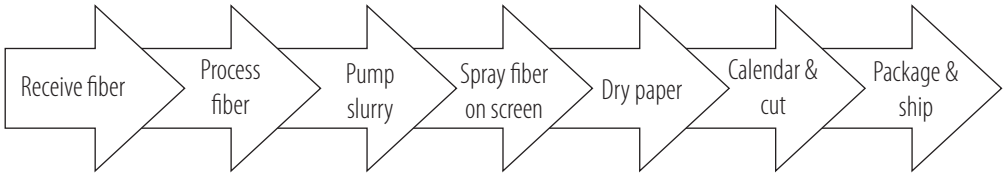
Pulp and Paper Mills

Sub-sector Description

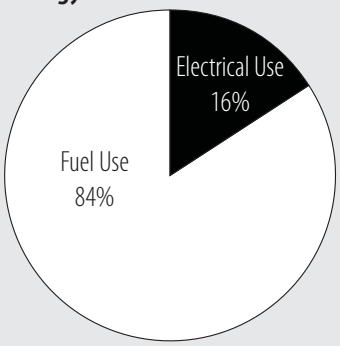
Pulp and paper mills make pulp, paper, or converted paper products. The manufacturing of pulp involves separating the cellulose fibers from other impurities in wood or used paper. The manufacturing of paper involves matting these fibers into a sheet.

Facility Type	SIC	NAICS		Facility Type	SIC	NAICS
Pulp mills	2611	322110		Paper mills	2621	322121
Paperboard mills	2679	322130				

Process Information



Energy Use[1]



Benchmarks

Thermal and electrical benchmarks were unable to be reliably derived from facility-specific energy use, sales, employee numbers, and area data. For more information about the benchmarking study that MnTAP conducted and how to determine if your facility may have energy efficiency opportunities remaining, view the report Web pages at http://www.mntap.umn.edu/resources/DOC/index.html.

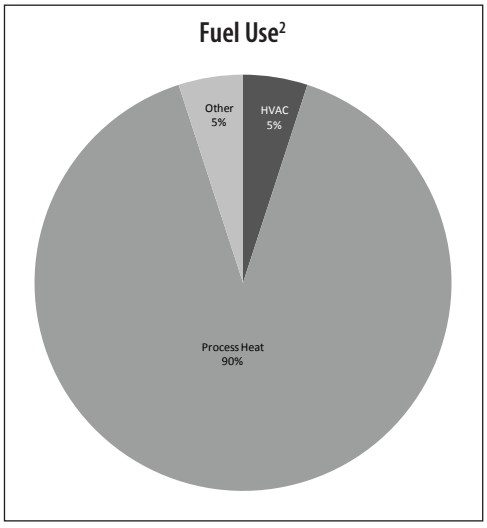
Savings Potential

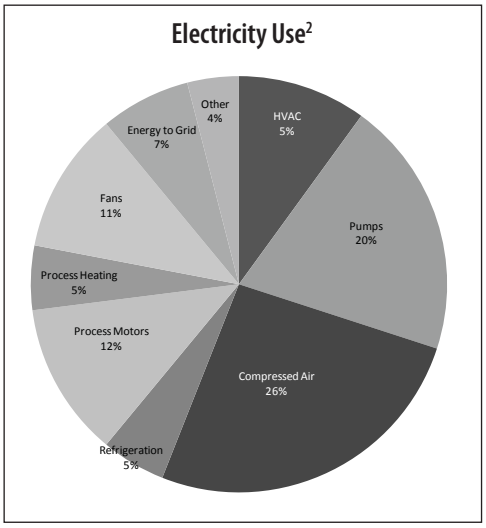
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation measures may apply to your facility. The tables on Page 2 of this summary reflect a number of energy conservation measures available for this sub-sector.

