TABLE 1. SYSTEMS AND PROCESSES EVALUATED FOR ENERGY EFFICIENCY IMPROVEMENTS AT CARAUSTAR'S CHESSIEPEL MILL

<table>
<thead>
<tr>
<th>System/Process</th>
<th>Estimated Project Implementation Cost</th>
<th>Estimated Annual Savings</th>
<th>Simple Payback Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add steam turbine generator to existing steam boiler for electric power production</td>
<td>$300,000</td>
<td>$197,200</td>
<td>1.5</td>
</tr>
<tr>
<td>Add steam-turbine-driven buffer pump from backup to primary pumps</td>
<td>$0</td>
<td>$11,800</td>
<td>0</td>
</tr>
<tr>
<td>Stack heat recovery to vapor-absorption systems</td>
<td>$15,000</td>
<td>$5,900</td>
<td>1.6</td>
</tr>
<tr>
<td>Stack heat recovery with fill water</td>
<td>$113,000</td>
<td>$32,200</td>
<td>2.1</td>
</tr>
<tr>
<td>Pulpers with fill water heat recovery</td>
<td>$16,000</td>
<td>$55,500</td>
<td>0.3</td>
</tr>
<tr>
<td>Projected OIT electric purchases</td>
<td>$0</td>
<td>$10,330</td>
<td>0</td>
</tr>
<tr>
<td>Change steam turbine-drive boiler power production</td>
<td>$300,000</td>
<td>$197,200</td>
<td>1.5</td>
</tr>
<tr>
<td>Replace direct steam injection into turbo-generators</td>
<td>$2,800,000</td>
<td>$1,130,000</td>
<td>2.5</td>
</tr>
</tbody>
</table>

TABLE 2. SYSTEMS AND PROCESSES EVALUATED FOR ENERGY EFFICIENCY IMPROVEMENTS AT CARAUSTAR'S RITTMAN MILL

<table>
<thead>
<tr>
<th>System/Process</th>
<th>Estimated Project Implementation Cost</th>
<th>Estimated Annual Savings</th>
<th>Simple Payback Years</th>
</tr>
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<tr>
<td>Add steam turbine generator to existing steam boiler for electric power production</td>
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</tr>
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<td>$0</td>
<td>$11,800</td>
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</tr>
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<td>$15,000</td>
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<tr>
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<tr>
<td>Pulpers with fill water heat recovery</td>
<td>$16,000</td>
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<td>0.3</td>
</tr>
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<td>$0</td>
<td>$10,330</td>
<td>0</td>
</tr>
<tr>
<td>Change steam turbine-drive boiler power production</td>
<td>$300,000</td>
<td>$197,200</td>
<td>1.5</td>
</tr>
<tr>
<td>Replace direct steam injection into turbo-generators</td>
<td>$2,800,000</td>
<td>$1,130,000</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Results

The plant-wide studies concentrated on identification of energy efficiency improvements for Caraustar’s Chesapeake and Rittman mills, with an extended focus on the development of efficiency concepts that could be transferred to other Caraustar facilities. Many of the efficiency measures identified and evaluated in this assessment will benefit other Caraustar mills as well as those of other recycled paperboard manufacturers. These include:

- Motor procurement and efficiency improvements
- Backpressure steam turbine generators
- Boiler feed pump variable speed drives
- Stack heat recovery to vapor-absorption systems
- Pulp and water heat exchangers
- Steam pipe insulations

The application of these energy efficiency measures is being reviewed for implementation at Caraustar’s Chesapeake mill. In addition to the efficiency benefits identified, other measures were found that did not offer immediate benefits for either Chesapeake or Rittman but would offer some benefits to other Caraustar locations. These measures include:

- Boiler forced draft variable speed drives
- Paper machine dryer section drive retrofits

Before initiating the two mill energy assessments, Caraustar had already undertaken a project to inventory electric motors at selected mills to identify savings opportunities that could be realized from implementation of a formal motor management program. The plant-wide energy assessment (permitted the team to accelerate the motor management effort) as a result. Caraustar has implemented a corporate motor efficiency program for electric motors, resulting in reduced cost of purchasing these items and boosted the opportunities to improve the overall efficiency of each plant's motor inventory.

