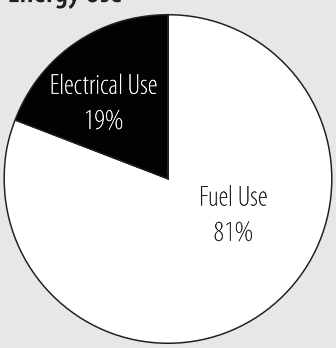
Resin Production

Sub-sector Description

Resin manufacturing is a fuel-intensive industry. One process, which uses a significant amount of fuel energy is cooking the resin, or initiating polymerization. This process creates the polymer chains that only solidify into a hard plastic once catalyzed. Fuel energy is used in this process by the thermal oxidizer for VOC destruction and in burners to heat the resin.

Energy Use[1]



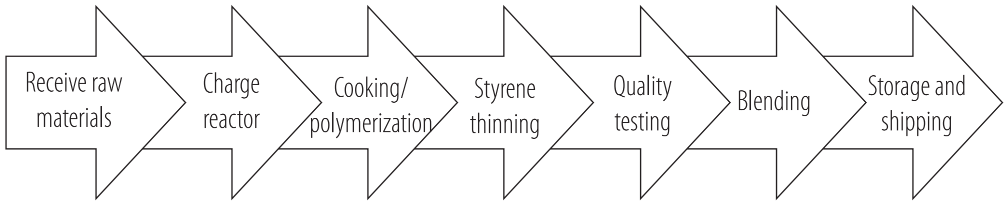
Savings Potential

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%

Facility Type	SIC	NAICS	
Resin production	2821	325211	

Process Information

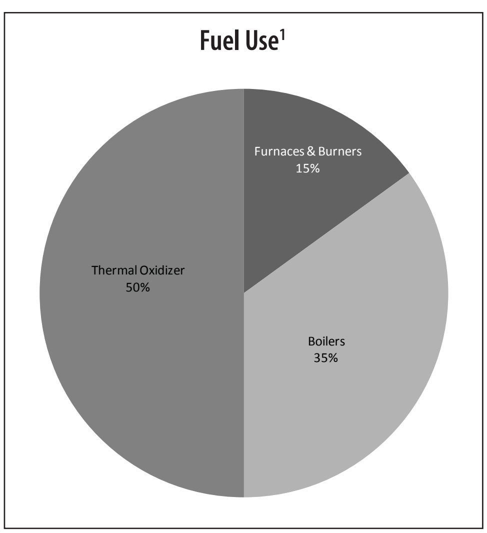


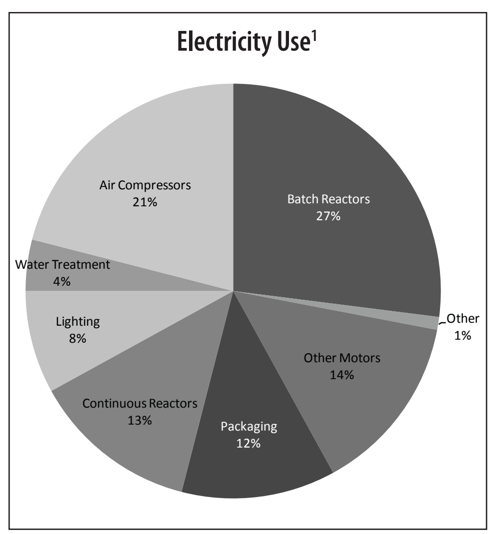
Benchmarks

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%
kWh/employee	< 6,097	6,097 - 10,256	10,256 - 17,253	> 17,253

Energy Use Footprints





Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Thermal Oxidizer Opportunities[2]			
Co-generation w/heat recovery system and HE chiller[3]	2-5 yr design and install, over $250,000 capital expense	10-15%	
Boiler Opportunities[4]			
Steam system optimization[5]	Can vary greatly depending on project scope	1-17%	
Burner Improvements[6]		0-5%	
TOTAL FUEL SAVINGS ESTIMATE			**24%**

Electric Savings Estimate and Opportunities

MnTAP researched and analyzed this sub-sector for a natural gas utility. Therefore, electric savings opportunities and an estimate of potential savings were not identified as part of MnTAP's industrial energy efficiency study.