Estimated Fuel Savings: **24%**

Estimated Electric Savings: **12%**

Energy Use Footprints





Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Heat System Optimization[3]			
Boiler O_2 tuning[4]	< 1 year	2-25%	
Insulate pipes and tanks[4]	1 year	1-15%	
Improve process measurements, control, calibration	2 years	5-10%	
Heat recovery of flue gas to preheat combustion air[5]	1-2 years	3-25%	
Heat recovery of flue gas to heat secondary operations[4,6]	1-2 years	3-25%	
Repair and eliminate steam leaks[4]	< 1 year	0.24-0.59%	
Preventative maintenance and remove boiler scaling[7]	< 1 year	1%	
Pinch analysis, balance cold and hot streams energy loads[6]	4 years	8-22%	
Press drying, impulse air, microwave, infrared, air impingement drying, steam impingement drying, and air less drying[7]	unknown	varies	
TOTAL FUEL SAVINGS ESTIMATE			**24%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process improvements and optimization			
Steam pressure reduction for electric generation[5]	3-4 years	0.2%	
Plant power factor improvement to reduce line resistance and improve motor operation[7]	2 years	2%	
Replace motors with soft-start or ASD supplies[5]	2 years	1.4%	
Process motor optimization & load reduction, belt improvements[7]	1-2 years	0.1-10.8%	
Properly size pumps/impellers and install pump controls to prevent dry or closed-conditions running[8]	< 1 year	1.0-3.0%	
Compressed air improvements, cold air intake, fix leaks and controls[9]	< 1 year	0.1-1%	
Combined Heat and Power (CHP) Integration[10]	unknown	varies	
Facility improvements			
Facility HVAC improvements[5]	< 1 year	0-0.1%	
Lighting improvements[11]	2 years	0.5-1%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**12%**

References

1 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/

2 Adapted Source: DOE Forest Products Manufacturing Footprint, http://www1.eere.energy.gov/industry/energy_systems/pdfs/forest_footprint.pdf

3 http://www1.eere.energy.gov/industry/bestpractices/pdfs/em_proheat_seven.pdf

4 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MS0291

5 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WV0365

6 N. Martin, et. al., "Opportunities to Improve Energy Efficiency and Reduce Greenhouse Gas Emissions in the US Pulp and Ppaer Industry," Ernest Orlando Lawrence Berkeley National Laboratory, July 2000.

7 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UW0030

8 "Augusta Newsprint: Paper Mill Pursues Five Projects Following Plant-Wide Energy Efficiency

9 MnTAP Intern Project Report, Boise Cascade Corporation 2007 (about 3.6%) IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=LL0249 (0.8%)

10 "Renewing Rock-Tenn: A Biomass Fuels Assessment for Rock-Tenn's Recycled Paper Mill," Green

11 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=LL0249

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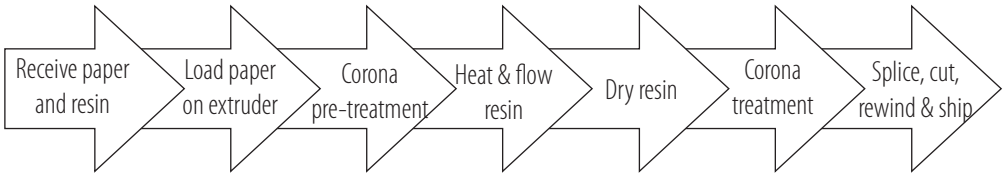
Extruding and Paper Coating

Sub-sector Description

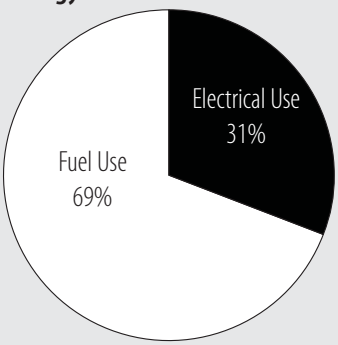
Facilities in this sub-sector cut and coat paper; cut and laminate paper and other flexible materials (except plastics film to plastics film); and laminate aluminum and other metal foils for non-packaging uses from purchased foils. These facilities purchase sheet materials and may print the products on-site.

Facility Type	SIC	NAICS		Facility Type	SIC	NAICS
Other coaters	2673	322222		Coating and laminating	2672	322221

Process Information



Energy Use[1]



Benchmarks

Thermal and electrical benchmarks were unable to be reliably derived from facility-specific energy use, sales, employee numbers, and area data. For more information about the benchmarking study that MnTAP conducted and how to determine if your facility may have energy efficiency opportunities remaining, view the report Web pages at http://www.mntap.umn.edu/resources/DOC/index.html.

