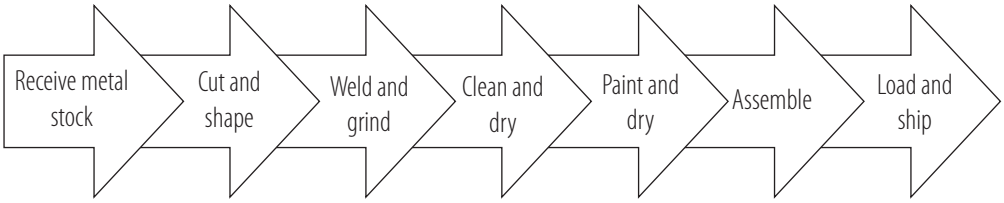
# Transportation Equipment Manufacturing

## Sub-sector Description

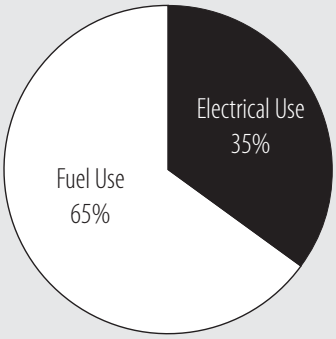
Facilities in this sub-sector utilize production processes similar to those of other machinery manufacturing establishments: bending, forming, welding, machining, and assembling metal or plastic parts into components and finished products. These particular facilities produce equipment for transporting people and goods.

| Facility Type | SIC | NAICS | | Facility Type | SIC | NAICS |
|---|---|---|---|---|---|---|
| Ship and boat building | 3732 | 336611 | | Other transportation equip. | 3799 | 336910 |
| Machine shops, other mfg | 3599 | 332710 | | Motor vehicle body & trailer mfg | 3711 | 336211 |
| Bus and other vehicle mfg | 3713 | 336211 | | Boat manufacturing | 3732 | 336612 |

## Process Information




## Energy Use[1]




## Benchmarks

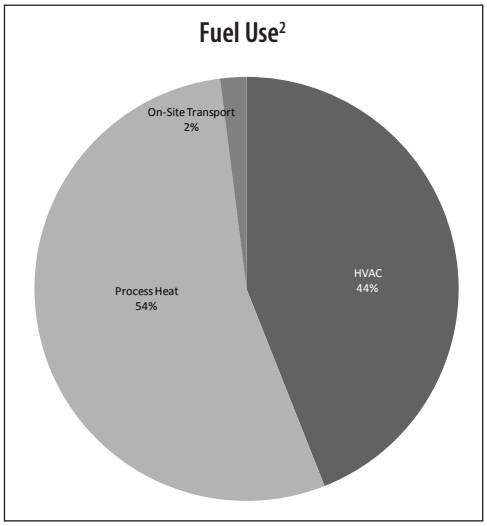
Thermal and electrical benchmarks were unable to be reliably derived from facility-specific energy use, sales, employee numbers, and area data. For more information about the benchmarking study that MnTAP conducted and how to determine if your facility may have energy efficiency opportunities remaining,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

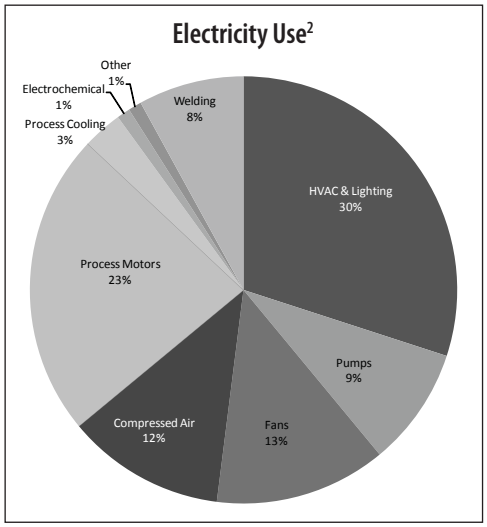
## Savings Potential

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 Electric Savings: 19%**

## Energy Use Footprints



## 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 | | | |
| Reduce compressed air pressure to minimum required and repair leaks[3] | < 1 year | 4.3% | |
| Update compressor controls and intake location[4] | < 1 year | 3.4% | |
| Replace motors with soft-start or ASD supplies[5] | 2 years | 1.5% | |
| Properly size motors and pumps, select efficient replacements[6] | 3 years | 1.9% | |
| Turn off equipment when not in use or reduce power consumption in stand-by[7] | < 1 year | 1.7% | |
| Optimize plant power factor, install power factor correction devices[8] | 1-2 years | 0.02% | |
| Fan and paint ventilation optimization and modification[2] | 2-3 years | 5.0% | |
| Welding control and inverter technologies[9] | 5 years | 5.0% | |
| Facility Improvements | | | |
| Facility HVAC improvements[2] | < 1 year | 2.0% | |
| Lighting improvements[10] | 2 years | 3.0% | |
| **TOTAL ELECTRICAL SAVINGS ESTIMATE** | | | **19%** |

## References


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

2 C. Galitsky and E. Worrell. Energy Efficiency Improvement and Cost Savings Opportunities for the Vehicle Assembly Industry. Lawrence Berkley National Laboratory. January 2003.

3 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=TA0067

4 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SU0228

5 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SD0394

6 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OK0662

7 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SF0304

8 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UU0050

9 http://www.americanmachinist.com/304/Issue/Article/False/9124/Issue

10 A. Price and M.H. Ross. Reducing Industrial Electricity Costs - An Automotive Case Study. The Electricity Journal, July 1989: 40-51.





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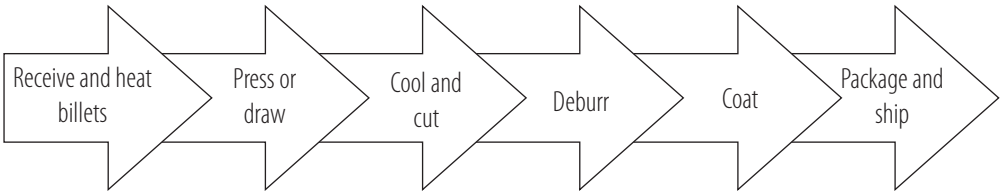
# Metal Tube Manufacturing

## Sub-sector Description

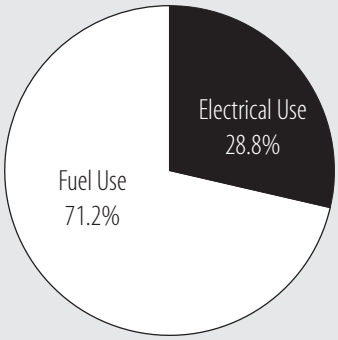
This industry group includes facilities establishments primarily engaged in manufacturing iron and steel tube and pipe, drawing steel wire, and rolling or drawing shapes from purchased iron, steel, or aluminum.

| Facility Type | SIC | NAICS | | Facility Type | SIC | NAICS |
|---|---|---|---|---|---|---|
| Steel pipe & tube manufacturing | 3317 | 331210 | | Alum. tubing & extruded prod. | 3354 | 331315 |

