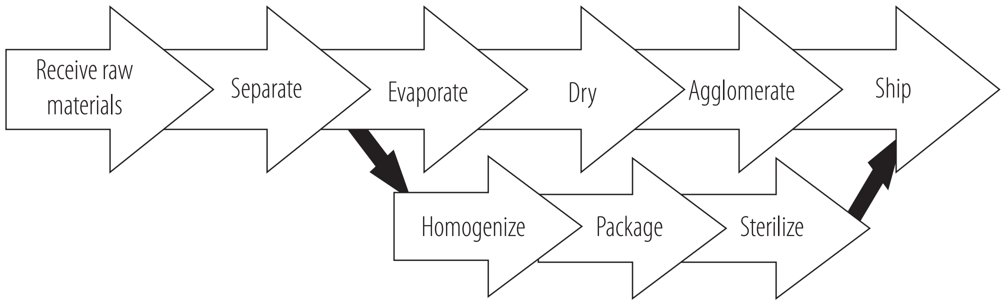
Dried Dairy Products

Sub-sector Description

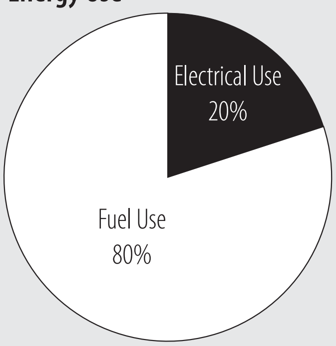
Facilities in this sub-sector manufacture dry, condensed, and evaporated milk and dairy substitute products.

Facility Type	SIC	NAICS	
Dried dairy products	2023	311514	

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.

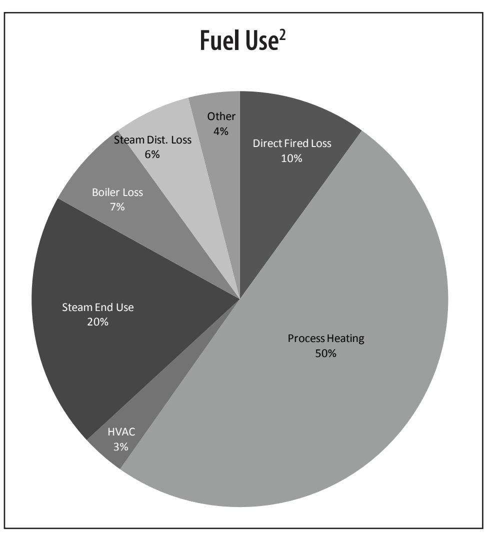
Savings Potential

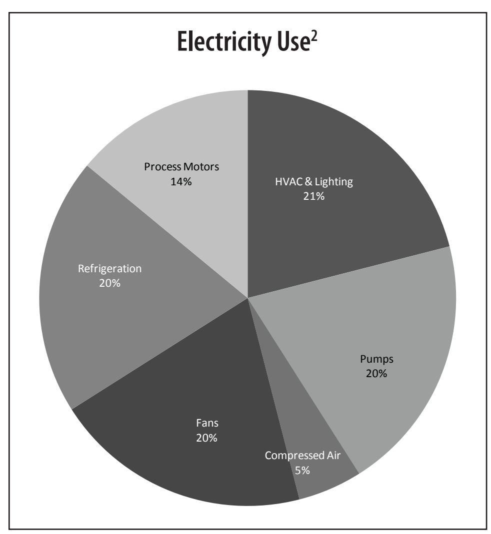
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: 6%

Estimated Electric Savings: 6%

Energy Use Footprints





Fuel Savings Estimate and Opportunities[1,3,4,5]

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Direct Fired Loss Opportunities			
Direct fire best practice: tune and maintain	< 1 year	0.1-0.7%	
Steam Distribution Improvements			
Boiler improvements: burner, O_2 control, turbulator, small boiler, new boiler, clean tubes, feed water improvements, insulation, heat combustion air	1-10 years	1-4%	
Boiler heat recovery: economizer, feed water	2-3 years	0.4-1.5%	
Boiler best practice: tune and maintain	< 2 years	1-3%	
Steam best practice: maintain traps, repair leaks, minimum operating pressure, capture condensate, insulate distribution	< 2 years	1-5%	
Process Equipment Improvements		22%	
Equipment heat recovery: process, dryer, refrigeration	1-6 years	1-15%	
Improve drying and heating operations	5-10 years		
Multiple effect evaporators or vapor recompression			
Direct fire water heater		20%	
Thermal storage (hot), provide opportunity for reducing peak loads			
TOTAL FUEL SAVINGS ESTIMATE			**6%**

Electric Savings Estimate and Opportunities[1,3,4]

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process and Equipment Improvements			
Replace hydraulic / pneumatic equipment with electric equipment	2-3 years	0.4-1.8%	
Use most efficient equipment at maximum capacity and less efficient equipment only when necessary	< 1 year	0.3%	
Modify refrigeration system to operate at a lower pressure	3-4 years	2-5%	
Install new refrigeration equipment	3-5 years	11-30%	
Improve freezer insulation	< 2 years	0.05-0.5%	
Optimize pump and fan operations	1-4 years		
Upgrade motors, install ASDs	2-5 years	0.5-5%	
Compressed air best practices: lower pressure, eliminate wasteful uses, repair leaks, improve dryers and filters, improve control and staging	< 2 years	0.2-2.5%	
Improve process control	< 2 years	0.3-1.4%	
Improve utilization of cooling towers and cooling tower water treatment	2-5 years	0-5%	
Operate an absorption chiller on waste heat	2-5 years		
Facility and HVAC Improvements		22%	
Lighting and HVAC improvements		0.5-1%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**6%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2 Generalized Food and Beverage Energy Footprint, DOE, http://www1.eere.energy.gov/industry/energy_systems/pdfs/food_footprint.pdf. Percentages adjusted by researcher to reflect higher drying levels.
3 Savings calculated by analyzing processed meat and drying assessments conducted by DOE. http://iac.rutgers.edu/database/assessments.php
4 http://alpha.cres.gr/besss/elearning/bess/pdfs/Outer_Ring/Case_Study_no.pdf
5 Energy Efficiency Improvement and Cost Saving Opportunities for the Fruit and Vegetable Processing Industry, August 2007, Lawrence Berkeley National Lab, http://ies.lbl.gov/iespubs/LBNL-59289.pdf

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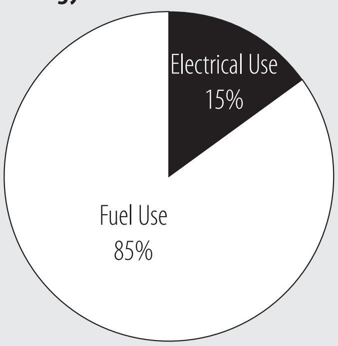
Snack Chip Production

Sub-sector Description

Facilities that manufacture potato chips, corn chips, and similar snacks are included in this sub-sector.

Energy Use[1]



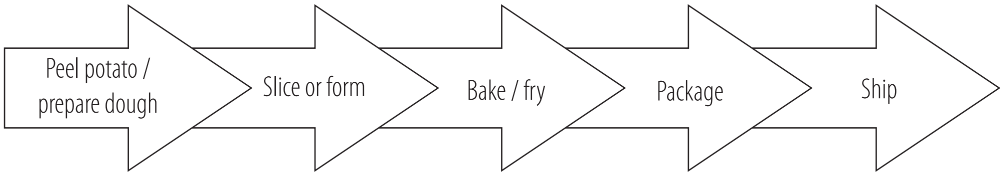
Savings Potential

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 Electric Savings: **8%**

Facility Type	SIC	NAICS	
Potato and Corn Snack Foods	2096	311919	

Process Information



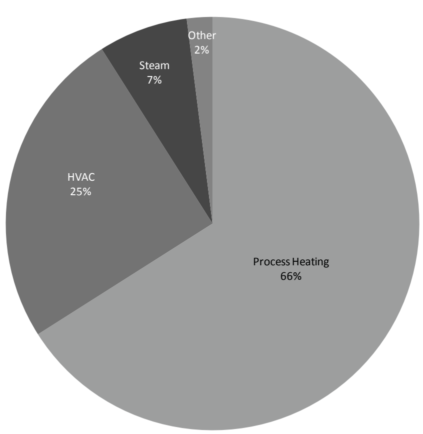
Benchmarks

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.

