Industrial Technologies Program

Improving Energy Efficiency at U.S. Plastics Manufacturing Plants

Summary Report and Case Studies

Prepared by

The Society of the Plastics Industry, Inc.

and the

U.S. Department of Energy

U.S. Department of Energy

Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

Acknowledgements

This report was produced for the U.S. Department of Energy's (DOE) Industrial Technologies Program. It is based on a comprehensive project summary and case studies prepared by staff of the Center for Advanced Energy Systems at Rutgers University, with contributions from student interns, staff at DOE, The Society of the Plastics Industry, Inc., and several of its member companies.

The study was carried out by faculty, staff, and students in the DOE Industrial Assessment Centers (IACs) at several universities. The IACs at the following universities conducted one or more of the assessments for this study:

- Bradley University, Peoria, Illinois
- North Carolina State University, Raleigh, North Carolina
- University of Dayton, Dayton, Ohio
- University of Illinois, Chicago, Illinois
- University of Michigan, Ann Arbor, Michigan
- University of Wisconsin, Milwaukee, Wisconsin
- West Virginia University, Morgantown, West Virginia

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Summary Report and Case Studies

Overview

U.S. plastics manufacturing companies stand to boost their competitiveness, productivity, and profits if they take steps now to make their industrial processes and equipment more energy efficient. This is the major finding of a series of assessments conducted in 2003 on the potential for greater energy efficiency, less waste, and lower operating costs at several representative U.S. plastics plants.

To date, 9 of 11 plants in the study have implemented at least one recommended improvement project. As a result, these 9 plants are reducing their energy costs an average of nearly 10% per year and saving thousands of dollars on energy bills annually.

Rising energy prices are becoming a major concern in the plastics industry. This is especially true for small- and medium-sized companies that have little wiggle room when trying to balance operating expenses against profitability. As adequate supplies of natural gas and other resources become more costly, many plastics manufacturing companies are realizing that they need to reduce the energy they use—and the energy they waste—to stay competitive in regional and global markets.

Therefore, in 2003 The Society of the Plastics Industry, Inc. (SPI), a major trade organization, began working with the U.S. Department of Energy (DOE) on a series of energy assessments at several SPI member companies' plants, as part of DOE's established Allied Partnership[1] activities. The 11 companies included in this study represent a broad cross-section of the industry in terms of size, production processes, and variety of products. The assessments showed that the companies were consuming an average of more than 53,000 million Btu (MMBtu) per year and spending an average of nearly $690,000 annually on energy costs.

The assessments were conducted by DOE's Industrial Technologies Program (ITP) through seven DOE-sponsored Industrial Assessment Centers (IACs).

[1] DOE's Allied Partners are manufacturers, trade associations, industrial service and equipment providers, utilities, and other organizations that agree to help promote energy efficiency and productivity for industries that participate in

These centers, which are based at 26 universities throughout the nation, conduct no-cost assessments for small and medium-sized companies that cannot readily afford to hire private contractors.

Measurements and analyses of the energy used in primary processes, ancillary services, and the building envelope were included in the assessments. Using the resulting data, IAC staff were able to identify opportunities for energy savings, waste-reduction measures, and productivity improvements for each plant. IAC faculty and students captured these opportunities in a set of recommendations made to the individual companies. A broad sampling of the recommendations is included in 11 case studies that are intended to help other companies identify similar opportunities for savings in their own manufacturing operations.

The IACs made a total of 99 recommendations to the 11 companies described here; these recommendations covered all aspects of plant operations. They ranged from no- or low-cost measures with immediate paybacks to those that required a significant investment on the part of the companies. By March 2005, 10 of the 11 facilities had already implemented at least 52 of the 99 recommendations to save, on average, $68,500 annually per plant. Additionally, 9 of 11 plants implemented energy-related recommendations to reduce their energy costs by an average of $45,000 per year, which is a savings of 9.7% on their annual energy bills.

Several recommendations involved relatively major expenditures, but they would also have major impacts on the company's annual operating costs. Here are some of them, along with an estimate of the resulting annual cost savings:

- Adding storage capacity to expedite production ($573,000)
- Improving a water cooling system ($132,000)
- Reducing the change-over time of large presses ($35,000).

While specific results are presented in the case studies in the appendix, general results and their implications are described in the following sections of this summary, including:

- Background information on the industry
- The participants in the study
- The steps in the assessment
- A summary of results, including the top recommendations

- A sampling of detailed recommendations
- Opportunities for savings in select processes
- Summary and conclusions.

The Industry

The plastics industry employs about 8% to 9% of the U.S. manufacturing workforce, and it consumes approximately 6% of all the energy used by U.S. industries. DOE and other data for 1998 indicated that plastic materials and resins companies were using nearly 1,070 trillion Btu (about 1.1 quadrillion Btu) of energy annually, valued at about $6 billion. Manufacturers of plastic and rubber products were consuming more than 320 trillion Btu (about one-third of a quadrillion Btu) in their operations each year, valued at $3.5 billion.

DOE estimates that reducing the plastics industry's energy use by even 1% by 2010 could shave at least $100 million from its total annual energy costs, if not more. Therefore, in 2002, SPI and DOE formed an Allied Partnership to assist industry members in reducing their overall energy use, enhancing productivity, and curbing environmental emissions. In March 2003, SPI and DOE began the project described here.

The Participants

The major participants in this project were SPI, DOE, IAC, and the 11 companies representing the plastics industry.

SPI. The Society of the Plastics Industry, Inc., was founded in 1937. This trade association represents one of the largest manufacturing industries in the United States. Its approximately 1,300 members, as of 2003, include processors, machinery and equipment manufacturers, and suppliers of raw materials. SPI's mission is to represent the plastics industry by promoting its development, increasing the public's awareness and understanding of the industry, and serving its members. SPI notes that U.S. plastics companies were shipping more than $310 billion in products annually, as of 2002 (see www.socplas.org for more information).

U.S. DOE. The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) is home to the Industrial Technologies Program (ITP). The program's mission includes improving industrial energy efficiency and reducing environmental emissions through partnerships with U.S. industries. The program seeks to invest in high-risk, high-value research and development that will reduce industrial energy requirements while stimulating economic productivity and growth (for more information, see www.eere.energy.gov/industry).

IAC. The DOE-sponsored Industrial Assessment Centers stimulate the near-term adoption of energy management best practices and technologies. The centers, located at 26 universities throughout the country, provide eligible small and medium-sized manufacturers with comprehensive industrial assessments performed at no cost to the manufacturer. The assessment teams are made up of engineering faculty and students; they provide recommendations to manufacturers to help them identify opportunities to improve productivity, reduce waste, and save energy (for more, see www.eere.energy.gov/industry/bestpractices/iacs.html).

The plastics companies. Each of the 11 companies selected for the project was matched with an IAC in an appropriate region of the country. Table 1 lists the companies, their primary products, estimated savings, and some key recommendations that came out of the assessments.

The Assessments

The in-plant assessments were conducted within a fairly consistent framework. First, project members contacted an appropriate IAC to schedule an assessment. Then, the company and the IAC selected a team to carry it out, and it was usually completed in 3 to 4 months. A typical assessment included the following four basic steps:

- ***Gather information.*** This involved collecting information about the plant's energy bills, its layout, and certain logistics, such as the primary product and the number of employees. The assessment team also prepared for the site visit and assessment by doing research on any novel technologies involved and obtaining the measurement instruments they needed.
- ***Visit the site.*** Assessment teams usually needed to spend only one day at the site.

Table 1. Companies Participating in the 2003 SPI-IAC Industrial Energy Assessments

Company, Location, and Participating IAC	Major Product	Recommended Total Cost Savings	Implemented Annual Energy Cost Savings *(as of 3/05)*	Implemented Total Annual Cost Savings[2] *(as of 3/05)*	A Major Cost-Saving Recommendation
Bemis Manufacturing, Sheboygan Falls, WI University of Wisconsin-Milwaukee IAC	Toilet seats	$58,892	$22,344	$22,344	Replace motor belts with synchronous belts
Dickten & Masch, Nashotah, WI University of Wisconsin-Milwaukee IAC	Thermal-set and injection-molded plastics	$46,900	$34, 743	$34,743	Install energy-efficient lighting
Ferro Corporation, Stryker, OH University of Michigan IAC	Performance materials	$209,534	$51,740	$183,737	Improve water cooling system
Moraine Molded Plastics, Cincinnati, OH University of Dayton IAC	Injection-molded component parts	$38,005	$4,585	$24,070	Air-condition the manufacturing area
National Plastics Corporation, Fort Wayne, IN University of Dayton IAC	Injection-molded automotive parts	$121,447	$0	$34,560	Reduce change-over time on presses
N-K Manufacturing Technologies, Grand Rapids, MI University of Michigan IAC	Custom-molded automotive parts	$609,705	$27,805	$27,805	Install large storage tanks
Precise Technology, Inc., North Versailles, PA West Virginia University IAC	Custom plastic injection moldings and parts	$115,841	$105,137	$105,137	Use T8 lighting, electronic ballasts
Spartech Plastics, Richmond, IN Bradley University IAC (Peoria, IL)	Custom extruded thermoplastic sheet and roll stock	$156,891	$56,872	$112,911	Recover compressor waste heat
Superfos Packaging, Cumberland, MD West Virginia University IAC	Plastic packaging	$179,959	$98,542	$98,542	Insulate molding machine surfaces
VPI, Inc., Sheboygan Falls, WI University of Wisconsin-Milwaukee IAC	Medical, commercial, and lenticular signing	$51,229	$6,795	$6,795	Use outside air for compressor
Wexco Corporation, Lynchburg, VA North Carolina State University IAC	Bimetallic plasticizing cylinders	$53,384	$0	$0	Recirculate exhaust gas to furnace
Annual averages as of 3/05		**$149, 253**	**$45,396**	**$68, 454**	

[2] Total annual cost savings includes energy cost savings, plus other productivity cost savings, if applicable, as a result of implementing assessment recommendations.

