

The background of the cover is a photograph of an industrial facility, likely a power plant or refinery. It features a complex network of large, metallic pipes, valves, and machinery. The lighting is a mix of cool blues and greens, with some bright white lights creating a high-contrast scene. A dark blue semi-transparent rectangle is overlaid on the center of the image, containing the title text in white.

***New York
Statewide
Industrial
Facilities
Stock Study:
Phase Two Final
Report***

NY Statewide Industrial Facilities Stock Study: Phase Two Final Report

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Glossary of key terms

ACS. American Community Survey. The US government performs the American Community Survey (ACS) on an ongoing basis to provide information used to plan infrastructure and other vital services.

Btu. British thermal unit. The quantity of heat required to raise the temperature of 1 pound of water by 1 degree Fahrenheit.

CEI. Continuous Energy Improvement. A program that received a five-year market evaluation conducted by NYSERDA to gather location-level information from industrial facilities, specifically around energy management practices, generally targeted to the largest ones throughout the state. Surveys for this study were conducted biannually from 2017 to 2021. This program is now known as Energy Management Practices.

CHP. Combined heat and power. The concurrent production of electricity or mechanical power and useful thermal energy (heating and/or cooling) from a single source of energy.

CO₂e. Carbon dioxide equivalents. The combined greenhouse gas effect of carbon dioxide, methane, and nitrous oxide, with methane and nitrous oxide's global warming potential normalized to that of carbon dioxide for comparison purposes. These factors are based upon NYSERDA greenhouse gas emissions studies¹ as of October 2023 and with the values at that time provided in Appendix F. CO₂e are always measured in metric tons.

Coefficient of Variation (CV). Coefficient of Variation is a statistical measure of the dispersion of data points around the mean.

EDI. Electronic Data Interchange. The New York State system available to partners to electronically request and receive consumption data for electric and gas customers, among other data in support of customer retail access.

Energy consumption. All direct energy used for heat and power at the facility, regardless of where the energy was produced.

EMS. Energy management system. An energy management system is a set of processes that allows an organization to achieve and maintain energy performance improvements.

¹ <https://www.nyserdera.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Greenhouse-Gas-Emissions#other>

EFLH. Equivalent full load hours. The equivalent hours that a measure would need to operate at its peak capacity to consume its estimated annual kWh consumption (annual kWh/connected kW).

Feedstock. Energy sources that are used for raw material input or for any purpose other than the production of heat or power.

Greenhouse. Facilities in NAICS code 1114 that are not nursery or floriculture and have fixed walls under glass (does not include hoop structures).

GHG (greenhouse gas) emissions (scopes). There are three scopes of GHG emission referred to in this report. **Scope 1** covers emissions from sources that facility owns or controls directly (e.g., furnace or boiler combustion). **Scope 2** covers direct GHG emissions associated with the purchase of electricity, steam, heat, or cooling. **Scope 3** encompasses emissions not produced by a facility itself but that the facility indirectly affects in its value chain. The Scope 3 emissions for one organization are the Scope 1 and 2 emissions of another organization.

HGL. Hydrocarbon gas liquids. Hydrocarbon gas liquids (HGLs) are produced when raw natural gas is processed at natural gas processing plants and when crude oil is refined into petroleum products.² Hydrocarbons include ethane, propane, normal butane, isobutane, and natural gasoline.

Hoop house. Hoop houses are generally arched ground covers constructed of hoop-shaped tubular ribs covered with a plastic film.

Hydrogen. Different colors are used to differentiate between the types of hydrogen in this report. Colors are based on the production process and its greenhouse gas emissions. The three colors of hydrogen referenced in this report include gray, green, and blue:

- **Green** hydrogen is produced from water electrolysis using renewable energy, such as solar or wind power. It emits zero-carbon dioxide in the process and is considered the cleanest form of hydrogen.
- **Blue** hydrogen is produced from natural gas using a process called steam reforming, which also produces carbon dioxide as a by-product. However, blue hydrogen uses carbon capture and storage to trap and store this carbon, reducing the emissions by as much as half.
- **Grey** hydrogen is the most common form and is generated from natural gas, or methane, through the process of steam reforming but unlike blue hydrogen, it does not use carbon capture and storage to reduce emissions.

² <https://www.eia.gov/energyexplained/hydrocarbon-gas-liquids/where-do-hydrocarbon-gas-liquids-come-from.php#:~:text=Hydrocarbon%20gas%20liquids%20are%20derived%20from%20natural%20gas,from%20natural%20gas%20at%20natural%20gas%20processing%20plants.>

- **Brown hydrogen** is produced from coal gasification without carbon capture, which makes it the most environmentally damaging form of hydrogen. It emits large amounts of carbon dioxide and other pollutants in the process.

ISO 50001. A voluntary international standard developed by ISO, the International Organization for Standardization, that provides requirements for establishing, managing, and improving their energy consumption and efficiency.³

Key industries. The industrial subsectors focused on in this report (i.e., key industries) include 324 - Petroleum and Coal Products, 325 – Chemicals, 327 - Nonmetallic Mineral Products, 331 - Primary Metals, 332 - Fabricated Metal Products, 334 - Computer and Electronic Products, 336 - Transportation Equipment

Low-carbon fuels. Alternative fuels such as natural gas or electricity that can replace carbon-intensive petroleum products such as gasoline and diesel.

Manufacturing facility. A location where the manufacture of products from a raw material to a finished good using industrial production equipment and processes has been determined or is believed to be present. In this study, this is based on facilities a Manufacturing NAICS code from Data Axle that has passed the screening performed.

MECS. Manufacturing Energy Consumption Survey. A national sample survey that collects information on the stock of U.S. manufacturing establishment, their energy-related building characteristics, and their energy consumption and expenditures.⁴ MECs reports value better than 50% RSE (see RSE definition below) and suppresses results above this threshold.

MT. Metric ton. In this study, CO_{2e} are reported in metric tons. A metric ton in this instance is the equivalent of 1,000 kg — not to be confused with a “ton” in the imperial system of measurement.

NAICS. North American Industry Classification System. A numeric classification system to categorize facilities by processes or production.

NAPCS. North American Product Classification System. A numeric classification system of products (goods and services) that can be linked to a NAICS industry.

Net electricity. Net electricity is obtained by summing purchases, transfers in, and generation from noncombustible renewable resources, minus quantities sold and transferred out. It does not

³ <https://datascope.io/en/blog/what-is-iso-50001/>

⁴ <https://www.eia.gov/consumption/manufacturing/about.php>

include electricity inputs from onsite cogeneration or generation from combustible fuels because that energy has already been included as generating fuel (e.g., coal).

Non-electric fuels. The term non-electric fuels in this study refers to natural gas, propane, fuel oil, kerosene, distillate, diesel, motor gasoline, hydrogen, purchased hot water or steam.

Non-key industries. Industries included in the non-key subsector include 339 Miscellaneous, 312 Beverage and Tobacco Products, 333 Machinery, 323 Printing and Related Support, 326 Plastics and Rubber Products Manufacturing, 335 Electrical Equipment Appliances, and Components, and 321 Wood Products.

Physical unit. The physical unit of an energy source is that commonly used to measure a specific type of energy or fuel, e.g., barrels or gallons for liquid fuels, short tons for coal, cubic feet for natural gas, and kWh for electricity.

RSE. Relative standard error. RSE is equal to the standard error of a survey estimate expressed as a fraction of the estimate, thereby showing if the standard error is large relative to the results. RSEs are used in this report to note results with uncertainty (RSEs between 50% and 100%), and to suppress results when greater than 100% RSE.

Shipments. Manufacturers' shipments measure the dollar value of products sold by manufacturing establishments and are based on net selling values.

Industrial Tiers 1, 2, 3. NYSERDA industrial facility classification where Tier 1 is defined as having greater than \$1 million in annual energy expenditures, Tier 2 is \$500k to \$1 million in annual energy expenditures, and Tier 3 is less than \$500k in annual energy expenditures.

VFDs. Variable frequency drives. A type of motor controller that drives an electric motor by varying the frequency and voltage supplied to the electric motor.⁵

⁵ <https://vfds.com/>

Executive summary

The goal of the New York Statewide Industrial Facilities Stock Study is to provide a deep, data-driven understanding of New York’s manufacturing (North American Industry Classification System [NAICS] 31-33) and greenhouse sectors regarding facility size, energy use characteristics, and energy efficiency, electrification, clean energy goals, and carbon reduction improvements already undertaken. This project supports achieving the New York State Climate Leadership and Community Protection Act (CLCPA) 2050 goals with results that can:

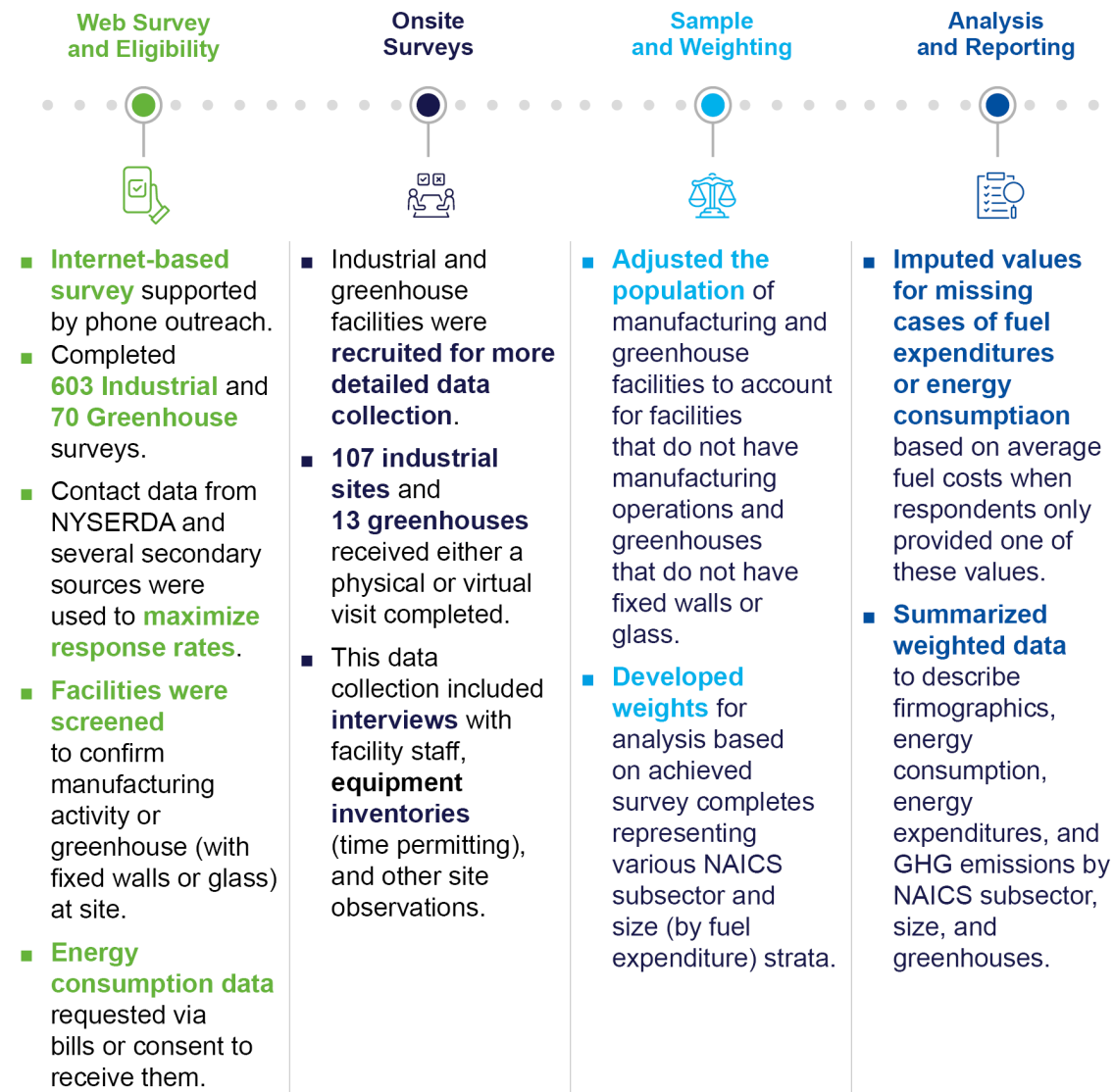
- Inform future clean energy and greenhouse gas (GHG) reduction potential studies
- Provide an understanding for incentive programs and support program benchmarking, design, implementation, and evaluation
- Provide a baseline for longitudinal market trending
- Educate service providers and industrial customers to take actions that advance NYS clean energy goals

Approach

This report provides results from the second phase of a two-phase study. The **Phase One Report**,⁶ published on January 17, 2023, established an initial understanding of industrial manufacturing facilities and indoor greenhouses in New York by synthesizing existing secondary data and research on New York State (NYS) industries. This **Phase Two Report** is based on primary data collection, including web surveys and physical and virtual site visits. This report updates estimates from the Phase One Report and provides additional facility characteristics of interest. The data collection and analysis steps are summarized in Figure ES-1.

⁶ DNV, *Industrial Facilities Stock Study: Phase One Final Report*, prepared for NYSERDA, January 2023. <https://www.nyserdanyc.gov/-/media/Files/Publications/PPSER/Program-Evaluation/Matter-No-1602180NYSERDAIndustrial-Facilities-Stock-Study-Phase-One-Report-March-2023.pdf>

Figure ES-1. Data collection and analysis steps



Results

Manufacturing sector characteristics

Table ES-1 shows selected manufacturing sector characteristics by subsector in order of annual energy consumption. All manufacturing sector estimates in this study are limited to facilities with confirmed manufacturing activity at the site. As a result, total facility counts and employment are smaller than in other data sources, including Phase One of this study, that used sources based on NAICS code without explicit screening for manufacturing activity. The table shows that Paper and Chemicals are the three-digit NAICS groups with the highest total energy consumption, energy expenditures, and energy-use emissions in the state, followed by Primary Metals, Food, Fabricated Metals, and Transportation Equipment.

Petroleum and Coal Products is comparatively small in terms of all the characteristics shown. While this subsector appears to be large based on reported employment in NAICS group 324, the screening conducted for this study determined that a large fraction of the facilities, particularly the large ones, were non-manufacturing. Hence, manufacturing energy use, expenditures, and emissions are small for this subsector.

Table ES-1. Manufacturing characteristics by subsector

NAICS and Subsector Manufacturing Type	Number of Facilities	Total Employees	Annual Energy Consumption (MMBtu)	Annual Energy Expenditures (\$1,000s)	Annual Emissions from Energy Use (1,000s MTCO _{2e}) ⁷
322 - Paper	90	9,132	30,193,506	309,313	2,742
325 - Chemicals	142	~18,520	25,360,873	268,539	2,288
331 - Primary Metals	74	5,196	~15,542,029	~235,872	~1,258
311 - Food	357	16,075	14,382,126	152,192	1,304
332 - Fabricated Metal Products	1,570	85,473	14,205,015	213,438	1,183
336 - Transportation Equipment	89	16,445	~11,964,122	119,080	~1,084
327 - Nonmetallic Mineral Products	155	7,058	7,513,926	84,800	677
334 - Computer and Electronic Products	196	30,950	~7,186,419	~113,073	~560
324 - Petroleum and Coal Products	21	364	500,542	6,938	45
Non-key	5,083	138,408	21,884,521	285,390	1,849
Total	7,777	327,622	148,733,079	1,788,634	12,990

Note: '~' indicates that one response made up 50% or more of a single result, or that the RSE was between 50% and 100%.

NYSERDA uses a tier system for categorizing industrial facilities. Tier 1 is defined as having greater than \$1 million in annual energy expenditures, Tier 2 is \$500k to \$1 million in annual energy expenditures, and Tier 3 is less than \$500k in annual energy expenditures. Table ES-1 shows the same results provided in Table ES-1 by Tier. While Tier 1 and Tier 2 have similar numbers of manufacturing facilities, Tier 1 has a much greater number of employees than Tier 2, and accounts for roughly three-fourths of the consumption, expenditures, and emissions in New York State. Tier 3 has the large majority of facilities and employees, but accounts for only about 20% of New York State manufacturing consumption, expenditures, and emissions.

⁷ Includes Scope 1 (emissions from sources that facility owns or controls directly) and Scope 2 (direct GHG emissions associated with the purchase of electricity, steam, heat, or cooling) emissions. Scope 3, which encompasses emissions not produced by a facility itself but that the facility indirectly affects in its value chain are not included.

Table ES-2. Manufacturing characteristics by tier

NAICS and Subsector Manufacturing Type	Number of Facilities	Total Employees	Annual Energy Consumption (MMBtu)	Annual Energy Expenditures (\$1,000s)	Annual Emissions from Energy Use (1,000s MTCO ₂ e)
Tier 1	172	72,517	111,697,147	1,302,872	9,788
Tier 2	142	23,358	8,384,380	99,287	739
Tier 3	7,643	231,747	28,651,551	386,475	2,462
Total	7,777	327,622	148,733,079	1,788,634	12,990

Manufacturing sector end uses

Table ES-3 shows manufacturing electric and non-electric⁸ energy consumption by high-level use. Since a boiler may have joint use for both facility HVAC and industrial processes, boilers are listed as a separate use category. The table shows that three-quarters of electricity is used for production processes, while around half of non-electric fuels are used for boilers and 30% is used for production. In terms of non-electric fuels used for heating processes, 80% of boiler use and 60% of non-boiler heating are for low and medium temperature heating (under 570°F). For both electric and non-electric energy sources, basic facility operations account for about 15% of total energy use. Table ES-4 shows this information by tier.

Table ES-3. Manufacturing energy consumption by high-level use

Fuel	Basic Facility Operations	Boilers or Generators	Manufacturing or Industrial Production Process	Don't Know/Unknown	Total
Electricity	15.6%	4.4%	74.8%	5.2%	100.0%
Non-Electric Fuels	17.6%	47.9%	29.6%	4.8%	100.0%

⁸ Includes natural gas, propane, fuel oil, kerosene, distillate, diesel, motor gasoline, hydrogen, purchased hot water, or steam.

Table ES-4. Manufacturing energy consumption by tier

Fuel	Tier	Basic Facility Operations	Boilers or Generators	Manufacturing or Industrial Production Process	Don't Know/Unknown	Total
Electricity	1	14.1%	4.8%	79.3%	1.8%	100.0%
	2	15.3%	5.9%	64.1%	14.7%	100.0%
	3	20.3%	3.0%	63.4%	13.3%	100.0%
	Total	15.6%	4.4%	74.8%	5.2%	100.0%
Non-Electric Fuels	1	12.2%	54.3%	30.8%	~2.7%	100.0%
	2	22.7%	32.3%	19.4%	25.6%	100.0%
	3	40.7%	23.0%	26.9%	9.5%	100.0%
	Total	17.6%	47.9%	29.6%	4.8%	100.0%

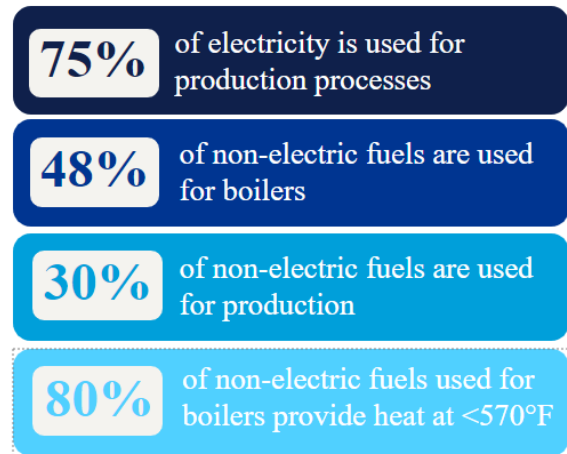
Note: '~' indicates that one response made up 50% or more of a single result, or that the RSE was between 50% and 100%.

