Save ENERGY Now

Based on recommendations from their Save Energy Now assessment, Shaw Industries plant #20 in Dalton, Georgia, installed a waste water heat exchanger on their Kuster dye line to capture excess heat and save a significant amount of money and energy.

Save Energy Now Assessment Helps Expand Energy Management Program at Shaw Industries

Flooring Company Saves $872,000 Annually by Improving Steam System Efficiency

Benefits

Implemented **$872,000 annually** in energy cost savings

Saved 93,000 MMBtu equivalent of natural gas and No.6 oil annually

Achieved a simple **payback of 1.7 years**

Key Findings

- The Save Energy Now assessment confirmed the success of the plant's energy management program and provided new ideas for energy efficiency.
- By optimizing boiler sequencing, installing waste heat exchangers and an economizer, and de-scaling boiler tubes, Shaw Industries' Dalton plant achieved significant energy savings.
- Energy efficiency measures identified by an independent, outside source can be integrated into a company's existing energy management program.

Applications

Steam systems are often found in textile products plants and can account for a significant amount of end-use energy consumption. Improving boiler efficiency and capturing excess heat can result in significant energy savings and improved production.

Summary

In 2006, a U.S. Department of Energy (DOE) Save Energy Now energy assessment was performed at Shaw Industries' plant #20 in Dalton, Georgia, to identify potential energy savings opportunities in their steam system. DOE Energy Expert George Lee, of the Georgia Institute of Technology, showed the facility's maintenance engineers how to analyze the plant's steam system using DOE's suite of steam system software tools. By capitalizing on some of these opportunities, plant personnel were able to achieve significant energy savings.

After determining which assessment recommendations had the quickest paybacks, plant personnel began taking steps to reduce the energy used by the steam system. They optimized boiler operation to fully load their most efficient boiler and installed waste heat exchangers on two separate processes in the dye house and an economizer on one of their boilers. By implementing these measures, the plant saved an annual total of $872,000 and the equivalent of 93,000 MMBtu in natural gas and No. 6 fuel oil combined. With project costs of approximately $1.5 million, the plant achieved a simple payback of 1.7 years. The success of the Save Energy Now assessment prompted Shaw to repeat the process and utilize DOE's software tools in its other plants.

Project Drivers

At Shaw Industries, energy efficiency and environmental stewardship are an important part of the corporate culture. Plant employees are open to new ideas that can assist them in meeting the company's objectives for reducing energy consumption. The Save Energy Now assessment affirmed several existing energy efficiency practices and also provided an additional perspective on potential solutions. The plant realized that several of the assessment's recommendations could be implemented cost-effectively and merged with some efficiency improvements already being considered. Plant employees integrated these opportunities into their energy efficiency program and took steps to start saving energy and money.

Shaw Industries installed a stack economizer on boiler #3, pictured above, to enable the plant to use excess heat to heat the boiler's feed water.

Company and Plant Background

Originally founded as Star Dye Company in 1946 in Dalton, Georgia, Shaw Industries is now a major manufacturer of floor products with more than $5 billion in annual sales and approximately 30,000 employees. The company manufactures a wide variety of carpeting and other flooring products such as laminate flooring for industrial, commercial, and residential markets. Energy efficiency is important at Shaw Industries, and as such each plant has an "Energy Czar" who monitors energy usage site-wide and manages all energy reduction efforts within the facility. The company has set corporate and plant goals for energy reduction and monitors energy usage very closely. A dedicated Corporate Energy Department assists the plants with energy management and allocates resources from Corporate Engineering to fund energy efficiency and pollution prevention efforts.

Located outside of Dalton, Georgia, plant #20 has almost 500 employees and is an important part of Shaw's carpet-making operations. It produces approximately 1.1 million square yards of finished polyester carpeting per week. Steam is critical for the plant's production as it is needed for water and yarn heating in the dye lines and in the dye preparation areas. The plant's steam system is served by three boilers, two dual-fuel units (natural gas and No. 6 oil), and one natural gas-fired unit. The system generates up to 120,000 lbs/hour at 125 psig.

Assessment Overview

The Save Energy Now assessment at Shaw Industries' plant #20 was conducted by DOE's Industrial Technologies Program (ITP), which provides Energy Experts who use DOE's software tools and technical information to evaluate and improve steam system efficiency. The DOE Energy Expert worked with the plant's "Energy Czar" and other team leaders to use DOE's steam system assessment tool (SSAT) software to model the plant's steam system. They then reviewed the results of the Steam System Scoping Tool and toured the dye house and boiler control room.

Assessment Recommendations

After analyzing the data collected in SSAT, the assessment team compared expected energy savings with technical and economic feasibility and associated payback periods. They classified the recommendations into near-, medium- , or long-term opportunities.

Near-term opportunities

- **Optimize boiler sequencing**—At the time of the assessment, the plant sequenced its three boilers at approximately a 50%, 50%, 25% fixed proportion average. The assessment showed that the plant could save energy by first loading the two dual fuel boilers, which were the most efficient of the three, and then operating the natural gas-fired boiler last. Because of the higher steam generation efficiency of these boilers, the net energy consumption would be lower. This opportunity would save more than $299,000 and the annual equivalent of 32,000 MMBtu of natural gas and No. 6 oil.