But that time could be extended for larger plants or when sophisticated recommendations were necessary. A typical site visit included the following:

- The initial interview with plant personnel to gain information about raw materials, plant processes, energy systems, and waste production
- A tour of the plant to observe production processes and identify general opportunities for savings
- A brainstorming session and discussion of ideas with plant personnel to determine energy-saving projects
- Data gathering in the production area to measure flow rates, temperatures, and other factors that could affect or help to determine savings
- An exit interview at the end of the visit to discuss the day's activities with plant personnel.

- ***Prepare and submit the assessment report.*** The assessment team analyzed the ideas and recommendations identified during the site visit and estimated potential savings, implementation costs, and paybacks. Within 60 days of the assessment, the teams submitted a detailed write-up of opportunities, including information on potential energy savings, energy cost savings, and savings resulting from reducing waste and enhancing productivity. Information from the reports was sent to the Center for Advanced Energy Systems (CAES) at Rutgers University, whose staff are the field managers for the IAC program. While maintaining confidentiality as needed, CAES added pertinent information to a publicly available database of IAC assessments (for more, see http://iac.rutgers.edu/database).
- ***Follow up on implementation.*** Within 6 to 9 months of the plant site visit, the assessment team contacted the plant to inquire about the implementation status of the projects identified in the report.

The Results

The case studies in the appendix provide details about the assessment teams' 99 recommendations to the 11 companies. In addition, CAES analyzed the recommendations as a whole to provide some insights into the potential for energy savings in the entire plastics industry. One of the results of this analysis is a list of the top assessment recommendations that came out of the study.

To determine the top recommendations, the analysts considered all the different types of projects involved, including those that called for little or no investment to obtain immediate paybacks and those that would require a sizable commitment of capital funds. Then, they sorted the recommendations by average annual savings while limiting them to the ones with a simple payback of less than 2 years. The resulting list (see Table 2) applies to projects that recommended ways to save energy, reduce waste, or increase productivity.

Table 2. Top Recommendations from the DOE-SPI 2003 Assessments
(According to highest amount of savings and shortest payback periods)

Recommendation	Total Annual Savings (estimated)	Implementation Cost (estimated)	Simple Payback (months)
Install large storage tanks	$573,000	$390,000	8
Improve water cooling system	$132,000	$31,500	3
Reduce changeover time at the 500 and 1,000-ton presses	$34,560	$0	Immediate
Sell unused equipment	$34,400	$10,000	4
Air-condition manufacturing area	$30,335	$50,000	20
Implement a motor management system	$27,875	$480	1
Add liquid pressure amplifiers to chillers	$20,554	$25,000	15
Insulate bare molding machines	$19,480	$4,640	3

Together, the top recommendations add up to a total cost savings of $872,204 per year, or 53% of the total estimated savings from all recommendations. The dollar amounts required to implement the top recommendations range from $0 to $390,000. Some these recommendations are described in more detail here.

Install a large storage tank. N-K Manufacturing Technologies' Grand Rapids, Michigan, plant had to dehumidify most of its polymer pellets before they could be used in the summer. During that time, pellets normally were placed in dehumidifiers on the production machines. During the 2- to 3-hour drying time, production machines were inactive and workers were idle, increasing labor downtime.

The recommendation suggested that the facility add a bulk storage system that would allow the new product to be contained and dehumidified before moving to the line. The company would then be able to buy products in quantity at low cost and to keep the material cleaner. Dehumidifying the pellets before they go to the production machine will help to reduce downtime during the summer to a lower, year-round average.

Improve the water cooling system. The water cooling system at Ferro Corporation's plant in Stryker, Ohio consists of an external cooling tower connected to the facility's well, a piping system connected to water baths, and Banbury lines, as shown in Figure 1. The water supplying the lines goes through a reservoir and a heat exchanger. At the time of the assessment, the heat exchanger had been malfunctioning because of the summer heat and fines from the water cut process. Water going into the Banbury lines was very hot; this decreased the lines' productivity because they require cool water.

The proposed new water cooling system is shown in Figure 2. Savings would be realized from the resulting increase in the productivity of the Banbury system, the decrease in the amount of cooling needed from the tower, the decrease in the pumping energy needed, and the lower maintenance costs for the water cooling tower and heat exchanger.

Reduce the change-over time for 500- and 1000-ton presses. Managers at National Plastics Corporation's plant in Fort Wayne, Indiana, reported that change-over times for tooling on the 500- and 1,000-ton presses—which run weekdays and two Saturdays per month—were averaging 1.5 times per week and taking a total of about 36 hours. Reducing this change-over time could also result in less overtime on weekends. In addition, if the machines did not have to operate on weekends, the amount of energy needed for lighting and other equipment each week would also decrease.

According to the managers, most mold changes are scheduled on the first shift and extend past the end of that shift. Because two first-shift operators are the only ones trained to perform this procedure, if the mold change could not be completed during first shift, the presses would sit idle until the next day, when the procedure could be completed. Managers also stated that an excessive

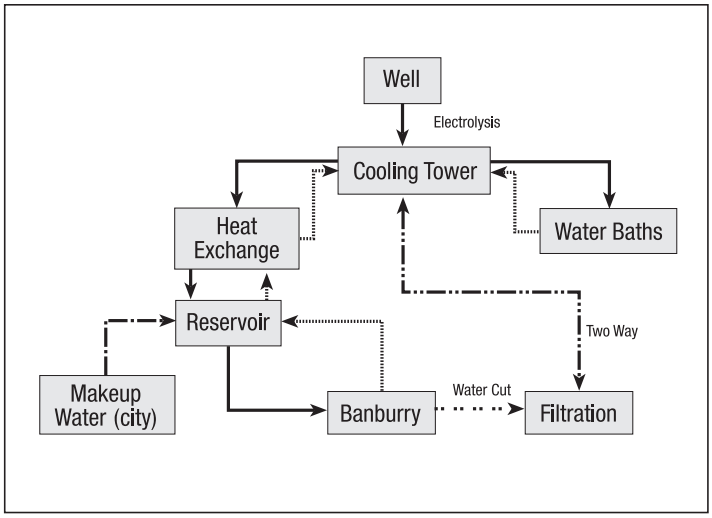

Figure 1. Ferro Corporation's current water cooling system

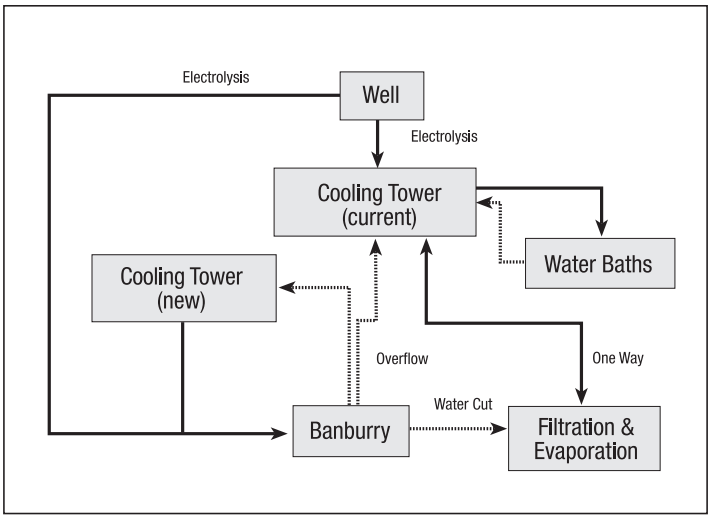

Figure 2. Proposed water cooling system for Ferro Corporation

amount of time was being wasted in looking for equipment needed to properly install the mold. The assessment team recommended the following procedure:

- Outfit the change-over molds with the correct hoses, knockouts, and bars
- Stage this equipment at the press before beginning the change-over
- Schedule the change-over early in the first shift.