Savings Potential

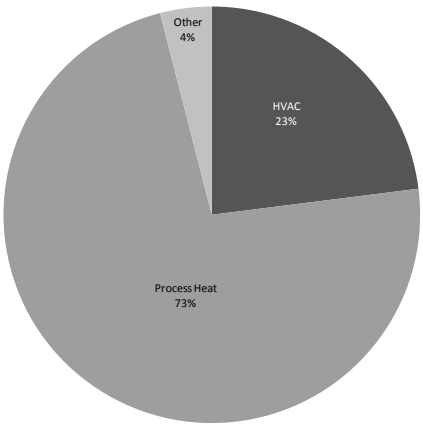
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation measures may apply to your facility. The tables on Page 2 of this summary reflect a number of energy conservation measures available for this sub-sector.

Estimated Fuel Savings: **11%**

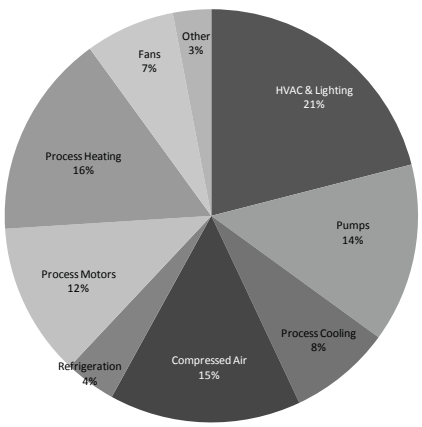
Estimated Electric Savings: **12%**

Energy Use Footprints

Fuel Use[2]



Electricity Use[3]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Heat System Optimization[2]			
Boiler O_2 tuning[4]	<1 year	1-14%	
Insulate pipes and tanks[5]	1-2 years	1-3%	
Improve process measurements, control, calibration	2 years	5-10%	
Heat recovery of flue gas to preheat combustion air[6]	2 years	1-41%	
Heat recovery from compressors and plant equipment[7]	1 year	1-54%	
Insulate extrusion equipment[8]	1-2 years	1-5%	
Facility HVAC Improvements			
Configure and operate spot heating during working hours[9]	< 1 year	1-62%	
Optimize make-up air ventilation, air recycling, reduce rate[10]	< 1 year	0.5-14.4%	
TOTAL FUEL SAVINGS ESTIMATE			**11%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Utilize energy-efficient belts[7]	< 1 year	0.1-13.4%	
Idle or turn of equipment when not in use, controls to shutdown[11]	< 1 year	0.1-3.4%	
Update to more efficient electric motors, NEMA[12]	3 years	0.1-4.7%	
Replace motors with soft-start or ASD supplies[13]	2-3 years	0.1-11.4%	
Insulate extrusion equipment[14]	1-2 years	1-12%	
Compressed air improvements, cold air intake, fix leaks, controls[9]	< 1 year	0.1-15.8%	
Facility Improvements			
Facility HVAC improvements[15]	< 1 year	0.1-0.4%	
Lighting improvements[16]	2 years	0.1-14%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**12%**

References

1 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/assessments.php
2 "Best Practices Guide #6: Environmental Considerations", The Web Offset Champion Group, 2007.
3 "Electricity Use in the Printing Industry", Electronic Power Research Institute Center for Materials Fabrication, June 1994.
4 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OD0121
5 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=DL0032
6 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=IA0241
7 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WI0396
8 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MA0602
9 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MA0493
10 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=IA0266
11 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SF0202
12 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MO0113
13 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WI0498
14 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=AM0205
15 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=IA0118
16 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MI0127