Manufacturing sector energy and climate practices and policies

Fewer than 9% of facilities report they have completed energy consumption baselines; and 16% are currently completing one or plan to within the next three years.

Twenty-three percent (23%) of facilities have completed process upgrades within the last three years, and 16% are currently completing them or plan to which the next three years.

Around 42% of facilities have used state and/or utility incentives to finance process upgrades and another 48% would consider using them.



Greenhouse characteristics

Table ES-5 shows key greenhouse characteristics. After screening, there are fewer greenhouses than originally estimated in Phase One. The screening restricted the study to structures with fixed walls and cultivation under glass, which excluded facilities that had only hoop houses (arched ground covers constructed of hoop-shaped tubular ribs covered with a plastic film).

Table ES-5. Greenhouse characteristics

Number of Facilities	Total Employees	Annual Energy Consumption (MMBtu)	Annual Energy Expenditures (\$1,000s)	Annual Emissions from Energy Use (MTCO _{2e})
344	6,427	3,740,279	57,751	338,520

Greenhouse sector end uses

Table ES-6 shows manufacturing electric and non-electric energy consumption by high-level use. The table shows that 56% of electricity is used for greenhouse lighting and another 19% for other greenhouse processes (e.g., packaging). In terms of non-electric fuels, 61% are used for boilers or generators and another 26% for other greenhouse processes (e.g., drying and curing).

Table ES-6. Manufacturing energy consumption by high-level use

Fuel	Basic Facility Operations	Boilers or Generators	Greenhouse Lighting	Other Process	Other	Don't Know/ Unknown	Total
Electricity	~6.5%	~6.2%	~56.3%	~19.1%	~1.7%	~10.2%	100.0%
Non-Electric Fuels	2.3%	61.3%	0.0%	25.8%	5.3%	~5.3%	100.0%

Fewer than 5% of greenhouse facilities report they have a written energy policy and zero reported having a climate action plan.

Around 15% of facilities have completed process upgrades within the last three years, and 7% are currently completing them or plan to within the next three years.

Around 32% of facilities have used state and/or utility incentives to finance process upgrades, and 58% were aware of them and would consider using them.

Key observations and opportunities

The NY Statewide Industrial Facilities Stock Study suggests opportunities within manufacturing facilities for GHG emission reductions through efficiency, electrification, and other interventions. The diverse nature of the subsectors examined, and the unique characteristics observed in them, allow tailored offerings to achieve GHG emission reductions across this important customer base. Some key observations that could be used for targeting specific subsectors, or for GHG gas emissions reductions across the subsectors, include:

- The top two manufacturing subsectors in terms of overall energy consumption and emissions in New York are paper and chemicals, together accounting for close to 40% of the manufacturing sector consumption and emissions. Primary metals, food, fabricated metal products, and transportation equipment each account for about 10% of consumption and of emissions. Thus, these six industries together account for the majority of industrial energy use and emissions. Effective decarbonization strategies targeted to these industries could have high impact for New York State’s clean energy initiatives.

- Several key subsectors were observed to have large portions of non-electric boiler and non-boiler fossil fuel use dedicated to low and medium temperature heating (under 570°F). These low- and medium-temperature heating processes are potential candidates for electrification.
- Energy management practices, including tracking energy consumption or energy performance, maintaining a written energy policy, mapping key consumption drivers, and completing a greenhouse gas inventory, all had relatively low incidence across the industrial subsectors (ranging from under 2% to under 40% across practices and subsectors). This finding suggests opportunities within the state for continued shaping of energy management practices, policies, and awareness of energy use within facilities.

Overall, it is clear that selective and systematic interventions with manufacturing facilities can create meaningful GHG reductions that will benefit both industrial customers and New York State residents.

1 Phase Two goals and description

The goal of the New York Statewide Industrial Facilities Stock Study is to provide a deep, data-driven understanding of New York State (NYS)'s manufacturing (North American Industry Classification System [NAICS] 31-33) and greenhouse sectors by providing information regarding industrial facility size, employment, energy use characteristics, and energy efficiency, electrification, and carbon reduction improvements already undertaken. This study helps identify industries, manufacturing facilities, and end uses that offer opportunities for greenhouse gas reductions, energy efficiency, beneficial electrification, and renewable energy for achieving the New York State Climate Leadership and Community Protection Act (CLCPA) 2050 goals.⁹ Data are reported for subsectors defined by three-digit NAICS code for the manufacturing sector, and for a greenhouse subsector defined as those facilities in NAICS code 1114 that are not nursery or floriculture.

1.1 Study phases

There are two key phases to this study:

A Phase One report¹⁰ that was completed and published on January 17, 2023. That document established an initial industrial and greenhouse characterization by synthesizing existing secondary data and research on NYS industries by subsector in terms of multiple dimensions related to energy use, employment, practices, and equipment. This information was used to identify the priority (key) industries that were the focus of this Phase Two report and is a central part of a preliminary industrial potential study shared with the New York State Department of Public Service (DPS).

A Phase Two report (this document) that builds off Phase One with primary data research focused on key industrial subsectors. This work involved collaboration between DNV and its subcontractors, Apprise and Antares. Apprise is a company that provides research and solutions for industrial facility outreach, while Antares is a consulting firm that focuses on clean energy with a focus on industrial facilities. The Phase Two research include web surveys, physical site visits, and virtual site visits. The Phase One study identified key industrial subsectors for Phase

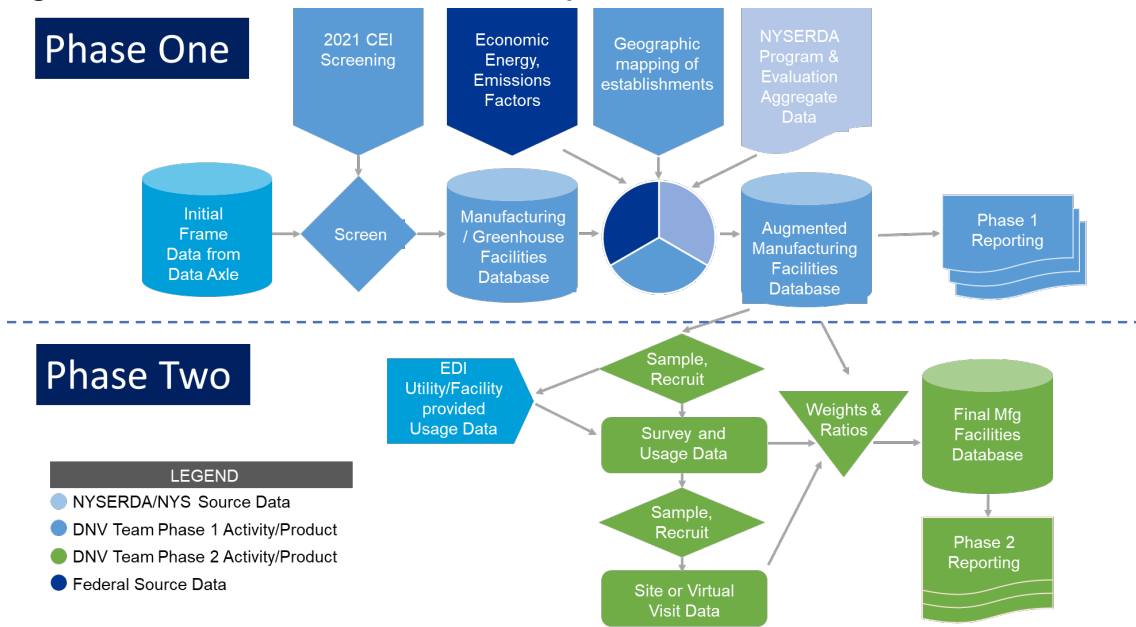
⁹ 85% reduction in greenhouse gas emissions from 1990 levels by 2050, 70% of electricity generation from renewable sources by 2030 and 100% zero-carbon electricity by 2040

¹⁰ DNV, *Industrial Facilities Stock Study: Phase One Final Report*, prepared for NYSERDA, January 2023. <https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/Matter-No-1602180NYSERDAIndustrial-Facilities-Stock-Study-Phase-One-Report-March-2023.pdf>

Two work based on their clean energy potential, energy intensity, energy-using equipment, and other characteristics (see Section 2.1) This second phase further refines the characterizations made in Phase One and provides additional dimensions including energy end use breakdowns, presence of waste capture and recycling processes, planned system improvements, and high-level equipment inventories.

Figure 1-1 shows the respective data sources and research approaches used in Phase One (above the dashed line) and Phase Two (below the dashed line).

Figure 1-1. Industrial stock characterization process overview



1.2 Study objectives

NYS’s industrial sector is a critical part of the state’s economy and a key component in achieving the state’s ambitious clean energy and climate goals. This industrial stock characterization study can facilitate the NYS industrial sector’s contribution to CLCPA goals by providing NYSERDA, the New York utilities, and other stakeholders with a rich data set to:

- Inform future clean energy and GHG reduction potential studies
- Provide an understanding for incentive programs and baseline for longitudinal market trending
- Support program benchmarking, design, implementation, and evaluation
- Help service providers and industrial customers take actions that advance NYS clean energy goals.

This study focuses on manufacturing facilities only.

2 Study methods

This section of the report summarizes the methods used to gather and analyze data to produce study results and findings. It begins with a summary of how key subsectors were selected as part of Phase One.

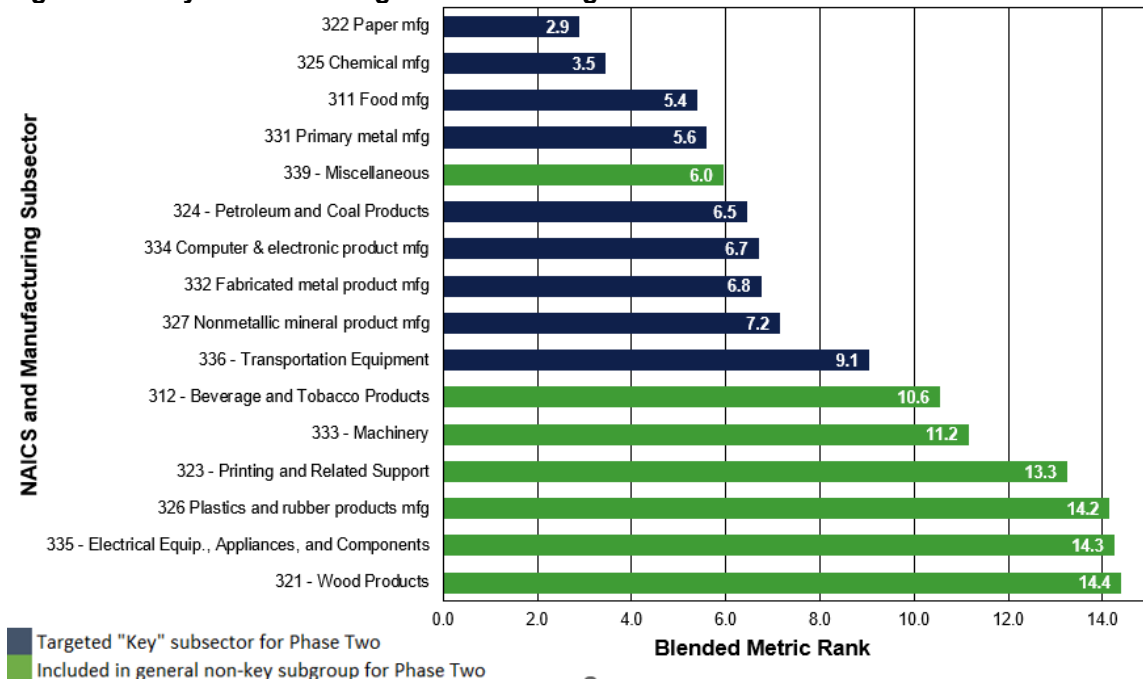
2.1 Summary of Phase One key subsector selection

The Phase One analysis provided a series of estimated characteristics for all manufacturing subsectors at the three-digit NAICs level. As key characteristics (bulleted below) were produced, a subsector rank of where that subsector fell among all subsectors accompanied the results. Ranks began at 1 for the highest value of a given result, 2 for next highest, etc. (e.g., the subsector with the highest estimated employment had a rank of 1, and the subsector with the highest estimated GHG emissions had a rank of 1). Weights were selected for each characteristic to balance various considerations in the identification of manufacturing subsectors with clean energy potential. The five major characteristics selected and the weights applied to identify the subsectors that would be considered “key” for targeting in Phase Two are bulleted below.

- Emissions (weight of 0.25) is the primary target of CLCPA, important both for overall statewide climate change abatement and for environmental justice considerations.
- Value of Shipments (weight of 0.25) is another key indicator of economic value to the state.
- Energy Expenditures (weight of 0.25) is an indicator of business costs in the state related to energy.
- Consumption (weight of 0.15) is the primary target of EE efforts.
- Employment (weight of 0.1) is a key metric of industry economic value to the state.

Figure 2-1 shows the final prioritization of key subsectors for Phase Two.

Figure 2-1. Key manufacturing subsectors targeted in Phase Two



2.2 Data sources

Table 2-1 shows sources of data used in Phase Two of the study. There are two types of secondary sources of information used in this study. The first is the preliminary population (sample frame) based on Phase One data sources and screening (first two rows). The second are assumptions in the energy expenditure and greenhouse gas emissions calculations (remaining rows). Details on energy prices and CO_{2e} assumptions are provided in Appendix F.

Table 2-1. Information sources used in Phase Two

Source	Description	How used
Phase One Population dataset	Listing and size metrics of companies with industrial NAICS codes of interest following preliminary screening based upon CEI and other NYSERDA data sources.	Provided the foundation for identifying the key manufacturing subsectors and used as preliminary population for primary data collection via web and onsite/virtual visits.
Greenhouse and Nursery state license list ^a	A listing of all certified nursery growers and greenhouses which are licensed by the NYS Department of Agriculture and Markets.	Provided the preliminary population for identifying greenhouses for primary data collection via web and virtual visits.
U.S. Energy Information Administration, 2023. ^b State Energy Data System (SEDS) 1960-2021 (Complete)	State level industrial fuel prices for New York.	Assumptions used to calculate energy expenditures.
MECs Table 7.3 Prices of Purchased Electricity, Natural Gas, and Steam, 2018	Regional industrial fuel price for hot water or steam.	Assumptions used to calculate energy expenditures.
AAA gas and diesel prices ^c	State level gas and diesel fuel prices for New York.	Assumptions used to calculate energy expenditures.
MECs Table 7.2 Average Prices of Purchased Energy Sources, 2018 ^d	Regional industrial fuel price for Hydrogen.	Assumptions used to calculate energy expenditures.
NYSERDA Greenhouse Gas emissions studies ^e	Electric and non-electric fuel emissions factor assumptions.	Assumptions used to calculate CO ₂ e emissions

a <https://data.ny.gov/Economic-Development/Nursery-Growers-and-Greenhouse/qke7-n4w8>

b <https://www.eia.gov/state/seds/seds-data-complete.php?sid=NY>

c <https://gasprices.aaa.com/?state=NY>. September 19, 2023

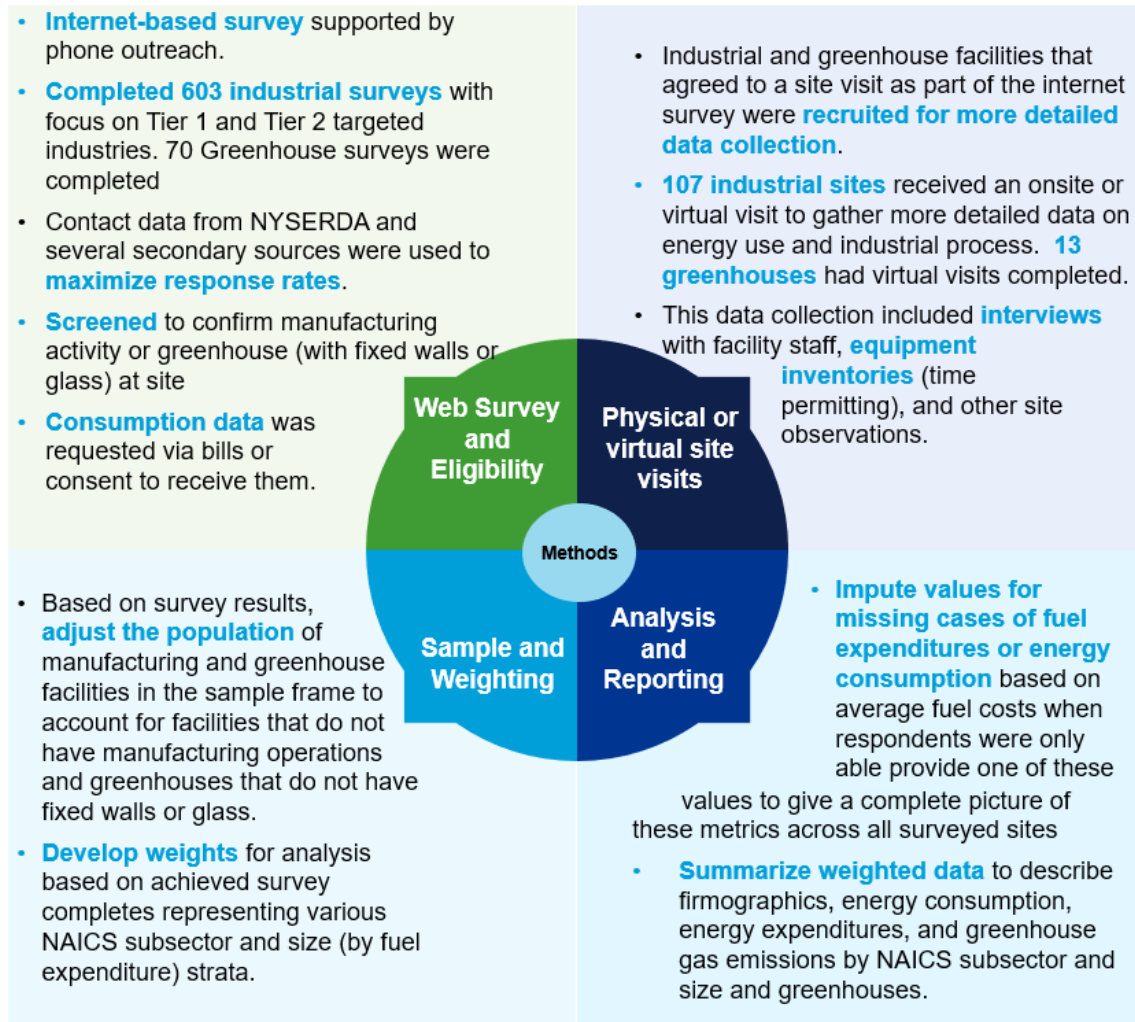
d <https://www.eia.gov/consumption/manufacturing/data/2018/>

e <https://www.nyserda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Greenhouse-Gas-Emissions#other>

2.3 Study methods

Figure 2-2 shows the key methods used in Phase Two. These methods include web surveys, sampling and weighting, onsite surveys, and analysis and reporting. Appendix C has a detailed discussion of population development, screening, sampling, and weighting. 0 has a detailed discussion of analysis methods, including imputation and variance estimation. Appendix E discusses the web survey and physical and virtual visit procedures.

Figure 2-2. Methods overview



* NYSERDA uses tiers as part of an industrial facility classification system. Tier 1 is defined as having greater than \$1 million in annual energy expenditures, Tier 2 is \$500k to \$1 million in annual energy expenditures, and Tier 3 is less than \$500k in annual energy expenditures.