Managers estimate that these changes alone could reduce change-over time to 5 hours, saving both energy and money.

Savings Opportunities for Selected Processes

The recommendations were also categorized in terms of specific plant-related processes, such as compressed air systems, lighting, and heating and cooling. Most of the recommendations fell into the compressed air category. Table 3 lists the categories, the number of recommendations in each one, and the average savings associated with them.

The total number of recommendations for each category includes several different specific ones. For example, the 29 recommendations in the compressed air category include such measures as fixing leaks, purchasing smaller compressors, and installing intermediate controllers in the system.

The savings shown in Table 3 represent the average recommended savings per assessment. For example, the potential average savings resulting from implementing recommendations in the compressed air category would be $27,143 per year. The average implementation cost would be $13,325 per year, for an average payback period of 6 months.

Table 3. Number of Recommendations and Potential Average Cost Savings in Major Improvements Categories

Improvement Category	Number of Recommendations	Average Annual Cost Savings per Category (estimated)
Compressed Air	29	$27,143
Lights	16	$17,012
HVAC	15	$14,695
Motors	8	$13,460
Heat recovery	7	$16,845
Insulation	6	$19,480
Waste reduction	6	$7,640
Load shedding/power factor	6	$12,690
Productivity	4	$240,217
Controls	3	$15,570

Summary and Conclusions

The average energy consumption of the 11 facilities assessed in the SPI Special Assessment Series was 53,101 MMBtu per year, and their average energy costs were $686,581 per year. The activities of the 11 participating member companies can be categorized into subsectors of the following North American Industry Classification System (NAICS) codes: 325 (Chemical Manufacturing) and 326 (Plastic and Rubber Products Manufacturing). See Table 1 for a list of some of these companies' major products.

The assessment teams contacted the companies several months after the assessments were carried out to find out which recommendations were being implemented. Therefore, the assessment results can be broken down according to both average recommended savings and average implemented savings.

Recommended savings. These potential energy and cost savings identified and recommended to the plants by the IAC teams can be described in terms of estimated averages per plant (see Table 4). The average number of recommendations per assessment is about nine.

Table 4. Estimated Average Savings Potential for 11 Plants
(Based on assessment recommendations)

Savings Category	Potential Average Annual Savings (estimated)
Energy savings	5,949 MMBtu
Percentage reduction in plant energy use per assessment	20%
Energy cost savings per assessment	$72,056
Percentage reduction in plant energy costs per assessment	17%
Total savings per assessment (energy and productivity cost savings combined)	$149,442

Example: A report from the University of Dayton on its IAC team's assessment at National Plastics Corporation notes that 17 opportunities for savings were identified in several different areas of the plant.

Of that total, 14 recommendations were energy-related. The total energy savings potential was 4,981 MMBtu per year; the corresponding potential energy cost savings would be $82,051. This represents 23% of the facility's annual energy usage and 21% of its total energy costs. The report also contained two recommendations that would reduce waste and one that would enhance productivity. The total estimated cost savings resulting from implementing the recommendations in the report would be $121,447 per year.

Implemented savings. The IAC teams followed up 6 to 9 months after the original assessment with the 11 companies to obtain information on the implementation status of the recommended projects. They found that, as of March 2005, 9 of the 11 companies were realizing energy and cost savings. The average of four recommendations per assessment had been implemented (see Table 5).

Table 5. Estimated Average Savings for 9 Plants
(Based on implemented recommendations)

Savings Category	Potential Average Annual Savings (estimated)
Energy savings	3,409 MMBtu
Percentage reduction in plant energy use per assessment	9.5%
Energy cost savings per assessment	$45,396
Percentage reduction in plant energy costs per assessment	9.7%
Total savings per assessment (energy and productivity cost savings combined)	$68,454

Example: As reported by the IAC team at Bradley University, Spartech Plastics has one of the highest implementation rates in the study. The assessment team had recommended energy savings of 10,141 MMBtu per year and had estimated cost savings at $100,852 annually. The recommendations actually implemented at the plant are yielding a total annual energy savings of 7,300 MMBtu (nearly 16% of the total amount of energy consumed) and energy cost savings of $56,872 (about 12% of the plant's total energy costs). The total dollar savings for all measures recommended by the IAC team amounted to $156,891, and Spartech is actually saving $112,911 per year as a result of the new projects.

The savings described here include only those resulting from recommendations that have been implemented and those that will be achieved in future projects with firm implementation dates. Two of the 11 companies have not yet implemented projects; they might be able to incorporate some recommendations in future energy efficiency plans.

Overall, however, the assessment results demonstrate that many of the recommendations could readily be adapted and replicated throughout the plastics industry to save energy and operating costs, enhance productivity and competitiveness, and reduce environmental emissions. The significant potential for greater energy efficiency found in the 11 assessments indicates that the plastics industry could reduce its energy costs by hundreds of millions of dollars by 2010 through cost-effective energy efficiency projects.

Implementing all the measures recommended in the 2003 assessments would reduce energy costs an average of 17% per company. Energy-efficient practices are thus proven ways for the plastics industry to cope with rising energy costs and maintain or increase its competitiveness in world markets.

Appendix: Case Studies

Assessment Date: July 6, 2003

Benefits:

- Saves more than $22,000 in operating costs per year
- Reduces electricity use by nearly 460,000 kWh per year and natural gas use by about 662 MMBtu per year
- Has payback periods ranging from 2 to 8 months

Applications:

To reduce energy use and costs, increase productivity, and enhance corporate competitiveness, the assessment team focused on manufacturing processes as well as lighting, heating, compressed air usage, and waste management.

Bemis Manufacturing Company: Compression Molding Company Saves More Than $22,000 Per Year by Implementing Industrial Energy Assessment Recommendations

Summary

The University of Wisconsin–Milwaukee's Industrial Assessment Center (IAC) conducted an energy audit at Bemis Manufacturing Company's production plant in Sheboygan Falls, Wisconsin, that should save more than $22,000 in operating costs. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

Opportunities for saving electricity were found that included installing a flow controller to better control the compressed air system, using outside air for the compressors, and installing synchronous belts on various motor systems. The assessment team also found that scheduling forklift charging during off-peak hours would reduce overall demand. Gas-saving opportunities involved adjusting the boiler air-fuel ratio and insulating some equipment. Implementing a reverse osmosis filtration system would provide savings on water and sewer costs. At least 57% of the assessment team's recommendations were implemented at the plant.

Company Background

Bemis Manufacturing Company is one of the world's largest manufacturers of molded wood, wood veneer, and plastic toilet seats. Its Sheboygan Falls facility annually generates approximately $150 million in sales and processes about 70 million pounds of wood flour per year. The facility assessed measures 330,000 square feet; the production area is 295,000 square feet. At the time of the assessment, production consumed nearly 47 million kWh of electricity and about 96,000 MMBtu of natural gas annually, for a total energy cost of approximately $2.6 million in the facility assessed.

Assessment Approach

A team consisting of students and a director from the University of Wisconsin–Milwaukee IAC carried out an assessment of this facility on June 6, 2003. The assessment team met with plant personnel, toured the facility, and collected data. After the team reviewed potential energy-saving opportunities, they presented their findings to the plant's managers. The assessment was led by IAC Director Dr. Umesh Saxena.

Recommendations

Energy Conservation Awareness. While making recommendations to reduce energy, as shown in the table, the assessment team found that employees were already using many conservation practices at the Bemis Manufacturing facility to reduce energy consumption. For example, management encourages employees to turn off or shut down idle processing equipment, lights, fans, air compressors, and other types of energy-consuming equipment when they are not in use.

Energy-Efficient Equipment. In addition to the recommendations for increasing the efficiency of equipment, as shown in the table, the assessment team noted that the facility has state-of-the-art, energy-efficient fluorescent lighting that consumes only about half the power used by standard, high-intensity discharge lighting. The team also found that Bemis filters and reuses heated plant air and has insulated molding equipment well. Plant personnel have also installed dock seals in the shipping department to reduce the loss of heated air through the doors.

Results

Bemis Manufacturing implemented four of the six recommendations provided by the IAC for the Sheboygan Falls facility. These projects will result in more than $22,000 in annual cost savings, as shown in the table. Energy conservation measures that were implemented will reduce electrical usage by more than 459,000 kWh, lowering electrical demand by approximately 734 kW-months per year (kW-mo/yr).[1] Annual natural gas usage will also be reduced by about 662 MMBtu.