References

1 http://www.baseco.com/Publications/ACEEE%202003%20Hydrocarbon%20Resin%20Manufacturing.pdf
2 Estimate from previous known data
3 http://apps1.eere.energy.gov/industry/bestpractices/energymatters/pdfs/ft_bragg_success_story.pdf
4 Best Practices in Steam System Management, Fred L. Hart, US Dept of Energy, David Jaber, Alliance to Save Energy, Steam Digest 2001.
5 Solutions for Energy Security and Facility Management Challenges, Joyce Wells and the Association for Energy Engineers. Fairmont Press 2004.
6 http://www1.eere.energy.gov/industry/bestpractices/printable_versions/pdfs/phast_tool.pdf

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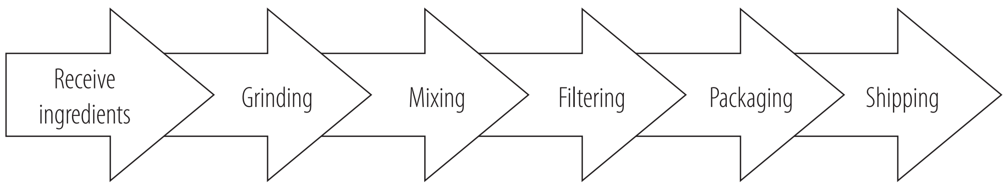
Paint, Ink, and Adhesive Production

Sub-sector Description

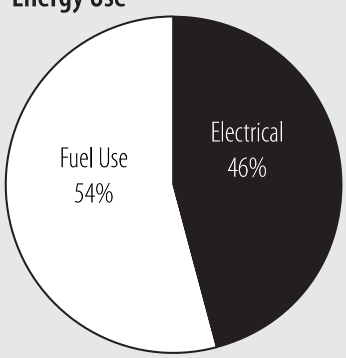
Facilities in this sub-sector mix pigments, solvents, and binders into paints and other coatings, such as stains, varnishes, lacquers, enamels, shellacs, and water repellent coatings for concrete and masonry. They also may manufacture allied paint products as well as adhesives.

Facility Type	SIC	NAICS		Facility Type	SIC	NAICS
Adhesives and Sealants	2891	325520		Paints	2851	325510
Inks	2893	325910				

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.

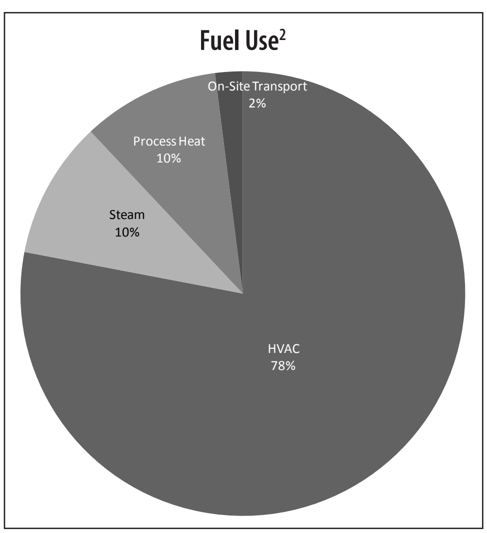
Savings Potential

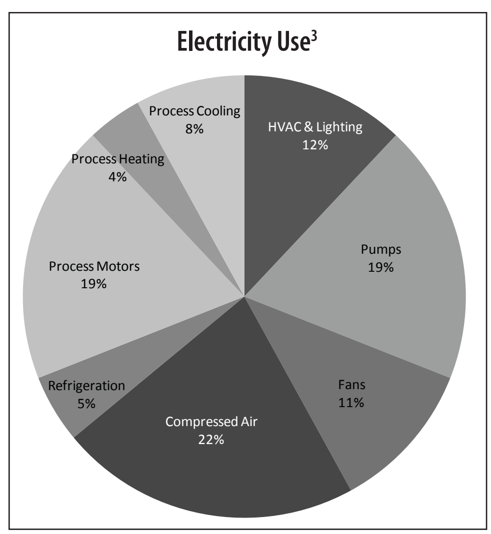
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: **26%**

