**Manufacturing Energy and Carbon Footprint**  
**Sector:** All Manufacturing (NAICS 31-33)  

**Primary Energy Use:** 19,663 TBtu  
**Total GHG Emissions:** 1,165 MMT CO₂e

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**Primary Energy, 2018**

- **Total Emission:** 1,164.9 TBtu  
  - **Onsite Generation:** 238.4 TBtu  
  - **Process Energy:** 827.0 TBtu  
  - **Nonprocess Energy:** 99.5 TBtu  
  - **Electricity Export:** 93 TBtu  
  - **Excess Steam:** 13 TBtu

- **Fuel:** 11,589 TBtu  
  - **Electricity:** 14,744 TBtu  
  - **Steam:** 2,591 TBtu

- **Offsite Energy:** 7,312 TBtu  
  - **Electricity Generation:** 344.1 TBtu  
  - **Steam Generation:** 40.5 TBtu

- **Onsite Energy:** 5,435 TBtu  
  - **Generation:** 4,143 TBtu  
  - **Losses:** 1,292 TBtu  
  - **Electricity and Steam Generation Losses:** 1,292 TBtu

- **Process Energy:** 827.0 TBtu  
  - **Losses:** 4,432 TBtu

- **Nonprocess Energy:** 99.5 TBtu  
  - **Losses:** 552 TBtu

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**Greenhouse Gas (GHG) Emissions**

- **Fuel Emissions:** 234.0 MMT CO₂e  
- **Electricity Emissions:** 344.1 MMT CO₂e  
- **Steam Emissions:** 40.5 MMT CO₂e

- **Total Emissions:** 780.4 MMT CO₂e

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**Notes:**

- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number.
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output.
- Electricity export refers to sales and transfers of electricity to utilities and other entities.
- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes.
- Excess steam refers to the sales and transfer of surplus steam or purging of surplus steam.

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**Energy for All Purposes estimated at 24,355 TBtu**

Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use.

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**Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics**
Fuel and GHG Emissions, 2018

Primary Energy Use: 19,663 TBtu
Total GHG Emissions: 1,165 MMT CO₂e

Fuel

- Offsite Generation
  - Electricity Generation
  - Steam Generation
- Onsite Generation
  - Conventional Boilers
  - CHP/Cogeneration
  - Other Electricity Generation
- Process Energy
  - Process Heating
  - Process Cooling and Refrigeration
  - Other Process Uses
  - Electro-Chemical
  - Machine Drive
    - Pumps, Fans, Compressed Air, Materials Handling, Materials Processing, Other Systems
- Nonprocess Energy
  - Facility HVAC
  - Facility Lighting
  - Other Facility Support
  - Onsite Transportation
  - Other Nonprocess

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy Use: 372 TBtu
Total GHG Emissions: 21 MMT CO₂e

Fuel: 118

Electricity Generation: 12.0

Steam Generation: 0.0

Onsite Generation: 12.0

Offsite Energy

Onsite Energy

Electricity and Steam Generation Losses: 4
Steam Distribution Losses: 2

Process Energy: 18.8
Nonprocess Energy: 1.6

Energy for All Purposes estimated at 381 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use.

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
- Electricity export refers to sales and transfers offsite of electricity to utilities and other entities
- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
- Excess steam refers to the sales and transfer offsite or purging of surplus steam

Energy use data source: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this webpage

Last Revised: December 2021
Fuel and GHG Emissions, 2018

Manufacturing Carbon Footprint
Sector: Alumina and Aluminum (NAICS 3313)

Primary Energy Use: 372 TBtu
Total GHG Emissions: 21 MMT CO₂e

Energy use data source:
2018 EIA MECS (with adjustments)
Process emissions data source:
See webpage for details
Last Revised: December 2021

Notes:
Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy, 2018

Manufacturing Energy and Carbon Footprint
Sector: Cement (NAICS 327310)

Primary Energy Use: 367 TBtu
Total GHG Emissions: 66 MMT CO₂e

Energy use: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this webpage
Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
- Electricity export refers to sales and transfers of electricity to utilities and other entities
- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
- Excess steam refers to the sales and transfer of steam or purging of surplus steam

Energy for All Purposes estimated at 367 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Fuel and GHG Emissions, 2018