Implemented Recommendations for Bemis Manufacturing's Sheboygan Falls, WI Plant

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Motors Replace belts with synchronous belts	270,071 kWh; 260.4 kW-mo/yr	$9,663	$3,433	5 months
Process Supply • Use outside air for compressor	189,274 kWh; 260.4 kW-mo/yr	$7,050	$1,240	3 months
• Adjust boiler air-fuel ratio	661.5 MMBtu	$3,486	$500	2 months
Demand Charge forklift trucks during off-peak hours	268.5 kW-mo/yr	$22,344	$1,400	8 months
Total	**459,345 kWh/yr; 733.9 kW-mo/yr; 661.5 MMBtu/yr**	**$22,344**	**$6,573**	

[1] kW-months per year represents total kW savings per year, based on kW savings per month.

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.

Project Partners:

Bemis Manufacturing Company
Sheboygan Falls, WI

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, DC

EERE Information Center
1-877-EERE-INF (1-877-337-3463)
www.eere.energy.gov

Center for Advanced Energy Systems
640 Bartholomew Road
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www.caes.rutgers.edu

DOE/GO-102005-2161
September 2005

Assessment Date: July 10, 2003

Benefits:

- Saves almost $35,000 per year as a result of implemented projects
- Lowers electricity use by nearly 633,000 kWh per year and natural gas use by about 211 MMBtu per year
- Has payback periods ranging from less than 1 month to 29 months

Applications:

The assessment team identified opportunities to decrease energy use and costs, increase productivity, and enhance corporate competitiveness by focusing primarily on manufacturing processes as well as on lighting, heating, compressed air use, and waste management.

Dickten & Masch Manufacturing Company: Industrial Energy Assessment Achieves $35,000 in Cost Savings for Plastics Manufacturer

Summary

The University of Wisconsin–Milwaukee's Industrial Assessment Center (IAC) conducted an energy audit at Dickten & Masch Manufacturing Company's production facility in Nashotah, Wisconsin; as a result, the company is already saving nearly $35,000 per year in operating costs. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

Opportunities for saving electricity at the Neshotah plant involved installing more energy-efficient lighting and using variable frequency drives for motors. The assessment team also recommended obtaining better control of the operation of the compressed air system as well as using outside air in the system. The team found that scheduling forklift-charging activities during off-peak hours would reduce overall energy demand. And, they identified an opportunity for gas savings by recommending temperature setbacks in the facility. In the first year following the assessment, Dickten & Masch implemented 66% of the assessment recommendations for saving energy and reducing costs.

Company Background

Dickten & Masch Manufacturing Company is a custom manufacturer of thermalset and injection-molded plastics. Its Nashotah facility generates approximately $50 million in sales and processes about 15 million pounds of a variety of plastics annually. The facility assessed measures 144,000 square feet; the production area covers 108,000 square feet. At the time of the assessment, production processes consumed more than 13.5 million kWh of electricity and nearly 6,000 MMBtu of natural gas per year, for a total annual energy cost of more than $700,000.

Assessment Approach

A team consisting of students and a director from the University of Wisconsin–Milwaukee IAC performed the assessment of this facility on July 10, 2003. The team met with plant personnel, toured the facility, and collected data. The team reviewed potential energy-saving opportunities and presented their findings to the plant's managers. The assessment was led by IAC Assistant Director Dr. Vjekoslav Pavelic.

Recommendations

Energy Conservation Awareness. In addition to the recommendations listed in the table, the assessment team identified several energy conservation practices that employees at the Dickten & Masch facility use to significantly reduce energy consumption. For example, management encourages employees to turn off or shut down idle processing equipment, lights, fans, air compressors, and other energy-consuming items when they are not in use.

Energy-Efficient Equipment. While identifying new ways to increase the plant equipment's energy efficiency, as shown in the table below, the assessment team found that the facility has an automated part-removal system and an efficient automated feed system. These systems reduce spillage and scrap while they increase accuracy and productivity. The facility has also installed dock seals on shipping doors to reduce the loss of heated and conditioned air through the doors.

Results

Dickten & Masch Manufacturing Company implemented four of the six recommendations made by the IAC. These changes will result in annual savings of almost $35,000, as shown in the table. Energy conservation opportunities that were implemented will reduce electrical usage by more than 632,000 kWh, thus reducing electrical demand by approximately 1,528 kW-months per year (kW-mo/yr)[1]. Annual natural gas usage will also be reduced by about 211 MMBtu.

Implemented Recommendations for the Dickten & Masch Plant in Nashotah, WI

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Facility Install energy-efficient lighting	562,170 kWh; 1,124.3 kW-mo/yr	$26,308	$61,875	29 months
Demand Charge forklift trucks during off-peak hours	255.2 kW-mo/yr	$4,115	$400	2 months
Process Supply Use outside air for a compressor	61,682.8 kWh; 148.3 kW-mo/yr	$3,128	$1,980	8 months
Heating Implement temperature setbacks in the facility	210.6 MMBtu	$1,192	$1,600	17 months
Total	**632,852.8 kWh/yr; 1,527.8 kW-mo/yr; 210.6 MMBtu/yr**	**$34,743**	**$65,855**	

[1] kW-months per year represents total kW savings per year, based on kW savings per month.

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Project Partners:

Dickten & Masch Manufacturing Company
Nashotah, WI

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, DC

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DOE/GO-102005-2162
September 2005

Assessment Date: June 18, 2003

Benefits:

- Could save nearly $210,000 in annual energy and productivity costs
- Could reduce energy use by almost 9.6% per year
- Achieves payback periods ranging from immediate to less than 6 months

Applications:

To decrease energy use and costs and enhance productivity, the assessment focused on the manufacturing process and on the heating and air compressor systems.

Ferro Corporation: Industrial Energy Assessment Identifies $210,000 in Savings Opportunities for Glaze and Coatings Manufacturer

Summary

The University of Michigan's Industrial Assessment Center (IAC) performed an energy audit at Ferro Corporation's plastic colorant plant in Stryker, Ohio; it showed that the plant could save almost $210,000 per year in energy-related and operating costs. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

Opportunities for saving electricity and natural gas and for increasing productivity included installing devices to improve water cooling and optimizing the use of the compressed air system. The assessment team also recommended making changes to the heating system as well as improving the water-cooling system, insulating dies and extruder cases, moving radiant heater units, and optimizing the use of compressed air, all of which would reduce annual energy consumption by 4,807 MMBtu and reduce operating costs by $209,534 per year.

Company Background

Ferro Corporation is the world's largest supplier of ceramic glaze and porcelain enamel coatings. Ferro produces powder coatings, pigments, specialty plastic compounds, polymer additives, and plastic colorant, which are used extensively in new buildings and renovations, major appliances, and industrial products. The facility assessed measures 100,000 square feet and has a total energy budget of approximately $1.13 million per year, chiefly for electricity but also for natural gas.

Assessment Approach

A team of students and staff from the University of Michigan IAC, led by IAC Assistant Director Dr. David Everest, performed an assessment of this facility on June 18, 2003. The following sections describe the team's approach to conducting the audit.

Recommendations

Energy Conservation Awareness. At the Stryker facility, 100% of total natural gas consumption goes for heating. Among electricity-using equipment, motors use 67% of the total, air compressors consume 14%, pumps use 8%, electric heaters use 8%, and lighting accounts for 3%. The assessment team identified some energy

conservation practices for Ferro employees to use to significantly reduce the amount of energy consumed by the equipment, such as turning off all energy-using equipment that is not being used.

The Water-Cooling System. The material mixers are critically important to production at the plant. If the temperature of the lubricating oil is too high, the mixing process will have to slow down or even stop. The mixer is a closed-loop system cooled by water from a cooling tower. Because fouling caused by other equipment affects the tower/loop heat exchanger, water going into the mixing lines is usually very hot; this lowers the productivity of the major production lines. The assessment team recommended installing additional equipment to reduce fouling of the heat exchanger.

The Compressed Air System. Compressed air systems require a significant amount of energy to operate. At Ferro's plant, compressed air was being used to dry product. This was expensive, in part because much of the energy required to compress air is lost to heat and leakage. The assessment team recommended that the facility install equipment that is better suited for drying operations.

The Heating System. Currently, the facility has approximately 1,000 lineal feet of radiant heaters on the ceiling of the finished goods warehouse. Most of the heaters are directly above boxes rather than above the aisles. Because radiant heaters will heat only those objects that are directly underneath them, most of the ones in the plant heat only the finished product boxes.

Results

The table shows Ferro's estimated annual cost savings if the plant implements the energy conservation and productivity opportunities identified. These results indicate that the facility can decrease natural gas usage by nearly 2,100 MMBtu and electrical usage by almost 800,000 kWh, lowering electrical demand by approximately 1,600 kW. These reductions will decrease natural gas and electricity usage and electric demand costs while increasing production, for a total savings of almost $210,000.