In 2000, Caraustar commissioned plant-wide energy assessments at two of its recycled paperboard mills, the Chesapeake Mill in Baltimore, Maryland, and the Rittman Mill in Rittman, Ohio. The assessments identified potential opportunities for systems and process efficiency improvements that could result in important energy savings and improved profit margins. The project would potentially improve the efficiency of plant steam systems and would substantially decrease dependence on purchased electricity and fuel. Annual cost savings at the Rittman mill were estimated at $1.2 million.

Company Background

Caraustar is a major manufacturer of recycled paperboard and converted paperboard products. Caraustar incorporated in the efficiency through the consolidation of six corporations in the recycled paperboard industry previously related by common ownership and administration. Caraustar operates over 100 facilities in the United States along with plants in Mexico and the United Kingdom. The company is divided into four business groups: Caraustar Consumer Products Group, Caraustar Specialty Container Group, Caraustar Commercial Products Group, and Recovered Fiber Group. Caraustar manufactures its products primarily from recycled fiber derived from industrial paper stock. At its 16 recycled paperboard mills, Caraustar produces various grades of uncoated and clay-coated recycled paperboard both for internal consumption and for sale to customers in four principal markets:

- (1) tubes, covers, and composite containers
- (2) folding cartons
- (3) private label retail paper
- (4) miscellaneous specialty and converted products

In addition to the mills, Caraustar’s facilities include tube and can-converting plants, composite container plants, folding carton plants, and specialty converting plants. The company’s principal manufacturing activity is the production of uncoated and clay-coated recycled paperboard. In the manufacturing process, paperboard is reduced to pulp, cleaned and refined, then processed into various grades of paperboard. Approximately 25% of the recycled paperboard sold by Caraustar’s mills is consumed internally by its converting facilities; the other 66% is sold in other paper markets. Large quantities of electricity, natural gas, coal, and oil are used in the production and delivery of recycled paperboard. Caraustar purchases electricity and natural gas for.
for quantifying process inputs and outputs before initiation of the energy byproducts). Caraustar had already implemented detailed reporting practices to enhance energy efficiency, and examination of process outputs (including waste and energy quantification of energy inputs to plant processes, assessment of process energy efficiency.) and operating procedures were also reviewed for their impact on operating expenses and is second only to raw material and labor in a mill’s operating cost structure.

Caraustar has made a commitment to continually maintain and improve its paperboard mills. During the past 5 years, Caraustar has spent over $20 million annually in capital expenditures, primarily to expand and upgrade its paperboard production and converting capacity by acquiring and maintaining state-of-the-art machine and technology. Caraustar continues to upgrade existing facilities with modern, cost-efficient, and more productive equipment.

Assessment Overview

Caraustar has historically monitored the coal/liner paper produced in its Mill Group. As a result, this company has also begun to document energy costs for the industrial paperboard divisions. One of the two mills studied, the Chesapeake Mill produces uncoated recycled paperboard while the Rittman Mill produces graphics board and clay coated board.

Caraustar conducted the plant-wide energy assessment in association with Steing Energy Services, LLC. The project was partially funded by the Department of Energy’s (DOE) Office of Industrial Technologies (OIT). OIT supports plant-wide energy-efficiency assessments that will lead to improvements in industrial efficiency, waste reduction, productivity, and global competitiveness in association with OIT’s industries of the Future strategy. The assessment team conducted comprehensive plant energy efficiency reviews using a systems approach combined with industry standard practices. Opportunities for energy savings were identified and documented, then evaluated and prioritized based on potential for energy savings. Maintenance practices and procedures were also reviewed for their impact on energy efficiency.

Caraustar recognized that an energy study should involve identification/quantification of energy inputs to plant processes, assessment of process efficiency, and examination of process outputs (including waste and energy byproducts). Caraustar had already implemented detailed reporting practices for quantifying process inputs and outputs before initiation of the energy assessment, therefore, was able to quantify the energy of the plant processes.

