

Aluminum BestPractices Plant-Wide Assessment Case Study

Industrial Technologies Program—Boosting the productivity and competitiveness of U.S. industry through improvements in energy and environmental performance

Alcoa: Plant-Wide Energy Assessment Finds Potential Savings at Aluminum Extrusion Facility

BENEFITS

- Identified potential annual energy cost savings of \$862,700
- Found potential annual electricity reductions of 3 million kWh
- Identified potential annual natural gas reductions of 150,000 MMBtu
- Found ways to decrease waste and recycling costs, air quality impacts, and equipment maintenance
- Increased energy awareness in the workforce
- Can achieve paybacks ranging from 0 to 2.1 years

APPLICATION

The Plant City assessment team discovered opportunities for Alcoa to decrease energy costs by more than 25% and thereby increase capacity, improve product quality, and enhance corporate competitiveness.

By focusing on 19 major process heating and combustion components, Alcoa identified more efficient ways to burn natural gas. A review of electricity consumption patterns revealed other savings opportunities throughout the plant. Results from Plant City will guide energy assessments at similar aluminum extrusion facilities, where the savings can be replicated.

Summary

Alcoa conducted an energy assessment of its Engineered Products aluminum extrusion facility in Plant City, Florida, to identify energy conservation opportunities throughout the plant and to prepare a report as an example for performing energy assessments at similar Alcoa facilities. Opportunities for saving electricity were identified in an energy awareness program; lighting; compressed air systems; pumping systems; electrical systems; drives; and heating, ventilating, and air conditioning (HVAC) systems. Corresponding opportunities for saving natural gas involved making changes to the combustion system and modifying the way the system is operated. The assessment team found that replacing the burners on the melting furnaces with more efficient burners would decrease annual natural gas consumption of these furnaces by 30% to 40%. Other suggested changes to the combustion system would save an additional 100,000 million British thermal units (MMBtu) of natural gas per year.

If implemented, the cost of energy for the plant would be reduced by more than \$800,000 per year by conserving 3 million kilowatt-hours (kWh) of electricity and 150,000 MMBtu of natural gas. Achieving this level of savings will require process improvements, modifications to operating procedures, changes in maintenance practices, and capital expenditures. Conserving energy will also increase capacity, improve product quality, increase profitability, reduce environmental emissions, and enhance corporate competitiveness.

DOE-Industry Partnership

The U.S. Department of Energy's (DOE) Industrial Technologies Program (ITP) cosponsored the assessment through a competitive process. DOE promotes plant-wide energy-efficiency assessments that will lead to improvements in industrial energy efficiency, productivity, and global competitiveness, and will reduce waste and environmental emissions. In this case, DOE contributed \$100,000 of the total assessment cost.

Company Background

Alcoa is the world's leading producer of primary aluminum, fabricated aluminum, and alumina, and is active in all major aspects of the industry. Alcoa serves the aerospace, automotive, packaging, building and construction, commercial transportation, and industrial markets, bringing design, engineering, production, and other capabilities as a single solution to customers. Alcoa also markets aluminum foil, aluminum wheels, and household wraps. Among its other businesses are vinyl siding, closures, precision casting, and electrical distribution systems for cars and trucks. The company has 31 business units with 129,000 employees in 38 countries.

Alcoa Engineered Products is one of Alcoa's business units with production facilities at 16 locations throughout the United States. The Plant City facility produces standard aluminum extrusions and custom architectural sections used by the building industry. Aluminum ingots and in-house scrap are melted and processed in a number of electric and gas-fired furnaces and ovens. The



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molten aluminum is then extruded into the required shapes. After cooling, the extrusions are cut, trimmed, and packaged for shipment. Most operations are conducted indoors, so a significant amount of energy is used for lighting and HVAC applications.