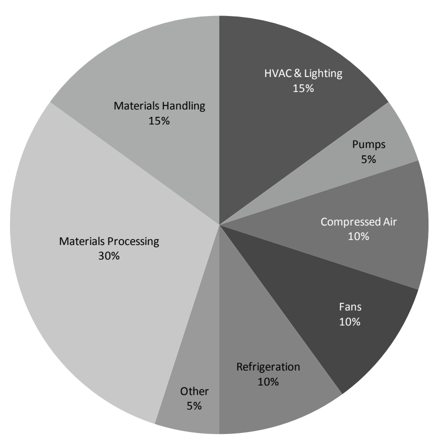
	Most efficient 25%	More efficient 25%	Less efficient 25%	Least efficient 25%
kWh/square feet	< 27	27 - 44	44 - 72	> 72
kWh/employee	< 6,010	6,010 - 11,768	11,768 - 23,043	> 23,043

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities

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

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: compressed air (fix leaks, lower pressure, use cool air, eliminate inappropriate uses, use blowers[3])	< 1 year	0-6%	
Best Practices: motors (replacement plan, preventive maintenance)		-	
Best Practices: process equipment (shut off, optimize settings)		-	
Compressed air (upgrade, better sequence/control, heat recovery, replace inefficient uses)		-	
Motor opportunities (upgrade motors & belts, ASD)[4]	1 year	0-14%	
Process equipment opportunities (improve controls, change product design, change process, upgrade equipment)[5]		-	
Lean Manufacturing (reduce material transport, reduce the length of transport, just enough processing, just enough heating or cooling)			
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce temperature, upgrade equip, upgrade controls)	< 1 year	0-1%	
Lighting (upgrade, use controls occupancy, light)	< 1 year	0-8%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**8%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2 Generalized Food and Beverage Energy Footprint, DOE, http://www1.eere.energy.gov/industry/energy_systems/pdfs/food_footprint.pdf. Electrical adjusted to increase fans, reduce pumps, eliminate refrigeration, reduce cooling. Gas adjusted for space heating using other data.
3 Energy Savings for a Bread Plant, www.baseco.com/casestudies/Bread Plant.pdf
4 Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf
5 www.foodprocessing.com/articles/2007/012.html

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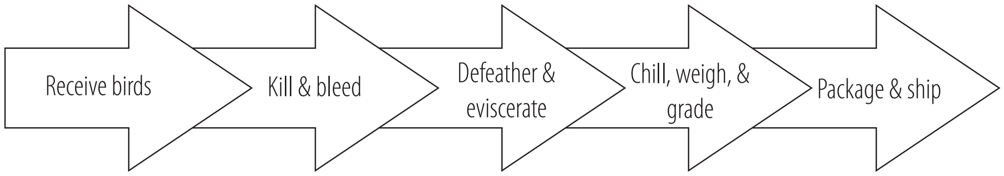
Poultry Processing

Sub-sector Description

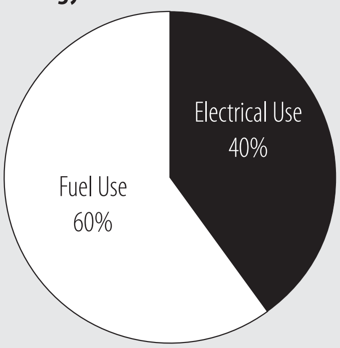
In the poultry processing sub-sector, facilities slaughter poultry and/or prepare processed poultry by-products.

Facility Type	SIC	NAICS	
Poultry Processing	2015	311615	

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%
kWh/employee	< 22,934	22,934 - 42,222	42,222 - 77,732	> 77,732

Savings Potential

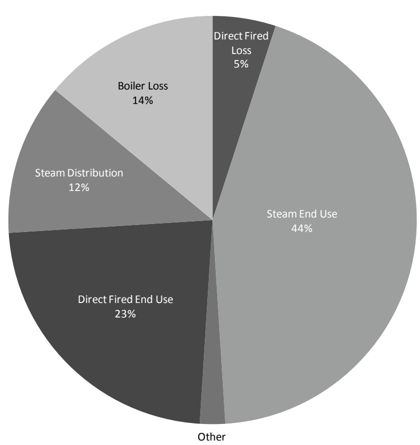
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation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

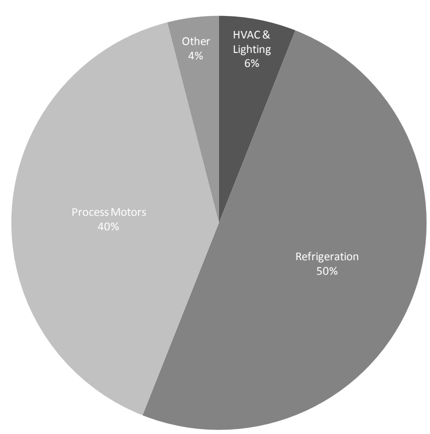
Estimated Electric Savings: 15%

Energy Use Footprints

Fuel Use[2]



Electricity Use[3]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Steam best practice: maintain traps, repair leaks, minimum operating pressure, capture condensate, insulate distribution components	< 2 years	1-6%	
Boiler opportunity: burner, O_2 control, turbulator, small boiler, clean tubes, feed water improvements	1-10 years	1-17%	
Boiler heat recovery: feed water, combustion air, process water, economizer	2 years	1-5%	
Boiler best practice: tune and maintain	< 2 years	0.1-1%	
Heat recovery from process equipment: hot water tanks/overflow and refrigeration	1-6 years	1-16%	
Dry/blow-off surface water before browning		0.1-0.2%	
Equipment best practice: insulate and maintain	< 2 years	0.5-2%	
Improved process equipment: direct-fired water heater		3-10%	
TOTAL FUEL SAVINGS ESTIMATE			**11%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: cooling refrigeration (clean condenser, optimize temps, avoid frost)	< 1 year	0.5-9%	
Best Practices: compressed air (fix leaks, lower pressure, use cool air,eliminate inappropriate uses)	< 1 year	0.2-3%	
Best Practices: motors (replacement plan, preventive maintenance)	1-2 years	0.3%	
Best Practices: process equipment (shut off, optimize settings)	1 year	0-6%	
Cooling & refrigeration opportunities (upgrade, recover heat, reduce floating head pressure, increase suction pressure setpoint, improve compressor sequencing, use ASDs, use ammonia sub-cooling, insulate, recover heat)[4,5,6,7]	2 years	0.5-21%	
Compressed air and vacuums (upgrade, better sequence/control, heat recovery, replace inefficient uses)	3 years	0-0.2%	
Motor opportunities (upgrade motors & belts, ASD)[8]	3-4 years	0.2-14%	
Process equipment opportunities (improve controls, change product design, change process, optimize pumps and fans)[9]	< 1 year	0.3-8%	
Lean Manufacturing (reduce material transport, just enough processing, just enough heating or cooling)			
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls)	1 year	0-2.5%	
Lighting (upgrade, use controls (occupancy, light)	1-2 years	0.2-5%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**15%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2 Generalized Food and Beverage Energy Footprint (modified). DOE. http://www1.eere.energy.gov/industry/energy_systems/pdfs/food_footprint.pdf
3 Poultry Industry Energy Uses. Tri-State Generation and Transmission Association. http://tristate.apogee.net/et/ezifpeu.asp
4 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp16
5 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp 30
6 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp 31-35
7 Energy Savings for a Frozen Food Processing Plant, www.baseco.com/casestudies/Frozen Food Processing.pdf
8 Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf
9 www.foodprocessing.com/articles/2007/012.html

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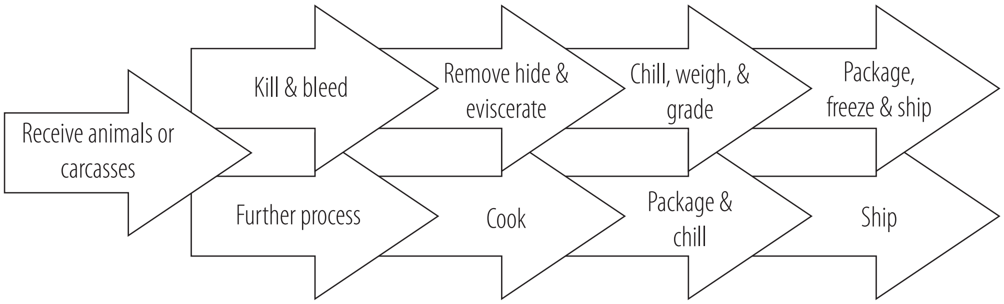
Meat Processing

Sub-sector Description

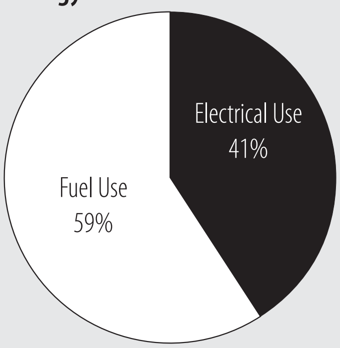
This sub-sector includes two types of facilities: those that slaughter large animals and process raw cuts of meat to be sold or to be used on the same premises and those that purchase meat and further process it into products.