2.3.1 Final web/phone survey sample

The final manufacturing web survey is in 0 and the final greenhouse survey is in Appendix H.

The following items guided the web survey sample design.

- The study team attempted to reach all Tier 1 and Tier 2 sites, with the goal of a 40%–50% response rate among manufacturing sites.
- The study team set targets for Tier 3 to achieve better than $\pm 20\%$ relative precision at the 90% confidence interval for Tier 3 metrics where the point estimate is greater than or equal to 1 and $\pm 10\%$ relative precision at the 90% confidence interval for the overall NAICS subsector where the point estimate is greater than or equal to 1 where possible.

Industrial web surveys were requested by phone and mail outreach and optimized through advance research on sampled facilities, custom procedures for particularly large facilities, and

working with gate keepers to screen for knowledgeable respondents. The final web survey completions and targets are presented in Table 2-2. More than 600 web surveys were completed. Response rates were 48% for Tier 1 40% for Tier 2, and 20% for Tier 3.

Table 2-2. Final industrial web survey targets and completions

Subsector	Tier 1		Tier 2		Tier 3		Total	
	Target	Complete	Target	Complete	Target	Complete	Target	Complete
311 Food Manufacturing	9	9	8	3	46	29	63	41
322 Paper Manufacturing	28	24	13	12	8	6	49	42
324 Petroleum and Coal Products	9	8	2	1	1	0	12	9
325 Chemical Manufacturing	10	8	12	8	27	20	49	36
327 Nonmetallic Minerals	13	10	6	4	30	25	49	39
331 Primary Metal Manufacturing	13	17	8	6	9	11	30	34
332 Fabricated Metals	5	5	7	7	55	54	67	66
334 Computer & Electronic Products	6	9	7	6	38	40	51	55
336 Transportation Equipment	5	7	6	8	12	13	23	28
Other (non-Key)	15	15	28	25	200	217	243	257
Total	113	112	97	80	426	415	636	607

Greenhouse web surveys were also requested by phone and mail outreach. Greenhouses were defined as structures with some fixed walls and cultivation under glass. Hoop structures were ineligible. The final web survey completions and targets are presented in Table 2-3. Seventy-one (71) web surveys were completed.

Table 2-3. Final greenhouse targets and web survey completions

Sector	Tier 1		Tier 2		Tier 3		Total	
	Target	Complete	Target	Complete	Target	Complete	Target	Complete
Greenhouses	0	0	0	0	68	70	68	71

2.3.2 Final onsite sample

Every respondent (i.e., facility) that completed a phone/web survey was also asked if they would be willing to have the engineering team visit their site or have a virtual visit. These onsite visits were optimized through use of the web survey responses, custom procedures for securing non-disclosure agreements (NDAs) with some facilities and working with facility staff to collect the priority information. The original list of target information was organized into levels of priority to

ensure that engineers came away with, at a minimum, certain pieces of key information, such as energy consumption information for all fuels, an understanding of the process and products and an end use breakdown for the energy consumption.

As part of the recruitment, potential respondents were offered an incentive of \$200. Initially, this incentive was offered in the form of a donation to one or more of a selection of charities, and later modified to include a choice of a donation or a direct monetary gift card to the facility. Most respondents selected the direct gift card after the change in offer. For more information on the site visit and recruitment process see Appendix E.

In total, almost 18% of the facilities that completed the phone/web survey allowed us to visit their sites and more than 100 site visits were completed, 34 of which consisted of virtual site visits. The final site visit completions and targets are presented in Table 2-4.

Table 2-4. Final industrial onsite survey targets and completions

Subsector	Tier 1		Tier 2		Tier 3		Total	
	Target	Complete	Target	Complete	Target	Complete	Target	Complete
311 Food Manufacturing	2	2	1	1	2	1	5	4
322 Paper Manufacturing	9	9	3	1	1	1	13	11
324 Petroleum and Coal Products	6	4	0	0	0	0	6	4
325 Chemical Manufacturing	4	2	1	1	2	2	7	5
327 Nonmetallic Minerals	1	3	0	0	6	4	7	7
331 Primary Metal Manufacturing	4	5	2	2	3	3	9	10
332 Fabricated Metals	1	1	0	0	3	5	4	6
334 Computer & Electronic Products	1	2	1	1	8	9	10	12
336 Transportation Equipment	3	2	1	1	0	0	4	3
Other (non-Key)	2	3	4	5	29	30	35	38
Total	33	33	13	12	54	55	100	100

In addition to the site visits completed for industrial manufacturing facilities, 12 greenhouse facilities were completed across the state. All greenhouse facilities visits were completed virtually, and the same methods and data collection techniques were used as with manufacturing facilities, targeting the energy consuming equipment within the greenhouses.

3 Results

This part of the report presents firmographic, expenditure, consumption, and energy management results at the NAICS subsector level. Figures in this section are accompanied by links (i.e., the language “for data and tier-level results, see Table X-N”) under each figure that jumps to a table with the data and a table with precisions in an appendix. All the results are for total NYS manufacturing and greenhouse populations. As detailed in Appendix C and O, all survey and onsite results have been weighted based on the final Tier and NAICS population estimates to best represent the final screened population estimates and mix of size and type of facilities in the final sample.

It is important to note that results in a cell in the body of this report were suppressed or should be used with caution according to the following conditions. The RSE threshold if 100% for result suppression differs from that used by MECs, which suppresses results with RSE of above 50%. The sample size in this study is lower than MECs and has an accompanying wider variability than MECs. In consultation with NYSERDA it was decided that it was valuable to making more estimates available, even those with greater uncertainty, provided there was a way of showing the higher uncertainty level.

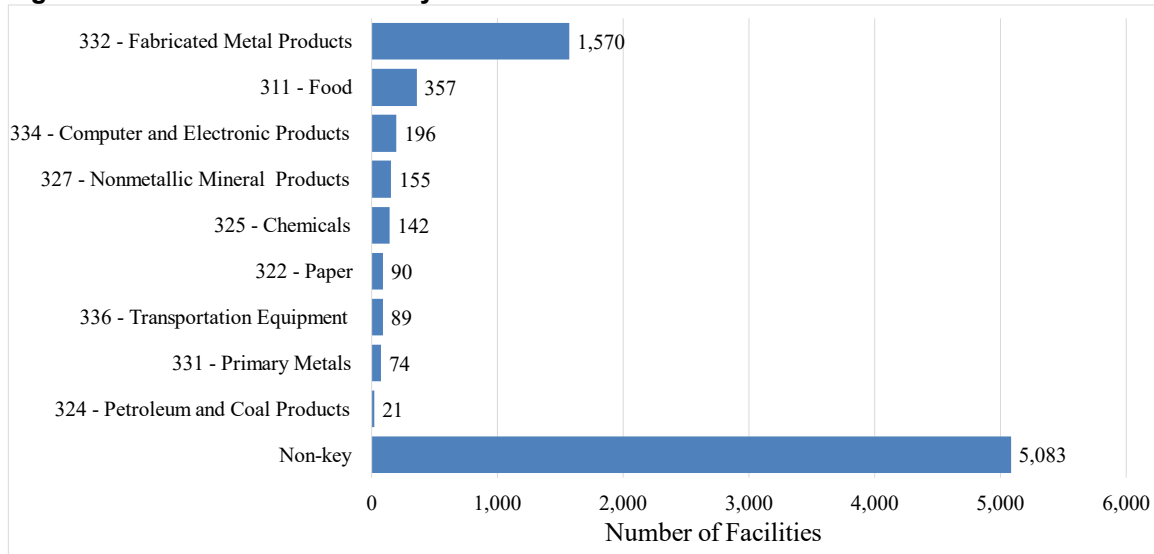
- ‘a’ indicates that there are too few responses in a single cell (<5), relative standard error (RSE) is greater than 100% (highly variable), or that complementary masking is performed when a row or column in a sum table would allow the masked value to be determined based on the total.
- ‘~’ indicates that one response made up 50% or more of a single result, or that the RSE was between 50% and 100%.

Detailed tables in Appendix A, which are accessible through the links under each table, provide more detailed notations about why a given result was masked.

3.1 Industrial firmographics

Figure 3-1 shows the number of industrial facilities by NAICS subsector identified in Phase Two. There are 7,777 industrial manufacturing facilities in New York State. Fabricated metals have the most facilities among the key subsectors followed by food and computer and electronic products. More than 65% (5,082) of facilities are in non-key subsectors. Most facilities identified as petroleum and coal and food by NAICS 3 were found to not have manufacturing activity during the Phase Two recruitment effort. As a result, the facility counts and related totals for this subsector throughout the results are much lower than indicated by NAICS data and in Phase One.

Figure 3-1. Number of facilities by subsector

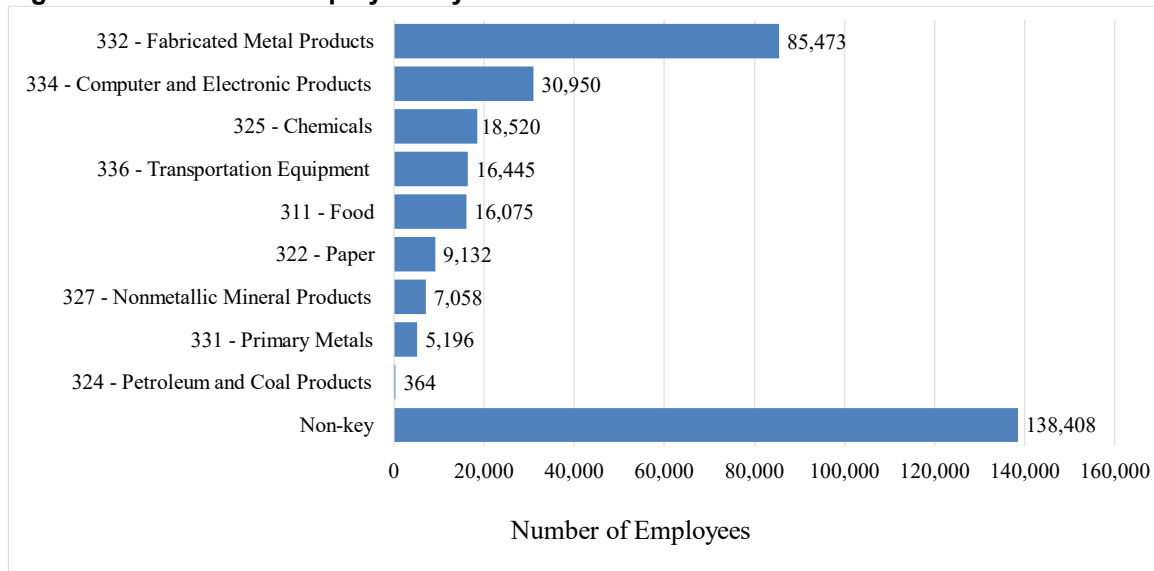


For data and tier-level results, see Table A-1.

Figure 3-2 shows the number of employees by subsector. Employees are a key metric of industry economic value to the state. The number of employees can also drive transportation and related office consumption and emissions. An estimated 327,622 employees work in facilities with manufacturing activity. Fabricated metals, computer and electronics, and chemicals have the most employees among the key subsectors.

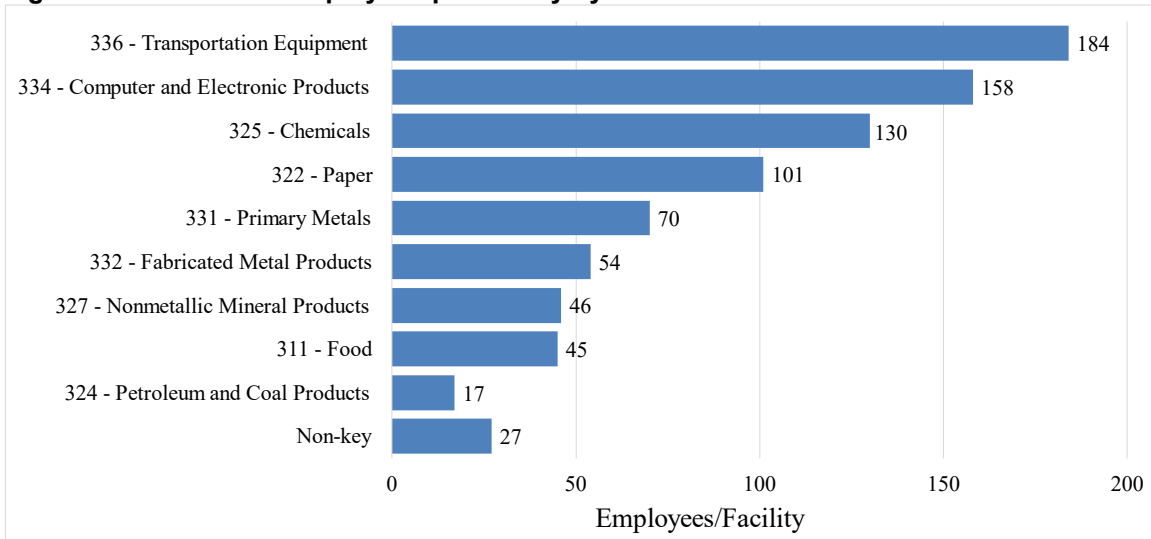
Figure 3-3 shows the number of employees per facility by subsector. Viewed in this way, the subsectors with the highest number of employees per facilities are transportation, computer and electronics, and chemical manufacturing.

Figure 3-2. Number of employees by subsector



For data and tier-level results, see Table A-3.

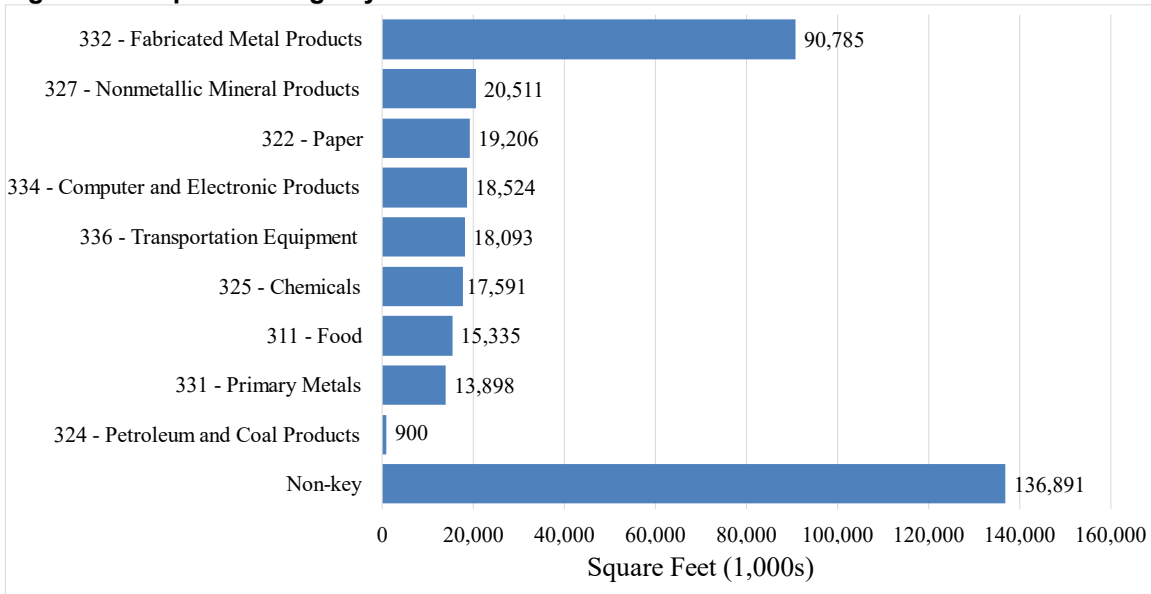
Figure 3-3. Number of employees per facility by subsector



For data and tier-level results, see Table A-5.

Figure 3-4 has estimates of total square feet by subsector. Square feet is one measure of a subsector’s size, but may be less meaningful than other size metrics, as some processes may not be fully enclosed, or are otherwise outside of a facility’s general footprint. Also, the energy intensity of activity within a given structural area can also be quite variable. New York State contains an estimated total of approximately 351,151 thousand square feet of manufacturing space, led by fabricated metals.

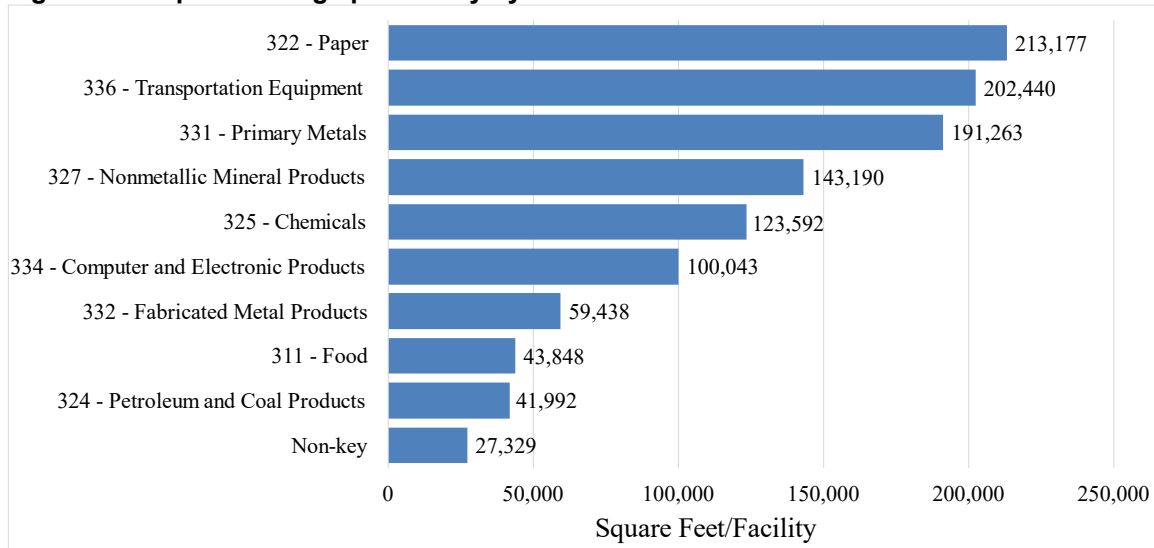
Figure 3-4. Square footage by subsector



For data and tier-level results, see Table A-7.

Figure 3-5 shows average square footage per facility by subsector. The sectors with the largest average facility sizes are paper, transportation equipment, and primary metals.

Figure 3-5. Square footage per facility by subsector

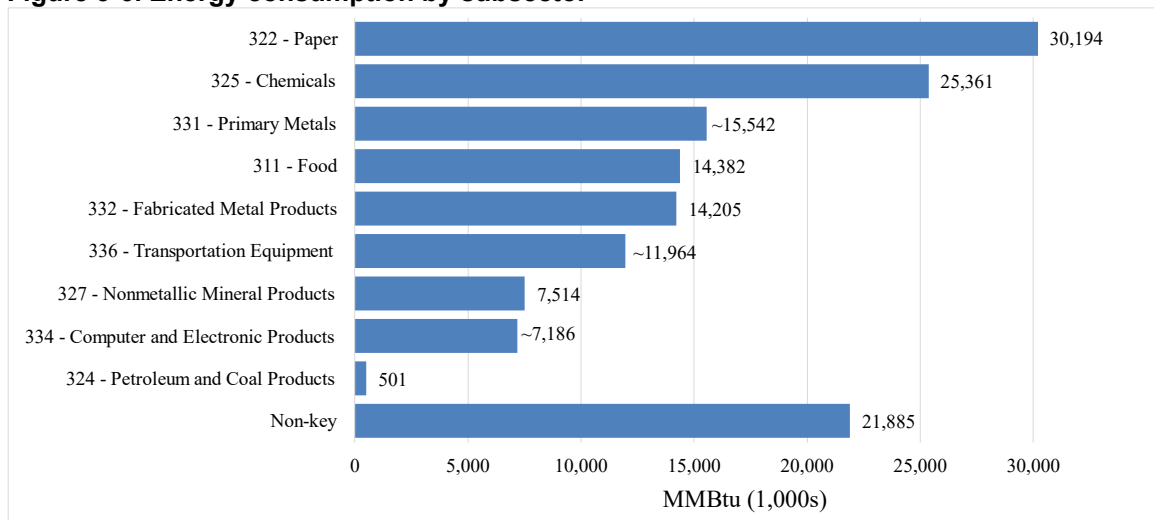


For data and tier-level results, see Table A-9.