Offsite Generation
- Electricity Generation
  - 110
- Steam Generation
  - 0

Onsite Generation
- Conventional Boilers
  - 0
- CHP/ Cogeneration
  - 0
- Other Electricity Generation
  - 0

Process Energy
- Process Heating
  - 218
- Process Cooling and Refrigeration
  - 6
- Other Process Uses
  - 0
- Electro-Chemical
  - 0
- Machine Drive
  - 32

Nonprocess Energy
- Facility HVAC
  - 0
- Facility Lighting
  - 0
- Other Facility Support
  - 0
- Onsite Transportation
  - 1
- Other Nonprocess
  - 0

Fuel (TBtu = Trillion British Thermal Units)

Greenhouse Gas (GHG) Emissions (MMT CO₂e - Million Metric Tons Carbon Dioxide Equivalent)

Combustion

Process
Primary Energy, 2018

Energy use: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, data source: visit this webpage

Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
- * Electricity export refers to sales and transfers offsite of electricity to utilities and other entities
- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
- ^ Excess steam refers to the sales and transfer offsite or purging of surplus steam

Energy for All Purposes estimated at 8,169 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use
Manufacturing Energy and Carbon Footprint
Sector: Chemicals (NAICS 325)

Onsite Energy Use: 3,814 TBtu
Onsite Emissions: 242 MMT CO_2e

Onsite Energy, 2018

### Onsite Generation

- **Conventional Boilers**: 34.2% 33.4%
- **CHP/Cogeneration**: 61.8% 61.8%
- **Other Electricity Generation (excludes 0.1 TBtu renewable, non-combustion electricity output)**: 0.4% 0.4%

### Other Energy Use

- **Natural Gas**: 78%
- **Waste Gas (byproduct fuel)**: 13%
- **Coal**: 4%
- **Distillate and Residual Fuel Oils**: < 1%
- **HGL (excl. natural gasoline)**: < 1%
- **Other Fuels**: 4%

### Fuel Types

- **Natural Gas**: 2,988
- **Waste Gas**: 1,052
- **Coal**: 574
- **Distillate and Residual Fuel Oils**: 274
- **HGL (excl. natural gasoline)**: 204
- **Other Fuels**: 574

### Process Energy

- **Process Heating**: 70.9% 52.8%
- **Process Cooling and Refrigeration**: 7.4% 0.6%
- **Other Process Uses**: 14.6% 11.3%
- **Electro-Chemical**: 8.1% 0.0%
- **Other Process Uses**: 3%

### Onsite Transportation

- **Facility HVAC**: 10.1% 3.7%
- **Facility Lighting**: 2.5% 0.0%
- **Other Facility Support**: 1.6% 0.7%

### Other Nonprocess

- **Onsite Nonprocess**: 16.1% 5.0%

### Nonprocess Energy

- **Electricity Export**: 47
- **Excess Steam**: 21

### Energy Use Data Source:

2018 EIA MECS (with adjustments); See [webpage](#) for details

Last Revised: December 2021

### Notes:

- Sector-wide aggregate data for year 2018; energy values and fuel type percentages rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
- *Refers to sales and transfers of electricity to others*
- *Combustion renewable output accounted for*
- Offsite generation includes non-combustion renewable output
- Feedstock energy excluded

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Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Fuel and GHG Emissions, 2018

Offsite Generation
- Electricity Generation: 68 TWh
- Steam Generation: 60 TWh

Onsite Generation
- Conventional Boilers: 94 TWh
- CHP/Cogeneration: 135 TWh
- Other Electricity Generation: 0 TWh

Process Energy
- Process Heating: 219 TWh
- Process Cooling and Refrigeration: 6 TWh
- Other Process Uses: 28 TWh
- Electro-Chemical: 0 TWh
- Machine Drive: 16 TWh

Nonprocess Energy
- Facility HVAC: 2 TWh
- Facility Lighting: 0 TWh
- Other Facility Support: 0 TWh
- Onsite Transportation: 0 TWh
- Other Nonprocess: 2 TWh

Total Greenhouse Gas Emissions: 54.8 MMT CO₂e

Fuel
(TBtu = Trillion British Thermal Units)

Greenhouse Gas (GHG) Emissions
(MMT CO₂e - Million Metric Tons Carbon Dioxide Equivalent)

Combustion

Process

Energy use data source: 2018 EIA MECS (with adjustments)
See webpage for details
Last Revised: October 2022