Facility Type	SIC	NAICS		Facility Type	SIC	NAICS
Meat (non-Poultry) Processing	2011	311611		Meat Processing (non-slaughter)	2013	311612

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%
kWh/employee	< 23,037	23,037 - 33,052	33,052 - 47,422	> 47,422

Savings Potential

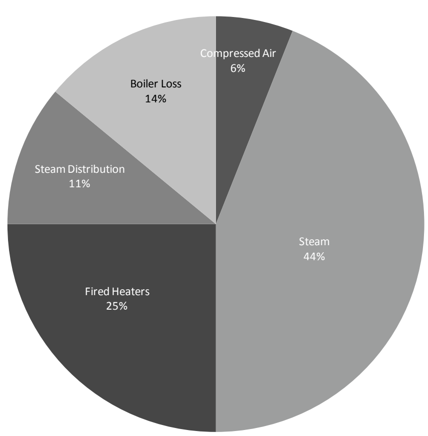
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: **7%**

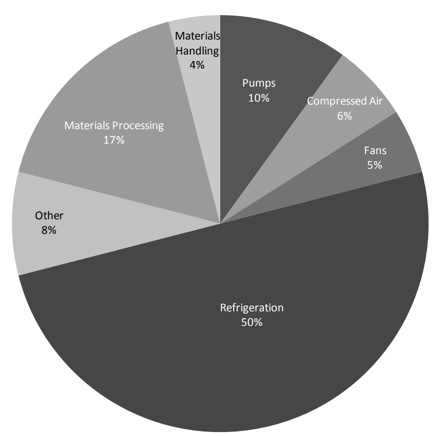
Estimated Electric Savings: **15%**

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities[1,3]

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Steam best practice: maintain traps, repair leaks, minimum operating pressure, capture condensate, insulate distribution components	1-2 years	0.5-5%	
Boiler opportunity: burner, O_2 control, turbulator, small boiler, clean tubes, feed water improvements, insulation, new boiler, heat combustion air	1-10 years	0.5-10%	
Boiler heat recovery: feed water, economizer, blowdown	2 years	0.1-1%	
Boiler best practice: tune and maintain	< 2 years	0.1-0.5%	
Direct fire best practice: tune and maintain	< 1 year	0.1-0.5%	
Improve retort insulation	< 2 years	0.1-0.7%	
Equipment best practices: insulate and maintain	< 2 years	0.5-2%	
Direct-fired water heaters	< 2 years	3-10%	
Heat recovery from process equipment or refrigeration	1-6 years	0.5-2%	
TOTAL FUEL SAVINGS ESTIMATE			**7%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: cooling refrigeration (clean condenser, optimize temps, avoid frost)	< 1 year	0.5-9%	
Best Practices: compressed air (fix leaks, lower pressure, use cool air,eliminate inappropriate uses)	< 1 year	0.2-3%	
Best Practices: motors (replacement plan, preventive maintenance)	1-2 years	0.3%	
Best Practices: process equipment (shut off, optimize settings)	1 year	0-6%	
Cooling & refrigeration opportunities (upgrade, recover heat, reduce floating head pressure, increase suction pressure setpoint, improve compressor sequencing, use ASDs, use ammonia sub-cooling, insulate, recover heat)[4,5,6,7]	2 years	0.5-21%	
Compressed air and vacuums (upgrade, better sequence/control, heat recovery, replace inefficient uses)	3 years	0-0.2%	
Motor opportunities (upgrade motors & belts, ASD)[8]	3-4 years	0.2-14%	
Process equipment opportunities (improve controls, change product design, change process, upgrade equipment)[9]	< 1 year	0.3-8%	
Lean Manufacturing (reduce material transport, reduce the length of transport, just enough processing, just enough heating or cooling)			
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls)	1 year	0-2.5%	
Lighting (upgrade, use controls (occupancy, light)	1-2 years	0.2-5%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**15%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2 Generalized Food and Beverage Energy Footprint (modified). DOE. http://www1.eere.energy.gov/industry/energy_systems/pdfs/food_footprint.pdf
3 http://alpha.cres.gr/besss/elearning/bess/pdfs/Outer_Ring/Case_Study_no.pdf
4 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp16
5 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp 30
6 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp 31-35
7 Energy Savings for a Frozen Food Processing Plant, www.baseco.com/casestudies/Frozen Food Processing.pdf
8 Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf
9 www.foodprocessing.com/articles/2007/012.html

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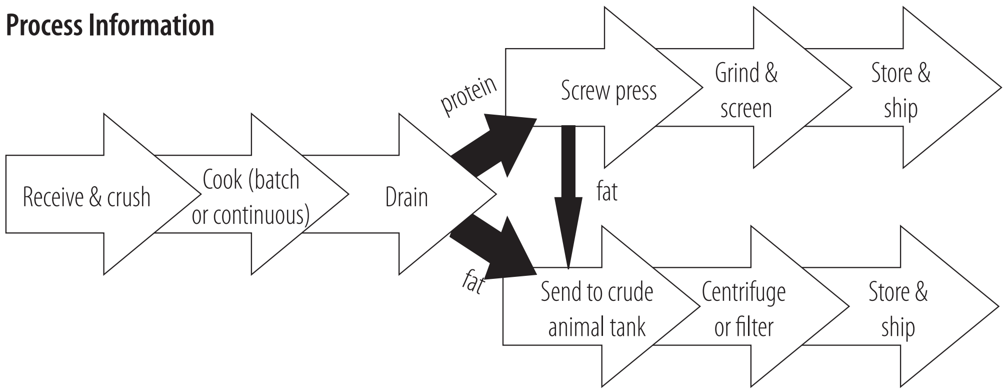
Rendering

Sub-sector Description

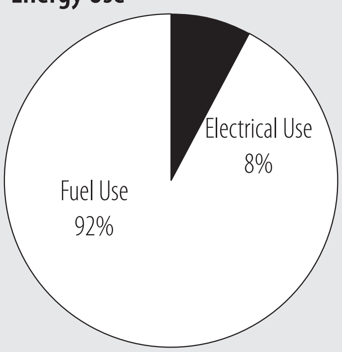
Rendering operations process meat and animal by-products from meat processing and some food service operations to create protein meal, blood meal, bone meal, and oil products that are used for animal feed, fertilizer, and cooking.

Facility Type	SIC	NAICS	
Rendering	2077	311613	

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

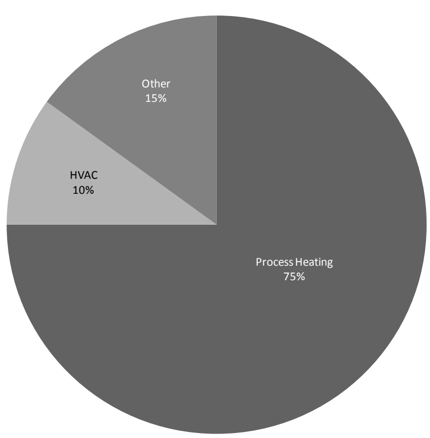
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: 15%

