeration system accounted for two thirds of the plant's total electrical consumption and costs. It thus became obvious that energy management efforts should initially focus on the this system. As it turned out, this approach revealed problems that may have existed for as long as 30 years, at a total cost of perhaps hundreds of thousands of dollars.

Shortly after the energy monitoring system was installed, an industrial power engineer with the local electric company phoned Holmes and informed him that Mariah was looking to add $100,000 in new electrical transformers, in preparation for adding more refrigeration equipment prior to summer. Holmes knew that the data showed that the plant already had at least twice the refrigeration capacity it needed. A meeting was set and the plant manager and engineering staff that had requested the new equipment were presented with evidence that showed the facility should not be having so much trouble keeping the meat cool on hot days.

"They were looking at what they were using and I was looking at what they needed," says Holmes. "The data from our monitoring system, when compared to the model of the energy needs of the plant, showed that even on the hottest day of the year, the plant had between two and three times the refrigeration capacity it would need. Rather than spending a lot of money on new transformers and chillers they didn't need, we needed to find out why what they already had wasn't doing its job."

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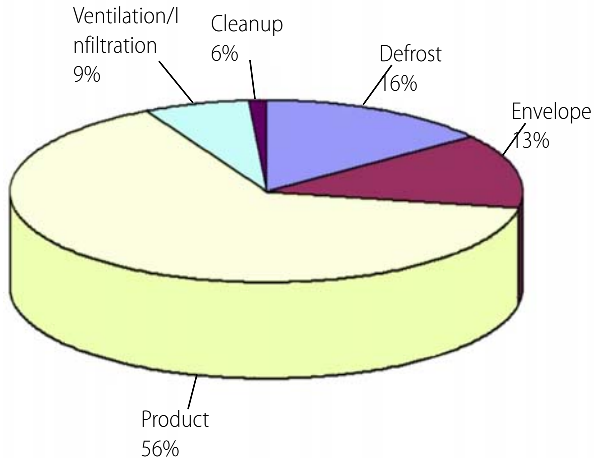
Annual Refrigeration Load Breakdown



DIGGING DEEPER

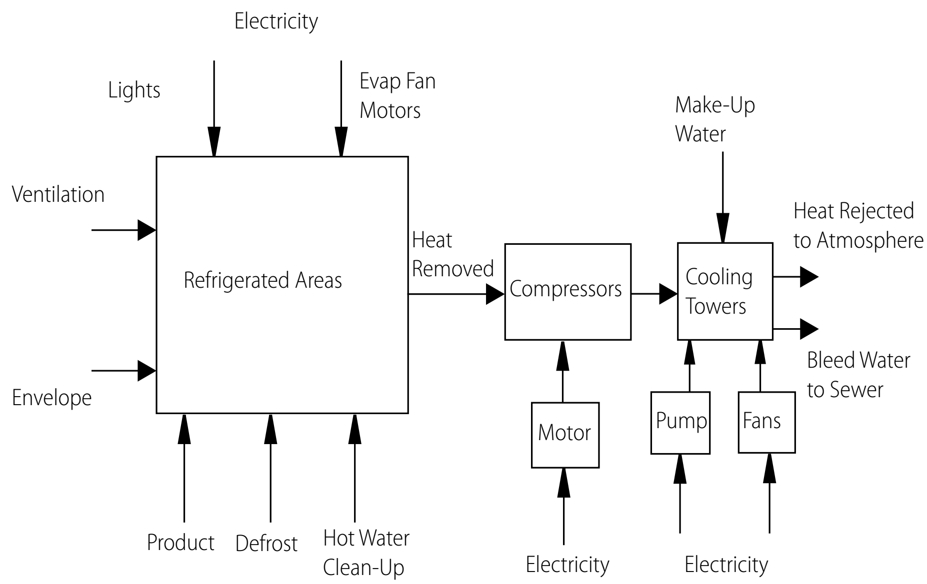
The newly acquired data provided an opportunity to reexamine the thermodynamics of the plant and possible reasons why cooling needs were not being met.