3.1.1 Energy consumption by subsector

Figure 3-6 shows overall energy consumption by subsector. Subsectors with the highest levels of consumption can be expected to have high GHG emissions from onsite fuel use or indirectly from electricity supplied by the grid. Total energy consumption across all subsectors is 148,733 thousand MMBtu. The top three energy consuming subsectors are paper, chemicals, and primary metals among the key subsectors. All remaining industrial facilities in the non-key group represents 21,885 thousand MMBtu, or 15% of total consumption. Although non-key overall consumption is high, the following tables show this consumption normalized by facility and square feet as much lower because there are so many of them.

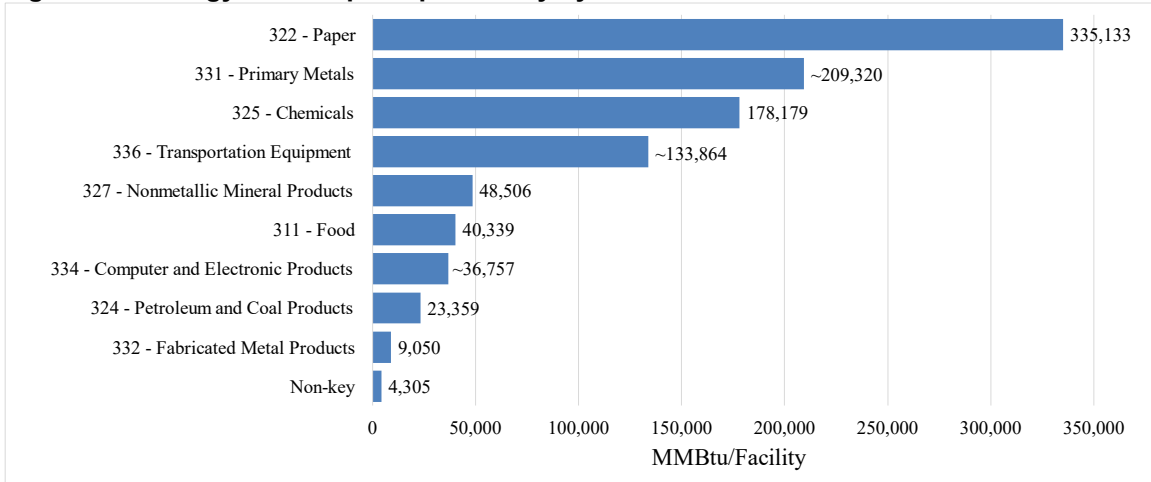
Figure 3-6. Energy consumption by subsector



For data and tier-level results, see Table A-11.

Figure 3-7 shows estimates of energy consumption per facility by subsector. Comparing consumption per facility can help identify which industries tend to have high consumption at an individual location to help target GHG emissions. Viewed in this way, paper, primary metals, and chemical subsectors are the most intensive per facility. As might be anticipated by the way this study targeted key subsectors based, in part, on energy consumption estimates in Phase One, the non key consumption per facility is much lower than most key subsectors, at 4,305 MMBtu per facility.

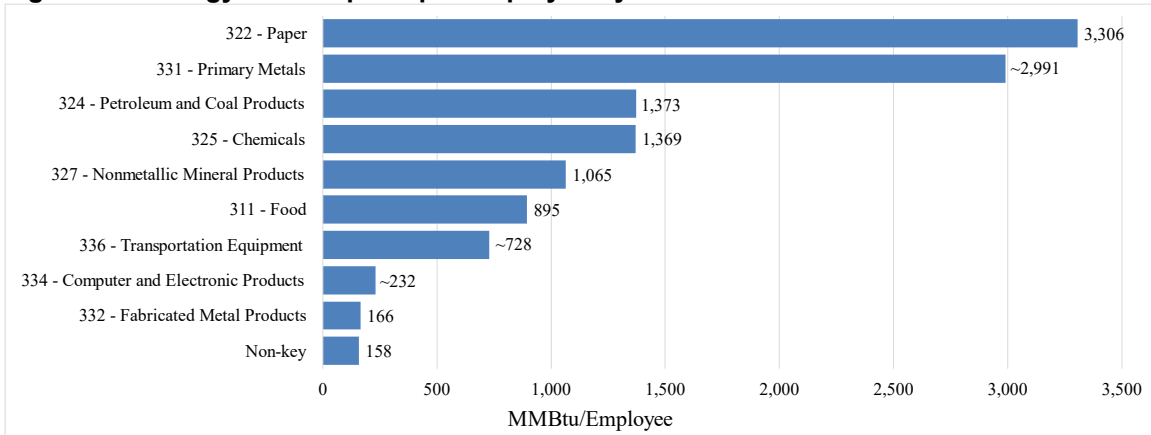
Figure 3-7. Energy consumption per facility by subsector



For data and tier-level results, see Table A-13.

Figure 3-8 shows energy consumption per employee by subsector. Examining energy consumption per employee can be a useful indicator of the environmental impacts (including GHG) of industrial activities. The paper, primary metals, petroleum and coal products, and chemicals subsectors have the highest rate of energy consumption per employee among the key subsectors targeted.

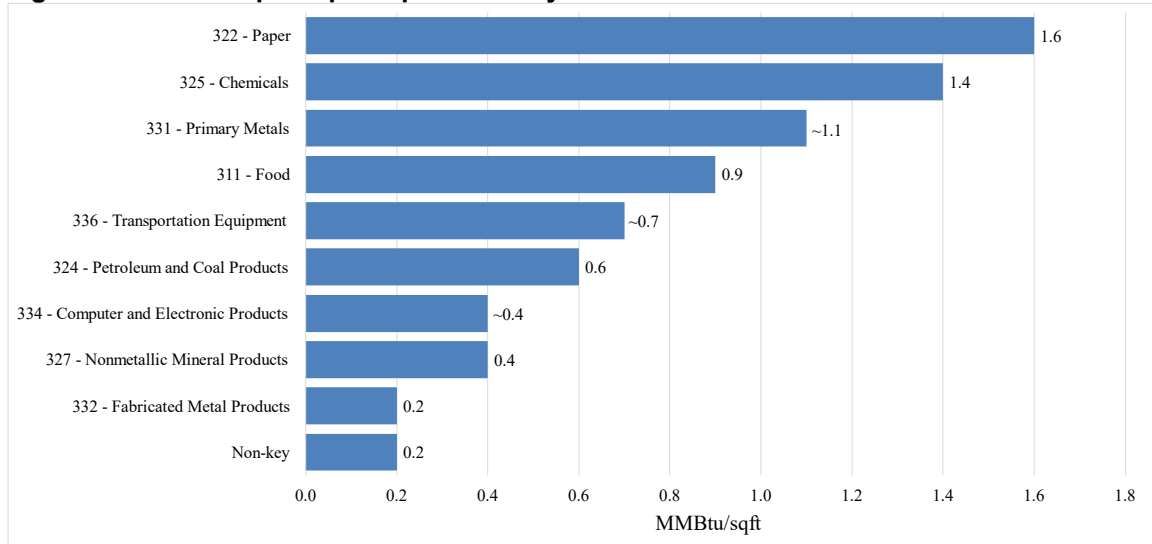
Figure 3-8. Energy consumption per employee by subsector



For data and tier-level results, see Table A-15.

Figure 3-9 shows consumption (MMBtu) per square foot by subsector. As noted earlier, square feet can be unreliable at manufacturing locations as some might not be in enclosed spaces. Though not ideal, MMBtu per square foot in industrial facilities another measure of energy intensity, which can be used to compare the energy efficiency of different facilities, or subsectors and identify potential areas for improvement. Paper, chemicals, and primary metals have the highest overall consumption per square foot.

Figure 3-9. Consumption per square foot by subsector



For data and tier-level results, see Table A-17.

3.1.1.1 Electric

This results section parses out electric results from the energy results presented above. These results are in net electric use¹¹ consistent with the definition used by the Manufacturing Energy Consumption Survey (MECS). Table 3-1 shows the various sources of electricity that a manufacturing facility might acquire electricity from, including utility purchased and onsite and offsite generation. It also shows the amount of electricity transferred out with resulting net electric use by sector in the second column from the right. Net energy includes electricity purchased from a utility, generated onsite by non-combustible means, or generated offsite by others minus that sold or transferred out. In this table, “don’t know” is assumed to be included in the net value.

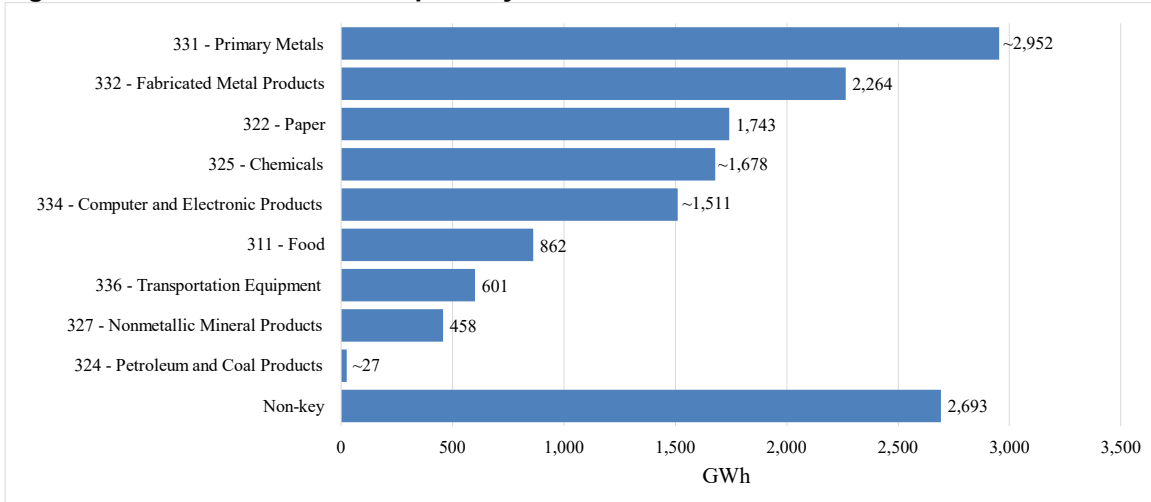
¹¹ Net electricity is obtained by summing purchases, transfers in, and generation from noncombustible renewable resources, minus quantities sold and transferred out. It does not include electricity inputs from onsite cogeneration or generation from combustible fuels because that energy has already been included as generating fuel (for example, coal).

Table 3-1. Total electric and net electric consumption by subsector

Industry Subsector	Total net electricity reported (MWh)	Electricity purchased from a utility (MWh)	Total electricity generated onsite (MWh)	Electricity generated onsite by noncombustible means (MWh)	Electricity generated offsite by own enterprise (MWh)	Electricity generated offsite by others (MWh)	Electricity transferred out - not used onsite (MWh)	Don't Know	Net electricity use (MWh)	Purchased electricity (MWh)
331 - Primary Metals	~2,952,456	~2,769,709	~153	~153	0	~155,004	0	~27,590	~2,952,456	2,952,303
332 - Fabricated Metal Products	2,264,441	1,308,383	~2,333	~2,333	~19,983	~32,151	0	~901,591	2,264,441	2,242,125
322 - Paper	2,098,274	1,675,196	~390,263	~37,239	0	~21,711	~2,362	~8,743	1,742,888	1,708,011
325 - Chemicals	~1,679,546	~1,639,865	~1,152	~32	0	~37,825	~25	~678	~1,678,401	1,678,394
334 - Computer and Electronic Products	~1,519,106	~1,474,164	~12,632	~12,632	~556	~8,106	~8,093	~15,555	~1,511,012	1,505,918
311 - Food	864,528	793,730	~2,368	~32	0	~55,115	0	~13,314	862,192	862,159
336 - Transportation Equipment	601,475	443,758	~4,191	~4,191	0	153,526	0	0	601,475	597,284
327 - Nonmetallic Mineral Products	536,367	~395,349	~74,962	~1,780	0	~36,613	~5,591	~23,852	457,593	461,405
324 - Petroleum and Coal Products	~26,527	~24,275	0	0	0	0	0	~2,251	~26,527	26,527
Non-Key	2,703,044	2,310,009	~42,396	~34,909	0	~292,647	2,552	~55,441	2,693,006	2,660,648
Total	15,245,764	12,834,438	530,451	93,302	~20,539	792,697	18,623	~1,049,015	14,789,991	14,694,774

Figure 3-10 shows net electric consumption by subsector. Primary metals, fabricated metals, and paper have the highest net electric consumption among the key subsectors. As noted in the overall energy results, non-key net electric consumption is high; however, in subsequent tables showing this, consumption by facility and square feet are much lower because there are so many of them.

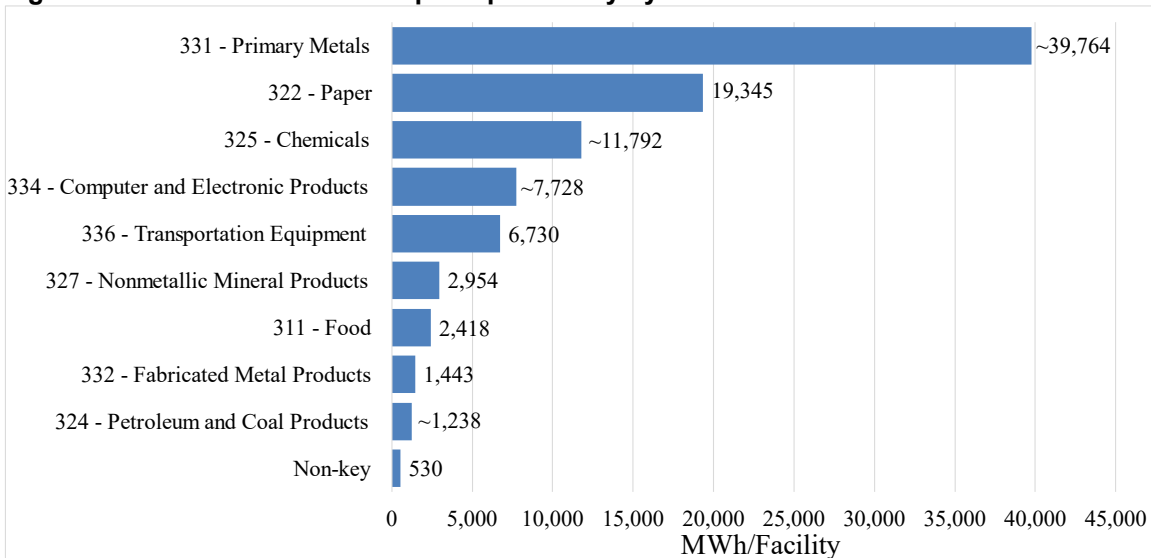
Figure 3-10. Net electric consumption by subsector



For data and tier-level results, see Table A-19.

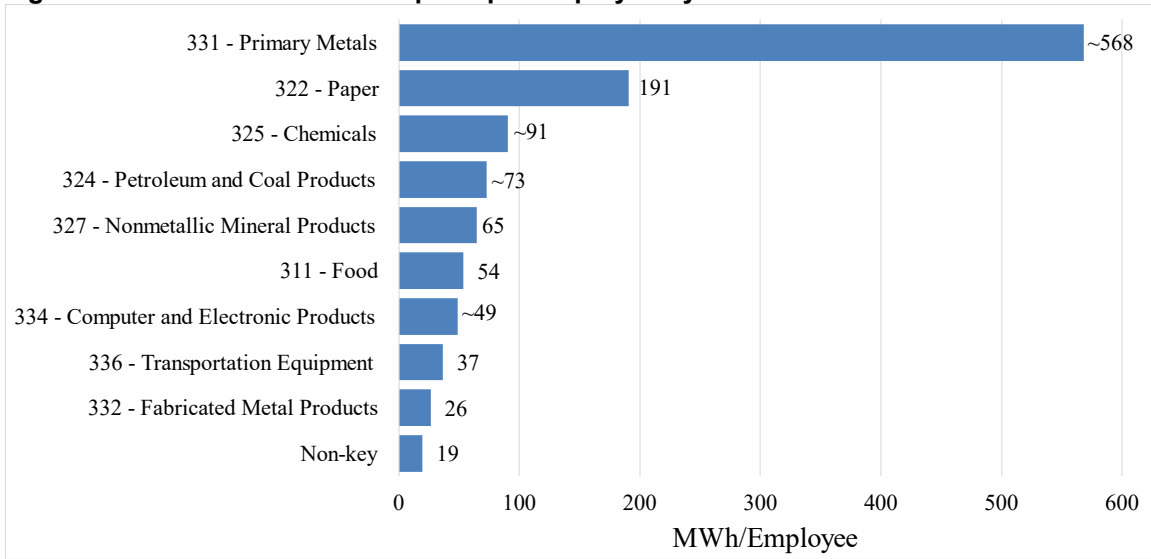
Figure 3-11 presents net electric consumption per facility, Figure 3-12 shows net electric consumption per employee, and Figure 3-13 shows net electric consumption per square foot. All these results are at the subsector level. The primary metals and paper subsectors have the highest consumption per facility and employee, with primary metals and chemicals having the highest electric consumption per square foot.

Figure 3-11. Net electric consumption per facility by subsector



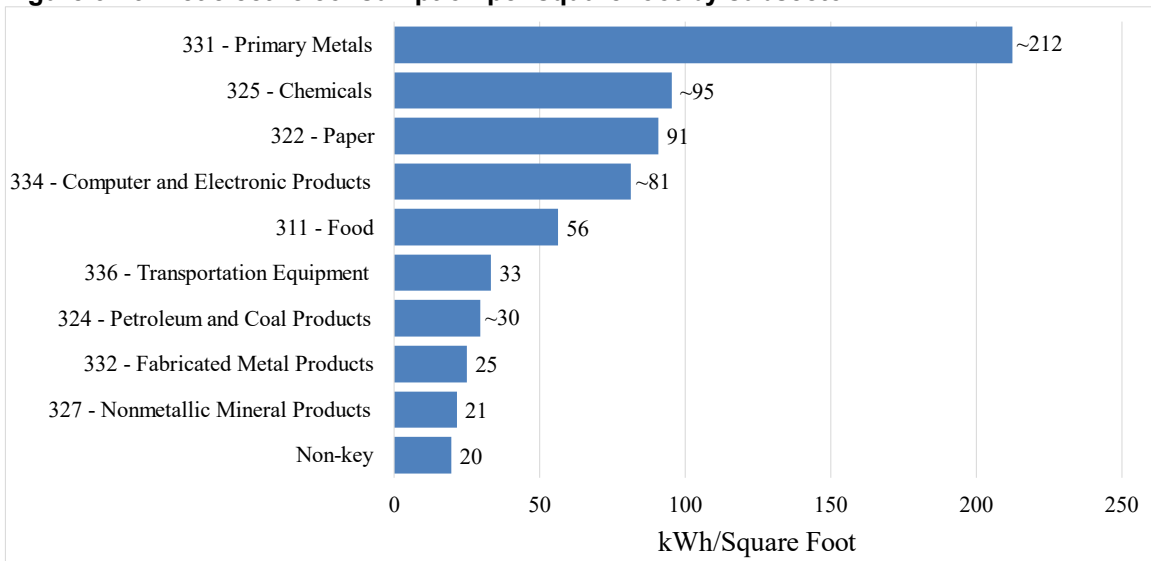
For data and tier-level results, see Table A-21.