Recommendations for Ferro Corporation's Plant in Stryker, OH

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Heating and Cooling System				
• Improve the water cooling system	357 MMBtu	$132,000	$31,500	3 months
• Insulate dies and extruder cases	783 MMBtu	$20,715	$4,565	3 months
• Move radiant heater units	2,082 MMBtu	$13,955	$6,000	5 months
Compressed Air				
• Replace compressed air drying units	942 MMBtu	$24,928	$520	Less than 1 month
• Repair compressed air leaks	486 MMBtu	$12,854	$150	Less than 1 month
• Duct outside air to the compressor	157 MMBtu	$5,082	$100	Less than 1 month
Total	**4,807 MMBtu/yr**	**$209,534**	**$42,835**	

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Project Partners:

Ferro Corporation
Stryker, OH

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, DC

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DOE/GO-102005-2163
September 2005

Assessment Date: June 27, 2003

Benefits:

- Saves nearly $4,600 per year initially
- Should save an additional $19,000 or more per year with new HVAC system
- Has payback periods ranging from immediate to nearly 4 years

Applications:

Opportunities were identified that would decrease energy usage and costs while increasing productivity, improve product quality, and enhance corporate competitiveness.

Moraine Molded Plastics, Inc.: Industrial Energy Assessment Finds Opportunities to Save $24,000 in Annual Operating Costs

Summary

The University of Dayton's Industrial Assessment Center (IAC) performed an energy audit of Moraine Molded Plastics, Inc., in Cincinnati, Ohio, that should save the company approximately $24,000 per year in operating costs. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

Some energy-saving opportunities identified by the assessment team and implemented at the plant included replacing inefficient lighting and reducing the temperature of the barrel heater on the injection molding machines when the machines were not being used. The company also decided to improve the efficiency of the plant's heating, ventilating, and air-conditioning (HVAC) system to reduce defects, increase productivity, and reduce operators' fatigue by air-conditioning the plant.

Company Background

Moraine Molded Plastics specializes in providing injection-molded component parts manufactured to extremely tight specifications for a variety of original equipment manufacturers. The plant facility measures 35,000 square feet, and its total energy budget is close to $119,000 per year, the majority of which is electricity costs.

Assessment Approach

A team of three students and one staff member from the University of Dayton IAC assessed this facility on June 27, 2003. The assessment was led by IAC Assistant Director Rebecca P. Blust.

Recommendations

Energy Conservation Awareness. The assessment team identified some energy conservation awareness practices for the employees at Moraine Molded Plastics as cost-effective ways to significantly reduce energy consumption. Employees will be encouraged to turn off or shut down idle processing equipment, lights, fans, air compressors, and other types of energy-consuming components when they are not being used.

Air-Conditioning for the Manufacturing Area. At the time of the assessment, the air temperature in the manufacturing areas of the plant was not being controlled. Managers said that the resulting inconsistent air temperatures had been adversely affecting the plant's performance and workers' productivity during summer months. They believe that if the temperature can be controlled better, production levels will increase while equipment downtime and the number of defective products both decrease. Greater productivity at a custom-made products plant means that less equipment and labor are needed to meet production levels. Although this recommendation actually increases energy use, the operation savings more than compensate for the additional cost. The assessment team therefore recommended installing new HVAC equipment to control the temperature in the plant.

Lighting. The plant production area is lit by 170 F96T12 fixtures, each containing two 60-W lamps. The average lighting level is about 35 foot-candles (fc) under the plant's skylights and about 20 fc in the rest of the plant. High-bay fluorescent lights are available that provide more light, improve the overall quality of the lighting, and use less energy than the T12 lights. The assessment team therefore recommended replacing the 170 F96T12 fixtures in the production area with 52 six-lamp, high-bay fluorescent fixtures.

Results

Moraine implemented three of the team's six recommendations. The table below describes these projects and shows that the company expects to save $24,070 in annual costs, in addition to energy savings and productivity gains.

Implemented Recommendations for the Moraine Molded Plastics Plant in Cincinnati, OH

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Productivity Air condition manufacturing area	77,850 pieces; 226 hours	$19,485	$50,000	2.6 years
Lighting Replace 2-lamp F96T12 lights with bay fluorescent lights	40,000 kWh; 9.6 kW	$3,360	$11,700	3.5 years
Controls Reduce the temperature of the barrel heater when not in use	37,065 kWh	$1,225	$0	Immediate
Total	**77,850 pieces 226 labor hours; 77,065 kWh/yr; 9.6 kW/yr**	**$24,070**	**$61,700**	

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Project Partners:

Moraine Molded Plastics, Inc.
Cincinnati, OH

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
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DOE/GO-102005-2164
September 2005

Assessment Date: July 11, 2003

Benefits:

- Saved more than $34,000 per year by implementing one recommendation
- Achieved an immediate payback
- Identified 13 other energy-related recommendations with cost savings potential of $82,000 per year

Applications:

The University of Dayton's IAC assessment team discovered opportunities to help National Plastics Corporation improve productivity and reduce energy use and waste. These measures will, in turn, improve product quality and enhance competitiveness.

National Plastics Corporation: Energy Assessment Helps Automotive Plastic Parts Maker Save $34,000 Per Year

Summary

The University of Dayton's Industrial Assessment Center (IAC) performed an energy conservation assessment of National Plastics Corporation's plant in Fort Wayne, Indiana; now the company can expect to save about $34,000 per year by implementing just one assessment recommendation. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

The assessment team found 17 opportunities; however, the company initially focused on one promising recommendation, which was to reduce the time required for press change-overs. This project had no implementation costs yet helped the company achieve immediate savings. National Plastics also plans to implement other recommended changes as funds become available, because most of the projects require capital investment or cash expenditure. The additional recommendations to reduce energy costs could be implemented in 2005. In addition, the assessment team recommended that the company apply for a sewer exemption and that it purchase an oil recycler to filter oil and reduce waste.

Company Background

National Plastics Corporation, an SPI member company, specializes in injection-molded automotive plastic parts. The company's state-of-the-art injection molding capabilities reduce variation by using closed-loop controls. The facility, which totals 40,000 square feet, uses a small amount of energy in its process. The total energy budget for the plant is approximately $400,000 per year, 96% of which is spent on electricity.

Assessment Approach

A team of four students and one staff member from the University of Dayton's IAC performed the assessment of the Fort Wayne plant on July 11, 2003. Rebecca P. Blust, the IAC's Assistant Director, led the team in this assessment.

Recommendations

Energy Conservation Awareness. The assessment team recommended practices to help National Plastics employees conserve energy, make the manufacturing process

leaner, and reduce waste. By taking these cost-effective measures, the company can significantly reduce energy consumption. Employees are encouraged to turn off or shut down idle processing equipment, lights, fans, air compressors, and other types of energy-consuming components when not in use.

Productivity Improvements. At the time of the assessment, the average change-over for the 500- and 1,000-ton presses was about 36 hours and occurred about 1.5 times per week. Even though company management agreed they could not sell any extra product generated by the increase in productivity, this line ran approximately two Saturdays per month, and the company was considering purchase of two new presses to increase capacity.

According to management, most mold changes had been scheduled on the first shift and extended past the end of the shift. Only the first-shift operators are trained to perform mold changes; thus, if not completed during first shift, the presses sat idle until the next day when the operators returned to work and complete the mold change.

In addition, an excessive amount of time was wasted in search of the proper equipment to install the mold. Company management suggested that if the molds were outfitted with the correct hoses, knockouts, bars, etc., the changes were staged at the press ahead of time, and the change-overs were scheduled early on first shift, times could be dramatically reduced to within one shift.

The assessment team recommended that National Plastics adopt new procedures to reduce press change-over time and make the process more efficient. Improvements in procedures would have the following results:

- A change-over period of 5 hours instead of 36 hours
- Increased productivity during the week, which reduces or eliminates weekend overtime
- Energy savings from shutting down the equipment on weekends.

Results

Although the IAC assessment team made a total of 17 recommendations to National Plastics Corporation, the company decided to start by improving change-over time procedures, which provided immediate payback and required no capital investment. As a result, the company has achieved annual cost of savings of $34,560 per year and has improved productivity. The table below summarizes project results so far.

Implemented Recommendations for National Plastics' Plant in Ft. Wayne, IN

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Productivity Reduce change-over time on the 500- and 1,000-ton presses	1,152 hours	$34,560	$0	Immediate

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Project Partners:

National Plastics Corporation
Fort Wayne, IN

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
Energy Efficiency and Renewable Energy
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DOE/GO-102005-2165
September 2005

Assessment Date: June 4, 2003

Benefits:

- Saves more than $27,000 per year in energy costs
- Reduces total energy use by 14.9% per year
- Has payback periods ranging from 1 month to 2 years

Applications:

To reduce energy usage and costs and increase capacity, productivity, and product quality, the assessment team focused on manufacturing processes as well as process water controls, grinding, lighting, heating, and compressed air.