Estimated Electric Savings: **23%**

Energy Use Footprints





Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements			
Process heat system optimization[4]		0-2%	
Insulate bare equipment[5,6]		0-1%	
Use heat in flue gases to preheat products or materials[5]		0-1%	
Improve boiler system		0-3%	
Facility HVAC & Lighting Improvements			
HVAC improvements[7] (adaptive climate)		10-20%	
Install air seals around truck loading dock doors[8]		1-2%	
Use heat exchanger to exchange building exhaust air with make-up air[9]		3-8%	
TOTAL FUEL SAVINGS ESTIMATE			**26%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements			
Pump system optimization[10]		1-4%	
Replace air driven motors with hydraulic pumps[11]		2-3%	
Process heat system optimization[4]		0-1%	
Use heat in flue gases to preheat products or materials[5]		0-1%	
Process control - turn systems off when not in use[12]		1-3%	
Better process controls[13]		0-2%	
Use ASD for variable pump, blower, and compressor loads[6,14]		4-8%	
Use most efficient type of electric motors[14,15,16]		0-2%	
Compressed air optimization[17]		2-7%	
Eliminate leaks in inert gas and compressed air lines and valves[18,19]		1-2%	
Facility HVAC & Lighting Improvements			
Lighting illumination reduction[19]		0-1%	
Utilize higher efficiency lamps and/or ballasts[20]		1-2%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**23%**

References

1 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/assessments.php
2 Developed from DOE Chemical Sector diagram by redistributing 18% HVAC to process heat and steam. http://www1.eere.energy.gov/industry/chemicals/footprints_detailed.html
3 Developed from DOE Chemical Sector diagram by redistributing electrochemical process electricity use to pumps, fans, compressed air, and process motors. http://www1.eere.energy.gov/industry/chemicals/footprints_detailed.html
4 http://www1.eere.energy.gov/industry/bestpractices/pdfs/em_proheat_seven.pdf
5 http://iac.rutgers.edu/database/findassessment.php?ID=WV0327
6 http://iac.rutgers.edu/database/findassessment.php?ID=OK0709
7 The Adaptive Climate Controller from Opto Generic Devices V-HVAC Inc. http://apps1.eere.energy.gov/industry/bestpractices/energymatters/articles.cfm/article_id=284
8 http://iac.rutgers.edu/database/findassessment.php?ID=MA0596
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11 Interview with Midway Industrial Supply Rep, Equipment. Graco Viscount Hydraulic 2-Ball Piston Pumps (3 times more efficient than air-powered pumps)
12 http://iac.rutgers.edu/database/findassessment.php?ID=IC0075
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14 http://iac.rutgers.edu/database/findassessment.php?ID=BD0255
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16 http://iac.rutgers.edu/database/findassessment.php?ID=MO0229
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19 http://iac.rutgers.edu/database/findassessment.php?ID=DL0019
20 http://iac.rutgers.edu/database/findassessment.php?ID=UD0615, http://iac.rutgers.edu/database/findassessment.php?ID=GT0679, http://iac.rutgers.edu/database/findassessment.php?ID=MO0146, http://iac.rutgers.edu/database/findassessment.php?ID=TA0062

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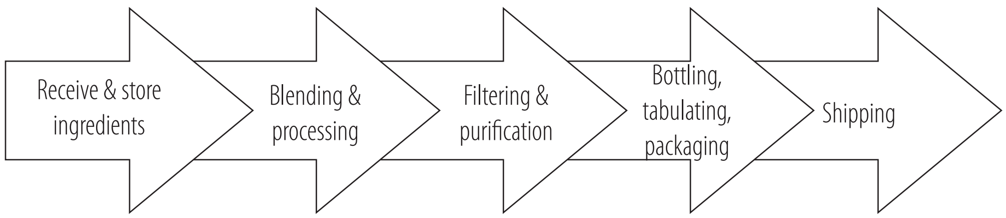
Pharmaceutical Manufacturing

Sub-sector Description

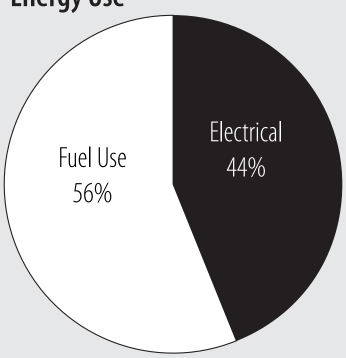
There are four process types used in pharmaceutical manufacturing. Through fermentation, microorganisms produce the end product, which then must be separated and purified. Extraction is used when no other means are available and uses larger organisms to produce the desired product, which then has to be separated and purified. Chemical synthesis can be used to create the desired drug product without the use of biological organisms. Lastly, mixing or compounding the purified ingredients is necessary for all pharmaceutical manufacturing processes.