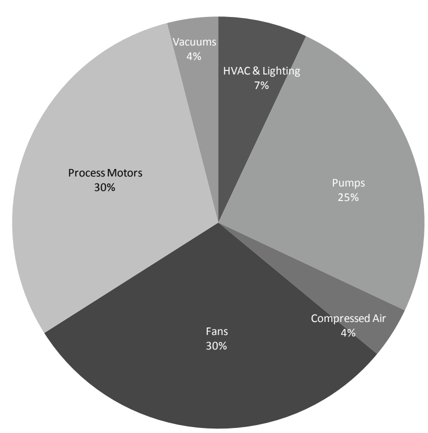
Estimated Electric Savings: 7%

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Steam best practices: insulate steam/hot water lines and bare equipment and repair steam traps/eliminate leaks[3,4]	< 2 years	1-2%	
Process heat recovery: recover waste heat from cookers or evaporators[2,5]	1-6 years	1-5%	
Heat recovery via adsorption cooling[6]			
Implement boiler best practices		1-2%	
Implement process equipment best practices[2]		0.5-1%	
Improved de-watering before drying			
Replace recuperative with regenerative thermal oxidizer	2-5 years	9-13%	
Replace regenerative thermal oxidizer with catalytic regenerative thermal oxidizer	< 1 year	2-6%	
Boiler heat recovery: economizer, feed water, combustion air, process water[6]	2 years	0.5-5.6%	
Implement boiler opportunities: improved burners, O_2 control, turbulator, small boiler, new boiler, minimize boiler blowdown with better wash treatment, insulate[6]	1-10 years	1-26%	
TOTAL FUEL SAVINGS ESTIMATE			**15%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Compressed air best practices: fix leaks, lower pressure, use cool air, eliminate inappropriate uses	< 1 year	0.3-0.5%	
Upgrade, better sequence/control, heat recovery, replace inefficient uses	3 years	0.5-1.5%	
Motors best practices: replacement plan, preventive maintenance	< 2 years	0-0.3%	
Upgrade motors & belts, ASD	3 years	0.2-14%	
Use cog belts or efficient transmissions		0.1-5%	
Install ASDs on fans or pumps, boiler combustion blowers, and HVAC chilled water pumps		0.1-6.7%	
Process equipment best practices: shut off, optimize settings	1 year	0-6%	
Improve controls, change product design, change process, upgrade equipment	< 1 year	0.3-8%	
Pump and fan optimization			
Lean Manufacturing: reduce material transport, just enough processing, just enough heating or cooling			
Facility Improvements			
HVAC: close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls	1 year	0-2.5%	
Lighting: upgrade, use controls (occupancy, light)	1-2 years	0.1-1%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**7%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2 Best Available Techniques in the Slaughterhouses and Animal By-products Industries, May 2005. European Commission.
3 Average of energy savings from 2 IAC studies. http://iac.rutgers.edu/database/assessments.php. (Ruiz-Avila study, IAC LT0046)
4 2 IAC studies. http://iac.rutgers.edu/database/assessments.php. (MIRINZ and Ruiz-Avila study; IAC SD0147 and WV0277)
5 Meat Research Corp, Australian Meat Technology; Nat Resources Canada
6 Energy Efficiency Improvement and Cost Saving Opportunities for the Fruit and Vegetable Processing Industry, August 2007, Lawrence Berkeley National Lab, http://ies.lbl.gov/iespubs/LBNL-59289.pdf

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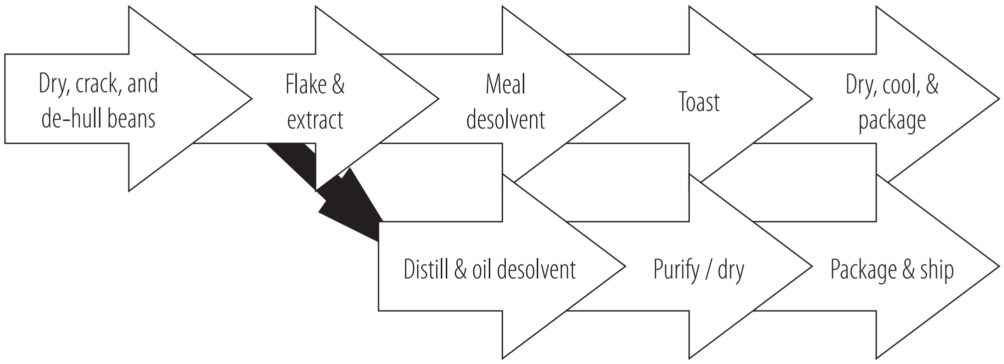
Soybean Processing

Sub-sector Description

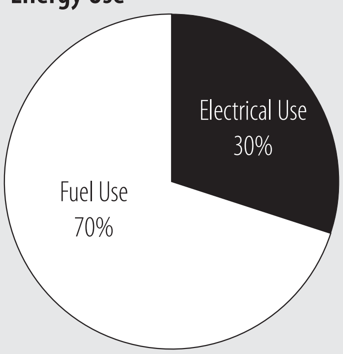
Facilities in this sub-sector crush soybeans to produce soybean oil, soybean cake and meal, and soybean protein isolates and concentrates.

Facility Type	SIC	NAICS	
Soybean Processing	2075	311222	

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

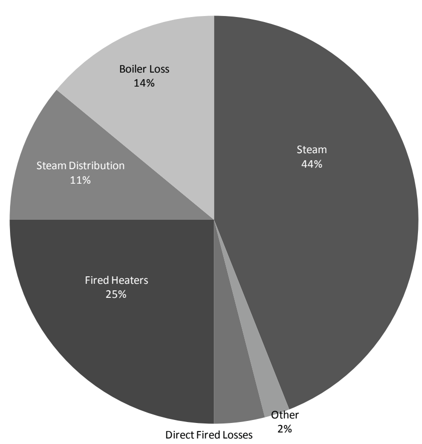
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: 6%

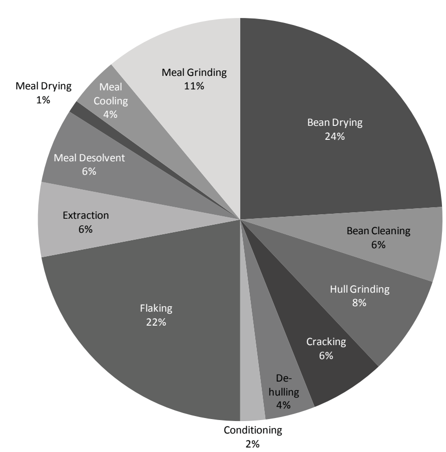
Estimated Electric Savings: 5%

Energy Use Footprints

Fuel Use[2]



Electricity Use[3]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Steam best practice: maintain traps, repair leaks, minimum operating pressure, capture condensate, insulate distribution components[4]	< 2 years	0.3-2%	
Boiler heat recovery: feed water, combustion air, process water, economizer[5]	2 years	0.5-2%	
Boiler best practice: tune and maintain[4]	< 2 years	0.1-1.3%	
Recirculate dryer cooling and drying air[6]		1-5%	
Improved process equipment		0.5-4%	
Upgrade dryer and add automated controls[7]		0.5-2%	
Microwave feed drying[8]		2-5%	
Routine maintenance on drying equipment[7]		0.5-1%	
Insulate and maintain equipment	< 3 years	0.2-1%	
Direct fired opportunities: burner upgrade, insulate, direct fired water heating, preheat drying air with dryer exhaust[1]	1-4 years	0.5-10%	
TOTAL FUEL SAVINGS ESTIMATE			**6%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: compressed air (fix leaks, lower pressure, use cool air,eliminate inappropriate uses)	< 1 year	0.1-1.2%	
Best Practices: motors (replacement plan, preventive maintenance)		-	
Best Practices: process equipment (shut off, optimize settings)		-	
Motor opportunities (upgrade motors & belts, ASD)	1 year	0.1-5%	
Install ASDs on boiler combustion blowers and HVAC chilled water pumps[9]		1.4-1.7%	
Process equipment opportunities (improve controls, change product design, change process, upgrade equipment)		-	
Pump and fan optimization[10]			
Lean Manufacturing (reduce material transport, just enough processing, just enough heating or cooling)			
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls)	< 1 year	0.1%	
Lighting (upgrade, use controls (occupancy, light)	< 1 year	0.0-0.8%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**5%**

References

1. DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2. Generalized Food and Beverage Energy Footprint, DOE, http://www1.eere.energy.gov/industry/energy__systems/pdfs/food__footprint.pdf
3. LifeCycle Inventory of Biodiesel and Petroleum Diesel, NREL/SR-580-24089
4. Soy Assessments (calculated by KD); http://iac.rutgers.edu/database/assessments.php; DOE
5. Energy Efficiency Improvement and Cost Saving Opportunities for the Fruit and Vegetable Processing Industry, August 2007, Lawrence Berkeley National Lab, http://ies.lbl.gov/iespubs/LBNL-59289.pdf
6. AE-701, Nov 1994, Dr. Kenneth J. Hellevang, PE. Extension Agricultural Engineer, NDSU
7. Strategies For Managing Energy-Related Grain Drying Costs. Wisconsin Focus on Energy. 2007.
8. Pulp frequency: Scientists test energy-saving microwaves to dry beet pulp for livestock feed. AURI AG Innovation News Apr-Jun 2009.
9. Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf
10. www.foodprocessing.com/articles/2007/012.html

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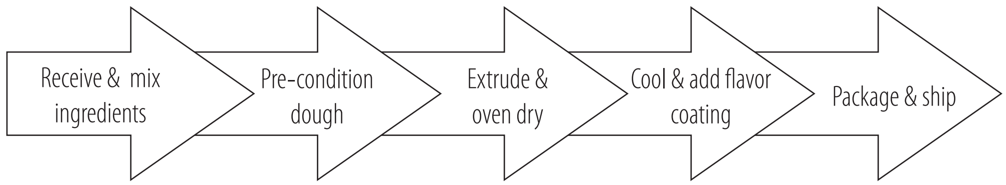
Pet Food & Animal Feed Manufacturing

Sub-sector Description

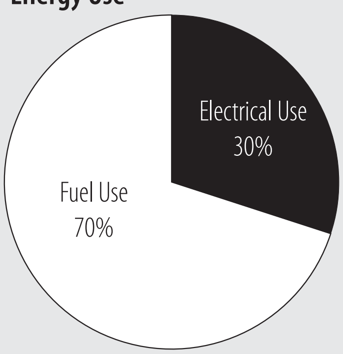
Pet food manufacturing facilities produce dog and cat food from cereal, meat, and other ingredients. These preparations may be canned or dry. Additionally, this sub-sector includes facilities that produce feed for livestock from grains.