Assessment Implementation

The assessment team first developed complete lists of the energy-consuming production and mill utility processes (steam, compressed air, on-line power production). The team conducted detailed audits of the processes believed to have the greatest energy savings potential. The areas identified included:

- Steam systems
- The generation, distribution, application, and condensate return of plant steam as well as operation and maintenance practices for steam systems were investigated. The steam consumption of various processes was also analyzed. Steam leaks and traps were identified and documented.
- Cogeneration assessment
- Caraustar’s paperboard mills have excellent thermal and electric load profiles. and several, including Rittman, already operate combined heating and power systems. The Chesapeake mill was evaluated for the application of a backpressure steam turbine that generates electric power. Rittman was analyzed with a focus on improving the overall efficiency of its aging plant. Gas turbines with increased steam generation were considered for both mills. Cogeneration applications were reviewed in conjunction with benefits that might also be available to the local electric utility.
- Waste heat recovery
- Sources of waste heat were identified and evaluated. Systems that could utilize waste heat from other processes were investigated, along with specific means by which heat recovery could be implemented and the potential size effects on the source and use processes.
- Motor analysis
- Electric motors account for approximately 80-90% of Caraustar’s electric power consumption, and are therefore targets for significant energy efficiency improvements. Caraustar’s existing motor database (based on DOE’s MotorMaster+) was used to identify candidate motors for replacement with more efficient models. A corporate-wide efficient motor efficiency program was developed that created a standard framework for evaluating motor rewind replace decisions and facilitated the reduced-cost purchasing of high-efficiency motors, further increasing opportunities for efficient motor conversions.
- Compressed air systems
- Both mill compressed air supply, distribution and storage systems, pressure and demand requirements, and operating and maintenance policies were reviewed. The merits of upgrading compressed air system leaks and eliminating poor compressed air applications were also evaluated.

Lighting systems

A mill’s lighting system is one of the largest consumers of electricity. A照明 system is therefore an obvious place to look for opportunities to reduce energy consumption. Caraustar realized that the assessment’s findings were valid for similar operations in the industry and other issues. In spite of this closure, the team continued their efforts to ensure that the findings were valid for similar facilities.

Electric variable speed drives analysis

An analysis was conducted to assess opportunities for installing new electric variable speed drives for selected applications. Candidate applications include boiler draft fans and lead pumps, other process applications, and replacement of older drive technologies.

Seven specific systems and/or processes were evaluated in detail for efficiency improvements or cost reductions for the Chesapeake mill: 1) The Chesapeake mill was selected for the assessment because of its higher production rate and the similarity of operations with several other Caraustar mills. The energy assessment conducted at the Chesapeake mill has been used as a template for improvements at other Caraustar mills. The systems and processes evaluated at the Chesapeake mill included:

- Baghouse steam turbine generator
- Boiler feed pump variable speed electric drive
- Boiler paper machine #2 variable speed electric drive retrofit
- Vapor-absorption system boiler stack heat recovery
- Stock pumper salt water heat exchangers
- Improved insulation of steam pipes

Six systems and/or processes were evaluated for efficiency improvements at the Rittman Mill. These included:

- Project requirements analysis for mill cogeneration (replacement or retrofit of existing operations)
- Benchmarking mill operations’ energy use
- Pulverized fuel water heaters
- Modifications to steam injection stack heater
- Boiler steam requirement efficiency or elimination
- Heat recovery for vapor-absorption system

1 Caraustar closed the Chesapeake mill in the spring of 2000/ because of overcapacity in the industry and other issues. In spite of this closure, the team continued their efforts to ensure that the findings were valid for similar facilities.
evaluate the efficiency of the plant processes.