## Process Information




## Energy Use[1]




## Benchmarks

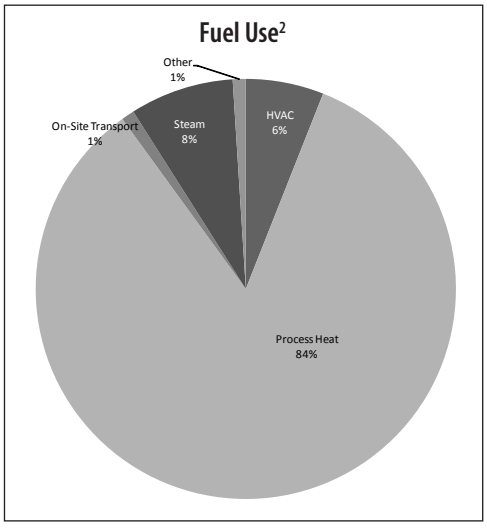
Thermal and electrical benchmarks were unable to be reliably derived from facility-specific energy use, sales, employee numbers, and area data. For more information about the benchmarking study that MnTAP conducted and how to determine if your facility may have energy efficiency opportunities remaining,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

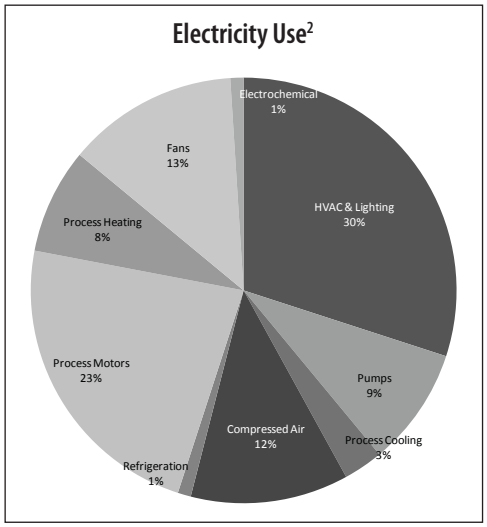
## Savings Potential

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: 42%**

## 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] | < 2 years | 5-25% | |
| Insulate bare equipment and piping[5] | 2 years | 2-15% | |
| Heat recovery of flue gas to preheat combustion air or heat secondary operations[6] | 5 years | 10-25%, 33% | |
| Improve process measurements, control, and calibration[6] | 3 years | 5-10% | |
| Upgrade heating and heat-treating equipment for better efficiency[7] | 8 years | 5-10% | |
| Heat Recovery | | | |
| Recover heat from compressed air systems[8] | 4 years | 4% | |
| Recover heat from material processing[9] | 4 years | 59% | |
| Recover heat from flue gas to heat boiler water[9] | 4 years | 1% | |
| Facility HVAC Improvements | | | |
| Use efficient building insulation[10] | 2 years | 1% | |
| Destratify air with circulation fans[11] | 2 years | 7% | |
| Use radiant heat for spot heating parts[4] | 7 years | 19% | |
| **TOTAL FUEL SAVINGS ESTIMATE** | | | **42%** |

## 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 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 DOE Aluminum Industry Energy Footprint, http://www1.eere.energy.gov/industry/energy_systems/pdfs/aluminum_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=BD0333
5 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=LL0192
6 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=UD0766
7 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=GT0815
8 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=WV0318
9 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=UM0338
10 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=TA0126
11 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=IA0434





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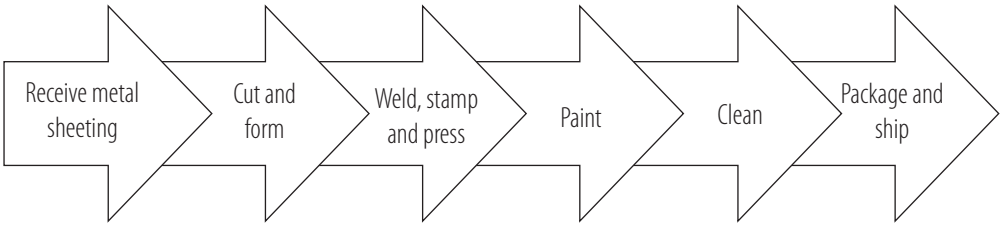
# Metal Can Manufacturing

## Sub-sector Description

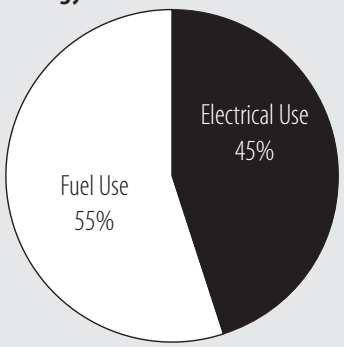
This sub-sector includes establishments primarily engaged in manufacturing metal cans, lids, and ends.

| Facility Type | SIC | NAICS | |
|---|---|---|---|
| Metal can manufacturing | 3411 | 332431 | |

## 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.

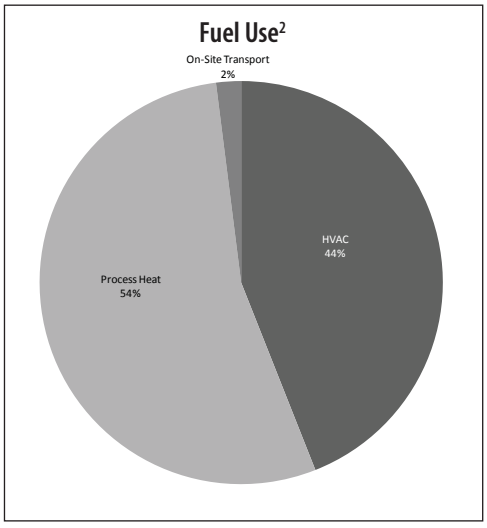
## Savings Potential

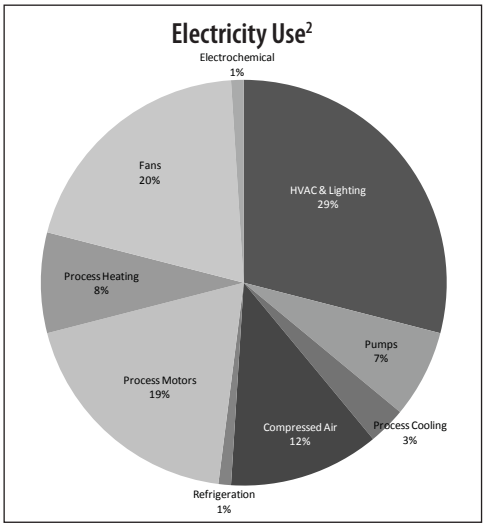
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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:** **25%**

**Estimated Electric Savings:** **11%**

## Energy Use Footprints



## Fuel Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Heat Recovery | | | |
| Recover heat from compressed air system[3] | 4 years | 7-20% | |
| Process Heat System Optimization[4] | | | |
| Boiler $O_2$ tuning[5] | < 2 years | 3-5% | |
| Heat recovery of flue gas to preheat combustion air or heat secondary operations[6] | 5 years | 10-25% | |
| Improve process measurements, control, and calibration[6] | 3-4 years | 5-10% | |
| Facility HVAC Improvements | | | |
| Reduce make-up air[7] | 2 years | 10% | |
| Use efficient building insulation[7] | 2 years | 14% | |
| Use radiant heat for spot heating work areas[8] | < 1 year | 5% | |
| Replace inefficient gas-fired HVAC units[9] | > 3 years | 3% | |
| **TOTAL FUEL SAVINGS ESTIMATE** | | | **25%** |