For instance, when live, 250-pound hogs were delivered to the plant for processing, each animal's body temperature was about 103 degrees. Regulatory guidelines require that after processing, the temperature of the resulting food products be lowered to the cooler or freezer temperature within a fixed number of hours. Using engineering physics and the specific heat of the hog, one can calculate exactly how much heat needs to be removed each hour and each day from each hog and from the total plant, and thus how much refrigeration is required.

Mariah's refrigeration system needed to remove the heat from the warm product brought into the coolers and freezers. It also had to remove heat from people, lights, motors, and the scalding water used for cleaning.

In the summer, the refrigeration system also battled the heat that came through the roof and walls, and the air that leaked in from the outside. Because parts of the building were 75 years old and the insulation was not very good, it was natural for the employees to assume these were all major reasons it was hard to keep the plant cool.

Whatever the reason, when all was said and done, in terms of energy balance for the total plant, "heat in" had to equal "heat out." The Mariah personnel understood this, but the question remained: why couldn't they sufficiently cool on hot days in the summer?



Gathered data from a Monday morning at 2:00 A.M., when the outside temperature was –20°, showed that the refrigeration system was providing 400 tons of cooling. This required running more than 600 horsepower, or approximately 600 kilowatts (kW). At five cents a kilowatt hour (kWh), this cost $30 an hour, or $720 a day.

But at 2:00 A.M. there were no lights on and no employees in the plant. No product had entered since the Friday before, and all of its heat had been removed within a few hours. Everything had been cleaned and sanitized that same day. The only thing running was the refrigeration system.

A PROBLEM UNCOVERED

Finally, they realized the issue. The cooling coils in the freezers had an automatic defrosting system. Periodically, hot refrigerant was blown through the cold coils so ice buildup on the surface would melt and evaporate. The hot gas for this procedure came from piping that ran from the refrigeration plant, and old automatic valves at each coil regulated the defrosting process.

If those old valves weren't working properly and the hot gas was continuously leaking to the coils in the freezers and coolers, a tremendous amount of heat was being introduced. To counteract this, the refrigeration system would be running a lot more (ironically, using much of its capacity just to support itself) and might not be able to provide enough cooling for the rest of the plant.

To investigate this possibility, engineers went through the plant to each of the coils and began manually closing the valves. Immediately, the AutoPilot monitoring system showed that the electricity used by each compressor and the total refrigeration system was dropping. (The refrigeration system, for example, started out at 600 kW and ultimately dropped down to less than 30 kW.) When they had finished, the plant cooling load peaked at less than 200 tons (down from approximately 550), thereby affirming Holmes Energy's contention that the cooling being provided was more than twice what was needed.

Uncovering the valve issue also confirmed that Mariah didn't need to spend the $100,000 for the new transformers (or the tens of thousands of extra dollars for new refrigeration equipment.) These avoided costs made a huge impact on Mariah's profitability.

By repairing the valves on the cooling coils, a false load in the refrigeration system was eliminated, which reduced the plant's electrical consumption by 600 kWh an hour each day for an annual savings of $250,000. This figure was more than 25% of Mariah's total annual utility costs!

Furthermore, many of the workers stated that Mariah's cooling problems had existed for close to 30 years. This means that those bad valves could have resulted in more than $2.5 million dollars in electrical costs. Plus, there was the loss of morale among Mariah's employees as they

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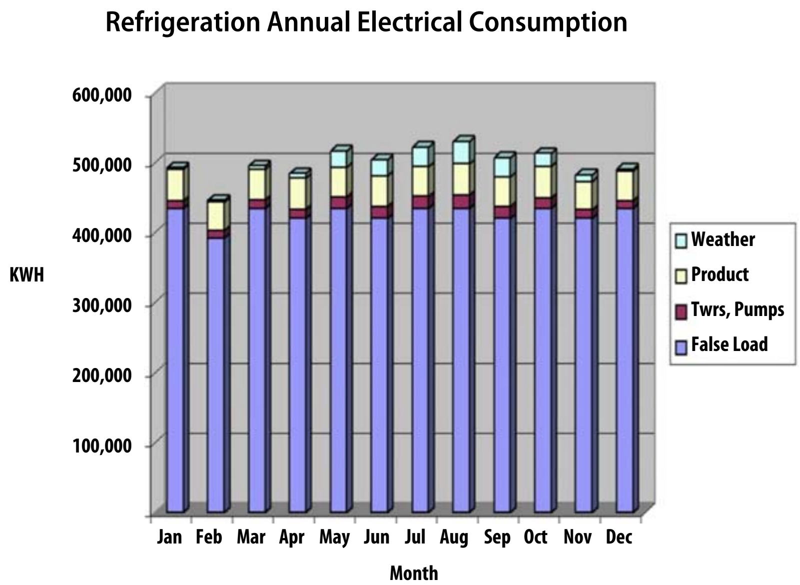