Facility Type	SIC	NAICS		
Dog and Cat Food	2047	311111		

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%
kWh/employee	< 10,357	10,357 - 21,310	21,310 - 43,846	> 43,846

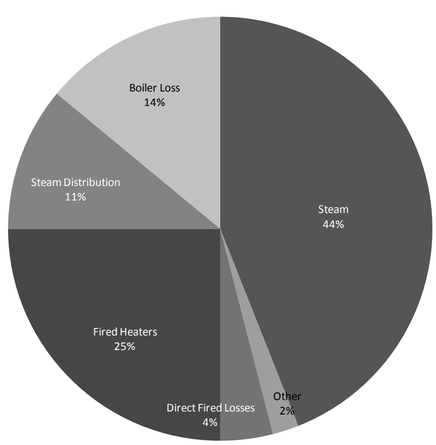
Savings Potential

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.

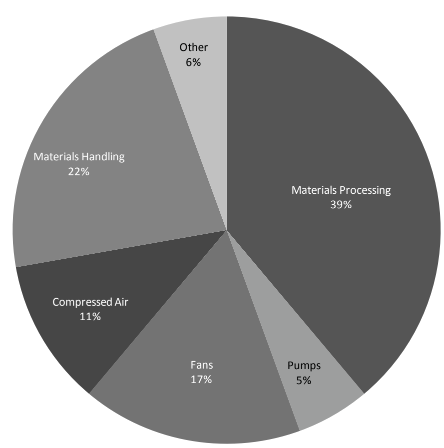
Estimated Electric Savings: 6%

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities

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

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: compressed air (fix leaks, lower pressure, use cool air,eliminate inappropriate uses)	< 1 year	0.1-2%	
Best Practices: motors (replacement plan, preventive maintenance)		-	
Best Practices: process equipment (shut off, optimize settings)		-	
Compressed air (upgrade, better sequence/control, heat recovery, replace inefficient uses)		-	
Motor opportunities (upgrade motors & belts, ASD)[3]	1 year	0.1-5%	
Process equipment opportunities (improve controls, change product design, change process, upgrade equipment)[4]		-	
Lean Manufacturing (reduce material transport, reduce the length of transport, just enough processing, just enough heating or cooling)		-	
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls)	< 1 year	0.1%	
Lighting (upgrade, use controls (occupancy, light)	< 1 year	0.0-0.8%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**6%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php

2 Generalized Food and Beverage Energy Footprint, DOE, http://www1.eere.energy.gov/industry/energy_systems/pdfs/food_footprint.pdf. Adjusted to increase fans, reduce pumps, eliminate refrigeration, reduce cooling (electrical).

3 Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf

8 www.foodprocessing.com/articles/2007/012.html

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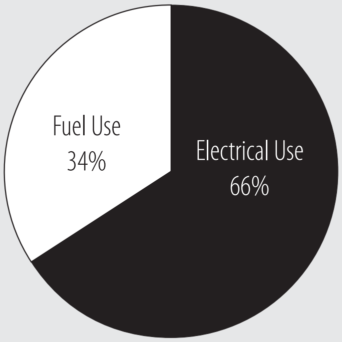
Seafood Processing

Sub-sector Description

This sub-sector includes facilities that preparing fresh and raw or cooked frozen fish and other seafoods and seafood preparations.

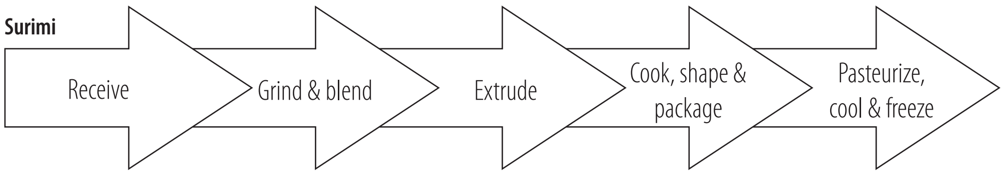
Facility Type	SIC	NAICS		Facility Type	SIC	NAICS
Seafood Canning	2091	311711		Fresh/Frozen Seafood Proc.	2092	311712

Energy Use[1]

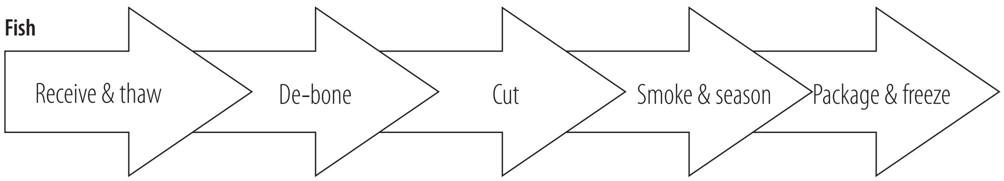


Process Information

Surimi



Fish



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.

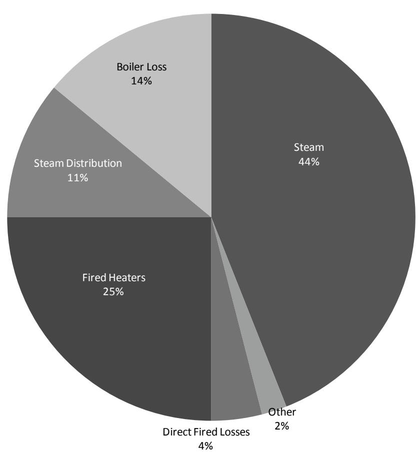
Savings Potential

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.

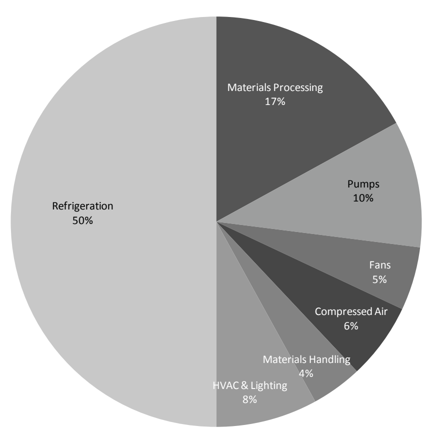
Estimated Electric Savings: 15%

Energy Use Footprints

Fuel Use[2]



Electricity Use[3]



Fuel Savings Estimate and Opportunities

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

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: cooling refrigeration (clean condenser, optimize temps, avoid frost)[1]	< 1 year	0-8%	
Best Practices: compressed air (fix leaks, lower pressure, use cool air,eliminate inappropriate uses)[1]	< 1 year	0.1-3.5%	
Best Practices: motors (replacement plan, preventive maint.)[1]	1 year	0.1-0.5%	
Best Practices: process equipment (shut off, optimize settings)[1]	< 1 year	1-11%	
Cooling & refrigeration opportunities (upgrade, recover heat, reduce floating head pressure, increase suction pressure setpoint, improve compressor sequencing, use ASDs, use ammonia sub-cooling, insulate, recover heat)[1,2,3,4,5,6]			
Compressed air (upgrade, better sequence/control, heat recovery, replace inefficient uses)[2]	1 year	0-4%	
Motor opportunities (upgrade motors & belts, ASD)[1,8,9]	2 years	0.2-8%	
Process equipment opportunities (improve controls, change product design, change process, upgrade equipment)[1]	1-2 years	0.4-1%	
Lean Manufacturing (reduce material transport, reduce the length of transport, just enough processing, just enough heating or cooling)			
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls)	1-2 years	0.1-11%	
Lighting (upgrade, use controls (occupancy, light)	2 years	0.1-2%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**15%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2 Generalized Food and Beverage Energy Footprint, DOE, http://www1.eere.energy.gov/industry/energy_systems/pdfs/food_footprint.pdf
3 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp16
4 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp 30
5 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp 31-35
6 Conserving Energy in Blast Freezers using Variable Frequency Drives, http://seagrant.oregonstate.edu/sgpubs/onlinepubs/fisheng/IETC_Report.pdf
7 Energy Savings for a Frozen Food Processing Plant, www.baseco.com/casestudies/Frozen Food Processing.pdf
8 Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf
9 www.foodprocessing.com/articles/2007/012.html

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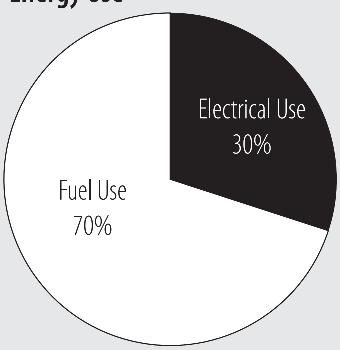
Commercial Bakeries

Sub-sector Description

Commercial bakeries specialize in manufacturing fresh or frozen bread and bread-type rolls and fresh cakes, pies, pastries and other similar "perishable" bakery products.