## Electric Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvements | | | |
| HVAC improvements[9,10] | | 3-8% | |
| Pump and fan sizing optimization | | 25-30% | |
| Compressed air evaluation[4,11] | | 5-9% | |
| Motor load reduction[12] | | 4% | |
| Efficient motors and lighting[11,12] | | 2-3% | |
| Welding control[13-18] | | 20% | |
| Process heat system optimization[6] | | 2-25% | |
| **TOTAL ELECTRIC SAVINGS ESTIMATE** | | | **11%** |

## References


1 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 C. Galitsky and E. Worrell. Energy Efficiency Improvement and Cost Savings Opportunities for the Vehicle Assembly Industry. Lawrence Berkley National Laboratory, January 2003.
3 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OR0182
4 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WV0359
5 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OR0598
6 http://www1.eere.energy.gov/industry/bestpractices/pdfs/em_proheat_seven.pdf
7 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OR0007
8 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=DS0010
9 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=CO0595
10 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=CO0598
11 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UW0009
12 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UF0112
13 http://www.nema.org/energy/miller-inverter.html
14 http://findarticles.com/p/articles/mi_m0BFE/is_4_47/ai_n27645182
15 http://www.americanmachinist.com/304/Issue/Article/False/9124/Issue
16 http://adsabs.harvard.edu/abs/1980STIN...8119404T
17 http://www.osti.gov/bridge/servlets/purl/882565-ao9Lab/882565.PDF
18 http://www.p2pays.org/ref/08/07503.pdf





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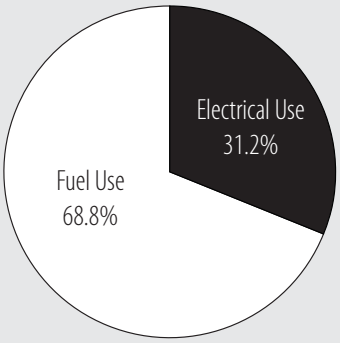
# Structural Metal Products

## Sub-sector Description

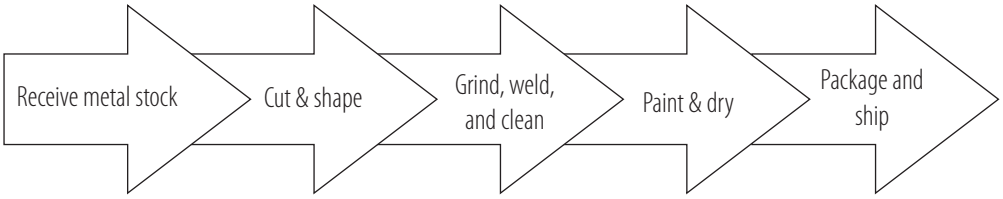
Facilities in this sub-sector are primarily engaged in manufacturing prefabricated metal buildings, panels and sections; structural metal products; and/or metal plate work products.

| Facility Type | SIC | NAICS | | Facility Type | SIC | NAICS |
|---|---|---|---|---|---|---|
| Office and store fixtures | 2542 | 337215 | | Concrete reinforcing stock | 3449 | 332312 |
| Rolled steel shape mfg | 3312 | 331221 | | Small arms ammunition mfg | 3482 | 332992 |
| Fabricated structural metal | 3441 | 332312 | | Ordnance systems manufacturing | 3489 | 332995 |
| Door systems and screens | 3442 | 336322 | | Industrial scale equipment | 3596 | 333997 |
| Heat exchangers and tanks | 3443 | 332410 | | Amusement park equipment | 3599 | 333319 |
| Ornamental ironwork | 3446 | 332323 | | Boat and lighthouse construction | 3731 | 332312 |

## Energy Use[1]




## Process Information




## 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.

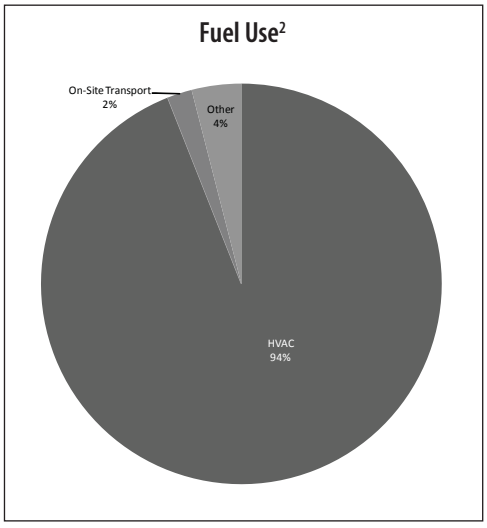
## Savings Potential

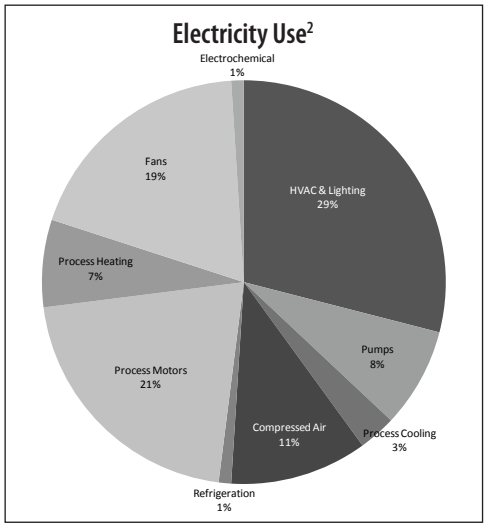
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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:** **14%**

## Energy Use Footprints



## Fuel Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Heat Recovery[3] | | | |
| Recover heat from hot wastewater and water heaters[4] | 4 years | 5% | |
| Recover heat from compressed air system[5] | 4 years | 3-21% | |
| Recover heat from refrigeration condensers[6] | 4 years | 3% | |
| Recuperate heat from melt furnaces[7] | 2 years | 12-15% | |
| Process Heat System Optimization | | | |
| Pre-form process heat optimization[3] | | 2-25% | |
| Facility HVAC Improvements | | | |
| Reduce make-up air[8] | 2 years | 5-18% | |
| Use efficient building insulation[9] | 2 years | 6-8% | |
| Destratify air with circulation fans[9] | 2 years | 4% | |
| Use radiant heat for spot heating parts[5] | < 1 year | 1% | |
| **TOTAL FUEL SAVINGS ESTIMATE** | | | **15%** |

## Electric Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvements | | | |
| HVAC improvements[10,11] | | 13-22% | |
| Pump and fan sizing optimization | | 25-30% | |
| Compressed air evaluation[12,13] | | 8-12% | |
| Motor load reduction[14,15] | | 4-5% | |
| Efficient motors and lighting[10,16] | | 12-20% | |
| Welding control[17-22] | | 20% | |
| **TOTAL ELECTRIC SAVINGS ESTIMATE** | | | **14%** |

## References


1 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 C. Galitsky and E. Worrell. Energy Efficiency Improvement and Cost Savings Opportunities for the Vehicle Assembly Industry. Lawrence Berkley National Laboratory, January 2003.
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=WV0225
5 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=BD0287
6 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=IA0394
7 Trade publications featuring recuperator manufacturers (i.e. Encon, First Thermal, North American Manufacturing Company)
8 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=WI0293
9 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=SU0255
10 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=AM0546
11 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OK0744
12 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UM0251
13 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=RU0110
14 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OK043
15 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UF0089
16 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=IC0005
17 http://www.nema.org/energy/miller-inverter.html
18 http://findarticles.com/p/articles/mi_m0BFE/is_4_47/ai_n27645182
19 http://www.americanmachinist.com/304/Issue/Article/False/9124/Issue
20 http://adsabs.harvard.edu/abs/1980STIN...8119404T
21 http://www.osti.gov/bridge/servlets/purl/882565-ao9Lab/882565.PDF
22 http://www.p2pays.org/ref/08/07503.pdf