Assessment Approach

Alcoa conducted a process heating assessment at the Plant City facility to identify opportunities for energy savings and production improvements by burning fuel more efficiently, recovering waste heat, minimizing heat loss, and modifying manufacturing processes. The assessment team focused on 19 major energy-consuming process heating components and recommended numerous energy-saving measures. Building on results from the process heating assessment, Alcoa conducted a wider-ranging energy assessment of this facility later the same year. Objectives were to review current energy consumption patterns, identify energy conservation opportunities, and prepare a report as an example for other Alcoa Extruded Construction Products facilities.

The assessment team also identified numerous opportunities for saving energy and increasing profitability in areas such as energy awareness, lighting, compressed air systems, combustion systems, pumping systems, electrical systems, drives, and HVAC systems. The goal is to reduce energy consumption at Plant City by 25%. Achieving this goal will require the staff to reduce electricity consumption through improved employee energy awareness. It will also require management to invest capital for process improvements that use less energy while reducing downtime, decreasing scrap, and maintaining production.

Plant-wide assessment partners from various organizations, including Air Products and Chemicals and Western Florida Lighting, Inc., explored energy conservation ideas for the Plant City facility and identified the following opportunities.

Energy Conservation Awareness

The assessment team identified energy conservation awareness practices for more than 300 employees at the Plant City facility as a cost-effective way to significantly reduce energy consumption. Employees are encouraged to turn off or shut down idle processing equipment, lights, fans, blowers, pumps, air compressors, and other types of energy-consuming components that are not being used. Implementing these actions requires no capital investment and saves more than \$15,500 annually.

Lighting

Lighting systems at the Plant City facility are inefficient. Some lights are poorly arranged; others illuminate unused areas. Alcoa would save \$13,600 annually by investing about \$3,500 in building modifications and by taking advantage of natural light.

Compressed Air Systems

The Plant City facility has six compressors that supply compressed air for production. A new 6-inch diameter header and 1,000-gallon air receiver that allow two compressors to be shut off most of the time were recently installed, saving more than \$76,000 in electricity costs annually. The team identified other ways to conserve energy:

- Repair leaks
- Use fans and air conditioners instead of compressed air to cool electrical cabinets
- Use brushes, blowers, and vacuums instead of compressed air to clean parts and remove debris.

An aggressive leak detection and repair program could reduce compressor operating time by 10% to 15% and save more than \$33,000 in annual electricity costs.

Combustion Systems

The assessment team conducted a comprehensive review of the combustion systems to reveal potential ways for reducing the amount of natural gas that is burned at the Plant City facility. A significant energy savings would be realized by replacing the existing burners on the melting furnaces with new, more efficient burners. Installation of these new burners would increase production by 15% to 18% and decrease natural gas consumption of the melting furnaces by 30% to 40%. Although the estimated cost for the new burners is \$105,000 per melter, this investment would save \$180,000 to \$240,000 in natural gas annually. In addition, the new burners would have a positive impact on air quality. When less natural gas is burned to produce aluminum extrusions, lesser amounts of combustion products (including carbon dioxide, carbon monoxide, and air polluting nitrogen oxides) are released into the atmosphere. Other energy-saving changes to the combustion process include the following.

- Tuning up the combustion system using appropriate operating practices to adjust the fuel-air ratio would save between \$15,000 and \$75,000 annually.
- Supplying preheated combustion air to the burners would recover waste heat and achieve a 5% to 25% fuel savings depending on the firing rate for the burners.
- Installing waste heat recovery equipment, such as a cogeneration system designed to capture and use the thermal energy released in flue gases and processing operations, would save energy. However, an engineering study is needed to determine the feasibility and cost of implementing this option.
- Reducing heat loss from ovens and furnaces due to structural damage or deteriorated door seals would save about \$10,000 annually. This energy conservation measure could be effectively accomplished by scheduling and performing the work at times when production is not impacted.

A special study was also conducted as part of the energy assessment to examine the feasibility and to estimate the energy savings that would be realized by installing electromagnetic induction stirrers on the melting furnaces. The study revealed that use of stirrers would increase production from 15% to 25% by increasing the melt rate, but would cost an estimated \$250,000 per furnace to install. Although installing stirrers and more efficient burners would conserve a significant amount of natural gas, accommodating the resulting increased production would involve additional process and plant modifications. Therefore, installation of stirrers and burners may not be implemented.