Figure 3-12. Net electric consumption per employee by subsector



For data and tier-level results, see Table A-23.

Figure 3-13. Net electric consumption per square foot by subsector

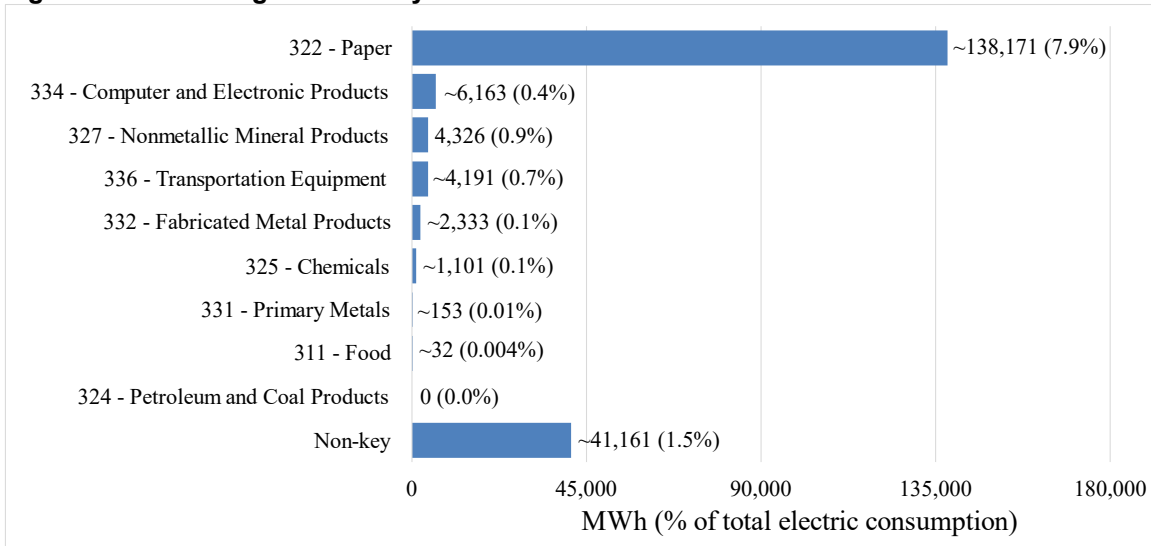


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For data and tier-level results, see Table A-25.

Figure 3-14 shows the amount of reported onsite generation by subsector and the proportion of each subsector’s total electricity consumption that is generated onsite. All but petroleum has some onsite generation, with paper, computers and electronics, and non-metallic minerals producing the most.

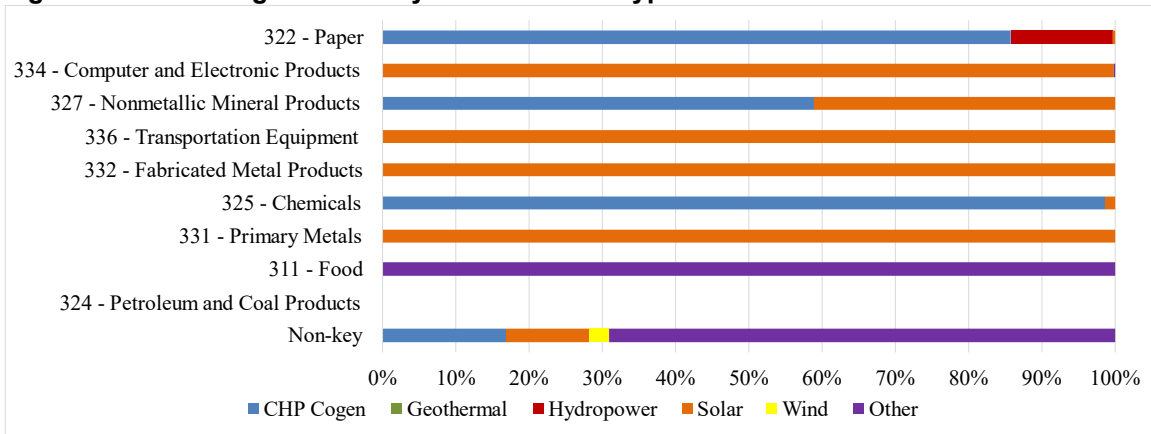
Figure 3-14. Onsite generation by subsector



For data and tier-level results, see Table A-27.

Figure 3-15 shows the breakdown of onsite generation by subsector and type. Combined heat and power (CHP) produce about 65% of all the onsite electric generation and represents the highest amount of electric generation across all onsite sources. CHP is most common in the paper, non-metallic mineral, and chemical sub-sectors.

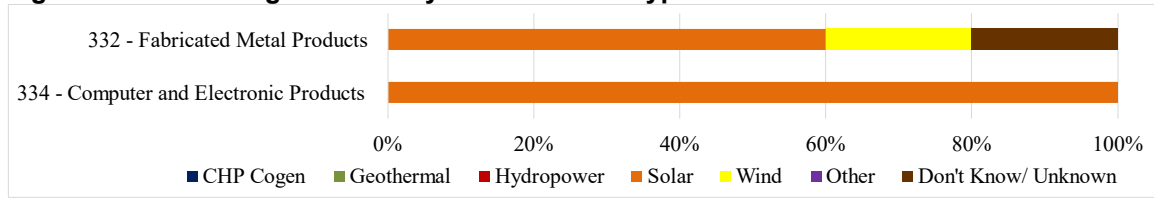
Figure 3-15. Onsite generation by subsector and type



For data and tier-level results, see Table A-27.

Fabricated metals had an estimated 20,000 MWh of offsite generated electricity, while computer and electronics had an estimated 560 MWh. Solar represents 61%, or 12,545 MWh, of off-site generation. Figure 3-16 shows the type of off-site generation reported for each subsector.

Figure 3-16. Off-site generation by subsector and type

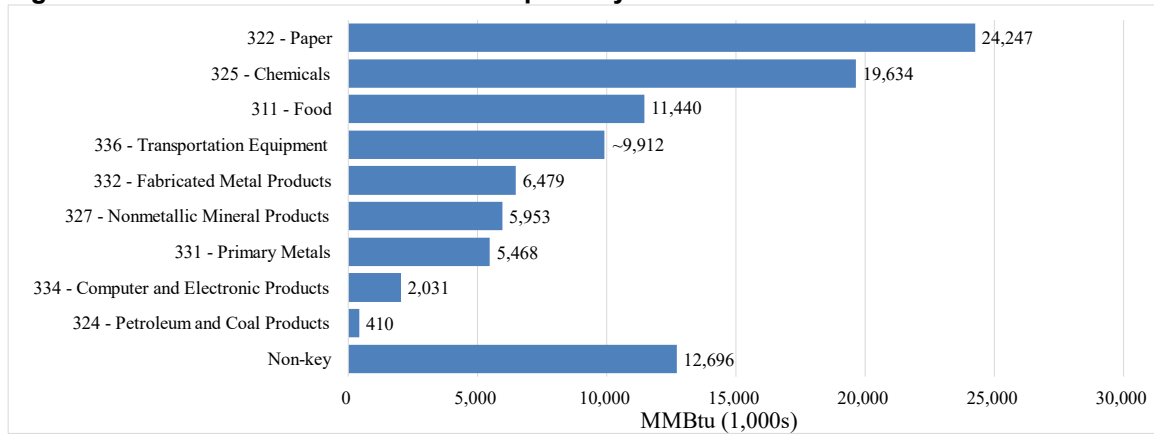


For data and tier-level results, see Table A-29.

3.1.1.2 Non-electric

This section reports non-electric energy consumption by subsector, fuel type, and per facility, square foot, and employee. Figure 3-17 shows non-electric consumption by subsector. Total non-electric consumption is 98,270 thousand MMBtus, with paper, chemicals, and food having the highest non-electric consumption among the key subsectors, representing roughly 56% of total non-electric consumption.

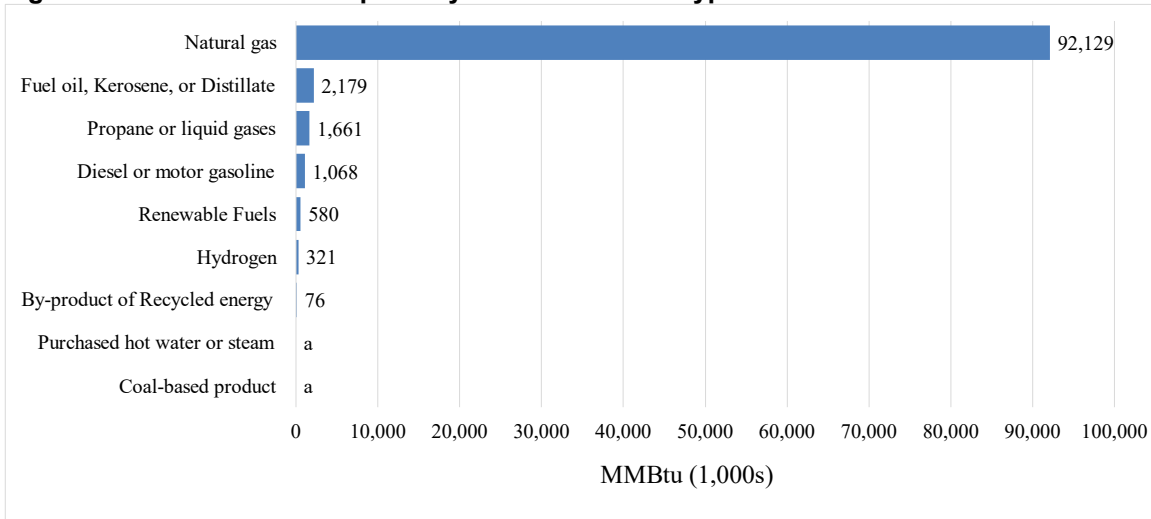
Figure 3-17. Non-electric MMBtu consumption by subsector



For data and tier-level results, see Table A-31.

Figure 3-18 shows a breakdown of the non-electric consumption by fuel type. Natural gas is by far the largest non-electric fuel consumed in New York State manufacturing, representing nearly 94% of the total fuels consumed by the industrial sector as a whole.

Figure 3-18. MMBtu consumption by non-electric fuel type

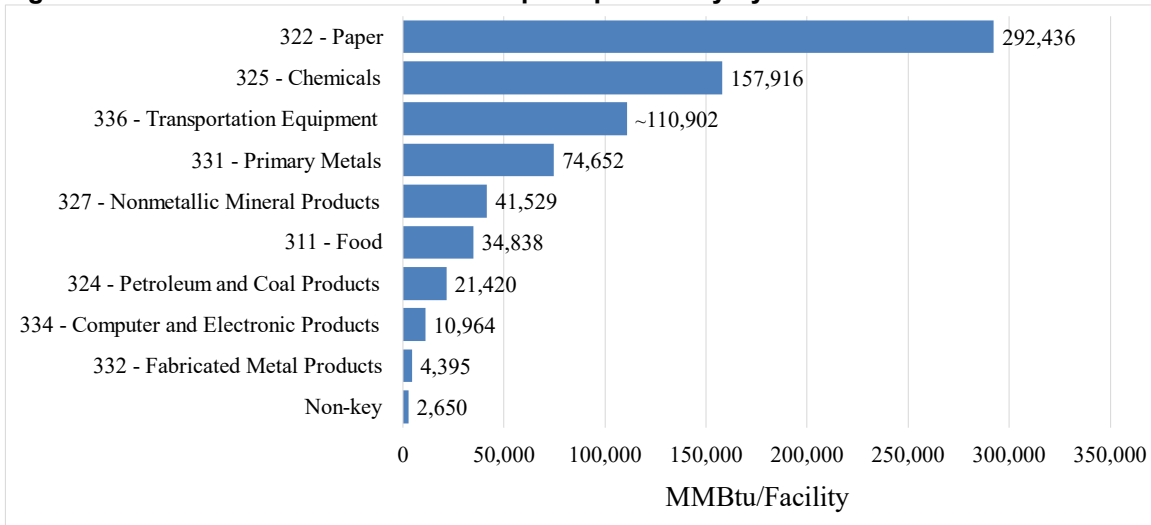


For data and tier-level results, see Table A-33.

Hydrogen is used by several manufacturing facilities throughout the state. The 321,000 MMBtu of hydrogen that is reported being used is a mix of gray, blue, and green. Green is the most prevalent, followed by gray.

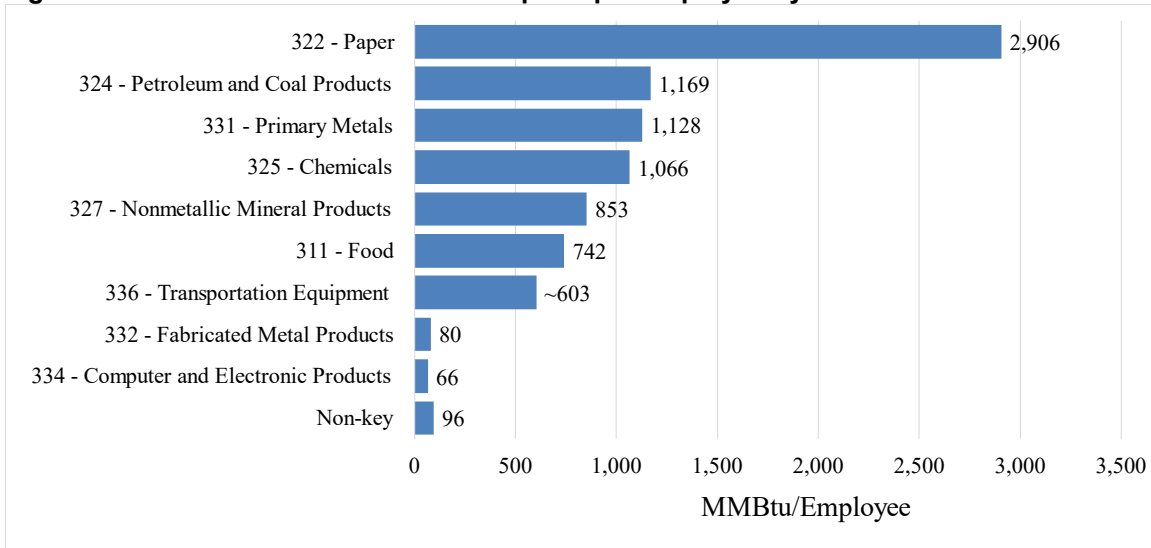
Figure 3-19 shows non-electric MMBtu fuel consumption per facility by subsector. Paper has the largest per-facility use at roughly 292,500 MMBtu, followed distantly by chemicals (roughly 157,900 per facility) and transportation (110,902 per facility). Figure 3-20 shows MMBtu consumption per employee by subsector with paper, petroleum and coal products, and primary metals having the highest consumption among the key subsegments.

Figure 3-19. Non-electric MMBtu consumption per facility by subsector



For data and tier-level results, see Table A-35.

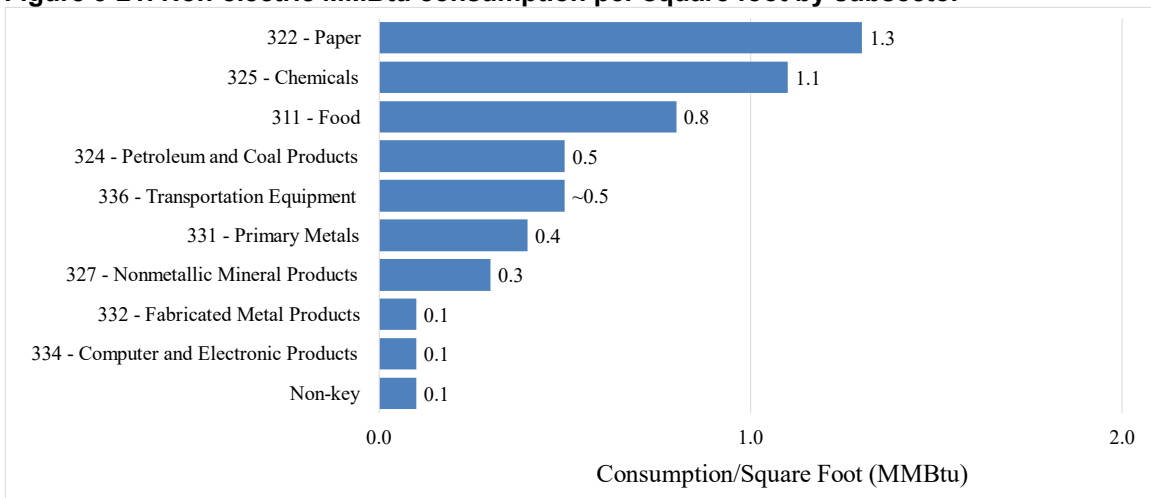
Figure 3-20. Non-electric MMBtu consumption per employee by subsector



For data and tier-level results, see Table A-37.

Figure 3-21 shows average MMBtu consumption per square foot by subsector, with, paper, chemicals, and food having the highest consumption for this metric.

Figure 3-21. Non-electric MMBtu consumption per square foot by subsector

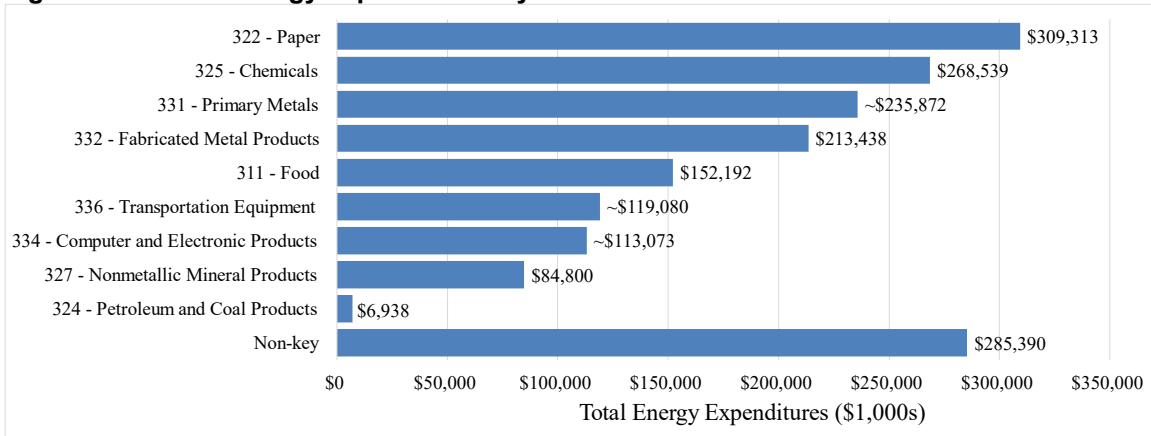


For data and tier-level results, see Table A-39.

3.1.2 Energy expenditures

Figure 3-22 shows energy expenditures by subsector. The costs used for each fuel unit in this analysis is provided in Appendix F. The paper, chemicals, and primary metals subsectors spend the most money on energy.