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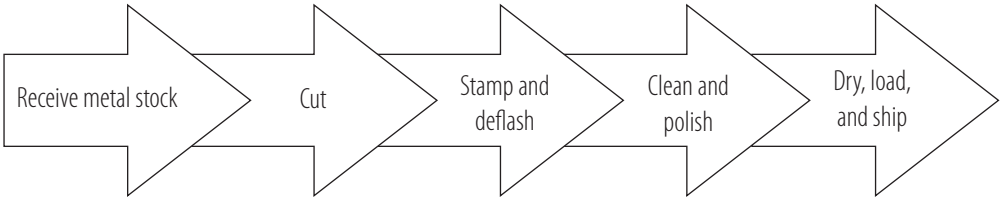
# Stamping & Forging Operations

## Sub-sector Description

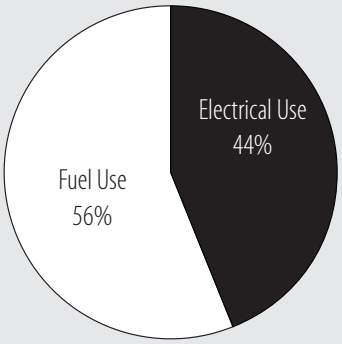
Facilities in this sub-sector manufacture forgings from purchased metals, metal custom roll forming products, metal stamped and spun products, and/or powder metallurgy products. Metal forging, metal stamping, and metal spun products facilities may perform surface finishing operations, such as cleaning and deburring, on the products they manufacture.

| Facility Type | SIC | NAICS | | Facility Type | SIC | NAICS |
|---|---|---|---|---|---|---|
| Forging and stamping | 3321 | 332116 | | Arch. & structural metals mfg | 3323 | 332323 |
| Cutlery and hand tool mfg | 3322 | 332211 | | Railroad rolling stock mfg | 3365 | 336510 |
| Gardening and hand tools | 3423 | 332212 | | Hardware furnishings | 3429 | 332510 |
| Automotive stampings | 3465 | 336370 | | All-trade metal stampings | 3469 | 332116 |
| Novelty and giftware | 3499 | 332999 | | | | |

## Process Information




## Energy Use[1]




## Benchmarks

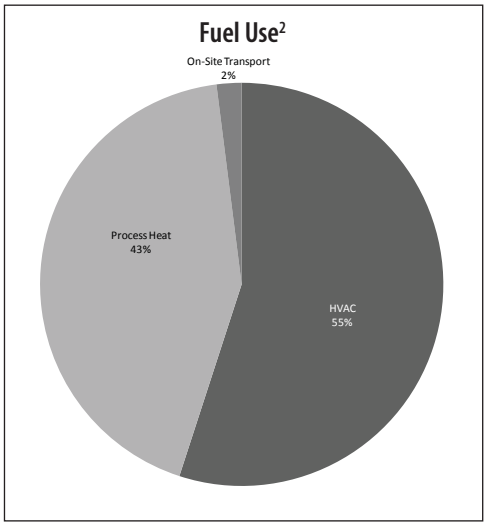
Thermal and electrical benchmarks were unable to be reliably derived from facility-specific energy use, sales, employee numbers, and area data. For more information about the benchmarking study that MnTAP conducted and how to determine if your facility may have energy efficiency opportunities remaining,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

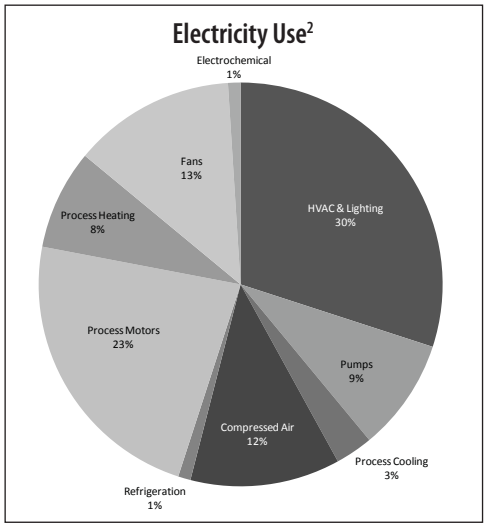
## Savings Potential

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 Electric Savings: 15%**

## Energy Use Footprints



## 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 | | | |
| Reduce compressed air pressure to minimum required and repair leaks[3] | < 1 year | 2-6% | |
| Update compressor controls and intake location[4] | < 1 year | 3.4% | |
| Replace motors with soft-start or ASD supplies[5] | 2 years | 1.5-30% | |
| Properly size motors and pumps, select efficient replacements[6] | 3 years | 2-30% | |
| Turn off equipment when not in use or reduce power consumption in stand-by[7] | < 1 year | 1.7% | |
| Optimize plant power factor, install power factor correction devices[8] | 1-2 years | 0.02% | |
| Utilize energy-efficient belts[9] | < 1 year | 0-7.7% | |
| Facility HVAC Improvements | | | |
| Facility HVAC improvements[2] | < 1 year | 2-14% | |
| Lighting improvements[10] | 2 years | 3-20% | |
| **TOTAL ELECTRICAL SAVINGS ESTIMATE** | | | **15%** |

## References


1 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 C. Galitsky and E. Worrell. Energy Efficiency Improvement and Cost Savings Opportunities for the Vehicle Assembly Industry. Lawrence Berkley National Laboratory, January 2003.
3 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=TA0067
4 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SU0228
5 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SD0394
6 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OK0662
7 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SF0304
8 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UU0050
9 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SU0264
10 Reducing Industrial Electricity Costs - An Automotive Case Study, A. Price and MH Ross, The Electricity Journal, July 1989: 40-51.





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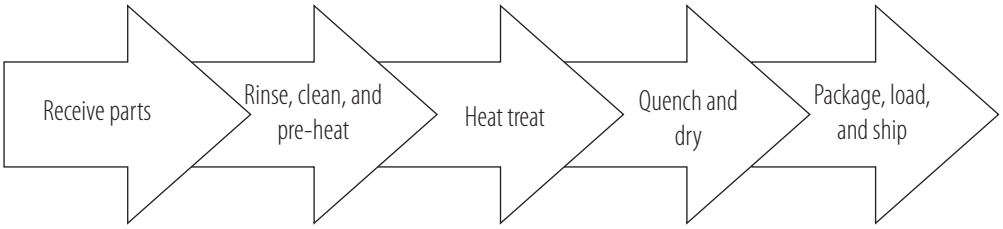
# Heat Treating