N-K Manufacturing Technologies: Industrial Energy Assessment Yields Savings of More Than $27,000 Per Year for Molded Plastics Company

Summary

The University of Michigan's Industrial Assessment Center (IAC) performed an energy audit at the N-K Manufacturing Technologies' plastics manufacturing plant in Grand Rapids, Michigan; implementing many of the audit's recommendations could save the company more than $500,000 each year. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

Opportunities for saving electricity identified in the N-K Manufacturing Technologies assessment involved installing several devices to control the use of both motors and electric heaters. Ideas for saving natural gas involved making changes to the plant's heating system. The assessment team noted that installing grinder chutes, high-efficiency lamps, and destratification fans would reduce energy consumption by more than 1,783 MMBtu and reduce energy costs by more than $27,000 each year. The team also found that installing large storage tanks with environmental controls would increase productivity and efficiency and reduce material costs, for an additional substantial cost savings of $573,000 per year.

Company Background

N-K Manufacturing Technologies, is a custom molder of plastics for the automotive and other industries. The company, which specializes in multishot, insert, and overmolding technologies, is part of the Nicholas Plastics Group, a single-source, vertically integrated provider of plastic solutions for the automotive, office furniture, appliance, and related industries. Based in Grand Rapids, Michigan, the Nicholas Group has manufacturing facilities in Allendale and Grand Rapids and a technical sales and design center in Troy. The facility that was assessed measures 80,000 square feet. It had a total energy budget of approximately $185,714 per year; most of that expense was for electricity and the remainder for natural gas.

Assessment Approach

A team of students and staff from the University of Michigan IAC carried out the assessment on June 4, 2003. The assessment was led by IAC Assistant Director Dr. David Everest. The approach emphasized increasing employees' awareness of energy conservation and enhancing productivity as well as reducing process energy use.

Recommendations

Energy Conservation Awareness. The assessment team found that 100% of the facility's total natural gas consumption was used for heating. Of the electricity used, 66% of the total powered the hydraulic motor drives, 13% powered grinders, 10% was used for lighting, 3% went to process chillers, and another 3% was used by the compressed air system. Therefore, the team identified several cost-effective ways that employees could significantly reduce the plant's energy consumption. For example, they encouraged employees to turn off or shut down all idle processing equipment, lights, fans, air compressors, and other energy-consuming items when they were not in use.

Productivity: Labor and Materials. During the summer, the facility has to dehumidify most of its polymer pellets before they can be used. The drying time can range from 1 to 3 hours, depending on the product and humidity levels. During this time, the production machine is inactive and workers are sometimes idle, increasing non-value-added labor hours. The assessment team recommended installing large storage tanks with dehumidification units to dehumidify the pellets before they are taken to the production machines. This will reduce machine downtime and non-value-added labor hours. The storage system will also allow the company to buy products in quantity at a lower cost. And, it will help to keep the material clean, even during transport.

Results

The table below shows the estimated annual cost savings and paybacks associated with N-K Manufacturing Technologies' decision to implement four of the six assessment recommendations for the plant. The implemented recommendations will reduce natural gas usage by nearly 1,000 MMBtu and electrical usage by almost 261,000 kWh, which will lower electrical demand by approximately 1,825 kW-month per year.[1] The facility can increase productivity, reduce labor costs by more than 3,900 labor hours, and save 7% of material costs. These savings will then reduce natural gas usage, electrical usage, and electrical demand costs by more than $27,000 per year.

Implemented Recommendations for N-K Manufacturing's Plant in Grand Rapids, MI

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Fuels Replace electric equipment with gas equipment	365 MMBtu	$17,350	$8,000	6 months
Compressed Air Eliminate leaks in gas and compressed air lines/valves	58 MMBtu	$910	$75	1 month
Heating Install destratification fans	1,027 MMBtu	$4,275	$2,100	5 months
Lighting Install high-efficiency lamps	333 MMBtu	$5.270	$10,510	2 years
Total	**1,783 MMBtu/yr**	**$27,805**	**$20,685**	

[1] kW-months per year represents total kW savings per year, based on kW savings per month.

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Project Partners:

N-K Manufacturing Technologies
Grand Rapids, MI

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
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U.S. Department of Energy
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DOE/GO-102005-2166
September 2005

Assessment Date: June 18, 2003

Benefits:

- Saves more than $105,000 annually in energy costs
- Reduces total energy usage by 22%
- Has payback periods ranging from less than 1 month to 9 months

Applications:

Electricity is the only energy source at the assessed plant and is used mainly for heating molds, compressing air, lighting, heating, and cooling. The molds were well insulated, so the assessment team concentrated on reducing the amount of energy used by compressors, lighting, and heating, ventilating, and air-conditioning (HVAC) equipment.

Precise Technology, Inc.: Molded Plastics Manufacturer's Energy Use Drops 22% as a Result of Industrial Energy Assessment Recommendations

Summary

West Virginia University's Industrial Assessment Center (IAC) performed an energy audit at the Precise Technology, Inc. plastic moldings manufacturing plant in North Versailles, Pennsylvania; as a result, energy use and costs are at least 20% lower at the plant. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

The assessment team made several recommendations for improvement. Those for the compressed air system included recovering waste heat, using outside air for intake, installing isolation valves, reducing pressure, and repairing leaks. Recommendations for the lighting system included replacing T12 fixtures with T8 fixtures, using electronic ballasts and reflectors, replacing fluorescent fixtures with metal halide lamps, installing occupancy sensors, and reducing lighting levels in some areas. The team also recommended installing thermostats in offices and implementing a motor management system. Six of the 11 total recommendations were implemented, reducing energy consumption by nearly 4,500 MMBtu per year and saving more than $105,000—or about 22% of pre-assessment energy use and costs—annually.

Company Background

Precise Technology, Inc., is a full-service injection molder of precision plastic components and assemblies, primarily serving the personal care, health care, and food and beverage industries. The company has 11 plants in the United States and one in the Netherlands; it specializes in the production of custom plastic injection moldings and parts. The North Versailles, Pennsylvania, plant and offices measure approximately 72,000 square feet. The office area is cooled and heated by one rooftop unit. The plant area makes use of the heat generated in the manufacturing process. The plant's primary energy source is electricity, and its total energy budget is approximately $328,000 per year.

Assessment Approach

An assessment team from the West Virginia University IAC spent one day at the plant, examining its operations and collecting data. The team, which included three graduate students and one undergraduate student, was led by IAC Assistant Director Dr. Wafik Iskander.

Recommendations

Energy Conservation Awareness. In general, the management and employees of Precision Technology, Inc., are energy-conservation oriented, and they follow many good practices to save energy. For example, the company uses an economizer on its air-conditioning unit, and the molding machines are very well insulated.

Compressed Air System. Because compressed air uses a significant amount of energy, the assessment team recommended the following measures to reduce energy usage:

- Repair compressed air leaks
- Set the air pressure at the level required by the system.

Motors. The assessment team recommended implementing a motor management system based on DOE's MotorMaster+ software. This software assists in the analysis of many energy- and cost-saving decisions, such as whether it is better to rewind a failed motor or to replace it with a new, energy-efficient motor. A motor management system can also help to reduce energy costs by providing both a preventive and predictive maintenance program.

Lighting. The lighting levels in many areas were more than adequate. The team recommended upgrading the fixtures to more efficient ones with electronic ballasts and reflectors. They also recommended increasing the use of task lighting and reducing general lighting levels, to reduce energy usage and costs.

Results

The table below shows the annual energy savings at the Precise Technology plant resulting from the implemented recommendations. This will reduce annual electricity use by approximately 4,450 MMBtu, about 22% of pre-assessment usage. The resulting energy cost savings will be more than $105,000 per year, and reductions in carbon dioxide emissions will be 2.9 million pounds per year. The payback periods range from less than 1 month to 9 months, with an average payback period of less than 4 months.