Caraustar recognized that an energy study should involve identification/quantification of energy inputs to plant processes, assessment of process energy efficiency, and examination of process outputs (including waste and energy byproducts). Caraustar had already implemented detailed reporting practices and operating procedures were also reviewed for their impact on energy efficiency. The assessment team first developed complete lists of the energy-consuming equipment and processes evaluated at the Chesapeake mill included:

- Boiler feed pump steam turbine generator
- Boiler feed pump variable-speed electric drive
- Paper machine #2 variable-speed electric drive retrofit
- Vapor-absorption system boiler stack heat recovery
- Stock pulper fill water heat exchangers
- Improved insulation of steam pipes

Six systems and/or processes were also evaluated for efficiency improvements or cost reductions for the Chesapeake mill. The energy assessment conducted at the Chesapeake mill has been used as a template for improvements at other Caraustar mills. The systems and processes evaluated at the Chesapeake mill included:

- Backpressure steam turbine generator
- Boiler feed pump steam turbine
- Boiler feed pump variable-speed electric drive
- Paper machine #2 variable-speed electric drive retrofit
- Vapor-absorption system boiler stack heat recovery
- Stock pulper fill water heat exchangers
- Improved insulation of steam pipes

Seven specific systems and/or processes were evaluated in detail for efficiency improvements or cost reductions for the Chesapeake mill. The Chesapeake Mill was selected for the assessment because of its higher production costs and the similarity of operations with several other Caraustar mills. The energy assessment conducted at the Chesapeake mill has been used as a template for improvements at other Caraustar mills. The systems and processes evaluated at the Chesapeake mill included:

- Backpressure steam turbine generator
- Boiler feed pump steam turbine
- Boiler feed pump variable-speed electric drive
- Paper machine #2 variable-speed electric drive retrofit
- Vapor-absorption system boiler stack heat recovery
- Stock pulper fill water heat exchangers
- Improved insulation of steam pipes

Six systems and/or processes were also evaluated for efficiency improvements at the Rittman mill. These included:

- Project requirements analysis for mill cogeneration (replacement or retrofit of existing operations)
- Benchmarking mill operations' energy use
- Pulper #1 water heat exchangers
- Modifications to steam injection stock heater
- Coater oven steam requirement efficiency or elimination
- Heat recovery for vapor-absorption system

Caraustar closed the Chesapeake Mill in the spring of 2000 because of overcapacity in the industry and other issues. In spite of this closure, Caraustar realized that the assessment's findings were valid for similar facilities.
all its facilities, but also purchases significant quantities of fuel oil and coal for its paperboard mills. Energy accounts for 15-25% of each mill’s total operating expenses and is second only to raw material and labor in a mill’s operating cost structure.

Caraustar has made a commitment to continually maintain and improve its paperboard mills. During the past 5 years, Caraustar has spent over $30 million annually in capital expenditures, primarily in upgrade and upgrade its paperboard production and converting capacity by acquiring and maintaining state-of-the-art machine technology. Caraustar continues to upgrade existing facilities with modern, cost-efficient, and more productive equipment.

Assessment Overview

Caraustar has historically monitored the cost/ton of paper produced in its Mill Group. As a result of this work, the company has also begun to document energy costs for the Industrial and Consumer Products and Packaging Group. As a result of this study, the company has also begun to document energy costs for the Industrial and Consumer Products and Packaging Group. The energy assessment conducted at the Chesapeake mill has been used as a template for improvements at other Caraustar mills. The systems and processes evaluated at the Chesapeake mill included:

- Backpressure steam turbine generator
- Boiler feed pump variable-speed electric drive
- Boiler feed pump steam turbine drive
- Paper machine #2 variable-speed electric drive retrofit
- Vapor-absorption system boiler stack heat recovery
- Stock pulper tilt water heat exchangers
- Improved insulation of steam pipes

Six systems and/or processes were also evaluated for efficiency improvements at the Rittman mill. These included:

- Project requirements analysis for new variable-speed electric drives
- Benchmarking mill operations’ energy use
- Pulse IR water heat exchangers
- Modifications to steam injection stock heater
- Cooler uses steam requirement efficiently or elimination
- Heat recovery for vapor-absorption system

Electric variable speed drive analysis

An analysis was conducted to assess opportunities for installing new electric variable speed drives for selected applications. Candidate applications include boiler draft fans and feed pumps, other process applications, and replacement of older drive technologies.