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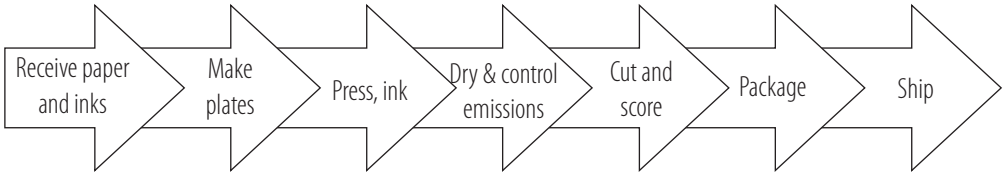
Multi-Wall Converting with Heat Set Operations

Sub-sector Description

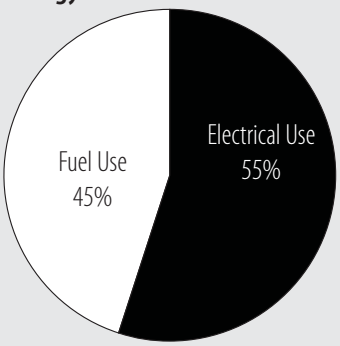
Facilities in this sub-sector manufacture corrugated and solid fiber boxes and related products from purchased paperboard. Final products include corrugated and solid fiberboard boxes, pads, partitions, display items, pallets, single face products, and corrugated sheets. Facilities in this sub-sector are set apart from other paperboard converting companies by their use of heat set operations in manufacturing their products.

Facility Type	SIC	NAICS		Facility Type	SIC	NAICS
Converted paper & paperboard	2679	32221		Folding paperboard containers	2657	322212
Corrugated box manufacturing	2653	322211				

Process Information



Energy Use[1]



Benchmarks

The following thermal and/or electrical benchmarks were derived from facility-specific energy use, employee numbers, and area data for the facilities that MnTAP analyzed. These benchmarks can be used to predict how efficient your facility is in comparison to peer facilities. If your facility's energy use is less efficient than your peers, there may be energy conservation opportunities available. The benchmarks included have been tested for reliability; however, they should be used with some caution. For more information on the benchmarking study including how to use the benchmarks, view the report Web pages at http://www.mntap.umn.edu/resources/DOC/index.html.

	Most efficient 25%	More efficient 25%	Less efficient 25%	Least efficient 25%
therms/employee	< 1,160	1,160 - 1,769	1,769 - 2,700	> 2,700

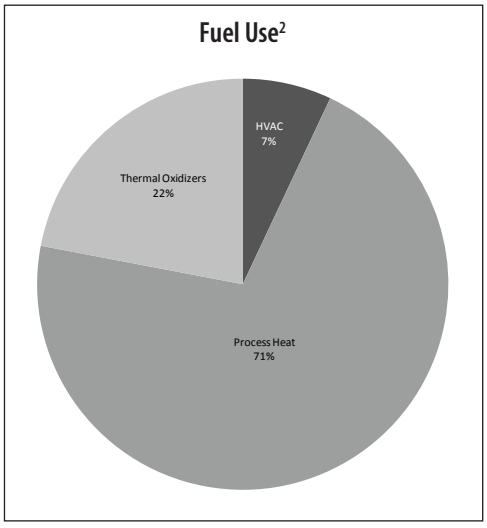
Savings Potential

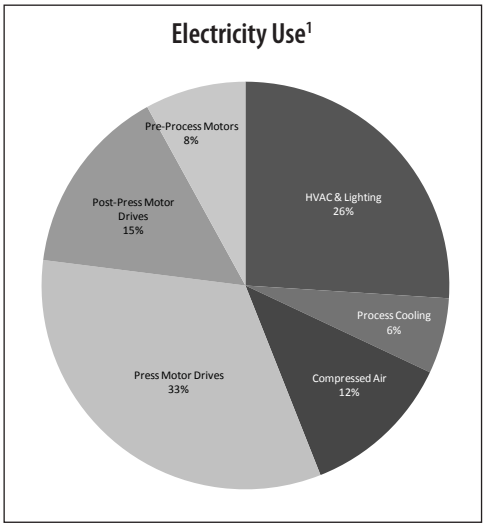
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation measures may apply to your facility. The tables on Page 2 of this summary reflect a number of energy conservation measures available for this sub-sector.