- **Install waste water heat exchanger**—The assessment team realized excess heat from the Kuster dye line was not being captured. By installing a waste heat exchanger on this line, the plant could capture it to heat process water for dying and avoid unnecessary sparging of steam. The assessment calculated that this measure would yield annual energy cost savings of more than $786,000 and the equivalent of 95,000 MMBtu in natural gas and No. 6 oil savings.

- **Install oxygen trim on boiler #3**—Boiler #3 operated with excess flue gas oxygen levels, resulting in lost heat and higher fuel consumption. By installing an oxygen trim controller on this boiler, the plant could save the Btu equivalent in No. 6 oil of nearly 5,000 MMBtu annually. The cost savings from installing this oxygen trim controller was estimated at approximately $40,000 per year.

Medium-term opportunity

- **Install economizer on boiler #3**—In addition to needing an oxygen trim controller, the assessment noted boiler #3 would benefit from having a stack economizer. At the time, excess heat from combustion in boiler #3 was not recovered. The installation of a stack economizer would enable the plant to use this excess heat to heat the boiler's feed water. The plant could save the Btu equivalent in No. 6 oil of nearly 9,500 MMBtu per year, which would yield annual energy cost savings of more than $76,000.

Long-term opportunities

- **Install economizer on boiler #1**—As with boiler #3, boiler #1 did not have a stack economizer, which allowed valuable heat to go unrecovered. Using the SSAT software, it was estimated that installing a stack economizer on this boiler would yield the Btu equivalent of almost 11,000 MMBtu per year of No. 6 oil, which would result in annual energy cost savings of more than $86,000.

- **Install hot water heater**—During the evaluation of the Kuster dye line, the assessment team realized that if they were to install the waste water heat exchanger, the waste water temperature would decline to 108°F, which was below the required process water temperature. They recommended installing a hot water heater unit to raise the waste water temperature back to the required level. Implementing this measure would yield the net Btu equivalent of 17,000 MMBtu of No. 6 oil and annual energy cost savings of $86,000.

- **Install oxygen trim on boiler #2**—Boiler #2 also had excess flue gas oxygen levels. The team calculated that if they installed an oxygen trim controller on this boiler, annual natural gas energy savings of 3,400 MMBtu and cost savings of approximately $32,000 were feasible.

If all the above recommendations were implemented, the total annual energy cost savings was estimated at more than $1.4 million.

"Our plant was very fortunate to be selected for the U.S. Department of Energy Save Energy Now study. The study helped us to identify and evaluate energy savings opportunities that we hadn't previously considered. The Energy Expert helped us to further evaluate and quantify known opportunities, providing needed justifications. With rising fuel costs and ever advancing competition, the need to be as energy efficient as possible is paramount. This study helped to shine the light on both large and small opportunities to become more efficient. The results speak for themselves."

—Robert Davidson, Plant Engineer, Shaw Industries

Results

After the assessment the employees at plant #20 integrated some of the recommendations into their energy management program. They began by optimizing the boiler sequencing to base load the more efficient boilers. Next, they installed a waste water heat exchanger on the Kuster dye line and on a separate process in the dye house. Rather than install a hot water heater at this time, the plant decided to use sparged steam to heat the water back to its required temperature.

Finally, they installed a stack economizer on boiler #3, which is now operational. This economizer was considered a higher priority than those on the other boilers because boiler #3 runs at a higher rate. Total annual energy savings from these measures was approximately $872,000 and 93,000 MMBtu. With implementation costs of approximately $1.5 million, the plant achieved a simple payback of 1.7 years.

Due to capital funding limitations, the plant was unable to implement the remaining recommendations at the time, including adding oxygen trim controllers to the boiler stacks and installing a direct-fired hot water heater on the Kuster dye line and the stack economizer on boiler #1. However, the success of Shaw's plant #20 assessment prompted the company to share what they learned with their other carpet plants in Northern Georgia. In addition, a Save Energy Now assessment was later performed at Shaw's plant #4 also located in Dalton, Georgia.

Shaw Industries' plant #20 utilized their energy management program to implement several of the Save Energy Now recommendations for significant savings in a short time period.

Lessons Learned

Industrial plants with longstanding energy efficiency programs can benefit from independent, expert analyses of steam and other motor-driven or process systems. At Shaw Industries' plant #20 in Dalton, Georgia, many plant employees had a good understanding of the plant's energy use patterns. A policy was in place to implement various industry best practices such as condensate return, blowdown heat recovery, minimizing blowdown, repairing steam leaks and traps, and proper boiler maintenance.

The Save Energy Now assessment confirmed the merit of these measures and suggested some additional steps that would further improve the efficiency of the plant's steam system. By implementing the most cost-effective recommendations, plant personnel achieved important energy savings.

In addition to the SSAT, DOE's other software tools can be used to analyze industrial systems and processes and generate energy efficiency opportunities. These tools include AIRMaster+, the Fan System Assessment Tool (FSAT), MotorMaster+, the Process Heating Assessment and Survey Tool (PHAST), the Pumping System Assessment Tool (PSAT), and 3E Plus®.

About Save Energy Now

Through Save Energy Now, DOE's Industrial Technologies Program (ITP) helps industrial plants operate more efficiently and profitably by identifying ways to reduce energy use in key industrial process systems.
Visit ***www.eere.energy.gov/industry/saveenergynow*** for more information.

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

For more information, contact the EERE Information Center, 1-877-EERE-INF (1-877-337-3463), www.eere.energy.gov
And visit the DOE Industrial Technologies Program home page: www. eere.energy.gov/industry

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