Energy Use[1]



Savings Potential

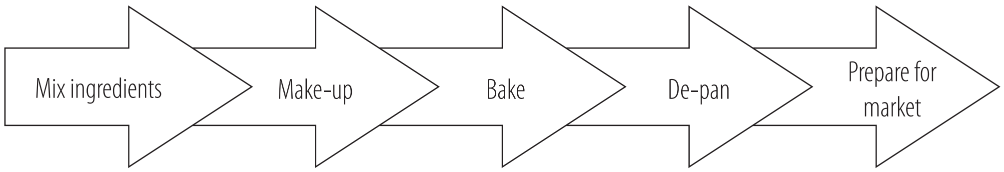
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: 10%

Estimated Electric Savings: 16%

Facility Type	SIC	NAICS	
Bakeries	2051	311812	

Process Information



Benchmarks

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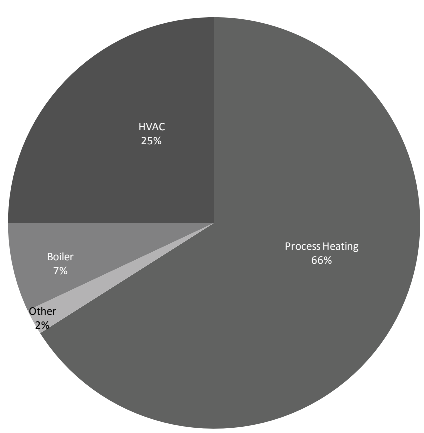
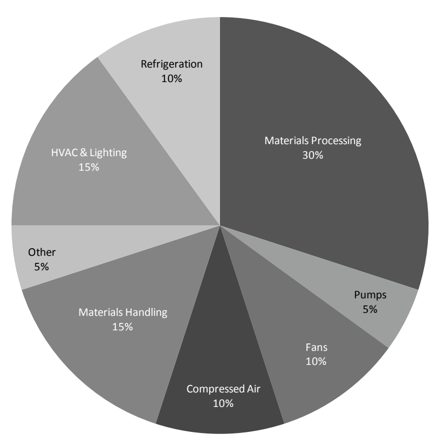
	Most efficient 25%	More efficient 25%	Less efficient 25%	Least efficient 25%
kWh/square feet	< 18	18 - 33	33 - 59	> 59
kWh/employee	< 6,502	6,502 - 10,926	10,926 - 18,362	> 18,362
therms/employee	< 494	494 - 666	666 - 899	> 899

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Direct fired best practices: reduce combustion air flow, insulate, maintain, optimize T, minimize oven ventilation[1]	< 1 year	0.5-3%	
Best practices boiler: minimize blowdown & steam bleed, O_2 tuning, minimize pressure, tune & maintain burner[1]	< 1 year	0.5-1.5%	
Best practices steam: repair traps & leaks, return condensate, insulate, isolate unused lines, shut down unused equip.	< 1 year	0.1-1.4%	
Best practices equipment: insulate, isolate hot equip., reduce leaks [infiltration, exfiltration], improve seals and insulation[3]	1-3 years	0.2-2%	
Boiler opportunities: improve burners & control, O_2 trim, new boiler, right-sized boiler, turbulators, improve feed water[1]	1-3 years	0.5-1.7%	
Recover heat from boiler blowdown or oven exhaust[1,4]	< 3 years	0.4-5%	
Heat pipe to recover oven heat for proofing oven[5]	3.5 years		
Heat recovery from thermal oxidizers[6]			
Improve large ovens[7]	4 years	0.2-2.8%	
Facility Improvements			
Reduce make-up air, insulate[8], use radiant heaters and set back thermostats		0.5-1.0%	
TOTAL FUEL SAVINGS ESTIMATE			**10%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: cooling refrigeration (clean condenser, optimize temps, avoid frost)		-	
Best Practices: compressed air (fix leaks, lower pressure, use cool air,eliminate inappropriate uses)[9]	< 1 year	0-6%	
Best Practices: motors (replacement plan, preventive maintenance)		-	
Best Practices: process equipment (shut off, optimize settings)		-	
Cooling & refrigeration opportunities (upgrade, recover heat, reduce floating head pressure, increase suction pressure setpoint, improve compressor sequencing, use ASDs, use ammonia sub-cooling, insulate, recover heat)[10]		-	
Compressed air (upgrade, better sequence/control, heat recovery, replace inefficient uses)		-	
Motor opportunities (upgrade motors & belts, ASD)[9,10]	1 year	0-14%	
Process equipment opportunities (improve controls, change product design, change process, upgrade equipment)[12]		-	
Lean Manufacturing (reduce material transport, just enough processing, just enough heating or cooling)		-	
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls)	< 1 year	0-1%	
Lighting (upgrade, use controls (occupancy, light)	< 1 year	0-8%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**16%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2 Generalized Food and Beverage Energy Footprint, DOE, http://www1.eere.energy.gov/industry/energy_systems/pdfs/food_footprint.pdf. Adjusted.
3 http://www.buseco.monash.edu.au/mgt/agribis/energyaward2003.html
4 http://earth2tech.com/2008/10/17/german-baking-supplier-cuts-bakeries-energy-waste-25-percent/
5 http://www.p2pays.org/ref/04/03323.htm
6 http://www.airmanagement.com/Onsite/Weston/weston.html
7 http://www.totalbakingsolutions.com/Energy_efficiency.htm
8 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UD0280
9 Energy Savings for a Bread Plant, www.baseco.com/casestudies/Bread Plant.pdf
10 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006 pp16, 30, 31-35
11 Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf
12 www.foodprocessing.com/articles/2007/012.html

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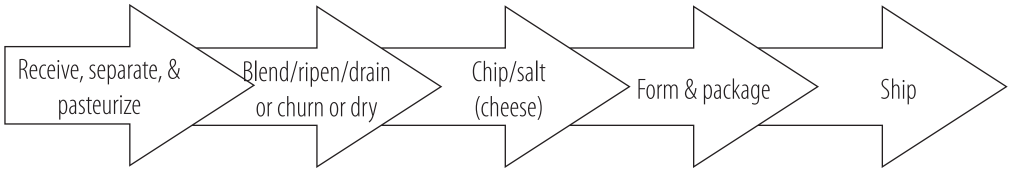
Cheese, Whey, and Butter Processing

Sub-sector Description

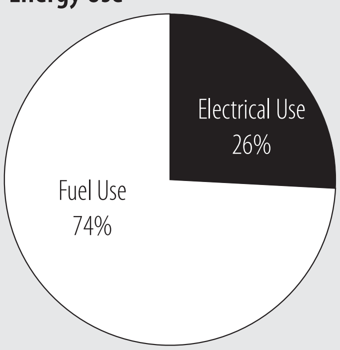
Facilities in this sub-sector manufacture cheese products from raw milk and/or processed milk products.

Facility Type	SIC	NAICS	
Cheese Processing	2022	311513	

Process Information



Energy Use[1]



Benchmarks

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	Most efficient 25%	More efficient 25%	Less efficient 25%	Least efficient 25%
therms/square feet	< 98.71	98.71 - 119.31	119.31 - 144.22	> 144.22
therms/employee	< 24,825	24,825 - 27,798	27,798 - 31,127	> 31,127

Savings Potential

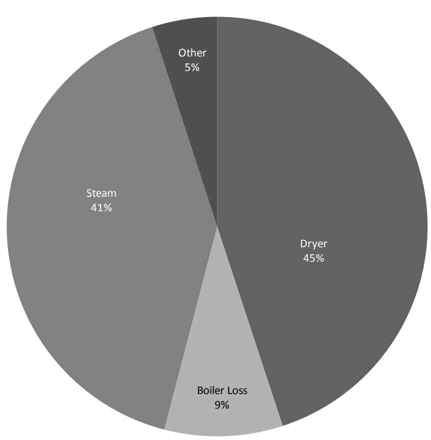
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation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

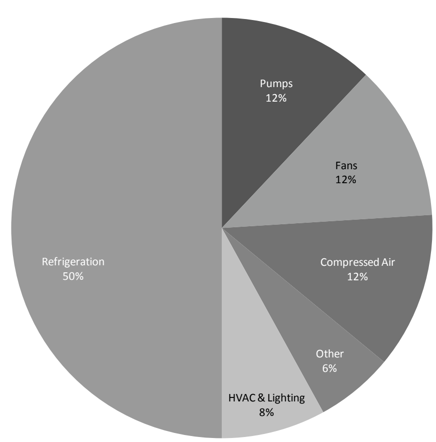
Estimated Electric Savings: 14%

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities[1]