## Sub-sector Description

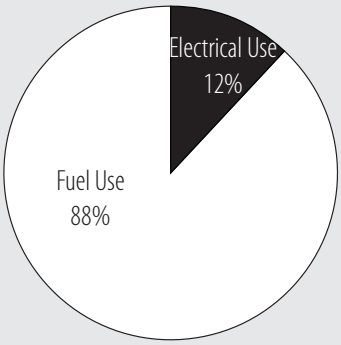
Facilities that are primarily engaged in heat treating, such as annealing, hardening, and tempering metals and metal products for the trade are included in this sub-sector. Some facilities specialize in heat treating as their sole function, while others heat treat metal as part of larger operations: metal casting or metal fabrication.

| Facility Type | SIC | NAICS | |
|---|---|---|---|
| Metal/steel heat treating | 3398 | 332811 | |

## 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.

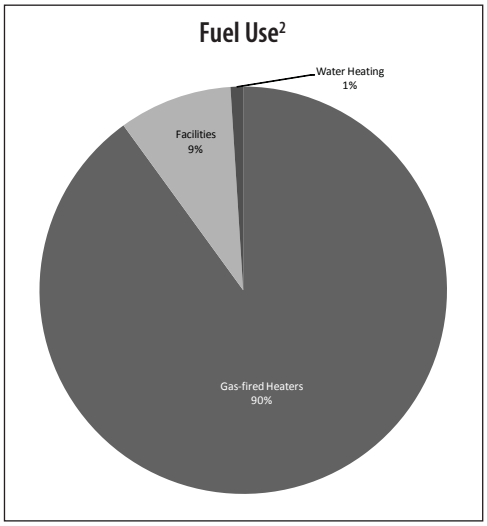
## Savings Potential

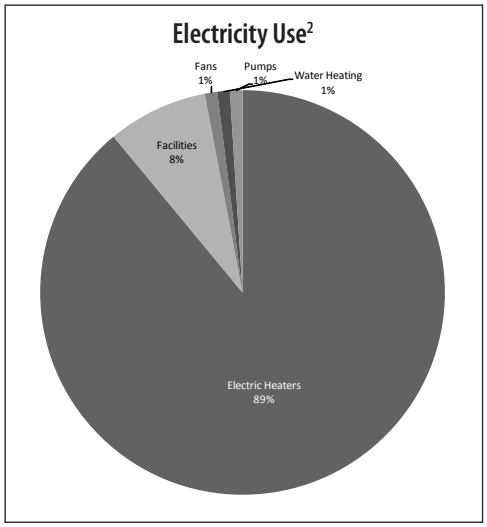
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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:** **12%**

**Estimated Electric Savings:** **22%**

## Energy Use Footprints



## Fuel Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvements | | | |
| Use waste heat from hot flue gases to preheat combustion air | 1-2 years | 14% | |
| Reduce combustion air flow to optimum | < 1 year | 1-2% | |
| Insulate bare equipment | < 1 year | 1-2% | |
| Increase insulation thickness | < 1 year | 0-1% | |
| Improve air circulation with destratification fans / other methods | 1-2 years | 5-10% | |
| **TOTAL FUEL SAVINGS ESTIMATE** | | | **12%** |

## Electric Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvements and Optimization | | | |
| Reduce compressed air pressure to minimum required and repair leaks[3] | < 1 year | 4.3% | |
| Update compressor controls and intake location[4] | < 1 year | 3.4% | |
| Replace motors with soft-start or ASD supplies[5] | 2 years | 1.5% | |
| Properly size motors and pumps, select efficient replacements[6] | 3 years | 1.9% | |
| Utilize energy-efficient belts[7] | < 1 year | 0.9% | |
| Turn off equipment when not in use or reduce power consumption in stand-by[8] | < 1 year | 1.7% | |
| Optimize plant power factor, install power factor correction devices[9] | 1-2 years | 0.02% | |
| Process heat optimization and process equipment insulation[10] | 3 years | 10.0% | |
| Facility HVAC Improvements | | | |
| Facility HVAC improvements[11] | < 1 year | 11.0% | |
| Lighting improvements[12] | 2 years | 2.6% | |
| **TOTAL ELECTRICAL SAVINGS ESTIMATE** | | | **22%** |

## References


1 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 Journal of Heat Treating, 1989, SOderstrom and Lewald, http://www.springerlink.com/content/h9266765hn831827/fulltext.pdf.
3 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=TA0067
4 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SU0228
5 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SD0394
6 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OK0662
7 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SU0264
8 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SF0304
9 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UU0050
10 DOE Best Practices; http://www1.eere.energy.gov/industry/bestpractices/pdfs/em_proheat_seven.pdf
11 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WI0504
12 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=IC0026





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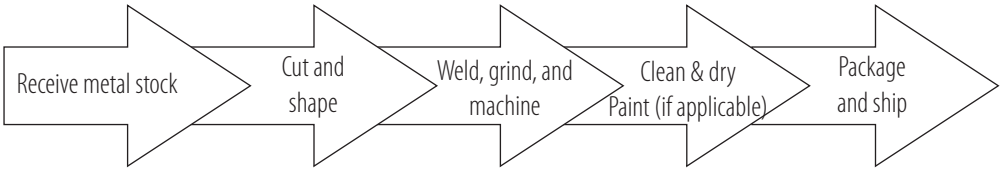
# Machine Shops

## Sub-sector Description

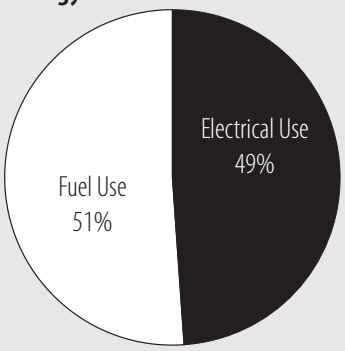
This sub-sector includes facilities that are engaged in machining metal and plastic parts and parts of other composite materials on a job or order basis. Generally machine shop jobs are low volume using machine tools such as lathes (including computer numerically controlled); automatic screw machines; and machines for boring, grinding, and milling.

| Facility Type | SIC | NAICS | | Facility Type | SIC | NAICS |
|---|---|---|---|---|---|---|
| Machine jobs, general | 3544 | 332710 | | Spring and wire product mfg | 3495 | 332611 |
| Screw machining | 3452 | 332722 | | Fabricated wire product mfg | 3496 | 332618 |
| Turned product and screw mfg | 3451 | 332721 | | | | |

## 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/square feet | < 14 | 14 - 22 | 22 - 34 | > 34 |
| kWh/employee | < 6,090 | 6,090 - 11,242 | 11,242 - 20,752 | > 20,752 |
| therms/square feet | < 0.15 | 0.15 - 0.27 | 0.27 - 0.47 | > 0.47 |

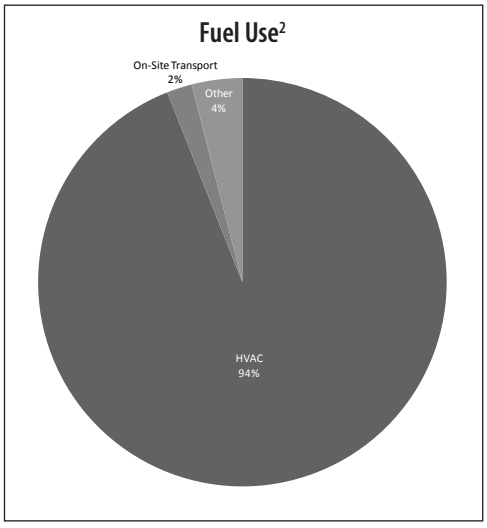
## Savings Potential

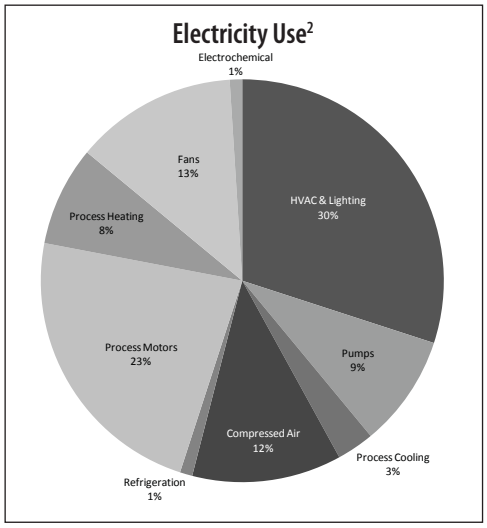
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation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