Seven specific systems and/or processes were evaluated in detail for efficiency improvements or cost reductions for the Chesapeake mill. The Chesapeake mill was selected for the assessment because of its higher production and the similarity of operations with several other Caraustar mills. The energy assessment conducted at the Chesapeake mill has been used as a template for improvements at other Caraustar mills. The systems and processes evaluated at the Chesapeake mill included:

- Steam systems
- Electric motors
- Electric variable speed drive analysis
- Lighting systems
- Compressed air systems
- Emissions systems
- Process steam

The assessment team first developed complete lists of the energy-consuming projects and mill utility processes (steam, compressed air, on-site power production). The team conducted detailed audits of the processes believed to have the greatest energy savings potential. The areas investigated included:

- Steam systems
- Electric motors
- Electric variable speed drive analysis
- Lighting systems
- Compressed air systems
- Emissions systems
- Process steam
- Process hot water

The assessment team then developed complete lists of the energy-consuming processes and mill utility processes (steam, compressed air, on-site power production). The team conducted detailed audits of the processes believed to have the greatest energy savings potential. The areas investigated included:

- Steam systems
- Electric motors
- Electric variable speed drive analysis
- Lighting systems
- Compressed air systems
- Emissions systems
- Process steam
- Process hot water

The Chesapeake mill was selected for the assessment because of its higher production and the similarity of operations with several other Caraustar mills. The energy assessment conducted at the Chesapeake mill has been used as a template for improvements at other Caraustar mills. The systems and processes evaluated at the Chesapeake mill included:

- Backpressure steam turbine generator
- Boiler feed pump variable-speed electric drive
- Boiler feed pump steam turbine drive
- Paper machine #2 variable-speed electric drive retrofit
- Vapor-absorption system boiler stack heat recovery
- Stock pulper tilt water heat exchangers
- Improved insulation of steam pipes

Six systems and/or processes were also evaluated for efficiency improvements at the Rittman mill. These included:

- Project requirements analysis for mill cogeneration (replacement or retrofit of existing operations)
- Benchmarking mill operations’ energy use
- Pulse IR water heat exchangers
- Modifications to steam injection stock heater
- Cooler uses steam requirement efficiently or elimination
- Heat recovery for vapor-absorption system

1 Caraustar closed the Chesapeake mill in the spring of 2000 because of overcapacity in the industry and other issues. In spite of this closure, the company realized that the assessment’s findings were valid for similar facilities.
The plant-wide studies concentrated on identification of energy efficiency improvements for Caraustar’s Chesapeake and Rittman mills, with an extended focus on the development of efficiency concepts that could be transferred to other Caraustar facilities. Many of the efficiency measures identified and evaluated in this assessment will benefit other Caraustar mills as well as those of other recycled paperboard manufacturers. These include:

- Motor procurement and efficiency improvements
- Backpressure steam turbine generators
- Boiler feed pump variable speed drives
- Stack heat recovery to vapor absorption systems
- Pulper, R.P. and heat exchangers
- Steam pipe insulation

The application of these energy efficiency measures is being reviewed for application to other Caraustar mills. In addition to the efficiency measures identified, other measures were found that did not offer immediate benefits for either Chesapeake or Rittman. Caraustar would offer some benefits to other Caraustar locations. These measures include:

- Boiler forced draft variable speed drives
- Paper machine dryer section drive motors

Before initiating the two mill energy assessments, Caraustar had already undertaken a project to inventory all electric motors at selected mills to identify savings opportunities that could be realized from a formal industrial motor management program. The plant-wide energy assessments permitted the project team to better allocate the motor management effort. As a result, Caraustar has implemented cost-saving measures, such as: improved motor specifications, use of energy-efficient motors, and use of direct stack gas heat recovery from boilers.