Notes:
Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth
Primary Energy, 2018

Manufacturing Energy and Carbon Footprint
Sector: Plastics Material and Resins (NAICS 325211)

Primary Energy Use: 809 TBtu
Total GHG Emissions: 43 MMT CO₂e

Energy Use

Energy Use data source: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this webpage
Last Revised: December 2021
Notes: Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number
Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
* Electricity export refers to sales and transfers offsite of electricity to utilities and other entities
Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
^ Excess steam refers to the sales and transfer offsite or purging of surplus steam

Energy for All Purposes estimated at 1,816 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Fuel and GHG Emissions, 2018

Primary Energy Use: 809 TBtu
Total GHG Emissions: 43 MMT CO₂e

Offsite Generation
- Electricity Generation: 164 TWh
- Steam Generation: 136 TWh

Onsite Generation
- Conventional Boilers: 3.6 Gt CO₂e
- CHP/ Cogeneration: 15.8 Gt CO₂e
- Other Electricity Generation: 0 TWh

Process Energy
- Process Heating: 5.5 Gt CO₂e
- Process Cooling and Refrigeration: 0.1 Gt CO₂e
- Other Process Uses: 3.0 Gt CO₂e
- Electro-Chemical: 0.0 Gt CO₂e
- Machine Drive: 0.3 Gt CO₂e

Nonprocess Energy
- Facility HVAC: 0.2 Gt CO₂e
- Facility Lighting: 0.0 Gt CO₂e
- Other Facility Support: 0.1 Gt CO₂e
- Onsite Transportation: 0.0 Gt CO₂e
- Other Nonprocess: 0.0 Gt CO₂e

Energy use data source: 2018 EIA MECS (with adjustments)
See webpage for details

Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy, 2018

**Energy Use: 393 TBtu**

- **Primary Energy Use:** 393 TBtu (with adjustments)
- **Total GHG Emissions:** 24 MMT CO₂e

**Notes:**
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
- *Electricity export refers to sales and transfers offsite of electricity to utilities and other entities
- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
- ^Excess steam refers to the sales and transfer offsite or purging of surplus steam

**Energy for All Purposes estimated at 403 TBtu**

Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use

**Data Source:** 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this [webpage](#).

**Last Revised:** December 2021
Fuel and GHG Emissions, 2018

Primary Energy Use: 393 TBo (Trillion British Thermal Units)
Total GHG Emissions: 24 MMT CO₂eq

Fuel emissions are represented by the purple arrows and numbers indicating the flow of energy through different processes and activities. The green boxes represent different sources of energy consumption, including Offsite Generation, Onsite Generation, Process Energy, and Nonprocess Energy.

- **Offsite Generation**:
  - Electricity Generation: 322 TBo
  - Steam Generation: 2 TBo

- **Onsite Generation**:
  - Conventional Boilers: 15.1 TBo
  - CHP/Cogeneration: 7 TBo
  - Other Electricity Generation: 1 TBo

- **Process Energy**:
  - Process Heating: 19.0 TBo
  - Process Cooling and Refrigeration: 0.0 TBo
  - Other Process Uses: 2.0 TBo
  - Electro-Chemical: 0.0 TBo
  - Machine Drive: 1.0 TBo

- **Nonprocess Energy**:
  - Facility HVAC: 1.3 TBo
  - Facility Lighting: 0.0 TBo
  - Other Facility Support: 2.0 TBo
  - Onsite Transportation: 0.0 TBo
  - Other Nonprocess: 0.0 TBo

**Energy use data source**: 2018 EIA MECS (with adjustments)


See webpage for details

**Last Revised**: December 2021

**Notes**: Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth.
Primary Energy Use: 127 TBtu
Total GHG Emissions: 6 MMT CO₂e

**Primary Energy, 2018**

### Energy Use
- **Fuel**
- **Electricity**
- **Steam**
- **Combined**

### Greenhouse Gas (GHG) Emissions

<table>
<thead>
<tr>
<th>Energy (TBtu = Trillion British Thermal Units)</th>
<th>Total</th>
<th>Offsite</th>
<th>Onsite</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuel</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Electricity</strong></td>
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<tr>
<td><strong>Steam</strong></td>
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<tr>
<td><strong>Combined</strong></td>
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</tr>
</tbody>
</table>