## Energy Use Footprints



## Fuel Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvement and Optimization | | | |
| Process heat system optimization[3] | | | |
| Boiler $O_2$ tuning[4] | < 2 years | 1% | |
| Place insulating materials around ovens and hot water heaters/boilers[5] | 2 years | 6% | |
| Heat recovery of flue gas to preheat combustion air or heat secondary operations[6] | 5 years | 2% | |
| Recover heat from process equipment[7] | 2 years | 2% | |
| Recover heat from compressed air system[8] | 4 years | 2% | |
| Facility HVAC Improvements | | | |
| Reduce make-up air[9] | 2 years | 4% | |
| Use efficient building insulation[10] | 2 years | 4% | |
| Use radiant heating for spot area heating[11] | < 1 year | 6% | |
| **TOTAL FUEL SAVINGS ESTIMATE** | | | **15%** |

## Electric Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvements and Optimization | | | |
| Reduce compressed air pressure to minimum required and repair leaks[12] | < 1 year | 4-9% | |
| Update compressor controls and intake location[13] | < 1 year | 3.4% | |
| Replace motors with soft-start or ASD supplies[14] | 2 years | 1.5% | |
| Properly size motors and pumps, select efficient replacements[15] | 3 years | 1-4% | |
| Turn off equipment when not in use or reduce power consumption in stand-by[16] | < 1 year | 1.7% | |
| Optimize plant power factor, install power factor correction devices[17] | 1-2 years | 0.02% | |
| Fan and paint ventilation optimization and modification[2] | 2-3 years | 5.0% | |
| Welding control and inverter technologies[18] | 5 years | 5.0% | |
| Facility HVAC Improvements | | | |
| Facility HVAC improvements[2] | < 1 year | 1-2% | |
| Lighting improvements[19] | 2 years | 3-6% | |
| **TOTAL ELECTRICAL SAVINGS ESTIMATE** | | | **9%** |

## References


1 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 C. Galitsky and E. Worrell. Energy Efficiency Improvement and Cost Savings Opportunities for the Vehicle Assembly Industry. Lawrence Berkley National Laboratory, January 2003.
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=MO0112
5 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=OK0239
6 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=WV0234
7 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=IA0032
8 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=IA130
9 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=WI0350
10 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=ME0277
11 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=BD0205
12 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=TA0067
13 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SU0228
14 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SD0394
15 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=OK0662
16 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SF0304
17 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UU0050
18 http://www.americanmachinist.com/304/Issue/Article/False/9124/Issue
19 A. Price and M.H. Ross. Reducing Industrial Electricity Costs - An Automotive Case Study. The Electricity Journal, July 1989: 40-51.





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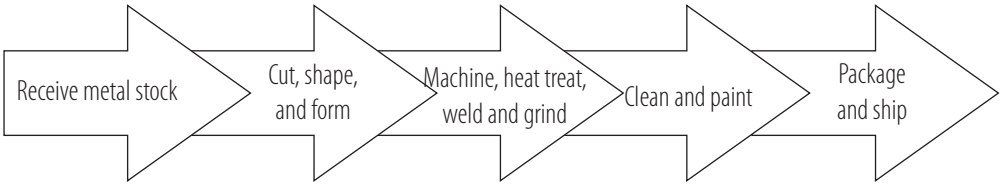
# Industrial Equipment Manufacturing

## Sub-sector Description

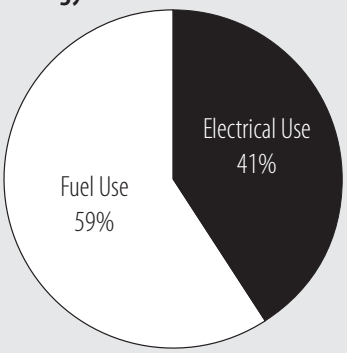
Facilities in this sub-sector create end products that apply mechanical force, for example, the application of gears and levers, to perform work. Some important processes for the manufacture of machinery are forging, stamping, bending, forming, and machining that are used to shape individual pieces of metal. Processes, such as welding and assembling are used to join separate parts together.

| Facility Type | SIC | NAICS | | Facility Type | SIC | NAICS |
|---|---|---|---|---|---|---|
| Heat exchanger/boiler mfg | 3559 | 332410 | | Motors, pump, and fan mfg | 3621 | 333612 |
| Metal working machinery | 3549 | 333518 | | General machinery mfg | 3599 | 333120 |
| Industrial machinery mfg | 3523 | 333120 | | | | |

## 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 | < 2,940 | 2,940 - 5,577 | 5,577 - 10,577 | > 10,577 |
| therms/employee | < 174 | 174 - 337 | 337 - 653 | > 653 |

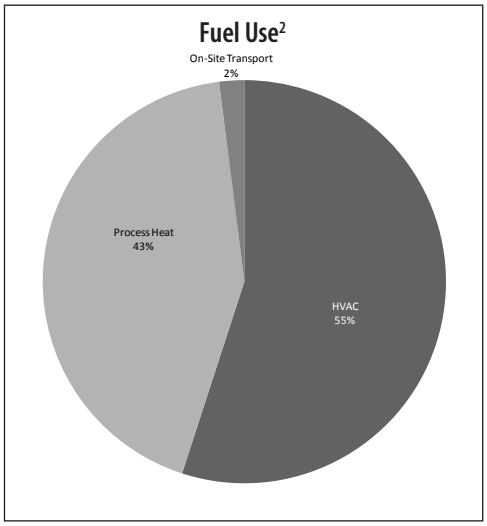
## Savings Potential

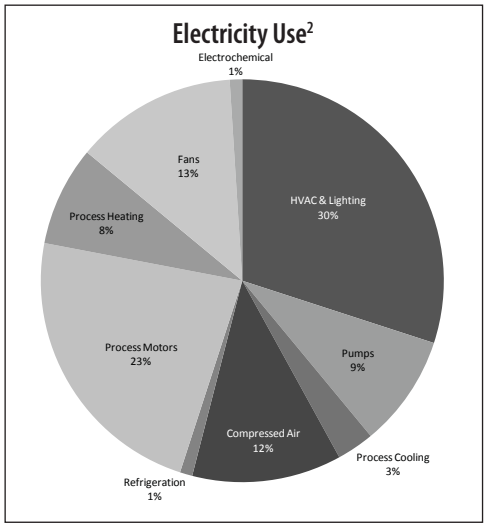
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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:** **21%**