Implemented Recommendations for Precise Technology's Plant in North Versailles, PA

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Air Compressor System Repair air leaks	352 MMBtu	$5,685	$500	1 month
HVAC Install thermostats in offices	584 MMBtu	$9,443	$2,500	3 months
Motors Implement motor management system	778 MMBtu	$11,747	$700	Less than 1 month
Lighting • Replace T12 with T8 lights and electronic ballasts	1,910 MMBtu	$46,327	$10,000	4 months
• Replace fluoride fixtures with metal halide fixtures	573 MMBtu	$27,812	$6,667	9 months
• Install occupancy sensors	255 MMBtu	$4,123	$2,500	7 months
Total	**4,452 MMBtu/yr**	**$105,137**	**$22,867**	

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Project Partners:

Precise Technology, Inc.
North Versailles, PA

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy
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DOE/GO-102005-2167
September 2005

Assessment Date: July 18, 2003

Benefits:

- Implemented 88% of recommendations
- Will save nearly $113,000 per year
- Showed paybacks periods of less than a year for most projects implemented
- Prompted assessments at other Spartech plants

Applications:

Bradley University's IAC team focused on the compressed air system, lighting, and machinery use at potential areas of savings for Spartech Plastics. Recycling, and in some cases, selling old equipment and pallets, helped to streamline waste.

Spartech Plastics: North American Thermoplastic Extruder Implements Industrial Assessment Findings and Saves More Than $100,000 Per Year

Summary

Bradley University's Industrial Assessment Center (IAC), in Peoria, Illinois, performed an energy audit of Spartech Plastics' Richmond, Indiana facility that helped the company save about $113,000 per year. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

The assessment showed that Spartech's Richmond plant could save money by improving waste heat recovery, insulating pipes, and installing high efficiency motors. By implementing many of the recommendations, the company cut energy consumption by more than 7,200 MMBtu, which led to cost savings of nearly $57,000 annually. Additional recommendations, including selling old equipment or pallets, will save another $56,000.

Company Background

Spartech Plastics, headquartered in Clayton, Missouri, has 22 other plants that are strategically positioned throughout the United States and Canada. The company is the largest extruder of custom thermoplastic sheet and roll stock in North America. Spartech has about 100 production lines, two-thirds of which have multi-layer extrusion capabilities. In addition, Spartech serves other markets, including transportation, packaging, building, construction, recreation, and leisure.

The Bradley University team assessed eight of the Spartech plants; the results for the Richmond plant are discussed here. Some of the eight assessed plants had much higher savings in comparison to those of this plant. However, this plant implemented a high percentage of the recommendations. The Richmond facility has one building that measures 93,000 square feet, and uses approximately $487,000 worth of energy per year. Most of the costs are for electricity and a small portion for natural gas.

Assessment Approach

A team of students and staff from Bradley University's IAC performed an assessment of Spartech's Richmond facility on July 18, 2003. The assessment was led by

Dr. Paul Mehta, IAC Director at Bradley University. The assessment team met on site with plant personnel, toured the facility, and collected data. After reviewing potential energy saving opportunities, the assessment team presented their findings to plant managers.

Recommendations

The assessment team made 16 recommendations to Spartech with potential to improve energy efficiency and reduce waste at the plant. Projects to improve energy efficiency included waste heat recovery, insulation, motor upgrades, and lighting efficiency. Selling old equipment will clean up the facility by reducing clutter, and will generate revenue for the plant. In addition, recycling waste wood and selling pallets will have a positive impact on the environment

Results

The Richmond plant's management team implemented 14 recommendations from the assessment, as described in the table below. The implemented energy efficiency measures account for half of the annual cost savings for the plant, while waste and productivity improvements account for the other half. Besides saving almost $113,000 per year, the changes will help this Spartech plant cut energy use by more than 15%.

Implemented Recommendations for Spartech Plastics' Plant in Richmond, IN

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Energy				
• Recover compressor waste heat	1,636 MMBtu	$13,627	$1,000	Less than 1 month
• Insulate extrusion lines	2,553 MMBtu	$13,156	$8,080	7 months
• Install high-efficiency motors	1,007 MMBtu	$8,345	$35,510	4.3 years
• Install radiant heaters	889 MMBtu	$7,407	$8,000	1 year
• Install photosensors	253 MMBtu	$5,082	$1,500	4 months
• Replace metal halide lamps	494 MMBtu	$3,389	$9,225	2.7 years
• Use synthetic lubricants	247 MMBtu	$2,306	$500	3 months
• Delamp lighting	63 MMBtu	$1,343	240	2 months
• Use outside air for compressor intakes	65 MMBtu	$606	$500	10 months
• Install occupancy sensors	92 MMBtu	$1,611	$4,125	2.6 years
Waste				
• Sell wooden pallets	11,664 pallets	$8,829	$336	Immediate
• Recycle wood scrap	210,000 lbs wood	$1,890	$240	1.5 months
Productivity				
• Sell unused equipment		$34,400	$10,000	3 months
• Automate time clock system	780 labor hours	$10,920	$5,000	5.5 months
Total	**7,299 MMBtu/yr; 210,000 lbs wood; 780 labor hours**	**$112,911**	**$84,256**	

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Project Partners:

Spartech Plastics
Richmond, IN

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, DC

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September 2005

Assessment Date: May 13, 2003

Benefits:

- Achieved nearly $100,000 in savings per year for implemented projects
- Showed ways to reduce total annual energy use by 14.5%
- Estimated payback periods ranging from immediate to 1 year
- Estimated reductions in CO_2 emissions by more than 5 million pounds annually

Applications:

The West Virginia University IAC assessment team focused on Superfos Packaging's energy use, primarily in the manufacturing process and for motors, lighting, and compressed air.

Superfos Packaging: Plastics Manufacturer Saves $100,000 Per Year by Implementing Industrial Energy Assessment Recommendations

Summary

West Virginia University's Industrial Assessment Center (IAC) performed an energy audit at Superfos Packaging in Cumberland, Maryland. By implementing measures recommended in the assessment, Superfos will save nearly $100,000 per year in energy costs. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

During the assessment, the IAC team found that Superfos could save electrical energy by insulating heated surfaces on molding equipment, starting a motor management system program with the help of DOE's MotorMaster+ software tool, improving the compressed air system, and making changes in the lighting system. These energy enhancements will reduce electrical energy consumption by 7,950 MMBtu per year.

Company Background

Superfos Corporation is one of the largest plastic packaging specialists in Europe and is expanding into the U.S. market. Cumberland is a modern and fully automated plant that develops and produces injection-molded, rigid containers with open tops. The Cumberland facility measures 187,000 square feet in size and operates continuously, 7 days per week. Energy costs at the plant total approximately $760,000 per year, most of which is for electricity and the remainder for natural gas.

Assessment Approach

A team of students and staff from West Virginia University's IAC performed the assessment at the Cumberland plant on May 13, 2003. IAC Director Dr. Ralph W. Plummer led the assessment team, which included IAC student lead, Nasr Alkadi and three graduate students.

Recommendations

Energy Conservation Awareness. Superfos management and employees are interested in energy conservation; at the time of the assessment they were already

taking many steps to save energy. The company had well-insulated pipes and valves in the chiller room, used synthetic lubricants in air compressors, and applied variable speed drives to control pumps, fans, and air compressors.

Molding Machines. The assessment team found that some molding machines were using significant energy because heated surfaces lacked insulation. However, by insulating these surfaces, the machines' heaters will operate less frequently, which will reduce energy consumption.

Motors. Another recommendation involved implementing a motor management system to help reduce motor energy costs. The assessment team suggested use of DOE's MotorMaster+ software to assist with analysis of energy and cost decisions, such as rewinding a failed motor versus replacing it with an energy-efficient motor.

Compressed Air System. The compressed air system at Superfos consumes a significant amount of energy. To help the company save energy and ensure a more efficient operation, the assessment team made these recommendations for the Cumberland plant:

- Set the air pressure at the level required by the system
- Repair compressed air leaks and install engineered nozzles to reduce air consumption.

Results

By putting into practice the IAC assessment recommendations, the Superfos Cumberland plant will lessen its annual electricity consumption by more than 2.3 million kWh, or 7,950 MMBtu. This translates to costs savings of nearly $100,000 per year. Furthermore, the company's actions improve environmental performance, reducing carbon dioxide emissions by more than 5 million pounds per year. The table below describes recommendations for the Cumberland plant and savings results.

Implemented Recommendations for Superfos Packaging's Plant in Cumberland, MD

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Process Insulate molding machine surfaces	5,464 MMBtu	$76,401	$2,253	1.2 months
Motor Implement motor management system	1,500 MMBtu	$8,388	$480	1.2 months
Compressed Air System • Reduce compressor air pressure	484 MMBtu	$6,764	$128	1.2 months
• Repair compressed air leaks	245 MMBtu	$3,425	$250	1.2 months
Lighting • Replace 400-W metal halide bulbs with 360W metal halide bulbs	197 MMBtu	$6,764	$0	Immediate
• Install occupancy sensors	60 MMBtu	$839	$800	1 year
Total	**7,950 MMBtu/yr**	**$98,542**	**$3,911**	

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Project Partners:

Superfos Packaging
Cumberland, MD

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

Industrial Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, DC

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September 2005

Assessment Date: July 24, 2003

Benefits:

- Saves nearly $7,000 in energy costs annually
- Has payback periods ranging from 3 to 8 months
- Provides a good example for scheduled assessment at another plant

Applications:

To reduce energy usage, waste, and operating costs and enhance productivity, the assessment team focused primarily on manufacturing processes as well as on lighting, heating, compressed air, and waste management.