### Notes
- Energy values rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
- *Electricity export refers to sales and transfers offsite of electricity to utilities and other entities*
- *Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes*
- ^Excess steam refers to the sales and transfer offsite or purging of surplus steam

### Energy for All Purposes estimated at 127 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use

### Last Revised: December 2021

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**Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics**
Fuel and GHG Emissions, 2018

Energy use data source: 2018 EIA MECS (with adjustments)
See webpage for details
Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth
Primary Energy, 2018

**Offsite Energy**

- **Generation and Transmission Losses**: 225 TBtu
- **Electricity Generation**: 16.5 TBtu
- **Steam Generation**: 0.1 TBtu

**Onsite Energy**

- **Electricity and Steam Generation Losses**: 4 TBtu
- **Electricity and Steam Generation (excludes 0.7 TBtu renewable, non-combustion electricity output)**: 16.5 TBtu
- **Steam Distribution Losses**: 2 TBtu

**Process Energy**

- **Process Losses**: 75 TBtu
- **Electricity Export**: 0 TBtu
- **Nonprocess Losses**: 30 TBtu

**Nonprocess Energy**

- **Total GHG Emissions**: 24 MMT CO₂e
- **Primary Energy Use**: 479 TBtu

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**Energy Use**

- **Energy use data source**: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this [webpage](#).
- **Last Revised**: December 2021
- **Notes**: Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number.
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output.
- *Electricity export refers to sales and transfers offsite of electricity to utilities and other entities.
- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes.
- *Excess steam refers to the sales and transfer offsite or purging of surplus steam.

**Greenhouse Gas (GHG) Emissions**

- **Total GHG Emissions** = Offsite Emissions + Onsite (Combustion + Process) Emissions
- **Fuel**: 248 MMT CO₂e
- **Electricity**: 23 MMT CO₂e
- **Steam**: 10 MMT CO₂e
- **Combined**: 281 MMT CO₂e
Fuel and GHG Emissions, 2018

Offsite Generation
- Electricity Generation: 349 TWh
- Steam Generation: 1 TWh

Onsite Generation
- Conventional Boilers: 0.1 TWh
- CHP/Cogeneration: 0.7 TWh
- Other Electricity Generation: 0 TWh

Process Energy
- Process Heating: 72 TWh
- Process Cooling and Refrigeration: 0 TWh
- Other Process Uses: 0.2 TWh
- Electro-Chemical: 0 TWh
- Machine Drive: 0.1 TWh

Nonprocess Energy
- Facility HVAC: 3 TWh
- Facility Lighting: 0 TWh
- Other Facility Support: 0.1 TWh
- Onsite Transportation: 0 TWh
- Other Nonprocess: 0 TWh

Total Energy Use: 479 TWh
Total GHG Emissions: 24 MMT CO₂e

Fuel and GHG Emissions:

Fuel (TWh = Trillion British Thermal Units)
Greenhouse Gas (GHG) Emissions (MMT CO₂e - Million Metric Tons Carbon Dioxide Equivalent)
Fuel and GHG Emissions, 2018

Manufacturing Carbon Footprint
Sector: Food and Beverage (NAICS 311, 312)

Primary Energy Use: 1,935 Tbtu
Total GHG Emissions: 96 MMT CO2e

Fuel and GHG Emissions, 2018

Offsite Generation
- Electricity Generation: 1,024 Tbtu
- Steam Generation: 45 Tbtu

Onsite Generation
- Conventional Boilers: 236 Tbtu
- CHP/ Cogeneration: 305 Tbtu
- Other Electricity Generation: 2 Tbtu

Process Energy
- Process Heating: 194 Tbtu
- Process Cooling and Refrigeration: 4 Tbtu
- Other Process Uses: 20 Tbtu
- Electro-Chemical: 0 Tbtu
- Machine Drive: 15 Tbtu

Nonprocess Energy
- Facility HVAC: 61 Tbtu
- Facility Lighting: 3 Tbtu
- Other Facility Support: 24 Tbtu
- Onsite Transportation: 3 Tbtu
- Other Nonprocess: 1 Tbtu

Fuel and Greenhouse Gas (GHG) Emissions
- Fuel (Tbtu = Trillion British Thermal Units)
- Greenhouse Gas (GHG) Emissions (MMT CO2e - Million Metric Tons Carbon Dioxide Equivalent)