**Estimated Electric Savings:** **13%**

## Energy Use Footprints



## Fuel Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvement and Optimization | | | |
| Process heat system optimization[3] | | | |
| Boiler $O_2$ tuning | < 2 years | 5% | |
| Place insulating materials around ovens, seal ovens, cover openings | 2 years | 2% | |
| Improve process measurements, control, and calibration | 2 years | 5% | |
| Heat recovery of flue gas to preheat combustion air or heat secondary operations | 5 years | 10% | |
| Use radiant heat for spot heating parts[4] | > 5 years | 1% | |
| Modify processes to reduce cure times and overheating | 2-3 years | 5% | |
| Facility HVAC Improvements | | | |
| Reduce make-up air, push/pull ventilation[5] | 2 years | 5% | |
| Use efficient building insulation[6] | > 3 years | 8% | |
| Use radiant heating for spot area heating[7] | < 1 year | 5% | |
| **TOTAL FUEL SAVINGS ESTIMATE** | | | **21%** |

## Electric Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvements and Optimization | | | |
| Reduce compressed air pressure and repair leaks[8] | < 1 year | 4-9% | |
| Update compressor controls and intake location[9] | < 1 year | 3.4% | |
| Replace motors with soft-start or ASD supplies[10] | 2 years | 1.5-4% | |
| Properly size motors and pumps, efficient replacements[11] | 3 years | 1.9% | |
| Utilize energy-efficient belts[12] | < 1 year | 0.9% | |
| Turn off equipment when not in use or reduce power consumption in stand-by[13] | < 1 year | 1.7% | |
| Optimize plant power factor, install correction devices[14] | 2 years | 0.02% | |
| Welding control and inverter technologies[15] | 5 years | 2-5% | |
| Facility HVAC Improvements | | | |
| Facility HVAC improvements[16] | < 1 year | 1-11% | |
| Lighting improvements[17] | 2 years | 1-6% | |
| **TOTAL ELECTRICAL SAVINGS ESTIMATE** | | | **13%** |

## References


1 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 DOE Heavy Machinery Manufacturing Footprint. http:///www1.eere.energy.gov/industry/energy_systems/pdfs/machinery_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=BD0287
5 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=MA0551
6 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=UD0280
7 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=UU0058
8 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=TA0067
9 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SU0228
10 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SD0394
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12 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=SU0264
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14 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UU0050
15 http://www.americanmachinist.com/304/Issue/Article/False/9124/Issue
16 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=WI0504
17 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=UM0238





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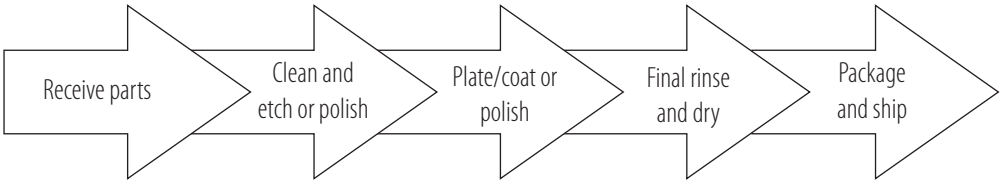
# Plating, Polishing, Coating, and Finishing

## Sub-sector Description

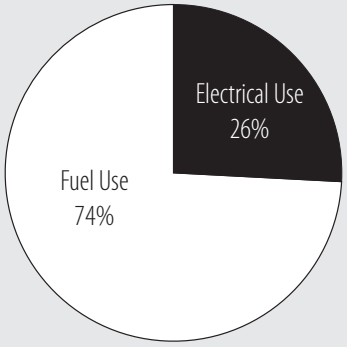
This sub-sector includes facilities engaged in engraving, chasing, or etching metals and metal products; electroplating, plating, anodizing, coloring, and finishing metals and metal products; and providing other metal surfacing services for the trade. Facilities in this industry generally coat, engrave, and metal formed products fabricated elsewhere.

| Facility Type | SIC | NAICS | | Facility Type | SIC | NAICS |
|---|---|---|---|---|---|---|
| Metal painting/power coating | 3479 | 332812 | | Plating, anodizing, etc. | 3471 | 332813 |
| Metal stamping w/plating | 3469 | 332813 | | Machine shops w/painting | 3599 | 332811 |
| Plating and polishing services | 3399 | 332813 | | | | |

## 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/square feet | < 21 | 21 - 31 | 31 - 47 | > 47 |
| kWh/employee | < 16,390 | 16,390 - 25,656 | 25,656 - 40,160 | > 40,160 |
| therms/square feet | < 1.17 | 1.17 - 2.53 | 2.53 - 5.47 | > 5.47 |

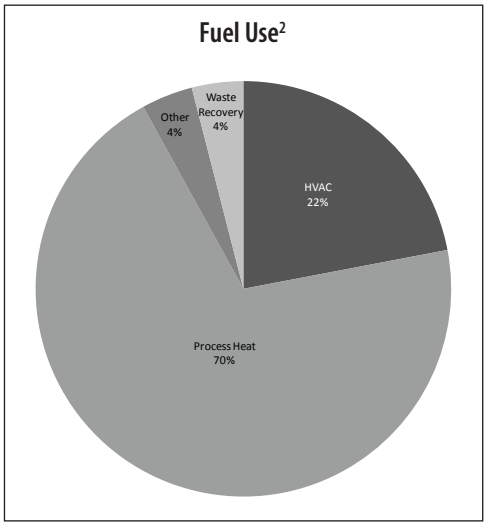
## Savings Potential

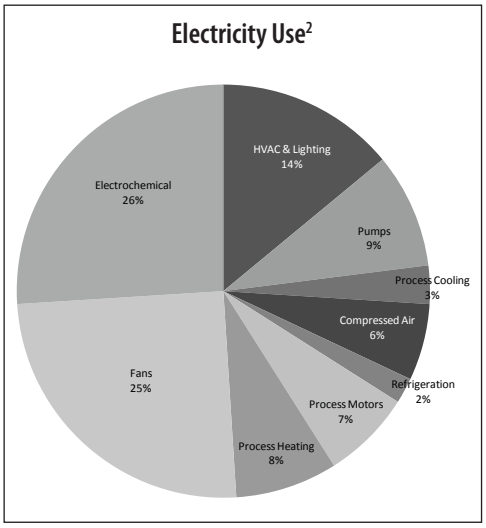
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation 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:** **25%**

**Estimated Electric Savings:** **17%**

## Energy Use Footprints



## Fuel Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvement and Optimization | | | |
| Process heat system optimization[3] | | | |
| Boiler $O_2$ tuning[4] | < 2 years | 5-25% | |
| Place insulating materials around ovens and hot water heaters/boilers[5] | 2 years | 6% | |
| Heat recovery of flue gas to preheat combustion air or heat secondary operations[6] | 5 years | 10-25% | |
| Recovery heat from process equipment[7] | 2 years | 2% | |
| Recover heat from compressed air system[8] | 4 years | 2% | |
| Use adequate insulation and maintain | 2 years | 2-15% | |
| Calibrate and maintain process sensors and control | 2 years | 5-10% | |
| Heat transfer improvement allowing better convection/radiation | > 3 years | 5-15% | |
| Modify processes to reduce soak times and overheating | 2-3 years | 5-10% | |
| Facility HVAC Improvements | | | |
| Reduce make-up air, push/pull ventilation[3] | 2 years | 5% | |
| Use efficient building insulation[4] | > 3 years | 8% | |
| Use radiant heating for spot area heating[5] | < 1 year | 5% | |
| **TOTAL FUEL SAVINGS ESTIMATE** | | | **25%** |