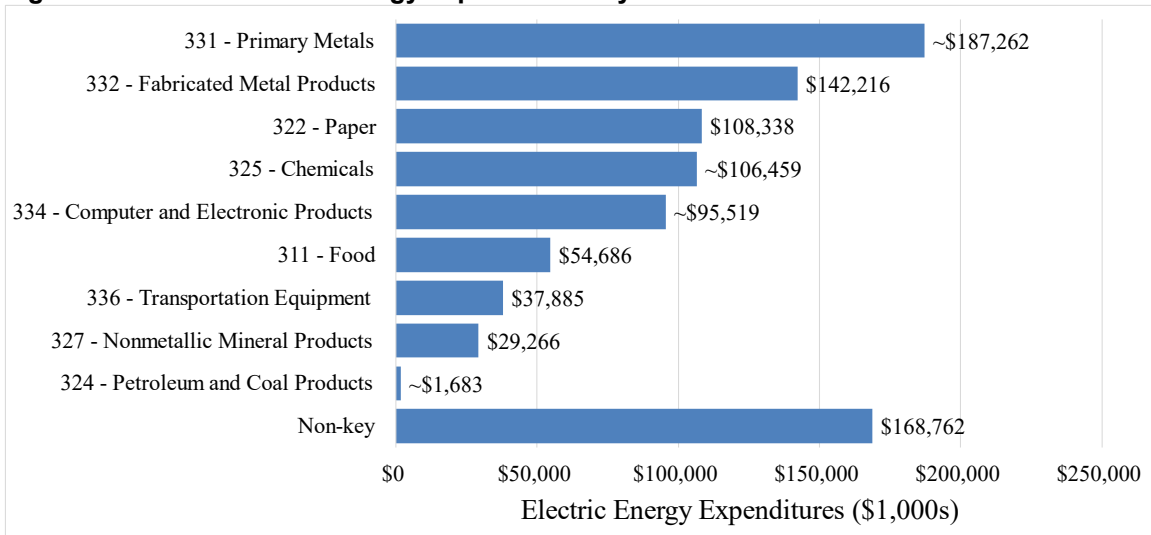
Figure 3-22. Total energy expenditures by subsector



For data and tier-level results, see Table A-41.

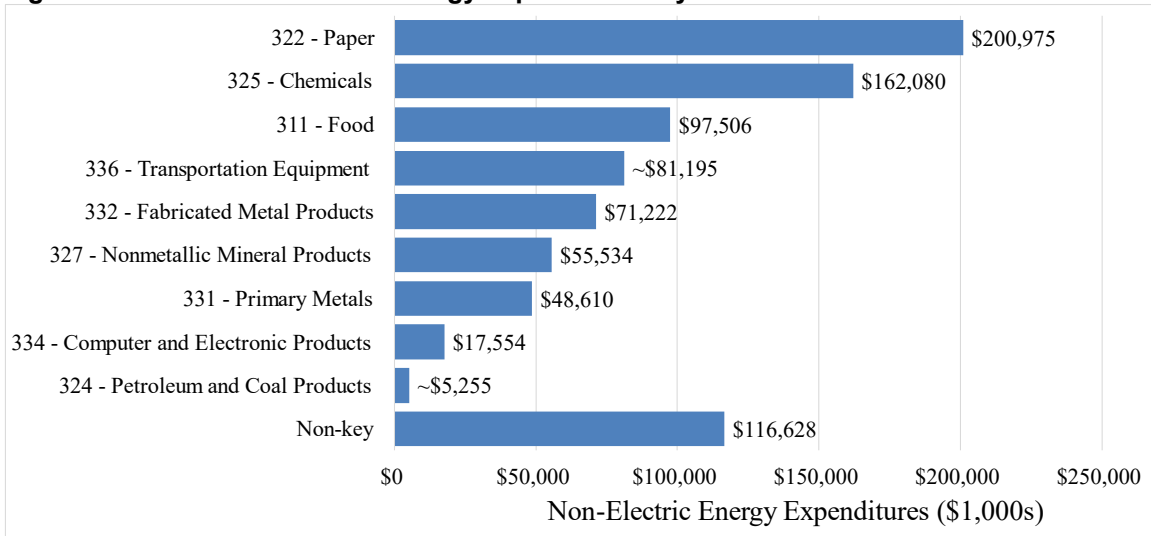
Figure 3-23 shows total expenditures for purchased electricity, while Figure 3-24 shows energy expenditure for purchased fuels. Primary metals and fabricated metals have the highest expenditures for electricity, while paper, chemicals, and food have the greatest fuel energy expenditures.

Figure 3-23. Total electric energy expenditures by subsector



For data and tier-level results, see Table A-43.

Figure 3-24. Total non-electric energy expenditures by subsector



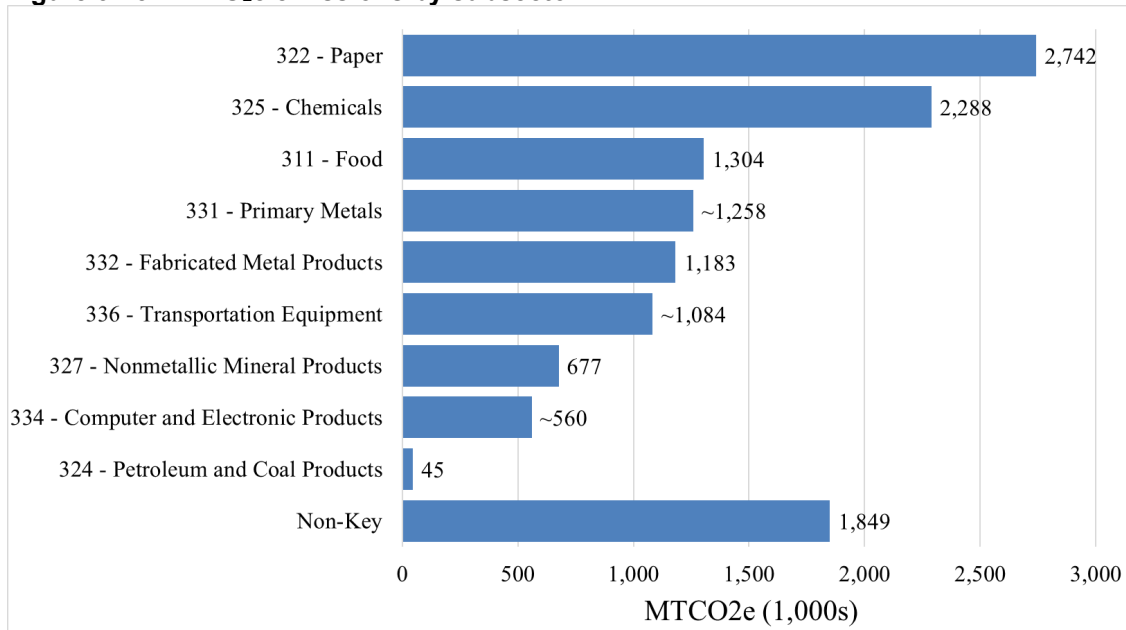
For data and tier-level results, see Table A-45.

3.1.3 GHG analysis

Figure 3-25 shows total emissions by subsector and tier. This only includes Scope 1 and Scope 2 emissions. Paper, chemicals, and food have the highest emissions outputs by key subsectors. In total, the greenhouse subsector emits about 12,990 thousand metric tons of CO₂e. This is the equivalent of 2.9 million gas-powered vehicles driven for one year¹². Overall, Tier 1 facilities represent just over 75% of total Scope 1 and 2 emissions. Metric tons in this analysis are the equivalent of 1,000 kg (not to be confused with imperial tons).

¹² US EPA Greenhouse gas equivalencies calculator

Figure 3-25. MTCO₂e emissions by subsector

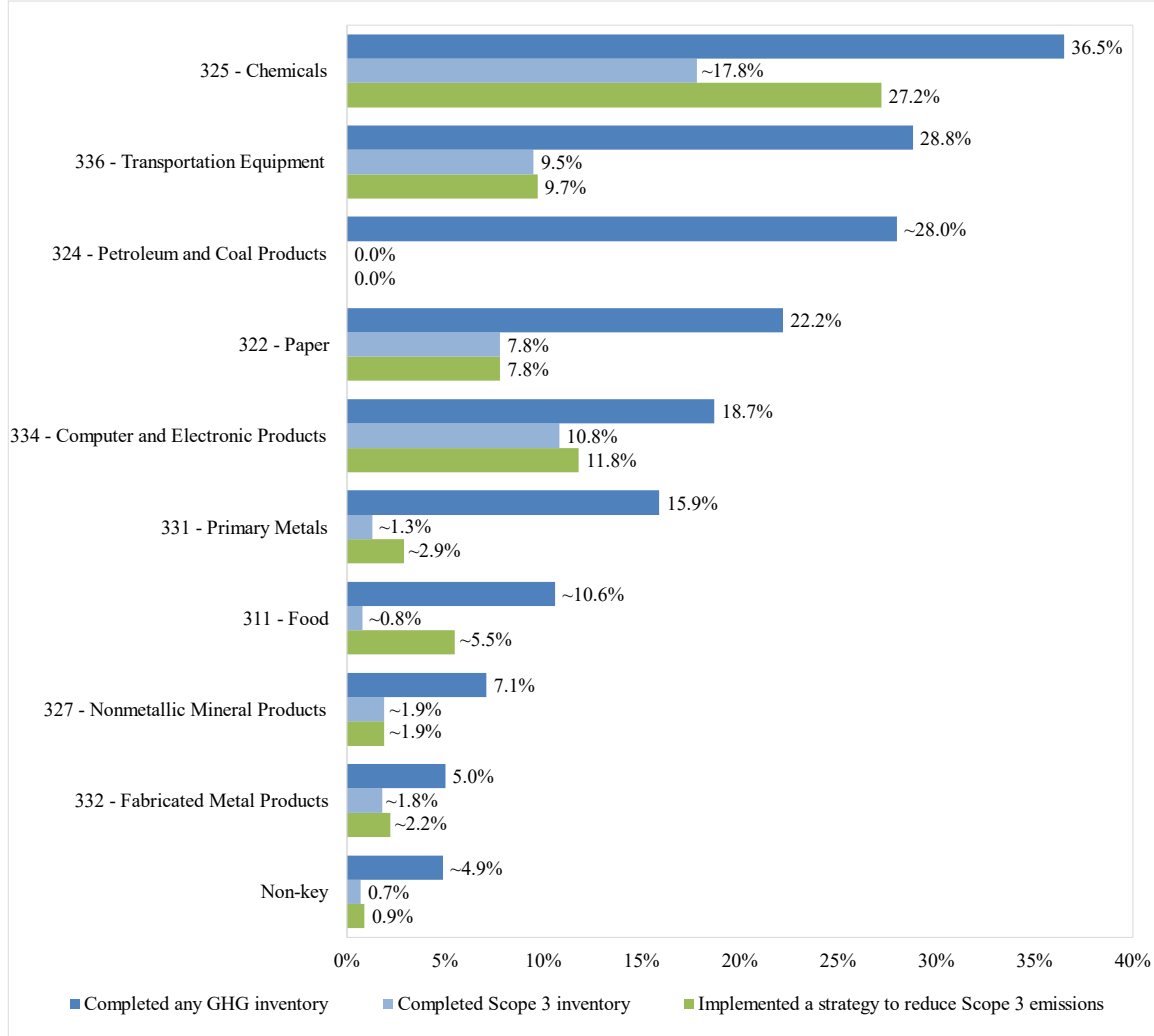


For data and tier-level results, see Table A-47.

Survey respondents were asked a series of questions; whether they had completed a GHG inventory, a Scope 3 inventory or Scope 3 reduction strategy for their facility (see Figure 3-26). Scope 3 encompasses emissions not produced by a facility itself but that the facility indirectly affects in its value chain. Types of Scope 3 emissions include those associated with purchased goods and services, fuel and energy related activities, business travel and employee commuting, and upstream and downstream transportation and distribution. The Scope 3 emissions for one organization are the Scope 1 and 2 emissions of another organization.

No more than 37% of facilities reported having performed any type of GHG inventory. Only one subsector (Chemicals) had more than 11% of facilities reported completing a Scope 3 inventory (most of the other subsectors reported less than 5% had completed a Scope 3 inventory), and few subsectors outside of Chemicals have a Scope 3 reduction strategy in place.

Figure 3-26. Percentage of facilities that have completed GHG inventories, Scope 3 inventories, or Scope 3 reduction strategies by subsector



For data and tier-level results, see Table A-49.

Table 3-2 shows a summary of the breakout of GHG emissions by fuel for each of the key subsectors. The total row at the bottom shows the total contribution of each fuel to manufacturing GHG emissions. These do not add up to 100%, as a small amount of emissions are attributed to other fuels, including purchased steam, recycled energy, renewable fuels, coal-based products, and hydrogen, which are suppressed due to low number of responses. Natural gas is the largest contributor to GHG emissions, representing nearly 68% of the total. Electric is the next largest, representing about 29%.

Table 3-2. GHG emissions by fuel and subsector

NAICS and Subsector Manufacturing Type	Electric	Natural Gas	Fuel Oil	Propane	Diesel	Total
322 - Paper	11.8%	25.5%	a	6.0%	~0.5%	21.1%
325 - Chemicals	~11.3%	21.1%	a	1.9%	~5.1%	17.6%
311 - Food	5.8%	12.1%	a	4.9%	~10.9%	10.0%
331 - Primary Metals	~20.0%	5.7%	3.5%	2.3%	~11.4%	~9.7%
332 - Fabricated Metal Products	15.3%	5.7%	9.5%	19.4%	~49.8%	9.1%
336 - Transportation Equipment	4.1%	~10.6%	0.6%	0.3%	~0.3%	~8.3%
327 - Nonmetallic Mineral Products	3.1%	5.9%	~0.5%	23.2%	~7.7%	5.2%
334 - Computer and Electronic Products	~10.2%	1.8%	~0.4%	6.7%	~0.9%	~4.3%
324 - Petroleum and Coal Products	~0.2%	a	a	0.0%	a	0.3%
Non-Key	18.2%	11.4%	42.0%	35.5%	10.2%	14.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Overall % of Total GHG Emissions	28.5%	67.5%	1.6%	1.2%	0.8%	99.6%

Results for purchased steam, recycled energy, renewable fuels, coal-based products and hydrogen are suppressed due to low number of responses
 For precisions, see Table A-51.

3.2 Industrial end-use analysis

3.2.1 Electric

Respondents were asked to share how their facility uses electricity among three end uses: boilers or generators, manufacturing or industrial production processes, basic facility operations, and/or unknown. These results are shared in Table 3-3. Roughly 75% of net electric¹³ use is associated with manufacturing or industrial production processes, with the balance largely used for basic facility operations such as heating and lighting.

Table 3-3. Percentage of net electricity by high-level end use by subsector

NAICS and Subsector Manufacturing Type	Boilers or generators (GWh)	Boilers or generators (%)	Manufacturing or industrial production process (GWh)	Manufacturing or industrial production process (%)	Basic facility operations (GWh)	Basic facility operations (%)	Don't know Unknown (GWh)	Don't know Unknown (%)	Total (GWh)
331 - Primary Metals	11	~0.4%	~2,601	~88.1%	~287	~9.7%	~55	~1.8%	~2,952
332 - Fabricated Metal Products	40	1.8%	1,379	60.9%	~547	~24.2%	~299	~13.2%	2,264
322 - Paper	~64	~3.7%	~1,461	~83.9%	85	4.9%	~133	~7.6%	1,743
325 - Chemicals	61	~3.6%	~1,474	~87.8%	116	~6.9%	~27	~1.6%	~1,678
334 - Computer and Electronic Products	~181	~12.0%	~917	~60.7%	~411	~27.2%	~3	~0.2%	~1,511
311 - Food	141	16.4%	583	67.6%	127	14.8%	~10	~1.2%	862
336 - Transportation Equipment	10	1.6%	451	75.0%	121	20.1%	~20	~3.3%	601
327 - Nonmetallic Mineral Products	9	1.9%	331	72.3%	~116	~25.4%	~2	~0.4%	458
324 - Petroleum and Coal Products	~1	~3.0%	~23	~87.0%	~3	~10.0%	0	~0.0%	~27
Non-Key	~136	~5.1%	1,844	68.5%	499	18.5%	214	8.0%	2,693
Total MWh/Overall %	653	4.4%	11,064	74.8%	2,311	15.6%	763	5.2%	14,790

Basic Facility Operations - e.g., lighting and HVAC

Boilers or Generators - e.g., gas turbines, boilers, or combustion turbines used for energy transformation

For precisions, see Table A-53.

¹³ Net electricity is obtained by summing purchases, transfers in, and generation from noncombustible renewable resources, minus quantities sold and transferred out. It does not include electricity inputs from onsite cogeneration or generation from combustible fuels because that energy has already been included as generating fuel (e.g., coal).

The study also collected more detailed information on the end use energy consumption during the onsite. Table 3-4 presents a summary of these breakdowns by subsector. Machine drive is the process that consumes the most electricity, nearly 45% of the total electric use across all sectors, followed by HVAC and cooling and refrigeration, consuming 11.6% and 10.5% respectively. The totals found while on site are similar to those reported on the web survey. In total the detailed onsite breakdowns attributed about 70% of the total electric consumption to the manufacturing process, while the web survey was slightly higher at 75%. Table 3-4 through Table 3-6 are sorted from highest to lowest by total net electricity consumption.

Table 3-4. Detailed percentage of total net electricity used for production and non-production end uses by subsector

NAICS and Subsector Manufacturing Type	Production						Non-production				
	Boilers	Process Heating	Cooling and refrigeration	Machine drive	Electrochemical processes	Other production use	HVAC	Lighting	Onsite Transportation	Other facility support	Other facility use
331 - Primary Metals	0.0%	11.7%	6.1%	62.9%	0.0%	0.0%	9.2%	6.6%	0.0%	1.5%	2.1%
332 - Fabricated Metal Products	0.0%	6.4%	11.9%	47.4%	0.1%	8.9%	14.5%	9.3%	0.0%	0.0%	0.1%
322 - Paper	0.0%	3.0%	0.4%	64.0%	0.0%	0.3%	3.8%	4.2%	0.0%	0.0%	0.0%
325 - Chemicals	a	a	a	a	a	a	a	a	a	a	a
334 - Computer and Electronic Products	1.1%	4.2%	6.7%	40.0%	0.4%	6.3%	26.7%	~13.8%	0.0%	0.5%	0.5%
311 - Food	a	a	a	a	a	a	a	a	a	a	a
336 - Transportation Equipment	0.0%	42.9%	2.5%	12.3%	0.0%	0.0%	3.1%	4.3%	0.0%	0.0%	0.0%
327 - Nonmetallic Mineral Products	0.0%	25.9%	0.0%	57.5%	0.0%	0.0%	7.5%	5.5%	0.0%	1.8%	1.7%
324 - Petroleum and Coal Products	a	a	a	a	a	a	a	a	a	a	a
Non-Key	0.2%	5.2%	5.5%	52.5%	0.0%	3.2%	11.1%	8.8%	0.0%	2.1%	0.1%
Overall	0.2%	9.7%	10.5%	44.7%	0.1%	2.5%	11.6%	7.7%	0.0%	1.1%	0.3%

Boilers - includes the transformation of energy to another usable energy source, as in a boiler, gas turbine, or combustion turbine

Heating - e.g., kilns, furnaces, ovens, strip heater

Other Facility Support – e.g., cooking, water heating, office equipment

For precisions, see Table A-55.

Table 3-5 shows the percentage of facilities within each subsector that use electric for their respective manufacturing processes. For example, 52% of food manufacturing facilities use electricity for process heating and 79% use electricity for machine drives. Machine drives are by far the most common use of electricity in manufacturing facilities, present in 83% of facilities overall with process heating, followed by process cooling/refrigeration.