Combustion
Process

Energy use data source: 2018 EIA MECS (with adjustments)
See webpage for details

Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy, 2018

**Manufacturing Energy and Carbon Footprint**
Sector: Foundries (NAICS 3315)

**Primary Energy Use:** 160 TBtu
**Total GHG Emissions:** 7 MMT CO$_2$e

### Offsite Energy
- **Fuel:** 55
- **Generation and Transmission Losses:** 68

### Onsite Energy
- **Steam Generation:** 0.0
- **Electricity Generation:** 4.9
- **Onsite Generation (excludes <0.1 TBtu renewable, non-combustion electricity output):**
  - **Onsite Distribution Losses:** 0
  - **Process Energy:**
    - **Onsite Generation:** 7.3
    - **Nonprocess Energy:**
      - **Energy Distribution Losses:** 0
      - **Process Losses:** 40

### Nonprocess Energy
- **Total GHG Emissions:**
  - **Onsite Emissions:**
    - **Onsite (Combustion + Process) Emissions:**
      - **Electricity Export:**
      - **Excess Steam:**

### Energy Use and GHG Emissions
- **Energy use data source:** 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this [webpage](https://example.com).
- **Last Revised:** December 2021
- **Notes:**
  - Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number
  - Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
  - Electricity export refers to sales and transfers offsite of electricity to utilities and other entities
  - Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
  - Excess steam refers to the sales and transfer offsite or purging of surplus steam

**Energy for All Purposes estimated at 161 TBtu**
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Fuel and GHG Emissions, 2018

Manufacturing Carbon Footprint
Sector: Foundries (NAICS 3315)

Primary Energy Use: 160 TBoe
Total GHG Emissions: 7 MMT CO₂e

Fuel (TBoe = Trillion British Thermal Units)

Greenhouse Gas (GHG) Emissions (MMT CO₂e - Million Metric Tons Carbon Dioxide Equivalent)

Combustion

Process

Energy use data source: 2018 EIA MECS (with adjustments)
See webpage for details

Last Revised: December 2021

Notes:
Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy, 2018

**Energy Use**

- **Primary Energy Use:** 272 TBtu
- **Total GHG Emissions:** 15 MMT CO$_2$e

**Energy Breakdown**

- **Offsite Energy:**
  - Fuel: 137 TBtu
  - Electricity Generation: 6.4 TBtu
  - Steam Generation: 0.0 TBtu
  - Total Offsite Energy: 143 TBtu

- **Onsite Energy**
  - Electricity Generation (excludes 0.1 TBtu renewable, non-combustion electricity output): 6.3 TBtu
  - Steam Generation: 0.0 TBtu
  - Total Onsite Energy: 6.3 TBtu

- **Process Energy**
  - Total Process Energy: 13.5 TBtu
  - Process Losses: 97 MMT CO$_2$e

- **Nonprocess Energy**
  - Total Nonprocess Energy: 8.1 TBtu
  - Nonprocess Losses: 6 MMT CO$_2$e

**Energy Use Summary**

- **Primary Energy Use:** 272 TBtu
- **Total GHG Emissions:** 15 MMT CO$_2$e

**Notes**

- **Last Revised:** December 2021
- **Energy Use Data Source:** 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this [webpage](#).
- **Energy Values:** Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number.
- **Offsite Generation:** Shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output.
- **Electricity Export:** Refers to sales and transfers offsite of electricity to utilities and other entities.
- **Excess Steam:** Refers to the sales and transfer offsite or purging of surplus steam.
- **Applicability:** Primarily relevant to sectors with a significant amount of primary energy use, such as manufacturing and power generation.

**Energy for All Purposes**

- **Energy for All Purposes estimated at 274 TBtu**
- **Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use**

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**Energetics**

Fuel and GHG Emissions, 2018

**Fuel**
(TBtu = Trillion British Thermal Units)

**Greenhouse Gas (GHG) Emissions**
(MMT CO₂e - Million Metric Tons Carbon Dioxide Equivalent)

- Combustion
- Process

**Primary Energy Use:** 272 TBtu
**Total GHG Emissions:** 15 MMT CO₂e

**Manufacturing Carbon Footprint**
Sector: Glass and Glass Products (NAICS 3272, 327993)

**Emission Sources and Sinks for Glass and Glass Products (NAICS 3272, 327993):**

- **Offsite Generation**
  - Electricity Generation
  - Steam Generation

- **Onsite Generation**
  - Conventional Boilers
  - CHP/ Cogeneration
  - Other Electricity Generation