## Electric Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvements and Optimization | | | |
| Electrochemical process efficiency[2] | > 3 years | 5% | |
| Pump optimization[12] | 2 years | 5% | |
| Process motor optimization and load reduction[13] | < 2 years | 4% | |
| Reduce ventilation[14] | 2.5 years | 2% | |
| Compressed air improvements, cold air intake, fix leaks and controls[15] | < 1 year | 9% | |
| Facility HVAC Improvements | | | |
| Facility HVAC improvements[16] | < 1 year | 1% | |
| Lighting improvements[17] | 2 years | 5% | |
| **TOTAL ELECTRICAL SAVINGS ESTIMATE** | | | **17%** |

## References


1 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 Energy Center of Wisconsin Publication 319-2. Metal Finishers Technical Supplement. 2006.
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4 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=MO0112
5 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=OK0239
6 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=WV0234
7 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=IA0032
8 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=IA130
9 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=WI0350
10 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/findassessment.php?ID=ME0277
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15 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=MA0548
16 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=LM0123
17 IAC Industrial Assessments; DOE, http://iac.rutgers.edu/database/findassessment.php?ID=IC0026





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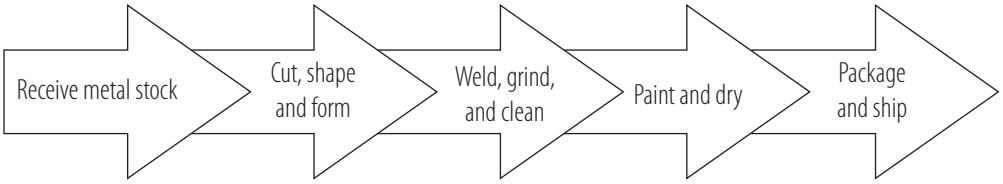
# Sheet Metal Fabrication

## Sub-sector Description

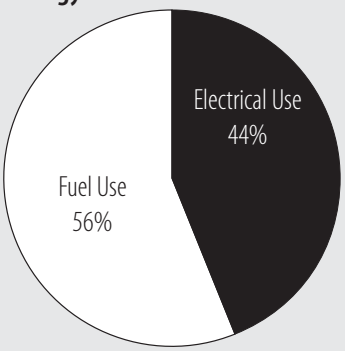
This sub-sector includes facilities that manufacture a variety of products from sheet metal. These products may include metal window frames, metal doors, sheet metal work, and ornamental and architectural metal products.

| Facility Type | SIC | NAICS | | Facility Type | SIC | NAICS |
|---|---|---|---|---|---|---|
| Sheet metal work manufacturing | 3444 | 332322 | | Ornamental metal work mfg | 3599 | 322323 |
| Custom sheet metal fab. | 3469 | 332322 | | | | |

## 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/square feet | < 8 | 8 - 16 | 16 - 32 | > 32 |
| kWh/employee | < 5,765 | 5,765 - 11,345 | 11,345 - 22,326 | > 22,326 |

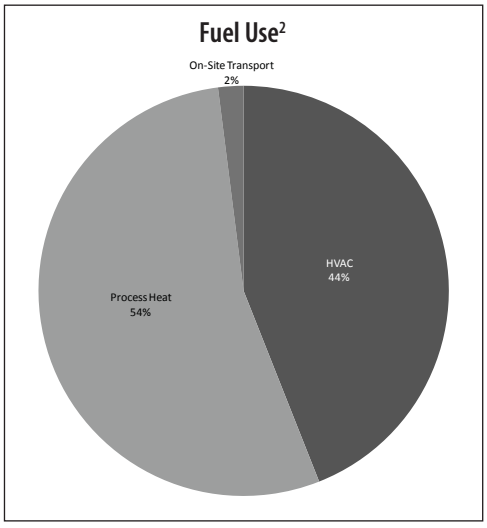
## Savings Potential

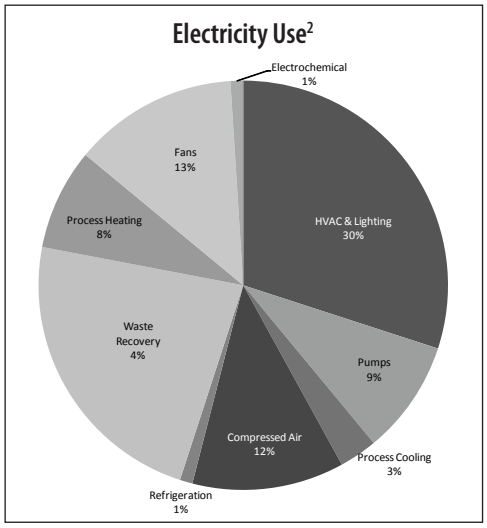
Opportunities and technologies for energy conservation were identified for facilities within this sub-sector. Industry case studies and reports of implementation were used to determine what opportunities may be available and achievable savings from those opportunities. However, additional energy conservation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

## Energy Use Footprints



## Fuel Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvement and Optimization | | | |
| Process heat system optimization[3] | | | |
| Boiler $O_2$ tuning | < 2 years | 5-25% | |
| Place insulating materials around ovens, seal ovens, cover openings. | 2 years | 2-15% | |
| Heat recovery of flue gas to preheat combustion air or heat secondary operations | 5 years | 10-25% | |
| Improve process measurements, control, and calibration | 3 years | 5-10% | |
| Modify processes to reduce cure times and overheating | 5 years | 5-10% | |
| Facility HVAC Improvements | | | |
| Reduce make-up air[4] | 2 years | 2% | |
| Use efficient building insulation[5] | 2 years | 8% | |
| Install air curtains to direct oven heat in facility[6] | < 1 year | 5% | |
| **TOTAL FUEL SAVINGS ESTIMATE** | | | **24%** |

## Electric Savings Estimate and Opportunities

| Improvement / Opportunity | Estimated Payback | Reported Savings | Overall Savings |
|---|---|---|---|
| Process Improvements and Optimization | | | |
| Fan and paint ventilation modifications[7] | > 3 years | 5% | |
| Reduce compressed air pressure to minimum required and repair leaks[8] | < 1 year | 4.3% | |
| Update compressor controls and intake location[9] | < 1 year | 3.4% | |
| Properly size motors and pumps, select efficient replacements[10] | 3 years | 1.9% | |
| Turn off equipment when not in use or reduce power consumption in stand-by[11] | < 1 year | 1.7% | |
| Optimize plant power factor, install power factor correction devices[12] | 1-2 years | 0.02% | |
| Welding control and inverter technologies[13] | 5 years | 5.0% | |
| Facility HVAC Improvements | | | |
| Facility HVAC improvements[7] | < 1 year | 2.0% | |
| Lighting improvements[14] | 2 years | 3.0% | |
| **TOTAL ELECTRICAL SAVINGS ESTIMATE** | | | **15%** |

## References


1 IAC Industrial Assessments. DOE. http://iac.rutgers.edu/database/assessments.php
2 Energy Center of Wisconsin Publication 319-2. Metal Finishers Technical Supplement. 2006.
3 http://www1.eere.energy.gov/industry/bestpractices/pdfs/em_proheat_seven.pdf
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