Estimated Fuel Savings: **12%**

Estimated Electric Savings: **12%**

Energy Use Footprints





Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Heat System Optimization			
Boiler O_2 tuning[3]	< 1 year	0.5-71.9%	
Direct warm air to combustion source[4]	1-2 years	0.3-7.2%	
Insulate pipes and tanks[5]	1-2 years	0.1-62.2%	
Improve process measurements, control, and calibration[6]	2 years	0.3-13.9%	
Heat recovery of flue gas to preheat combustion air[7]	2 years	1.1-27.6%	
Heat recovery from compressors and plant equipment[8]	1 year	0.1-74.6%	
Replace recuperative or older regenerative thermal oxidizer with regenerative TO[9]	3 years	2-3%	
Install catalyst in recuperative TO to convert it to a regenerative[10]	2 years	1-3%	
Update drying technology, replace old dryers[11]	2 years	4-5%	
Insulate heat-set equipment[12]	1-2 years	0.3-44.1%	
Facility HVAC Improvements			
Configure and operate spot heating during working hours[13]	< 1 year	0.9-8.4%	
Optimize make-up air ventilation, air recycling, reduce rate[14]	1 year	3-15.3%	
Improve air circulation with forced destratification[15]	2 years	0.8-32.4%	
TOTAL FUEL SAVINGS ESTIMATE			**12%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Utilize energy efficient belts[16]	< 1 year	0.1-15.3%	
Idle or turn off equipment when not in use, controls to shutdown[17]	< 1 year	0.1-11.0%	
Update to more efficient electric motors, NEMA and regenerative[18]	3 years	0.1-55.1%	
Replace motors with soft-start or ASD supplies[19]	2 years	0.7-27.2%	
Utilize automated controls to operate press systems[20]	1-2 years	0.2-32.6%	
Maintain bearing lubrication, use synthetics where applicable[21]	< 1 year	0.2-2.6%	
Compressed air improvements, cold air intake, fix leaks, controls[22]	< 1 year	0.1-47.8%	
Facility Improvements			
Facility HVAC and lighting improvements[23,24]	1-2 years	0.1-56.4%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**12%**

References

1 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/assessments.php
2 Adapted source: DOE Plastics and Rubber Products Footprint
3 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=DL0003
4 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=IA0090
5 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MA0465
6 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=BD0201
7 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=CO0205
8 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=KU0349
9 "RTO Innovation." Pollution Engineering 39 (2007): 50-54, "Improve Catalytic Oxidizer Operation." Chemical Engineering Progress 103 (2007): 47, "Energy Management at Hess Print Solutions." GATFWorld. April 2008.
10 "Improve Catalytic Oxidizer Operation." Chemical Engineering Progress 103 (2007): 47.
11 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SD0043
12 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=VW0221
13 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UM290
14 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=NC0248
15 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WI0277
16 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WI0278
17 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UF0391
18 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=ND0297
19 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=AS0202
20 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=TA0014
21 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WI0198
22 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=TA0044
23 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=CO448
24 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=AR0161

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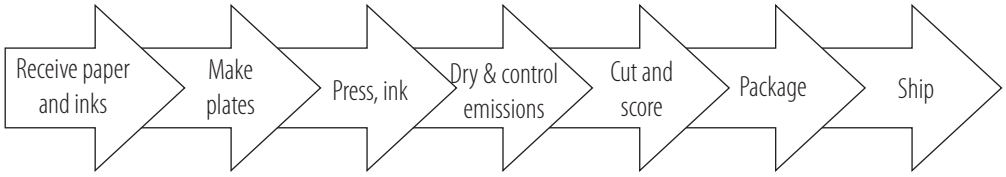
Board Converting (Non-Heat Set)

Sub-sector Description

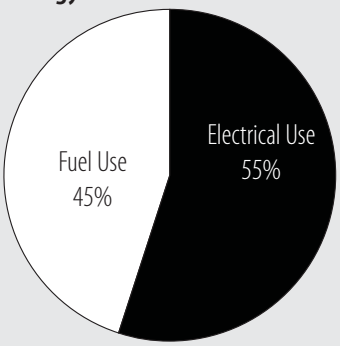
Facilities in this sub-sector manufacture corrugated and solid fiber boxes and related products from purchased paperboard. Final products include corrugated and solid fiberboard boxes, pads, partitions, display items, pallets, single face products, and corrugated sheets. Facilities in this sub-sector do not use of heat set operations for manufacturing their products.