Facility Type	SIC	NAICS		Facility Type	SIC	NAICS
Pharmaceutical Preparations	2834	325412		Medicinal and Botanical Prod.	2833	325411
In Vivo Diagnostic Substances	2893	325412		Biological Products & Vaccines	2836	325414
Skin and Haircare Products	2844	325620				

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

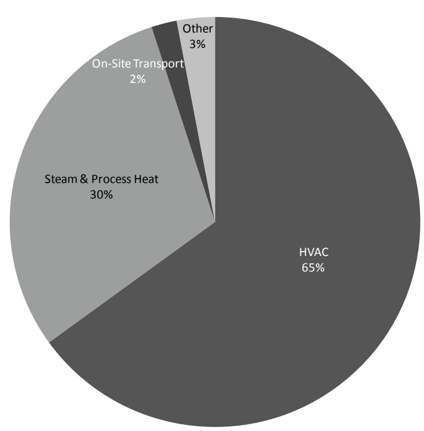
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: **18%**

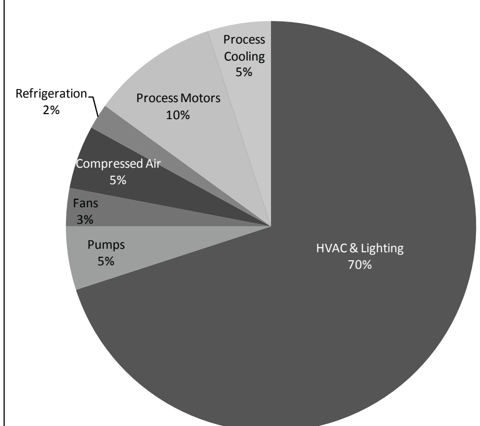
Estimated Electric Savings: **16%**

Energy Use Footprints

Fuel Use[1]



Electricity Use[1]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Heat System Improvements[2]			
Boiler O_2 tuning[3]	< 2 years	1-8%	
Insulate bare equipment and piping[4]	2 years	1-5%	
Repair steam leaks[5]	< 1 year	0-3%	
Heat recovery of flue gas to preheat combustion air or heat secondary operations[6]	5 years	3-8%	
Improve process measurements, control, and calibration[7]	3 years	2-3%	
Heat Recovery Opportunities			
Recover heat from compressed air systems[8]	4 years	0-2%	
Recover heat from material processing[9]	4 years	1-4%	
Recover heat from flue gas to heat boiler water[10]	4 years	0-1%	
Facility HVAC & Lighting Improvements			
Use efficient building insulation[11]	2 years	0-1%	
Properly tune make-up air units in clean rooms[12]	2 years	1-9%	
TOTAL FUEL SAVINGS ESTIMATE			**18%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements			
Pump system optimization[13]		0-2%	
Use adjustable speed drive to replace mechanical drive[14]		0-6%	
Change procedures/equipment/operating conditions[15]		0-1%	
Better process controls[7]		0-1%	
Facility HVAC & Lighting Improvements			
Utilize higher efficiency lamps and/or ballasts[6,16]		0-2%	
HVAC improvements[17]		0-10%	
Repair and eliminate steam leaks[6]		0-1%	
Replace existing HVAC unit with high efficiency model[15,18]		0-1%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**16%**

References

1 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/assessments.php
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12 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UF0397
13 http://www.pumpsystemsmatter.org/
14 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=IC0141
15 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MI0047
16 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MI0162
17 The Adaptive Climate Controller from Opto Generic Devices V-HVAC Inc. http://apps1.eere.energy.gov/industry/bestpractices/energymatters/articles.cfm/article_id=284
18 http://iac.rutgers.edu/database/findassessment.php?ID=LE0259

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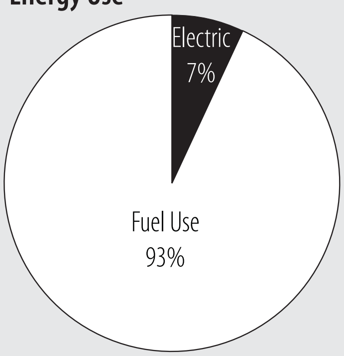
Ethanol Production

Sub-sector Description

The primary product at ethanol facilities is fuel-grade ethanol. A by-product can also produced at such facilities: dried distillers grains (DDGs). There are eight essential steps in the ethanol production process: grain receiving/handling, starch conversion, fermentation, distillation, dehydration, separation, drying, and shipping. Starch conversion, distillation, and drying are the most fuel intensive operations in the process, consuming 99% of the natural gas used by each facility.