### Table 1. Systems and Processes Evaluated for Energy Efficiency Improvements at Caraustar’s Chesapeake Mill

<table>
<thead>
<tr>
<th>System/Process</th>
<th>Estimated Project Implementation Cost</th>
<th>Estimated Annual Savings (Million $)</th>
<th>Estimated Simple Payback Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add steam turbine generator to existing steam boiler for electric power production</td>
<td>$300,000</td>
<td>$197,303</td>
<td>1.5</td>
</tr>
<tr>
<td>Boiler feed pump variable speed drives</td>
<td>$15,000</td>
<td>$9,300</td>
<td>1.6</td>
</tr>
<tr>
<td>Stack heat recovery to vapor absorption systems</td>
<td>$32,200</td>
<td>$27,150</td>
<td>1.2</td>
</tr>
<tr>
<td>Pulper, R.P. and heat exchangers</td>
<td>$16,000</td>
<td>$8,500</td>
<td>2.3</td>
</tr>
</tbody>
</table>

### Table 2. Systems and Processes Evaluated for Energy Efficiency Improvements at Caraustar’s Rittman Mill

<table>
<thead>
<tr>
<th>System/Process</th>
<th>Estimated Project Implementation Cost</th>
<th>Estimated Annual Savings (Million $)</th>
<th>Estimated Simple Payback Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler forced draft variable speed drives</td>
<td>$0</td>
<td>$11,800</td>
<td>0</td>
</tr>
<tr>
<td>Paper machine dryer section drive motors</td>
<td>$11,000</td>
<td>$9,300</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Caraustar Industries Energy Assessment

Caraustar is a major manufacturer of recycled paperboard and converted products products. It is a conglomerate of six corporations in the recycled paperboard industry previously related by common ownership and administration. Caraustar operates 125 facilities in the United States along with plants in Mexico and the United Kingdom. The company is divided into four business groups – the Mill Group, Industrial and Converted Products Group, Custom Packaging Group, and Recovered Fiber Group.

Caraustar manufactures its products primarily from recovered fiber derived from general paper products. At its 16 paperboard mills, Caraustar produces various grades of uncoated and clay-coated recycled paperboard both for internal consumption and for sale to customers in four principal markets:

1. tubes, crates, and container boxes
2. folding cartons
3. gypsum wallboard facing paper
4. miscellaneous specialty and converted products

In addition to the mills, Caraustar’s facilities include tube and core converting plants, composite paperboard plants, folding carton plants, and specialty converting plants. The company’s principal manufacturing activity is the production of uncoated and clay-coated recycled paperboard. In the mill manufacturing process, paperboard is reduced to pulp, cleaned and refined, then processed into various grades of paperboard. Approximately 30% of the recycled paperboard sold by Caraustar’s mills is consumed internally by its converting facilities; the other 60% is sold in other paper markets.

Large quantities of electricity, natural gas, coal, and oil are used in the production of recycled paperboard. Caraustar purchases electricity and natural gas for
Table 1: Systems and Processes Evaluated for Energy Efficiency Improvements at Caraustr’s Cheapside Mill.

<table>
<thead>
<tr>
<th>System/Process</th>
<th>Estimated Project Implementation Cost</th>
<th>Estimated Annual Savings</th>
<th>Estimated Simple Payback Year(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add steam turbine generator to existing boiler for electric power production</td>
<td>$300,000</td>
<td>$107,200</td>
<td>1.5</td>
</tr>
<tr>
<td>Replace direct steam injection into pulpers with fill water heat exchangers</td>
<td>$15,000</td>
<td>$9,300</td>
<td>1.6</td>
</tr>
<tr>
<td>Up (preferred option)</td>
<td>$220,000</td>
<td>$93,000</td>
<td>2.2</td>
</tr>
<tr>
<td>Eliminate coater oven steam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use boiler stack heat recovery with tubo-generators</td>
<td>$2,800,000</td>
<td>$1,130,000</td>
<td>2.5</td>
</tr>
<tr>
<td>Motor procurement and efficiency improvements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backpressure steam turbine generators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiler feed pump variable speed drives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stack heat recovery to vapor-absorption systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulp 6” water heat exchangers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steam pipe insulation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The application of these energy efficiency measures is being reviewed for implementation at Rittman. In addition to the above listed benefits, other measures were found that did not offer immediate benefits for either Cheapside or Rittman that would offer some benefits to other Caraustr locations. These measures include:

- Boiler forced draft variable speed drives
- Paper machine dryer section drive retrofits

Before initiating the two mill energy assessments, Caraustr had already undertaken a project to inventory electric motors at selected mills to identify energy savings opportunities that could be realized from implementation of a formal total motor management program (preliminary assessment of the project team to accelerate the motor management effort). As a result, Caraustr has implemented a comprehensive program for electric motor management that has reduced the cost of purchasing these items and boosted the opportunities to improve the overall efficiency of the company’s electric motor inventory. The plant-wide energy assessment project has been an important component in extending Caraustr’s focus on energy efficiency and cost reduction measures in all divisions.

Table 2: Systems and Processes Evaluated for Energy Efficiency Improvements at Caraustr’s Rittman Mill.

<table>
<thead>
<tr>
<th>System/Process</th>
<th>Estimated Project Implementation Cost</th>
<th>Estimated Annual Savings</th>
<th>Estimated Simple Payback Year(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add steam turbine drive boiler feed pump to back-up primary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace existing blowers for vapor compression system</td>
<td>$106,000</td>
<td>$48,000</td>
<td>1.8</td>
</tr>
<tr>
<td>Pulpers with sealed heat exchangers on fill water</td>
<td>$16,000</td>
<td>$9,500</td>
<td>0.3</td>
</tr>
<tr>
<td>Recycle discharge water to pulpers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The project-wide energy assessment project has been an important component in extending Caraustr’s focus on energy efficiency and cost reduction measures in all divisions.

Table 1: Systems and Processes Evaluated for Energy Efficiency Improvements at Caraustr’s Cheapside Mill.

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<td>Eliminate coater oven steam</td>
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<td>Use boiler stack heat recovery with tubo-generators</td>
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</tr>
<tr>
<td>Backpressure steam turbine generators</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Boiler feed pump variable speed drives</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Stack heat recovery to vapor-absorption systems</td>
<td></td>
<td></td>
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<tr>
<td>Pulp 6” water heat exchangers</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Steam pipe insulation</td>
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</tbody>
</table>

The application of these energy efficiency measures is being reviewed for implementation at Rittman. In addition to the above listed benefits, other measures were found that did not offer immediate benefits for either Cheapside or Rittman that would offer some benefits to other Caraustr locations. These measures include:

- Boiler forced draft variable speed drives
- Paper machine dryer section drive retrofits

Before initiating the two mill energy assessments, Caraustr had already undertaken a project to inventory electric motors at selected mills to identify energy savings opportunities that could be realized from implementation of a formal total motor management program (preliminary assessment of the project team to accelerate the motor management effort). As a result, Caraustr has implemented a comprehensive program for electric motor management that has reduced the cost of purchasing these items and boosted the opportunities to improve the overall efficiency of the company’s electric motor inventory. The plant-wide energy assessment project has been an important component in extending Caraustr’s focus on energy efficiency and cost reduction measures in all divisions.

Table 2: Systems and Processes Evaluated for Energy Efficiency Improvements at Caraustr’s Rittman Mill.

<table>
<thead>
<tr>
<th>System/Process</th>
<th>Estimated Project Implementation Cost</th>
<th>Estimated Annual Savings</th>
<th>Estimated Simple Payback Year(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add steam turbine drive boiler feed pump to back-up primary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace existing blowers for vapor compression system</td>
<td>$106,000</td>
<td>$48,000</td>
<td>1.8</td>
</tr>
<tr>
<td>Pulpers with sealed heat exchangers on fill water</td>
<td>$16,000</td>
<td>$9,500</td>
<td>0.3</td>
</tr>
<tr>
<td>Recycle discharge water to pulpers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The project-wide energy assessment project has been an important component in extending Caraustr’s focus on energy efficiency and cost reduction measures in all divisions.