- **Process Energy**
  - Process Heating
  - Process Cooling and Refrigeration
  - Other Process Uses

- **Nonprocess Energy**
  - Facility HVAC
  - Facility Lighting
  - Other Facility Support
  - Onsite Transportation
  - Other Nonprocess

**Notes:**
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth
- See webpage for details
- Last Revised: December 2021

**Energy Use Data Source:**
2018 EIA MECS (with adjustments)

**Process Emissions Data Source:**

**Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics**

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**See page 3 of 3 for more details.**
Manufacturing Energy and Carbon Footprint
Sector: Iron and Steel (NAICS 331110, 3312)

Primary Energy Use: 1,469 TBtu
Total GHG Emissions: 100 MMT CO₂e

Primary Energy, 2018

Offsite Energy

- Fuel: 855
- Generation and Transmission Losses: 391
- Electricity Generation: 28.4
- Steam Generation: 0.5

Onsite Energy

- Electricity and Steam Generation Losses: 36
- Steam Distribution Losses: 25
- Total GHG Emissions: 100.2

Process Energy

- 934
- Nonprocess Energy
- 29

Nonprocess Energy

- Total Energy: 3.5
- 1.4

Energy use data source: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this [webpage](#).

Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
- Electricity export refers to sales and transfers offsite of electricity to utilities and other entities
- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
- Excess steam refers to the sales and transfer offsite or purging of surplus steam

Energy for All Purposes estimated at 1,493 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use
Greenhouse Gas (GHG) Emissions and Sinks:

- Emission and energy data sources:
  - Energy use data source: 2018 EIA MECS (with adjustments)
    - See webpage for details
  - Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth
Manufacturing Energy and Carbon Footprint
Sector: Machinery (NAICS 333)

Primary Energy, 2018

Primary Energy Use: 299 TBtu
Total GHG Emissions: 14 MMT CO₂e

Energy (TBtu = Trillion British Thermal Units)
- Fuel
- Electricity
- Steam
- Combined

Greenhouse Gas (GHG) Emissions (MMT CO₂e = Million Metric Tons Carbon Dioxide Equivalent)
- Offsite
- Total
- Onsite

Total Emissions = Offsite Emissions + Onsite (Combustion + Process) Emissions

Energy use data source: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this webpage
Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
- Electricity export refers to sales and transfers offsite of electricity to utilities and other entities
- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
- Excess steam refers to the sales and transfer offsite or purging of surplus steam

Energy for All Purposes estimated at 302 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Onsite Energy, 2018

Onsite Energy Use: 145 TBtu
Onsite Emissions: 4 MMT CO₂e

Energy (TBtu = Trillion British Thermal Units)

Fuel
Electricity
Steam
Combined

Greenhouse Gas (GHG) Emissions (MMT CO₂e = Million Metric Tons Carbon Dioxide Equivalent)

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>91%</td>
</tr>
<tr>
<td>HGL (excl. natural gasoline)</td>
<td>5%</td>
</tr>
<tr>
<td>Distillate Fuel Oil</td>
<td>3%</td>
</tr>
<tr>
<td>Other Fuels</td>
<td>2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Onsite</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site</td>
<td>80 (%)</td>
<td>79 (%)</td>
</tr>
<tr>
<td>Site/Process</td>
<td>0 (%)</td>
<td>0 (%)</td>
</tr>
</tbody>
</table>

Steam Distribution Losses

Notes:
1. Onsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
2. Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output
3. Other systems refers to sales and transfers of electricity to utilities and other entities
4. Excess steam refers to sales and transfers offsite or purging of surplus steam

Energy use data source:
2018 EIA MECS (with adjustments);
See webpage for details
Last Revised: December 2021

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy Use: 3,728 TBtu
Total GHG Emissions: 244 MMT CO₂e

Prim  (728)
ector: Petroleum Refining (NAICS 324110)

Electricity
mbined
ermal Units)

Losses
203

a
2.7

G
arbon Dioxide Equivalent)

Offsite Emissions +

Onsite (Combustion +

Process) Emissions

3,728

3,059

466

301

Generation and Transmission Losses

925

702

Process Energy

223

Steam Distribution Losses

158

Nonprocess Energy

2.7

62.8 62.7

Onsite Generation
(excludes 0.1 TBtu renewable, non combustion electricity output)