Pumping Systems

The assessment team found that upgrading the controls for four process pumps and two cooling tower pumps (estimated at \$65,000) would save \$39,000 in electricity costs annually.

Electrical Systems

Five transformers supply electricity to the Plant City facility. Building alterations and process modifications over the years have outdated the electrical systems. Under current operating conditions, one or more transformers could be eliminated to save energy, especially if Alcoa implements many of the energy-saving opportunities identified in the assessment. Alcoa plans on conducting a comprehensive engineering study of the various electrical systems to ensure adequate power supply and distribution before eliminating transformers and rewiring circuits.

The assessment team recommended replacing standard motors with energy-efficient ones to further reduce loads on the electrical systems. Alcoa can use *MotorMaster+* software, available from DOE, as a tool to select replacements.

Drives

The assessment team recommended that Alcoa replace V-belt drives with synchronous-belt drive systems in the two continuously operating fan systems studied to save \$2,000 annually.

Heating, Ventilating, and Air Conditioning Systems

The assessment team suggested that the Plant City facility install set-back thermostats to conserve energy during nonworking hours. Using these thermostats would reduce energy costs by as much as \$5,000 annually.

Results

Table 1 shows the annual cost savings that would accrue at Plant City if the energy conservation opportunities identified in the energy assessment are implemented. Based on these results, the facility can achieve its goal of reducing natural gas and electrical energy costs by more than 25%. At current energy prices, it is possible for Alcoa to save more than \$800,000 per year.

Projects Identified

Opportunities for reducing energy consumption that were identified during the assessment are described in Table 1.

Table 1. Opportunities for Reducing Energy Consumption at Alcoa's Plant City Facility

Recommended Action	Annual Resource Savings	Annual Cost Savings (\$)	Implementation Cost (\$)	Payback (years)
<i>Energy Conservation Awareness</i>				
Shut off electrical equipment when not in use	242,000 kWh	15,500	*	0
<i>Lighting</i>				
Use natural light and upgrade to energy-efficient lighting	431,000 kWh	27,600	22,000	0.8
<i>Compressed Air Systems</i>				
Identify and repair leaks	525,000 kWh	33,600	*	0
Install air compressor controls and identify alternatives for inefficient compressed air use	1,094,000 kWh	70,000	45,000	0.6
<i>Combustion Systems</i>				
Install energy-efficient burners	57,000 MMBtu natural gas	240,000	210,000	0.9
Install electromagnetic induction stirrers	57,000 MMBtu natural gas	240,000	500,000	2.1
Reduce heat loss through improved maintenance practices	2,400 MMBtu natural gas	10,000	*	0
Tune up combustion systems	18,000 MMBtu natural gas	75,000	*	0
Install waste heat recovery equipment and supply preheated combustion air to the burners	24,000 MMBtu natural gas	100,000	50,000	0.5
<i>Pumping Systems</i>				
Install pump controls for two pumping systems	609,000 kWh	39,000	65,000	1.8
<i>Electrical Systems</i>				
Replace standard motors with energy-efficient motors at end of life	78,000 kWh	5,000	*	0
<i>Drives</i>				
Replace V-belt drives with synchronous-belt drives	31,000 kWh	2,000	1,500	0.8
<i>HVAC Systems</i>				
Install set-back thermostats and shut off HVAC systems when not needed	78,000 kWh	5,000	*	0
Totals		\$862,700	\$893,500	1.0 (Avg.)

* Implementation is performed as part of regular operations and maintenance.

BestPractices is part of the Industrial Technologies Program, and it supports the Industries of the Future strategy. This strategy helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together emerging technologies and energy-management best practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices emphasizes plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small- and medium-size manufacturers.

PROJECT PARTNERS

Alcoa North American Extrusions
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Air Products and Chemicals
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Western Florida Lighting, Inc.
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