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Direct fire opportunity: install more efficient burners, control, insulation, direct fired water heaters	3-4 years	0.1-0.3%	
Boiler best practice: tune and maintain	< 1 year	0.4-2%	
Steam best practice: maintain traps, repair leaks, minimum operating pressure, capture condensate, insulate distribution components	< 2 years	0.5-3%	
Boiler opportunity: efficient burners, O_2 control, turbulator, small boiler, clean tubes, feed water improvements	3-5 years	0.1-2%	
Boiler heat recovery: feed water, combustion air, process water	2 years	0.2-2.5%	
Equipment heat recovery: compressor, refrigeration, process	1-6 years	0.5-10%	
Equipment best practice: insulate and maintain	< 3 years	0.2-1%	
Improved process equipment		0.5-2%	
TOTAL FUEL SAVINGS ESTIMATE			**11%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: cooling refrigeration (clean condenser, optimize temps, avoid frost)	4 years	-	
Best Practices: compressed air (fix leaks, lower pressure, use cool air, eliminate inappropriate uses)[1]	< 1 year	0.1-1.2%	
Best Practices: motors (replacement plan, preventive maintenance)		-	
Best Practices: process equipment (shut off, optimize settings)		-	
Cooling & refrigeration opportunities (upgrade, recover heat, reduce floating head pressure, increase suction pressure setpoint, improve compressor sequencing, use ASDs, use ammonia sub-cooling, insulate, recover heat)[3,4,5,6]		1-20%	
Compressed air (upgrade, better sequence/control, heat recovery, replace inefficient uses)	< 1 year	0.6%	
Motor opportunities (upgrade motors & belts, ASD)[1,4]	2 years	0.2-2%	
Process equipment opportunities (improve controls, change product design, change process, upgrade equipment)[1,7]	< 1 year	0-14%	
Lean Manufacturing (reduce material transport, reduce the length of transport, just enough processing, just enough heating or cooling)			
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls)[1]	< 1 year	0.05-0.1%	
Lighting (upgrade, use controls (occupancy, light)	1 year	0-6%	
Reduce lighting in over lit and unused space[4]		4.8%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**14%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php
2 Mn Dairy industry contact
3 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006. pp 16
4 Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf
5 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006. pp 30
6 Focus on Energy, Dairy Processing Best Practices Guidebook, 2006. pp 31-35
7 www.foodprocessing.com/articles/2007/012.html

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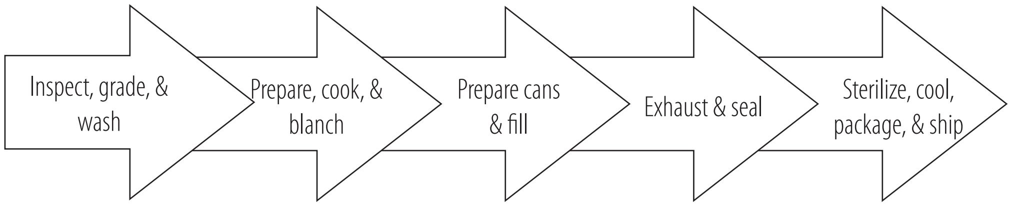
Fruit and Vegetable Canning

Sub-sector Description

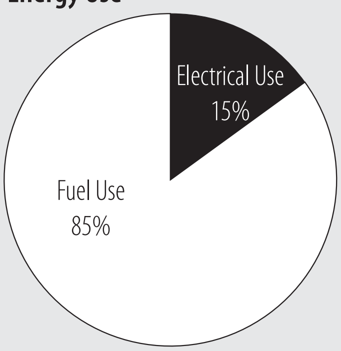
Canning facilities manufacture canned, pickled, and brined fruits and vegetables. In Minnesota, corn and beans are the primary products canned in these facilities; however, additional products may include canned juices; canned jams and jellies; canned tomato-based sauces; and pickles, relishes, and sauerkraut.

Facility Type	SIC	NAICS	
Fruit and Vegetable Canning	2033	311421	

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

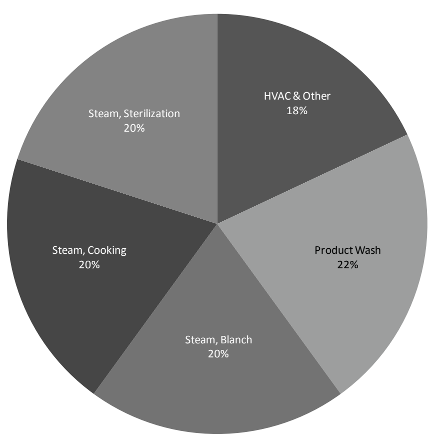
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: 9%

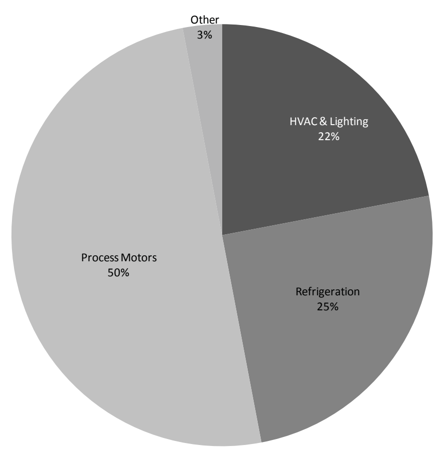
Estimated Electric Savings: 5%

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Direct fire opportunity: burner, control, insulation	3-4 years	0.5-3.8%	
Direct fire best practices: tune and maintain	< 1 year	0.1-0.3%	
Boiler opportunity: burner, O_2 control, turbulator, small boiler, clean tubes, feed water improvements	3-5 years	1-3.4%	
Boiler heat recovery: feed water, combustion air, process water	2 years	0.5-2%	
Boiler best practices: tune and maintain	< 1 year	0.1-0.3%	
Steam best practices: maintain traps, repair leaks, minimum operating pressure, capture condensate, insulate distribution components	< 2 years	0.1-0.6%	
Install more efficient burners (burners with stable flame at low fire and low excess air)	2-5 years		
Improved process equipment	3 years	1-2%	
TOTAL FUEL SAVINGS ESTIMATE			**9%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Replace hydraulic / pneumatic equipment with electric equipment	2-3 years	0.4-1.8%	
Use most efficient equipment at maximum capacity and less efficient equipment when necessary	< 1 year	0.3%	
Optimize pump and fan operation	1-4 years		
Improved control	< 2 years	.3-1.4%	
Improve utilization of cooling towers and cooling tower water treatment[4]	2-3 years	0-1.7%	
Operate an absorption chiller on waste heat	2-5 years		
Compressed air improvements: lower pressure, repair leaks, improve dryers and filters, and improve controls and staging	< 1 year		
Motor improvements		1%	
Lighting and HVAC improvements		0.5-1%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**5%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php

2 Energy Use in Minnesota Agriculture, Barry Ryan and Douglas G.Tiffany, Minnesota Agricultural Economist Newsletter, No. 693, Fall 1998, pp288

3 Utility rebate data

4 Intern engineering report for General Mills, 2001. MnTAP site visit information from freezing facility in Minnesota.

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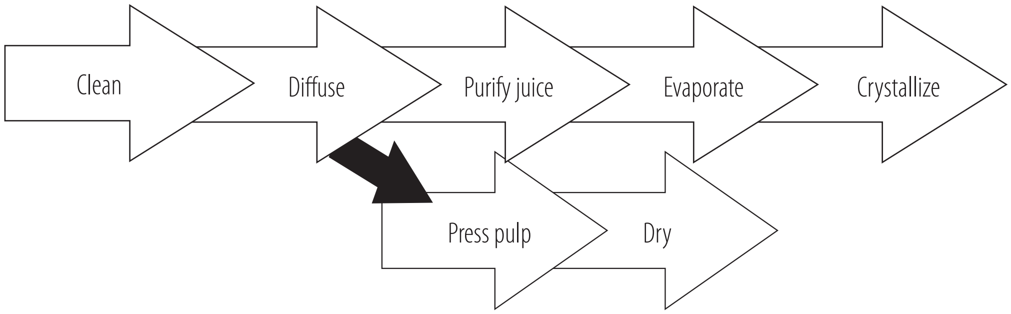
Sugar Manufacturing from Beets

Sub-sector Description

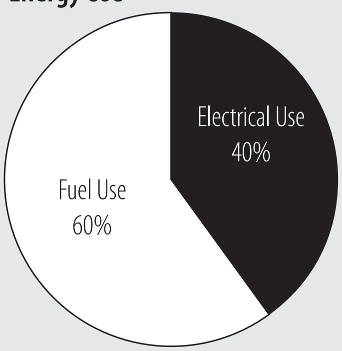
Facilities in this sub-sector manufacture refined sugar from sugar beets.