Facility Type	SIC	NAICS		Facility Type	SIC	NAICS
Pulp/paper board converting	2621	322299		Paperboard converting	2631	322299
Converted paper/paperboard	2652	322299		Corrugated box manufacturing	2653	322211
Paper drums and tubes	2655	322214		Folding paperboard boxes	2657	322212
Paper bag manufacturing	2674	322223		Paper die-cutting	2675	322231

Process Information



Energy Use[1]



Benchmarks

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	Most efficient 25%	More efficient 25%	Less efficient 25%	Least efficient 25%
kWh/square feet	< 24	24 - 37	37 - 58	> 58
kWh/employee	< 8,168	8,168 - 16,197	16,197 - 32,117	> 32,117
therms/employee	< 337	337 - 554	554 - 912	> 912

Savings Potential

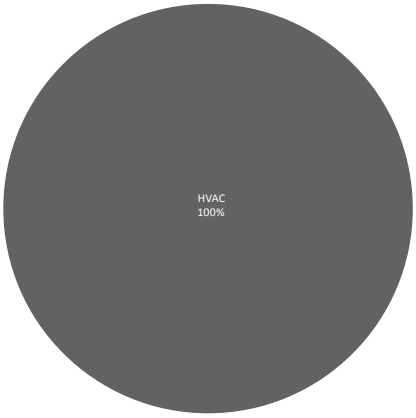
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation measures may apply to your facility. The tables on Page 2 of this summary reflect a number of energy conservation measures available for this sub-sector.

Estimated Fuel Savings: **9%**

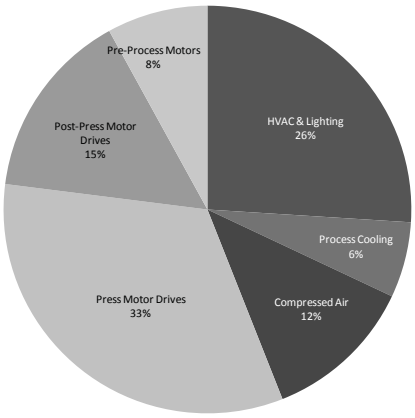
Estimated Electric Savings: **14%**

Energy Use Footprints

Fuel Use[2]



Electricity Use[1]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Heat System Optimization[3]			
Heat recovery from compressors and plant equipment[4]	1 year	0.1-74.6%	
Facility HVAC Improvements			
Configure and operate spot heating during working hours[4]	< 1 year	0.9-8.4%	
Optimize make-up air ventilation, air recycling, reduce rate[5]	< 1 year	3.0-15.3%	
Improve air circulation with forced destratification[6]	2 years	0.8-32.4%	
TOTAL FUEL SAVINGS ESTIMATE			**9%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Utilize energy-efficient belts[7]	< 1 year	0.1-15.3%	
Idle or turn off equipment when not in use, controls to shutdown[8]	< 1 year	0.1-11.0%	
Update to more efficient electric motors, NEMA and regenerative[9]	3 years	0.1-55.1%	
Replace motors with soft-start or ASD supplies[10]	2 years	0.7-27.2%	
Utilize automated controls to operate press systems[11]	1-2 years	0.2-32.6%	
Maintain bearing lubrication, use synthetics where applicable[12]	< 1 year	0.2-2.6%	
Compressed air improvements, cold air intake, fix leaks, controls[12]	< 1 year	0.1-56.4%	
Facility Improvements			
Facility HVAC improvements[13]	< 1 year	0.1-2.5%	
Lighting improvements[14]	2 years	0.1-56.4%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**14%**

References

1 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/assessments.php
2 Adapted source: DOE Plastics and Rubber Products Footprint
3 http://www1.eere.energy.gov/industry/bestpractices/pdfs/em_proheat_seven.pdf
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