243.8

211.1

177.9 147.5

Energy use data source: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this webpage

Last Revised: December 2021

Notes: Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number

Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output

* Electricity export refers to sales and transfers of electricity to utilities and other entities

Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes

^ Excess steam refers to the sales and transfer of surplus steam or purging of surplus steam

Total Emissions =

Offsite Emissions +

Onsite (Combustion +

Process) Emissions

Energy for All Purposes estimated at 3,728 TBtu

Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy, 2018

Manufacturing Energy and Carbon Footprint
Sector: Plastics and Rubber Products (NAICS 326)

Primary Energy Use: 562 TBtu
Total GHG Emissions: 27 MMT CO₂e

Offsite Energy

Onsite Energy

Process Energy

Nonprocess Energy

Primary Energy Use:

Greenhouse Gas (GHG) Emissions

Energy use data source: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this webpage.

Last Revised: December 2021

Notes:
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- Feedstock energy excluded from primary, offsite, and onsite energy values and included in Energy for All Purposes
- Excess steam refers to the sales and transfer offsite or purging of surplus steam

Energy for All Purposes estimated at 563 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use.
Onsite Energy, 2018

Onsite Energy Use: 92 TBtu
Onsite Emissions: 2 MMT CO₂e

Fuel Types
- Natural Gas: 91%
- HGL (excl. natural gasoline): 3%
- Coal: 2%
- Distillate and Residual Fuel Oils: 2%
- Other Fuels: 1%

Energy (TBtu = Trillion British Thermal Units)
- Fuel
- Electricity
- Steam
- Combined

Greenhouse Gas (GHG) Emissions
(MMT CO₂e = Million Metric Tons Carbon Dioxide Equivalent)

Onsite Emissions = Onsite Combustion Emissions + Process Emissions

Steam Distribution Losses

Machine Drive
- Pumps: 6
- Fans: 12
- Compressed Air: 5
- Materials Handling: 1
- Materials Processing: 7
- Other Systems: 1

Energy use data source:
2018 EIA MECS (with adjustments);
See webpage for details
Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values and fuel type percentages rounded to nearest whole number
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion carbon dioxide output
- Excludes on-site non-steam renewable output
- Refers to sales and transfers of electricity to utilities and other entities
- Refers to sales and transfers of excess or purging of surplus steam
- Feedstock energy excluded
Fuel and GHG Emissions, 2018

Manufacturing Carbon Footprint
Sector: Textiles (NAICS 313-316)

Energy use data source: 2018 EIA MECS (with adjustments)
See webpage for details

Last Revised: December 2021

Notes:
Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth

Fuel
(TBtu = Trillion British Thermal Units)

Greenhouse Gas (GHG) Emissions
(MMT CO₂e - Million Metric Tons Carbon Dioxide Equivalent)

Combustion
Process

Primary Energy Use: 183 TBtu
Total GHG Emissions: 9 MMT CO₂e

Total Greenhouse Gas Emissions 9.0

Offsite Generation
- Electricity Generation
- Steam Generation

Onsite Generation
- Conventional Boilers
- CHP/ Cogeneration
- Other Electricity Generation

Process Energy
- Process Heating
- Process Cooling and Refrigeration
- Other Process Uses
- Electro-Chemical
- Machine Drive

Nonprocess Energy
- Facility HVAC
- Facility Lighting
- Other Facility Support
- Onsite Transportation
- Other Nonprocess
Primary Energy, 2018

<table>
<thead>
<tr>
<th>Energy (TBu = Trillion British Thermal Units)</th>
<th>Greenhouse Gas (GHG) Emissions (MMT CO₂e = Million Metric Tons Carbon Dioxide Equivalent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td>Offsite</td>
</tr>
<tr>
<td>Electricity</td>
<td>Total</td>
</tr>
<tr>
<td>Steam</td>
<td>Total Emissions = Offsite Emissions + Onsite (Combustion + Process) Emissions</td>
</tr>
</tbody>
</table>

Energy use data source: 2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this webpage.