Table 3-5. Percentage of facilities by subsector using electricity for production processes by end use

NAICS and Subsector Manufacturing Type	Process heating	Process cooling and refrigeration	Machine drive	Electrochemical processes	Other manufacturing or production process	Don't Know
331 - Primary Metals	58.1%	21.0%	91.1%	13.8%	19.8%	0.0%
332 - Fabricated Metal Products	28.6%	16.1%	85.5%	8.1%	11.0%	~2.4%
322 - Paper	29.0%	23.3%	85.7%	~1.1%	~1.1%	0.0%
325 - Chemicals	37.7%	26.7%	76.8%	~7.3%	17.3%	0.0%
334 - Computer and Electronic Products	47.5%	37.8%	73.0%	12.7%	30.0%	0.0%
311 - Food	52.4%	74.5%	79.1%	~4.8%	~4.8%	0.0%
336 - Transportation Equipment	41.4%	33.3%	78.6%	~3.3%	34.2%	0.0%
327 - Nonmetallic Mineral Products	64.4%	25.4%	88.8%	~6.5%	21.9%	0.0%
324 - Petroleum and Coal Products	26.0%	~15.3%	89.3%	~4.7%	~10.7%	0.0%
Non-Key	31.9%	30.2%	82.5%	1.1%	15.6%	0.0%
Overall	33.6%	29.3%	82.9%	3.3%	14.8%	~0.5%

Electrochemical processes - e.g., reduction process

Machine drive - e.g., motors, pumps, etc. associated with manufacturing process equipment

Process heating - e.g., kilns, furnaces, ovens, strip heaters

For precisions, see Table A-57.

Table 3-6 shows the percentage of facilities by subsector using electricity for basic facility operations end uses. For example, 83% of food manufacturing facilities use electricity for basic equipment or appliances, and 90% of food manufacturing facilities use electricity for HVAC.

Table 3-6. Percentage of facilities by subsector using electricity for basic facility operations by end use

NAICS and Subsector Manufacturing Type	Basic equipment or appliances	HVAC	Lighting	Onsite transportation	Other use
331 - Primary Metals	84.8%	90.6%	96.5%	~5.7%	0.0%
332 - Fabricated Metal Products	74.4%	85.2%	90.8%	2.5%	~1.6%
322 - Paper	75.4%	78.7%	85.7%	6.3%	0.0%
325 - Chemicals	86.2%	91.3%	91.3%	~11.5%	13.1%
334 - Computer and Electronic Products	85.0%	94.2%	96.2%	~4.6%	3.4%
311 - Food	83.2%	90.2%	92.1%	12.8%	0.0%
336 - Transportation Equipment	84.2%	87.6%	84.2%	9.0%	~1.7%
327 - Nonmetallic Mineral Products	82.4%	79.6%	88.4%	~1.7%	~9.6%
324 - Petroleum and Coal Products	70.7%	89.3%	100.0%	0.0%	0.0%
Non-Key	79.6%	82.5%	91.8%	2.1%	2.2%
Overall	79.1%	83.9%	91.5%	3.0%	2.3%

Basic equipment or e.g., appliances - cooking appliances, water heating, office equipment

Onsite

transportation - excluding highway use

For precisions, see Table A-59.

3.2.2 Non-electric

Respondents were asked to share how their facility uses non-electric fuels among four high-level end uses. These results are shared in Table 3-7. Roughly 48% of non-electric fuel is associated with boilers or generators with another 30% associated with facility industrial or manufacturing processes.

Table 3-7. Percentage of non-electric fuel consumption by high-level end use and subsector

NAICS and Subsector Manufacturing Type	Boilers or generators (1,000 MMBtus)	Boilers or generators (%)	Manufacturing or industrial production process (1,000 MMBtus)	Manufacturing or industrial production process (%)	Basic facility operations (1,000 MMBtus)	Basic facility operations (%)	Don't know/ Unknown (1,000 MMBtus)	Don't know/ Unknown (%)	Total (1,000 MMBtus)
322 - Paper	17,024	71.0%	3,374	14.1%	2,286	9.5%	~1,289	~5.4%	23,972
325 - Chemicals	~14,372	~74.4%	~2,555	~13.2%	~1,749	~9.1%	~632	~3.3%	19,308
311 - Food	4,946	49.3%	~4,360	~43.5%	692	6.9%	35	0.4%	10,032
336 - Transportation Equipment	~2,356	~23.8%	~4,635	~46.8%	~2,693	~27.2%	228	~2.3%	~9,912
332 - Fabricated Metal Products	447	6.9%	3,247	50.4%	1,711	26.6%	1,036	16.1%	6,441
327 - Nonmetallic Mineral Products	1,096	18.5%	3,611	61.0%	1,140	19.2%	76	1.3%	5,923
331 - Primary Metals	269	4.9%	4,035	74.2%	1,039	19.1%	~96	~1.8%	5,439
334 - Computer and Electronic Products	464	22.9%	~887	~43.7%	619	30.5%	60	3.0%	2,031
324 - Petroleum and Coal Products	~38	~9.3%	370	90.3%	~2	~0.4%	0	0.0%	410
Non-Key	4,894	39.7%	1,319	10.7%	4,955	40.2%	1,163	9.4%	12,331
Total MMBtu/ Overall %	45,906	47.9%	28,393	29.6%	16,885	17.6%	4,616	4.8%	95,799

Basic facility operations - e.g., lighting and HVAC
 Boilers or generators - e.g., gas turbines, boilers, or combustion turbines used for energy transformation
 For precisions, see Table A-61.

Table 3-8 shows the detailed end use breakdown derived from data collected while onsite. Process heating and boilers are the two highest consumers of non-electric fuels, accounting for 38% and 35%, respectively, which means they total 73% of the non-electric consumption. When other production uses are included, the total production use is about 79% of the non-electric consumption, which is consistent with what was found in the web survey as well, which was about 78%. Of the non-production end uses, HVAC was the highest at 19%.

Table 3-8. Detailed percentage of total non-electric fuel used for production and non-production end uses

NAICS and Subsector Manufacturing Type	Production						Non-Production				
	Boilers	Process Heating	Cooling and refrigeration	Machine drive	Electro-chemical processes	Other prod. use	HVAC	Lighting	Other facility support	Onsite transportation	Other facility use
322 - Paper	72.8%	~26.9%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%
325 - Chemicals	a	a	a	a	a	a	a	a	a	a	a
311 - Food	a	a	a	a	a	a	a	a	a	a	a
336 - Transportation Equipment	a	a	a	a	a	a	a	a	a	a	a
332 - Fabricated Metal Products	a	a	a	a	a	a	a	a	a	a	a
327 - Nonmetallic Mineral Products	a	a	a	a	a	a	a	a	a	a	a
331 - Primary Metals	0.0%	94.6%	0.0%	0.0%	0.0%	4.3%	1.0%	0.0%	0.0%	0.1%	0.0%
334 - Computer and Electronic Products	65.5%	1.5%	0.0%	0.0%	0.0%	0.5%	17.7%	0.0%	0.1%	0.0%	14.2%
324 - Petroleum and Coal Products	a	a	a	a	a	a	a	a	a	a	a
Non-Key	34.6%	4.9%	0.0%	0.0%	0.0%	0.8%	53.4%	0.0%	0.2%	0.0%	0.5%
Overall	35.3%	37.8%	0.0%	0.0%	0.0%	6.1%	19.2%	0.0%	~0.1%	~0.2%	~1.1%

Boilers - includes the transformation of energy to another usable energy source, as in a boiler, gas turbine, or combustion turbine

Heating - e.g., kilns, furnaces, ovens, strip heater

Other Facility Support – e.g., cooking, water heating, office equipment

Onsite transportation – excluding highway use

For precisions, see Table A-63.

Table 3-9 shows the percentage of facilities by subsector using fuels for production processes by end use. Roughly 20% of facilities overall use fuels for process heating and 12% for machine drives.

Table 3-9. Percentage of facilities using non-electric fuel for production processes by end use and subsector

NAICS and Subsector Manufacturing Type	Process heating	Process cooling and refrigeration	Machine drive	Electrochemical processes	Other manufacturing or production process
322 - Paper	23.3%	~2.6%	20.3%	0.0%	21.1%
325 - Chemicals	21.1%	~3.5%	20.4%	5.4%	~6.8%
311 - Food	43.0%	~10.2%	11.3%	0.0%	14.9%
336 - Transportation Equipment	27.7%	0.0%	15.1%	0.0%	8.3%
332 - Fabricated Metal Products	25.0%	~3.3%	23.1%	~1.8%	18.3%
327 - Nonmetallic Mineral Products	36.0%	~0.6%	15.8%	~1.7%	34.4%
331 - Primary Metals	40.5%	~1.6%	17.6%	3.1%	26.5%
334 - Computer and Electronic Products	15.0%	~0.5%	~1.4%	~2.2%	8.3%
324 - Petroleum and Coal Products	~34.0%	0.0%	~29.3%	0.0%	~44.7%
Non-Key	15.1%	1.4%	7.8%	~0.2%	19.1%
Overall	19.5%	2.2%	11.7%	~0.7%	18.6%

Process heating - e.g., kilns, furnaces, ovens, strip heaters
 Machine drive - e.g., motors, pumps, etc. associated with manufacturing process equipment
 Electrochemical processes - e.g., reduction process
 For precisions, see Table A-65.

Table 3-10 shows the percentage of non-electric fuels used to heat boilers to a particular temperature range. Seventy-five percent (75%) of non-electric boiler fuel use is dedicated to heat boilers at either a low (<140°C /280°F) or medium temperature (140°C/280°F and <300°C/570°F). Lower or medium boiler temperatures present opportunities for electrification using currently available technology.

Table 3-10. Percentage of non-electric fuel dedicated to boilers by subsector by temperature range

NAICS and Subsector Manufacturing Type	Low Temp (<140°C /280°F)	Med Temp (140°C/280°F & <300°C/570°F)	High Temp (>=300°C/ 570°F)	Don't Know/ Unknown (MMBtu)
322 - Paper	~2.7%	~53.8%	~15.5%	~28.0%
325 - Chemicals	~57.4%	30.1%	~4.8%	~7.7%
311 - Food	~44.8%	40.6%	~14.3%	~0.3%
336 - Transportation Equipment	~74.3%	~25.0%	~0.7%	a
332 - Fabricated Metal Products	62.5%	~19.8%	~4.8%	~12.9%
327 - Nonmetallic Mineral Products	~44.0%	11.6%	~1.5%	~43.0%
331 - Primary Metals	a	~28.4%	a	~16.1%
334 - Computer and Electronic Products	~78.2%	a	a	~15.0%
324 - Petroleum and Coal Products	a	a	a	a
Non-Key	43.8%	39.2%	~4.4%	~12.6%
Overall	35.1%	40.0%	~9.4%	15.6%

For precisions, see Table A-67.

Table 3-11 shows the percentage of non-electric fuels dedicated to non-boiler processes by temperature range. Roughly 56% of non-electric fuels are used to heat non-boiler processes at either a low (<140°C /280°F) or medium temperature (140°C/280°F and <300°C/570°F) and represent opportunities for electrification.

Table 3-11. Percentage of non-electric fuel dedicated to non-boiler process by subsector and temperature

NAICS and Subsector Manufacturing Type	Low Temp (<140°C /280°F) (MMBtu)	Med Temp (140°C/280°F & <300°C/570°F) (MMBtu)	High Temp (>=300°C/570°F) (MMBtu)	Don't Know/ Unknown (MMBtu)
322 - Paper	~3.1%	~16.5%	~12.9%	~67.5%
325 - Chemicals	~40.2%	~34.5%	~23.6%	~1.6%
311 - Food	~29.0%	~61.6%	~3.6%	~5.7%
336 - Transportation Equipment	~91.6%	~1.1%	~3.8%	~3.5%
332 - Fabricated Metal Products	16.7%	~41.3%	~7.6%	~34.5%
327 - Nonmetallic Mineral Products	~11.0%	19.1%	~64.3%	~5.5%
331 - Primary Metals	~30.5%	~0.7%	~35.3%	~33.5%
334 - Computer and Electronic Products	~0.5%	~4.9%	~72.2%	~22.4%
324 - Petroleum and Coal Products	~5.8%	0.0%	~73.9%	~20.4%
Non-Key	30.1%	~24.0%	6.9%	39.1%
Overall	32.5%	23.2%	22.4%	21.8%

For precisions, see Table A-69.

Table 3-12 shows the percentage of manufacturing facilities that reported specific equipment types present at their facilities followed by the percentage that reported an efficiency upgrade on that equipment in the last three years. Many equipment types reported were found in very few

facilities (<1%) and have been removed from this table but can be found in the appendix link below the table.¹⁴ No more than 8.2% of any one type of equipment was reported to have undergone an energy efficiency upgrade in the last three years.

Table 3-12. Percentage of facilities with specific equipment and that recently upgraded each equipment type

Equipment Type	% of facilities with equipment	% of facilities that received EE upgrades on equipment in last 3 years
Other materials processing (e.g., grinding, agitating/mixing, debarking, drilling, pressing)	55.0%	8.2%
Material handling (e.g., conveyers, belts, materials movers)	46.7%	7.4%
Air compressors	22.4%	7.1%
Welding	12.4%	2.4%
Process pumping	8.9%	2.1%
Refrigeration	6.8%	1.9%
Drying and curing	6.4%	0.8%
Process Fans	4.8%	~0.6%
Other process heating	4.4%	1.1%
Process cooling (above 40F)	3.4%	1.2%
Process boiler	3.1%	~0.7%
Pasteurization and sterilization	1.6%	~0.3%
Other	35.9%	5.0%

For precisions, see Table A-71.

Table 3-13 shows the percentage of manufacturing facilities that reported having specific equipment types followed by the percentage of facilities that reported their equipment to be low, medium, or high efficiency. As in the previous table, low levels (<1%) have been removed from this table but can be found in the appendix link below the table.

¹⁴ Basic oxygen furnace, blast furnace, carburizing furnace, casting, distillation, electric arc furnace, evaporators, hot rolling, dry kiln, wet kiln, kraft pulping, thermal oxidizer, mechanical pulping, ball mill, roller mill, tube mill, impact mill, other process motors, semiconductor manufacturing, other electro-chemical processes, separators, computer assembly, silicon wafer manufacturing.

Table 3-13. Percentage of facilities with specific equipment types, with percentage of facilities at different equipment efficiency levels

Equipment Type	% of facilities with equipment	Equipment efficiency			
		Low %	Moderate %	High %	DK %
Other materials processing (e.g., grinding, agitating/mixing, debarking, drilling, pressing)	55.0%	4.0%	16.5%	14.5%	18.1%
Material handling (e.g., conveyers, belts, materials movers)	46.7%	1.7%	21.7%	9.4%	11.9%
Air compressors	22.4%	~1.2%	10.6%	6.1%	4.5%
Welding	12.4%	a	4.7%	3.7%	3.4%
Process pumping	8.9%	a	5.1%	1.6%	1.5%
Refrigeration	6.8%	a	4.0%	1.4%	0.9%
Drying and curing	6.4%	0.3%	2.9%	1.2%	1.9%
Process Fans	4.8%	~0.9%	2.7%	a	0.6%
Other process heating	4.4%	0.2%	2.2%	0.8%	1.3%
Process cooling (above 40F)	3.4%	.	1.6%	1.1%	a
Process boiler	3.1%	0.3%	1.4%	1.0%	0.4%
Pasteurization and sterilization	1.6%	a	0.9%	a	a
Other	35.9%	~3.6%	12.4%	7.4%	12.4%

For precisions, see Table A-73.

3.3 Industrial energy and climate practices and policies

The study also collected information regarding the energy and climate policies for the manufacturing sector in New York. This section summarizes the various questions from both the web/phone survey and information collected onsite by our engineers. These questions generally addressed the facilities’ policies with respect to tracking energy use and emissions and facilities’ policies or goals to reduce either or both.

Table 3-14 shows a summary of the percentage of facilities by subsector that reported having conducted an energy consumption baseline. This is an annual energy accounting used to measure changes between time periods. Typically, an energy consumption baseline is conducted for a particular year that the company feels is representative of their operations. On average, over half of the facilities reported having no plans in place to establish an energy consumption baseline.

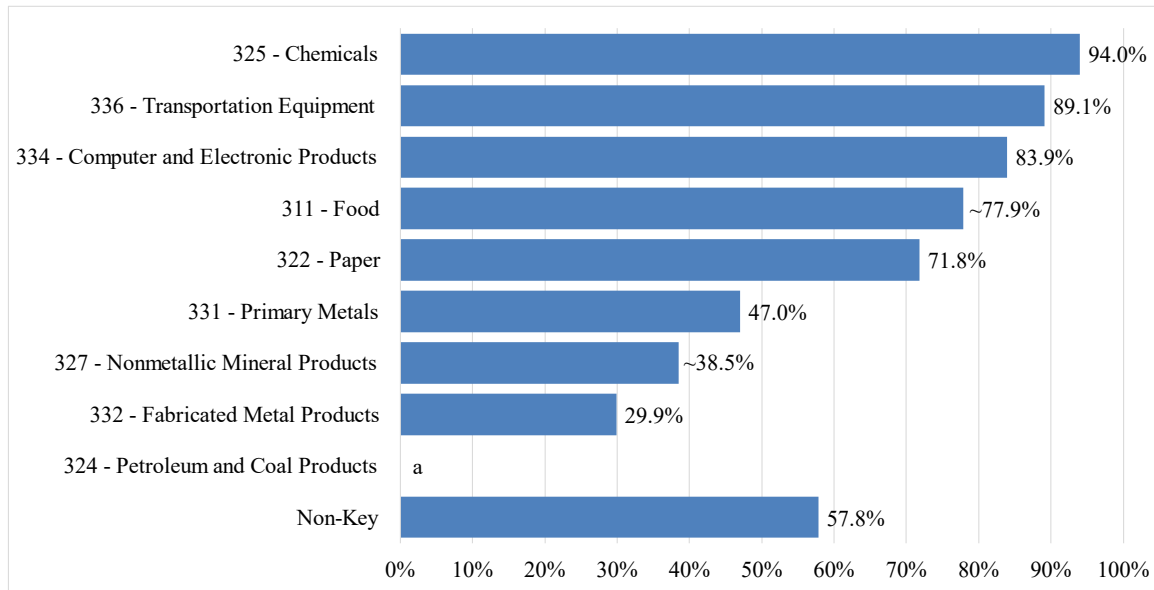
Table 3-14. Percentage of facilities with an established energy consumption baseline by subsector

NAICS and Subsector Manufacturing Type	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	Don't know
325 - Chemicals	27.4%	0.0%	0.0%	~5.6%	5.6%	48.5%	~12.9%
336 - Transportation Equipment	25.8%	0.0%	~4.9%	0.0%	~7.1%	43.2%	19.1%
324 - Petroleum and Coal Products	~23.3%	0.0%	0.0%	~10.7%	~23.3%	32.0%	~10.7%
322 - Paper	19.2%	~1.1%	~6.9%	~5.2%	9.7%	35.9%	22.0%
334 - Computer and Electronic Products	12.8%	3.5%	~5.8%	6.0%	~2.8%	52.7%	16.3%
332 - Fabricated Metal Products	~6.9%	~2.7%	~1.4%	1.0%	14.8%	47.9%	25.3%
327 - Nonmetallic Mineral Products	~5.1%	~1.3%	~5.3%	~3.4%	~7.5%	51.9%	25.5%
311 - Food	4.1%	~7.0%	~3.9%	~6.1%	~4.3%	59.0%	15.7%
331 - Primary Metals	3.1%	~2.1%	~5.9%	~3.6%	18.1%	40.0%	27.2%
Non-Key	2.4%	1.9%	0.8%	~3.4%	12.9%	67.0%	11.7%
Overall	4.7%	2.3%	1.4%	~3.2%	12.3%	60.7%	15.4%

For precisions, see Table A-75.