VPI Corporation: Industrial Energy Assessment Helps Manufacturer Start Saving $7,000 in Less Than a Year

Summary

The University of Wisconsin–Milwaukee's Industrial Assessment Center (IAC) performed an energy audit at VPI Corporation's sheet products facility in Sheboygan Falls, Wisconsin, that is saving the company almost $7,000 per year in energy costs. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

The assessment team identified several opportunities for saving electricity, including installing liquid pressure amplification systems for chillers, using more energy-efficient lighting and motor belts, and achieving better control of the compressed air system. The team also found that scheduling forklift-charging tasks during off-peak hours would reduce overall energy demand.

Company Background

VPI's facility in Sheboygan Falls manufacturers medical, commercial, and lenticular signage. It is a division of VPI Corporation, which manufactures rubber, vinyl, and plastic products for a variety of industries, including flooring and related products. The Sheboygan Falls plant generates approximately $40 million in sales annually and processes about 48 million pounds of polyester, polystyrene, and polyethylene plastics. The assessed facility measures 73,000 square feet; the production area covers 66,000 square feet. At the time of the assessment, production consumed more than 13 million kWh of electricity and about 2,300 MMBtu of natural gas annually, for a total energy cost of almost $667,000.

Assessment Approach

An assessment team consisting of students and a director from the University of Wisconsin–Milwaukee IAC assessed this facility on July 24, 2003. Team members met with plant personnel on the site, toured the facility, and collected data. After they reviewed potential energy-saving opportunities, they presented their findings to plant managers. The assessment was led by IAC Director Dr. Umesh Saxena.

Results

VPI implemented two of the six recommendations made by the assessment team. The facility's staff also modified two other recommendations, using similar energy-

saving practices and equipment to save energy and costs. For example, staff at VPI decided not to install a flow controller on the compressed air system, as the assessment team had recommended, to better regulate and reduce pressure. Instead, they reduced the compressor's discharge pressure to match the recommended pressure listed in the report, thus making it work more efficiently. They also decided not to implement a recommendation to install synchronous belts on the 15 vacuum pump motors used to convey raw material to the extruder lines. Instead, they eliminated the 15 pump motors altogether and replaced them with a more efficient, centralized system.

The table below shows the annual cost savings at the VPI Sheboygan Falls facility that result from implementing some of the assessment team's recommendations. Energy conservation projects that were implemented will reduce electrical usage by more than 146,000 kWh annually, in turn reducing electrical demand by about 410 kW-months per year (kW-mo/yr)[1].

Implemented Recommendations for VPI's Plant in Sheboygan Falls, WI

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Process Supply Use outside air for compressor	146,507 kWh 158.8 kW-mo/yr	$5,138	$1,240	3 months
Motor Charge forklift trucks during off-peak hours	252 kW-mo/yr	$1,657	$1,000	8 months
Total	**146,507 kWh/yr 410.8 kW-mo/yr**	**$6,795**	**$2,240**	

[1] kW-months per year represents total kW savings per year, based on kW savings per month.

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Project Partners:
VPI, LLC
Sheet Products Division
Sheboygan Falls, WI

The Society of the Plastics Industry, Inc.
Washington, DC

For Additional Information:

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Assessment Date: May 20, 2003

Benefits:

- Made six recommendations with total potential cost savings of more than $53,000
- Showed potential to cut energy use by up to 50% per year
- Prompted company to consider three recommendations that could save of $16,000 per year with a combined payback of 1 year

Applications:

To help the Wexco Corporation reduce energy use and optimize its operation, the North Carolina State University IAC focused primarily the plant's manufacturing process, compressed air, and lighting systems.

Wexco Corporation: Assessment Uncovers $53,000 in Energy Efficiency Opportunities at Plastic Extrusion Cylinder Manufacturer

Summary

North Carolina State University's Industrial Assessment Center (IAC) performed an energy conservation assessment of Wexco Corporation's plant in Lynchburg, Virginia, and found the company could save more than $53,000 per year by implementing assessment recommendations. The IAC, sponsored by the U.S. Department of Energy (DOE) Industrial Technologies Program (ITP), is one of 26 across the nation in which faculty and students provide eligible small- and medium-sized manufacturers with no-cost energy assessments. This assessment project was sponsored by ITP and The Society of the Plastics Industry, Inc. (SPI), a DOE Allied Partner.

The assessment team identified six opportunities to save electricity and natural gas, including waste heat recovery and new equipment to improve plant ventilation and air compressor operation. The team found that Wexco could improve operation of its heat-treating furnace, either by recirculating a portion of the diluted flue gases to the furnace's burner to preheat it, or by using electric heating elements instead of natural gas elements. The first option could reduce natural gas demand by more than 1,600 MMBtu per year—nearly 25% of the furnace's current natural gas consumption—and could save more than $10,000 per year. The second option would virtually eliminate the stack loss from the existing setup, with net energy cost savings of more than $43,000 per year.

Company Background

Wexco Corporation is a leading producer of bimetallic cylinders for plastic extrusion equipment. With sales of about $10 million per year, Wexco produces custom, high-quality cylinders for after-market distribution and for new equipment use by major extrusion machine builders around the world. The Lynchburg facility measures 48,000 square feet and includes manufacturing space and corporate and engineering offices. The total energy budget for the plant is approximately $146,000 per year, with electrical costs about twice that of natural gas costs.

Assessment Approach

A team of students and staff from North Carolina State University's IAC performed the assessment of the Lynchburg plant on May 20, 2003. IAC Director James W. Leach and Extension Specialist Stephen Terry led the assessment. The team examined processes at the plant to determine major sources of energy use. They collected key data, such as process temperatures, lighting levels, and nameplate information from process equipment, Additionally, the team gathered typical operating schedules to use in modeling the heat-treating furnace.

Recommendations

Process Heating. The furnace used for heat-treating the cylinders uses 50% of the energy at the facility, which amounts to about 30% of total annual energy costs. During the assessment, two options were explored to reduce these costs. However, only one of the options can be implemented.

- Recirculate a portion of the diluted flue gases to the burner of the heat-treating furnace, preheating the combustion air to 700°F.
- Install an electrically heated furnace to eliminate the stack loss (estimated to be 90% of the total fuel fired). This option will replace 6,950 MMBtu of natural gas with 161,000 kWh of electricity. While this measure has a higher initial cost, it reduces the furnace operating costs by more than 75%.

Heating, Ventilation, and Air-Conditioning. The plant uses five rooftop air-conditioning units with a combined rating of 190 tons. Several large ceiling fans force about 24,000 cubic feet per minute of air from the plant to remove smoke from the welding areas. Much of the air-conditioning and space heating loads result from hot, humid air in the summer, and cold air in the winter.

To improve efficiency, the assessment team recommended that Wexco install smoke eliminators and change fan schedules. Portable smoke eliminators to the welding stations will filter air to remove smoke particles. The plant could then deactivate at least two of the three exhaust fans and will reduce electrical power needed for cooling and natural gas for space heating.

Compressed Air Systems. Wexco's process requires compressed air, which is currently supplied by a 60-horsepower screw compressor. To reduce energy use and improve energy efficiency of the compressed air system, the assessment team suggested installing equipment to recover heat from the air compressor. This hot air can be directed into the plant in the winter for space heating, which would offset natural gas use to heat the building.

Results

Since the assessment, Wexco has shown significant interest in implementing three of the six recommendations from the assessment. The table below shows that these three measures could help the company achieve annual savings of more than 2,700 MMBtu in natural gas and nearly 39,000 kWh in electricity. If implemented, Wexco would see costs savings of about $16,000 per year from these three measures.

Selected Recommendations for Wexco Corporation's Plant in Lynchburg, VA

Project Category/ Recommendation	Annual Resource Savings	Annual Cost Savings	Implementation Cost	Payback Period
Process Heat-Treating Recirculate exhaust gas to furnace inlet	1,678 MMBtu	$10,471	$10,000	1 year
Compressed Air Recover compressor waste heat	205 MMBtu	$1,284	$800	8 months
HVAC Systems Install smoke eliminators and change fan schedules [1]	773 MMBtu; 38,711 kWh	$4,325	$5,653	1.3 years
Total	**2,788 MMBtu/yr 38,711 kWh/yr**	**$16,080**	**$16,453**	

[1] Wexco reports that this recommendation was implemented as of September 2005.

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Project Partners:

Wexco Corporation
Lynchburg, VA

The Society of the Plastics Industry, Inc.
Washington, DC

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