constantly struggled to keep conditions safe, equipment working properly, and meet regulatory guidelines—all while hampered by a strained cooling system.

The information provided by the Opto 22-based AutoPilot monitoring system designed and implemented by Holmes Energy didn't just reduce Mariah's utility costs; it allowed the company to increase profits by giving it a way to make critical business decisions regarding plant operations based on facts, not estimates or educated guesses. Rather than throwing money at the problem, management used the accuracy of the system to reveal flaws in Mariah's processes. Once identified, the situation was rectified and the company, which was losing money and on the verge of closing, was able to stay in business and thrive in ways it hadn't before.

This financial turnaround was made possible by an influx of energy-related, real-time data. Effective energy monitoring provided information that Mariah couldn't have accessed any other way. Suddenly, employees could view data on their computer screens or in reports and have enough information to understand problems that had been a mystery before.

This was the data that management needed to authorize and fund a fix they were confident would work. This led not only to immediate problems being remedied, but also to unnecessary expenditures being canceled and the entire plant being reevaluated and reorganized to increase profitability under a new energy-efficient paradigm.

"Knowing the utility costs associated with specific systems and areas within our plant helped us to determine that it was no longer competitive in our industry," said Mariah's General Manager Joe Brands. "When the data showed that the utility costs associated with parts of our operation were more than twice what they would be at one of our new plants, the need for major changes was clear."

"Without the data from the monitoring system, we would not have been able to understand and solve the problem," says Holmes. "Complete, accurate information presented in an easy-to-use format is critical; it is the key to creating and maintaining energy savings on an ongoing basis.

"Understanding the problems before attempting to provide solutions is good engineering and the only valid approach. And real-time data is the key to ensuring that energy systems are operated, maintained, and controlled to produce the lowest total costs to the owner."

ABOUT HOLMES ENERGY

Founded in 1979, Holmes Energy is headed by Bill Holmes, a practicing engineer, mechanical systems designer, and professor of thermodynamics, power systems and energy conservation at Purdue University. Holmes' impressive client list includes General Electric, Dupont, Honda, GenCorp, and Hoover, and he is the recipient of multiple awards and recognition from the State of Indiana, the Association of Energy Engineers, and the U.S Department of Energy. For more information go to www.holmesenergy.com.

ABOUT OPTO 22

Opto 22 was started in 1974 by a co-inventor of the solid-state relay (SSR), who discovered a way to make SSRs more reliable.

Opto 22 has consistently built products on open standards rather than on proprietary technologies. The company developed the red-white-yellow-black color-coding system for input/output (I/O) modules and the open Optomux® protocol, and pioneered Ethernet-based I/O.

In early 2013 Opto 22 introduced *groov* View, an easy-to-use IoT tool for developing and viewing mobile operator interfaces—mobile apps to securely monitor and control virtually any automation system or equipment.

Famous worldwide for its reliable industrial I/O, the company in 2018 introduced *groov* EPIC® (edge programmable industrial controller). EPIC has an open-source Linux® OS and provides connectivity to PLCs, software, and online services, plus data handling and visualization, in addition to real-time control.

All Opto 22 products are manufactured and supported in the U.S.A. Most solid-state SSRs and I/O modules are guaranteed for life.

The company is especially trusted for its continuing policy of providing free product support, free training, and free pre-sales engineering assistance.

For more information, visit opto22.com or contact
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