Last Revised: December 2021

Notes:
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- †Excess steam refers to the sales and transfer offsite or purging of surplus steam

Energy for All Purposes estimated at 662 TBtu
Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use
Fuel and GHG Emissions, 2018

Manufacturing Carbon Footprint
Sector: Transportation Equipment (NAICS 336)

Primary Energy Use: 659 Tبدا
Total GHG Emissions: 32 MMT CO2e

Offsite Generation
- Electricity Generation: 485
- Steam Generation: 2

Onsite Generation
- Conventional Boilers: 22.8
- CHP/ Cogeneration: 12
- Other Electricity Generation: 1

Process Energy
- Process Heating: 63
- Process Cooling and Refrigeration: 2
- Other Process Uses: 3
- Electro-Chemical: 0
- Machine Drive: 137

Nonprocess Energy
- Facility HVAC: 58
- Facility Lighting: 0
- Other Facility Support: 2
- Onsite Transportation: 0
- Other Nonprocess: 4

Total Greenhouse Gas Emissions: 32.3

Fuel
- Btu = Trillion British Thermal Units

Greenhouse Gas (GHG) Emissions
- MMT CO2e - Million Metric Tons Carbon Dioxide Equivalent

Combustion
- Process

Energy use data source: 2018 EIA MECS (with adjustments)
See webpage for details

Last Revised: December 2021

Notes:
- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy, 2018

**Energy Use (TBtu = Trillion British Thermal Units)**

<table>
<thead>
<tr>
<th>Energy</th>
<th>2018 EIA MECS (with adjustments). For full information on references, definitions, assumptions, and other sectors, visit this <a href="https://example.com">webpage</a>.</th>
</tr>
</thead>
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<tr>
<td>Fuel</td>
<td>45</td>
</tr>
<tr>
<td>Electricity</td>
<td>10 (excludes &lt;0.1 TBtu renewable, non-combustion electricity output)</td>
</tr>
<tr>
<td>Steam</td>
<td>10</td>
</tr>
<tr>
<td>Combined Losses</td>
<td>125</td>
</tr>
</tbody>
</table>

**Greenhouse Gas (GHG) Emissions (MMT CO₂e = Million Metric Tons Carbon Dioxide Equivalent)**

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- Excess steam refers to the sales and transfer offsite or purging of surplus steam

**Energy for All Purposes estimated at 126 TBtu**

Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by [Energetics](https://example.com)
Fuel and GHG Emissions, 2018

Manufacturing Carbon Footprint
Sector: Automobile and Light Duty Motor Vehicle (NAICS 33611)

Primary Energy Use: 125 TWh
Total GHG Emissions: 6 MMT CO₂e

Fuel (TWh = Trillion British Thermal Units)

Greenhouse Gas (GHG) Emissions (MMT CO₂e - Million Metric Tons Carbon Dioxide Equivalent)

Combustion

Process

Energy use data source: 2018 EIA MECS (with adjustments)
See webpage for details
Last Revised: December 2021
Notes: Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number; emissions values rounded to nearest tenth

Prepared for the U.S. Department of Energy, Advanced Manufacturing Office by Energetics
Primary Energy, 2018

**Energy Use**

- **Primary Energy Use:** 124 TBtu
- **Total GHG Emissions:** 6 MMT CO₂e

**Energy Breakdown**

- **Onsite Energy**
  - **Electricity Generation:** 4.4
  - **Fuel:** 31
  - **Steam Generation:** 0.0
- **Offsite Energy**
  - **Electricity Generation:** 64
  - **Generation and Transmission Losses:** 33
  - **Steam Generation:** 0

**Greenhouse Gas (GHG) Emissions**

- **Total Emissions:** 6.1
- **Nonprocess Energy:** 1.7
- **Process Energy:** 2.5

**Notes**

- Sector-wide aggregate data for year 2018; energy values rounded to nearest whole number.
- Offsite generation shown on net basis (purchases, sales, and transfers accounted for) and includes onsite non-combustion renewable output.
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- Excess steam refers to the sales and transfer offsite or purging of surplus steam.

**Energy for All Purposes estimated at 126 TBtu**

Includes primary energy plus net energy consumed for nonfuel purposes, including feedstock use.
Manufacturing Carbon Footprint
Sector: Aerospace Product and Parts (NAICS 3364)

Primary Energy Use: 124 TBTu
Total GHG Emissions: 6 MMT CO₂e

Fuel and GHG Emissions, 2018

Fuel (TBtu = Trillion British Thermal Units)

Greenhouse Gas (GHG) Emissions (MMT CO₂e - Million Metric Tons Carbon Dioxide Equivalent)

Combustion

Process