Facility Type	SIC	NAICS		
Beet Sugar Manufacturing	2063	311313		

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

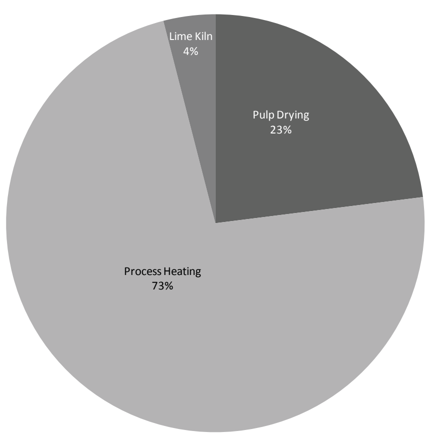
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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: 4%

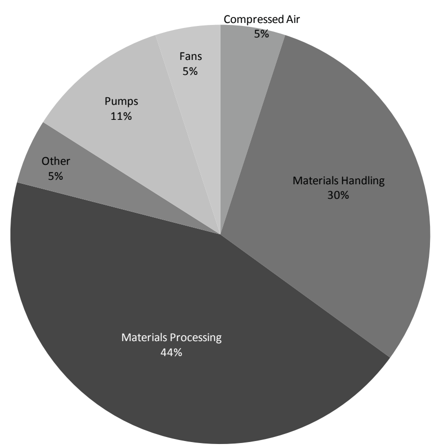
Estimated Electric Savings: 3%

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Direct fire opportunity: burner, control, insulation, concentrate whey before drying, recover heat to preheat inlet and combustion air, direct fired water heating	2-4 years	0.1-0.5%	
Boiler best practice: tune and maintain	< 1 year	0-0.5%	
Direct fire best practice: tune and maintain		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%	
Equipment best practices: insulate and maintain	< 3 years	0-0.5%	
Heat recovery via absorption cooling			
TOTAL FUEL SAVINGS ESTIMATE			**4%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Best Practices: compressed air (fix leaks, lower pressure, use cool air,eliminate inappropriate uses)[1]	< 1 year	0.1-0.3%	
Best Practices: motors (replacement plan, preventive maintenance)		-	
Best Practices: process equipment (shut off, optimize settings)		-	
Compressed air (upgrade, better sequence/control, heat recovery, replace inefficient uses)		-	
Motor opportunities (upgrade motors & belts, ASD)[1,3]	2 years	0.2-4%	
Process equipment opportunities (improve controls, change product design, change process, upgrade equipment)[4]		-	
Lean Manufacturing (reduce material transport, reduce the length of transport, just enough processing, just enough heating or cooling)			
Facility Improvements			
HVAC (close building openings/leaks, reduce heated space, reduce T, upgrade equip, upgrade controls)[1]	< 1 year	-	
Lighting (upgrade, use controls occupancy, light)[1]	2.5 years	-	
TOTAL ELECTRIC SAVINGS ESTIMATE			**3%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php

2 MPCA Emission Inventory Summary for 2007

3 Energy Savings for a Cheese Plant, www.baseco.com/casestudies/Dairy Product.pdf

4 www.foodprocessing.com/articles/2007/012.html

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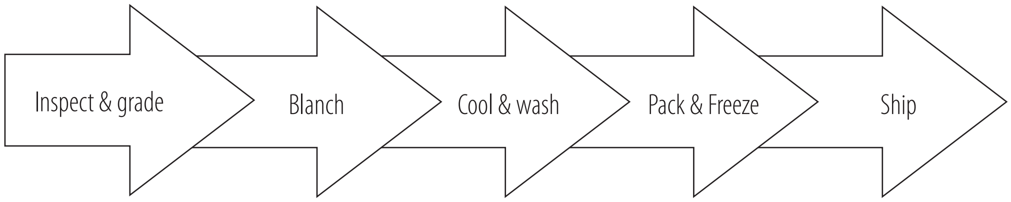
Frozen Fruit and Vegetable Processing

Sub-sector Description

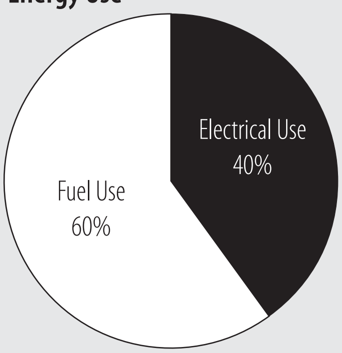
This sub-sector includes facilities that manufacture frozen fruit, frozen juices, frozen vegetables, and frozen specialty foods (except seafood). Final products can include frozen dinners, entrees, and side dishes; frozen pizza; frozen whipped toppings; and frozen waffles, pancakes, and french toast.

Facility Type	SIC	NAICS	
Frozen Fruit and Vegetable Mfg.	2037	311411	

Process Information



Energy Use[1]



Benchmarks

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Savings Potential

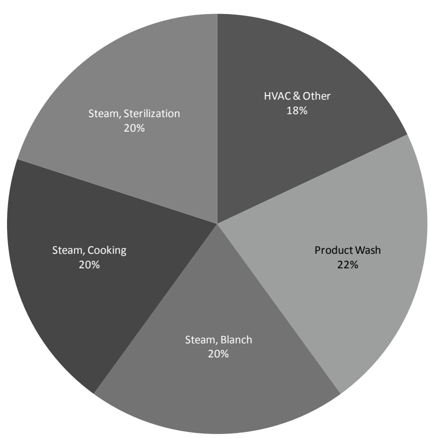
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation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

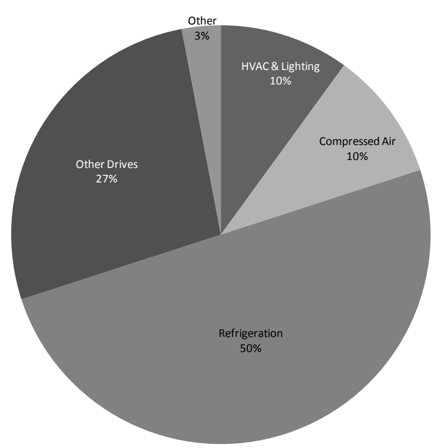
Estimated Electric Savings: 10%

Energy Use Footprints

Fuel Use[2]



Electricity Use[2]



Fuel Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Direct fire opportunity: burner, control, insulation	3-4 years	0.5-3.8%	
Direct fire best practices: tune and maintain	< 1 year	0.1-0.3%	
Boiler opportunity: burner, control, turbulator, small boiler, clean tubes, feed water improvements	3-5 years	1-3.4%	
Boiler heat recovery: feed water, combustion air, process water	2 years	0.5-2%	
Boiler best practices: tune and maintain	< 1 year	0.1-0.3%	
Steam best practices: maintain traps, repair leaks, minimum operating pressure, capture condensate, insulate distribution components	< 2 years	0.1-0.6%	
Install more efficient burners (burners with stable flame at low fire and low excess air)	2-5 years		
Improved process equipment	3 years	1-2%	
TOTAL FUEL SAVINGS ESTIMATE			**9%**

Electric Savings Estimate and Opportunities

Improvement / Opportunity	Estimated Payback	Reported Savings	Overall Savings
Process Improvements and Optimization			
Replace hydraulic / pneumatic equipment with electric equipment	2-3 years	0.4-1.8%	
Use most efficient equipment at maximum capacity and less efficient equipment when necessary	< 1 year	0.3%	
Modify refrigeration to operate at a lower pressure or higher suction	3-4 years	2.4-5%	
Install new refrigeration equipment[3]	3-5 years	11-30%	
Improve freezer insulation			
Optimize pump and fan operation	1-4 years		
Improved control	< 2 years	.3-1.4%	
Improve utilization of cooling towers and cooling tower water treatment[4]	2-3 years	0-1.7%	
Operate an absorption chiller on waste heat	2-5 years		
Compressed air improvements: lower pressure, repair leaks, improve dryers and filters, and improve controls and staging	< 1 year		
Motor improvements		1%	
Lighting and HVAC improvements		0.5-1%	
TOTAL ELECTRIC SAVINGS ESTIMATE			**10%**

References

1 DOE Industrial Assessments. http://iac.rutgers.edu/database/assessments.php

2 Energy Use in Minnesota Agriculture, Barry Ryan and Douglas G. Tiffany, Minnesota Agricultural Economist Newsletter, No. 693, Fall 1998, pp288

3 Utility rebate data

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