Energy Use[1]



Savings Potential

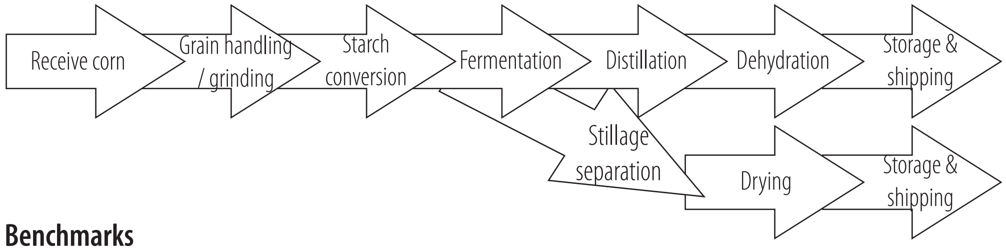
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: 20%

Estimated Electric Savings: 11%

Facility Type	SIC	NAICS	
Ethanol Production	2869	325193	

Process Information



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.

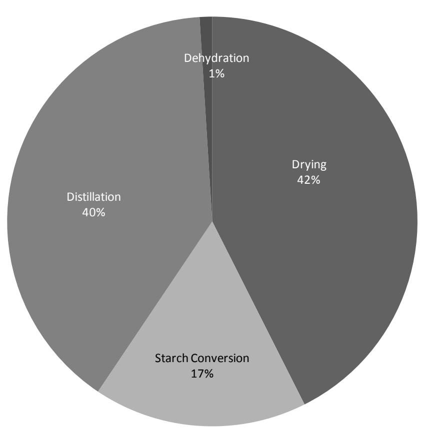
	Most efficient 25%	More efficient 25%	Less efficient 25%	Least efficient 25%
kWh/square feet	< 1,070	1,070 - 1,422	1,422 - 1,889	> 1,889
kWh/employee	< 612,896	612,896 - 803,404	803,404 - 1,053,129	> 1,053,129
therms/employee	< 241,686	241,686 - 302,801	302,801 - 379,369	> 379,369

Additionally, energy use benchmarks for ethanol facilities have been developed for energy use per gallon of ethanol produced. This is another way to ensure your facility is operating efficiently as compared to your peers'.

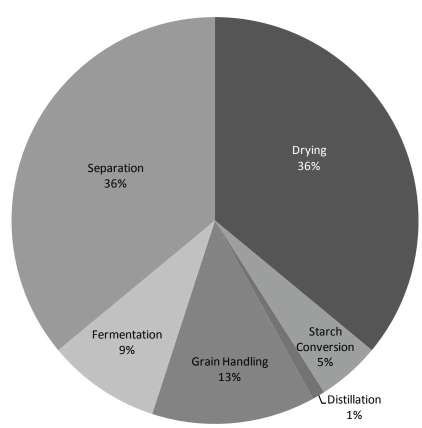
	Average thermal energy use		Average electrical energy use	
	Start up before 1999	Start up after 2005	Start up before 1999	Start up after 2005
Energy per gal[1]	37,000 Btu/gal	29,000 Btu/gal	1.02 kWh/gal	0.61 kWh/gal

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements			
Boiler best practice: tune and maintain	< 1 year	0-0.5%	
Steam best practice: maintain traps, repair leaks, minimum operating pressure, capture condensate, insulate distribution components	< 2 years	0.2-1%	
Boiler opportunity: new burner, O_2 control, turbulator, small boiler, clean tubes, feed water improvements, boiler refractory insulation	2-10 years	0.1-1%	
Boiler heat recovery: economizer, feed water, combustion air, process water	2 years	0.4-1%	
Preheat dryer combustion air[3]	< 1 year	4-8%	
Cold cooking OR corn fractionation[4,5]		5-15%	
TOTAL FUEL SAVINGS ESTIMATE			**20%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements			
Use multiple speed motors or ASD for variable pump, blower and compressor loads[6]	< 1 year	2-6%	
Corn fractionation[5]		5-15%	
Not drying stillage[7]		0-1%	
Hammermill improvements			
Combined Heat and Power (CHP) from natural gas combustion[8]		Varies	
Combustion of biomass (DDGS or corn stover) to provide combined heat and power		Varies	
Anaerobic digestion of thin stillage		Varies	
TOTAL ELECTRIC SAVINGS ESTIMATE			**11%**

References

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2 J.R. Kwiatkowski, A.J. McAloon, F. Taylor, and D.B. Johnston. Modeling the process and costs of fuel ethanol production by the corn dry-grind process. (August 2005).
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