Figure 3-27 shows the percentage of facilities that track their energy use compared to that established baseline as a percentage of those that have a baseline. For those companies that have this practice established, most of them do continue to track their energy use against that baseline. The chemical subsector is the highest with 94% of the facilities tracking their energy use, while fabricated metals is the lowest at about 30%.

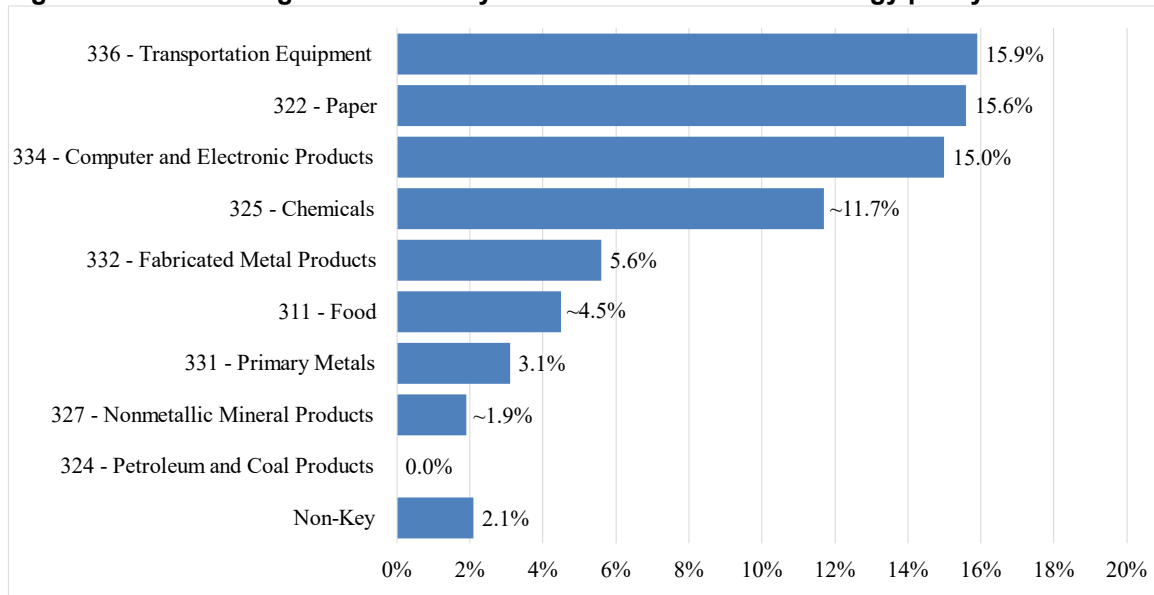
Figure 3-27. Percentage of facilities by subsector that track energy use using an established baseline



For data and tier-level results, see Table A-77.

Figure 3-28 shows the percentage of facilities by subsector that have a written energy policy. A written policy formalizes the goals and policies and usually includes energy reduction goals, either annually or at set milestones. The transportation, paper, and computer and electronic products subsectors reported having the highest instances of energy policies in place, between 15% and 16% of facilities within these subsectors.

Figure 3-28. Percentage of facilities by subsector with a written energy policy



For data and tier-level results, see Table A-79.

Table 3-15 shows which facilities have completed an energy map identifying the top energy drivers and end uses. A low number of facilities reported having this in place, and over 68% reported having no plans in place to complete this inventory as well.

Table 3-15. Percentage of facilities by subsector with an energy map identifying the top energy drivers and end uses

NAICS and Subsector Manufacturing Type	Yes				No		Don't know	Total
	Completed in the last three years	More than 3 years ago	Completed (don't know when)	In process now	Planning to within next 3 years	No plans in place		
336 - Transportation Equipment	13.5%	~3.4%	0.0%	~1.5%	9.3%	56.0%	16.3%	100.0%
325 - Chemicals	~12.9%	~1.6%	~1.6%	~3.5%	6.8%	71.9%	~1.6%	100.0%
322 - Paper	12.3%	~2.5%	~2.6%	~4.4%	13.0%	51.9%	13.3%	100.0%
331 - Primary Metals	9.0%	4.3%	0.0%	1.3%	9.4%	50.2%	25.8%	100.0%
334 - Computer and Electronic Products	7.5%	~1.9%	~4.4%	6.5%	8.8%	59.8%	11.0%	100.0%
327 - Nonmetallic Mineral Products	~4.9%	~1.3%	~7.3%	0.0%	16.2%	45.8%	24.4%	100.0%
332 - Fabricated Metal Products	0.8%	~0.6%	~2.8%	1.4%	10.8%	64.9%	18.7%	100.0%
311 - Food	0.0%	0.0%	~2.5%	~2.9%	8.9%	79.0%	6.7%	100.0%
324 - Petroleum and Coal Products	0.0%	0.0%	0.0%	0.0%	~15.3%	66.0%	~18.7%	100.0%
Non-key	1.8%	~0.8%	~0.8%	~3.5%	13.1%	70.2%	9.8%	100.0%
Overall	2.2%	0.8%	1.5%	~3.0%	12.2%	68.2%	11.9%	100.0%

For precisions, see Table A-81.

Table 3-16 shows the percentage of facilities that reported various energy performance tracking or having standard maintenance schedules. This information was collected during site visits. Less than 5% overall reported having energy performance tracking or utilizing an EMS, and less than 10% reported having an individual or team responsible for energy performance. About 25% did have standard maintenance schedules.

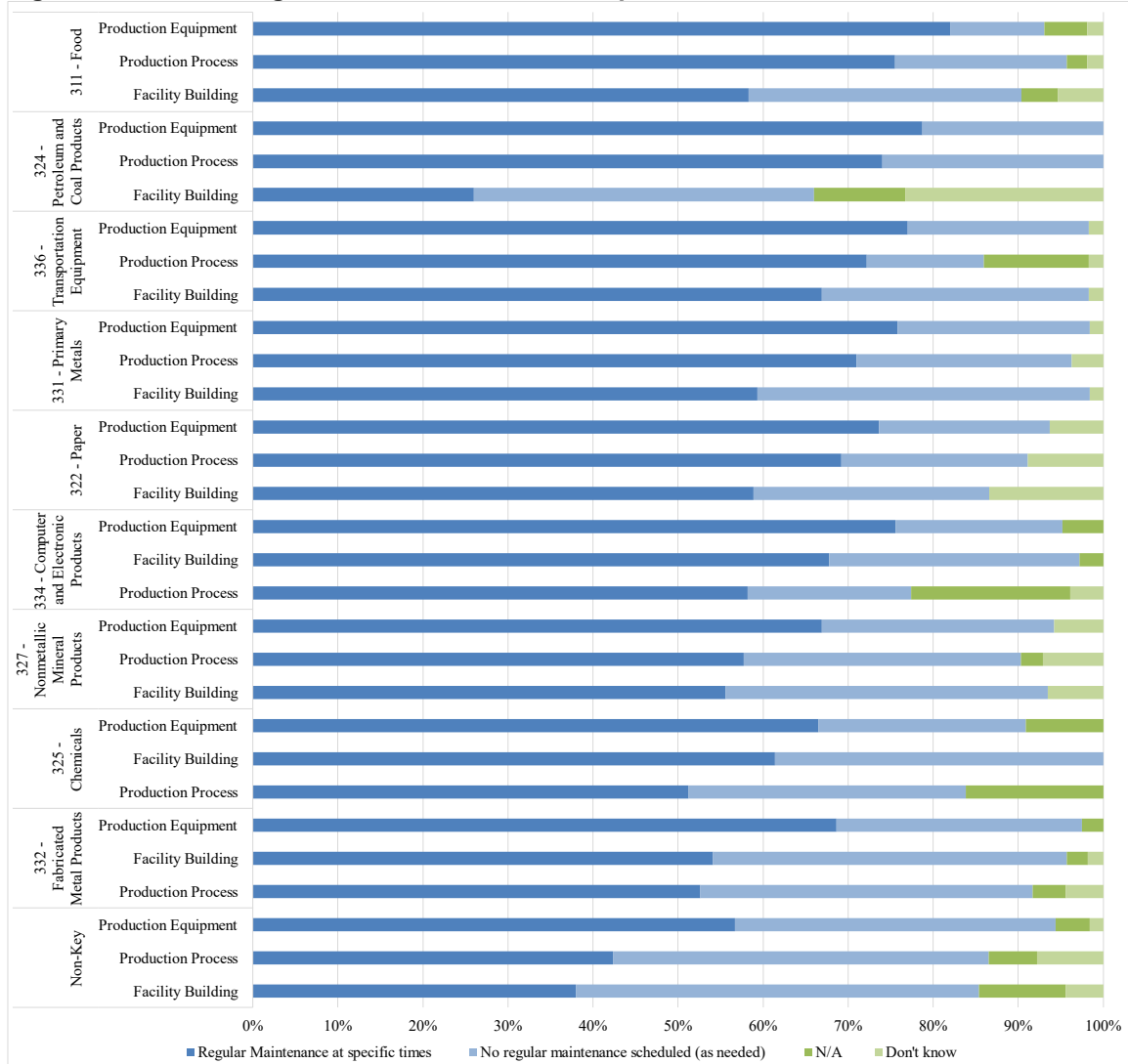
Table 3-16. Energy performance tracking by subsector

NAICS and Subsector Manufacturing Type	% of Facilities that Conduct Energy Performance Tracking	% of Facilities that Utilize an EMS	% of Facilities with an Individual or Team Responsible for Energy Performance	% of Facilities with Standard Maintenance Schedules
322 - Paper	~18.2%	0.0%	~36.5%	100.0%
336 – Transportation Equipment	11.1%	11.1%	11.1%	~30.2%
334 - Computer and Electronic Products	~1.0%	~40.5%	~52.1%	77.8%
332 - Fabricated Metal Products	~0.6%	0.0%	~11.3%	~15.7%
327 - Nonmetallic Mineral Products	0.0%	~1.6%	~37.2%	74.2%
331 - Primary Metals	0.0%	0.0%	0.0%	75.1%
311 - Food	a	a	a	a
324 - Petroleum and Coal Products	a	a	a	a
325 - Chemicals	a	a	a	a
Non-key	~0.9%	1.2%	5.7%	24.1%
Overall	1.1%	2.5%	8.9%	24.9%

For precisions, see Table A-83.

Figure 3-29 shows reported subsector maintenance practices (regular, as needed) by general system type (facility, production equipment, or production processes). Most facilities reported regular maintenance on their production equipment and processes.

Figure 3-29. Percentage of facilities maintenance practices



For data and tier-level results, see Table A-85.

Table 3-17 shows the percentage of facilities by subsector that have completed process upgrades and the timing of those upgrades. Roughly a quarter of manufacturing facilities across the key subsectors have completed a process upgrade in the last three years, while 35% noted they have not completed one nor have plans to do so.

Table 3-17. Percentage of facilities by subsector that have completed process upgrades

NAICS and Subsector Manufacturing Type	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	Don't know
322 - Paper	44.4%	~5.2%	~6.9%	0.0%	7.7%	19.1%	16.7%
331 - Primary Metals	41.5%	~3.8%	~1.3%	9.4%	0.0%	26.9%	16.9%
336 - Transportation Equipment	41.0%	~1.7%	~3.4%	0.0%	~5.1%	40.2%	8.6%
325 - Chemicals	34.2%	~3.7%	~14.3%	~5.2%	~12.2%	30.4%	0.0%
311 - Food	32.7%	~3.5%	~4.1%	~2.9%	~2.7%	43.1%	11.0%
327 - Nonmetallic Mineral Products	28.7%	~4.1%	10.7%	7.5%	14.4%	21.1%	13.6%
332 - Fabricated Metal Products	19.7%	~5.6%	5.9%	~5.3%	10.9%	34.8%	17.8%
334 - Computer and Electronic Products	18.4%	10.3%	10.2%	9.1%	8.0%	38.6%	~5.4%
324 - Petroleum and Coal Products	~10.7%	~18.7%	0.0%	0.0%	~4.7%	32.0%	~34.0%
Non-Key	22.0%	~5.1%	~4.1%	10.7%	6.4%	35.8%	15.9%
Overall	22.9%	5.2%	4.9%	8.8%	7.4%	35.4%	15.4%

For precisions, see Table A-87.

During the site visits, information was also collected about facility energy efficiency improvements and the timing of their completion. Table 3-18 provides a summary of the responses received while on site. About 40% of facilities reported having plans for either facility expansions or other improvements in the next one to three years.

Table 3-18. Facility energy efficiency improvements by subsector

NAICS and Subsector Manufacturing Type	% of Facilities With Equipment, Process or Supply Chain Improvements in Last 3 Years	% of Facilities With Facility Expansions in Last 3 Years	% of Facilities with Recent Energy Efficiency Upgrades	% of Facilities with Planned Expansions in Next 1-3 Years	% of Facilities with Planned Equipment, Process or Supply Chain Improvements in Next 1-3 Years
336 – Transportation Equipment	~42.1%	~5.5%	~36.6%	0.0%	~42.1%
331 - Primary Metals	~37.6%	~16.3%	54.8%	~16.3%	66.5%
334 - Computer and Electronic Products	~32.1%	~5.9%	84.0%	~12.1%	~50.4%
322 - Paper	~31.8%	0.0%	47.6%	0.0%	~20.6%
327 - Nonmetallic Mineral Products	~15.4%	~15.4%	77.5%	0.0%	~15.4%
332 - Fabricated Metal Products	~13.6%	~4.3%	~95.4%	~0.6%	~10.6%
311 – Food	a	a	a	a	a
324 - Petroleum and Coal Products	a	a	a	a	a
325 - Chemicals	a	a	a	a	a
Non-key	~40.3%	~2.5%	25.0%	58.9%	~50.2%
Overall	~32.5%	3.4%	41.7%	40.2%	~39.1%

For precisions, see Table A-89.

Table 3-19 presents the percentage of facilities with awareness and use of various funding sources for process upgrades. With the exception of self-funding and commercial loans, that 41% to 61% of facilities have used, 48% to 77% of respondents reported not being aware of the other funding types shown. Twenty percent (20%) to 22% reported awareness and use of utility incentives and state incentives, and only 7% were aware of on-bill financing opportunities.

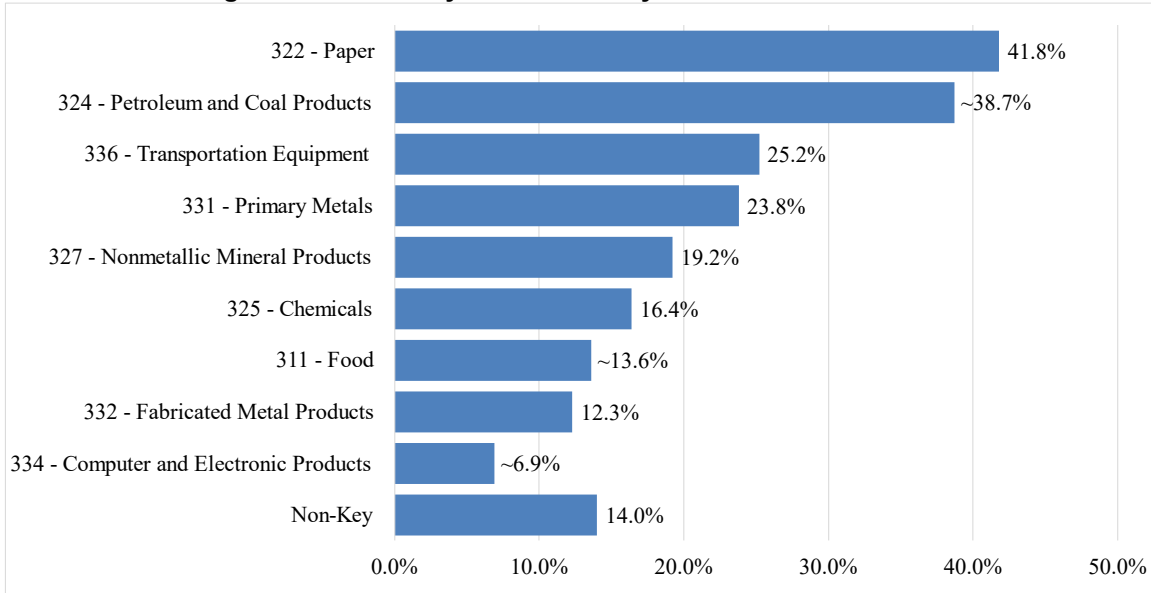
Table 3-19. Percentage of facilities with awareness and usage of funding sources for process upgrades

Funding Type	Aware have used	Aware would consider using	Aware won't use	Not aware have not used	Did not answer	Total
Self-funding	60.7%	5.9%	4.5%	26.4%	~2.5%	100.0%
Commercial lending (loans)	41.0%	14.6%	23.7%	20.0%	0.8%	100.0%
Utility Incentives	21.7%	24.3%	5.7%	47.7%	0.6%	100.0%
State Incentives	19.5%	24.0%	3.8%	52.0%	0.7%	100.0%
On-bill financing	7.4%	9.9%	22.4%	59.2%	1.1%	100.0%
Energy-as-a-service (EaaS)	~2.6%	6.3%	13.1%	77.1%	1.0%	100.0%
Other	0.0%	0.0%	a	0.2%	99.7%	100.0%

For precisions, see Table A-91.

Figure 3-30 shows the percentage of facilities that have calculated the portion of materials used in manufacturing that contain recycled content. This is a potential indicator of sustainability practices in the company. Paper is the sector with the highest percent at almost 42% of the facilities, and petroleum and coal products was second at nearly 39%.

Figure 3-30. Percentage of facilities that have calculated the proportion of materials used in manufacturing that contain recycled content by subsector



For data and tier-level results, see Table A-93.

More information was also gathered onsite, when possible, on the waste capture and recyclable content used in manufacturing. Table 3-20 shows those results. Overall, over 50% of facilities have waste capture or recycling processes and over 86% of raw materials were reported as being obtained domestically.

Table 3-20. Waste capture and recyclable content in manufacturing by subsector

NAICS and Subsector Manufacturing Type	% of Facilities that Have Waste Capture or Recycling Processes	% of Input Materials that are From Recycled Sources	% of Materials Obtained Domestically
322 - Paper	100.0%	52.2%	96.7%
331 - Primary Metals	100.0%	a	68.0%
334 - Computer and Electronic Products	68.1%	~0.9%	61.9%
327 - Nonmetallic Mineral Products	~43.9%	~15.0%	58.9%
336 – Transportation Equipment	~42.1%	a	a
332 - Fabricated Metal Products	~31.4%	~4.4%	~90.8%
311 - Food	a	a	a
324 - Petroleum and Coal Products	a	a	a
325 - Chemicals	a	a	a
Non-key	58.0%	~2.5%	~84.8%
Overall	50.5%	4.0%	86.4%

For precisions, see Table A-95.

Figure 3-31 outlines the percentage of facilities that have defined energy performance goals and which facilities of those have a written plan to achieve those goals. The sector with the least number of facilities reporting having performance goals was primary metals at less than 7%, and the sector with the most was petroleum and coal at 40%. In many cases, even facilities that reported having goals didn’t have a written plan to achieve them, with most sectors falling below 50%.

Figure 3-31. Percentage of facilities by subsector that have defined energy performance goals and written plans

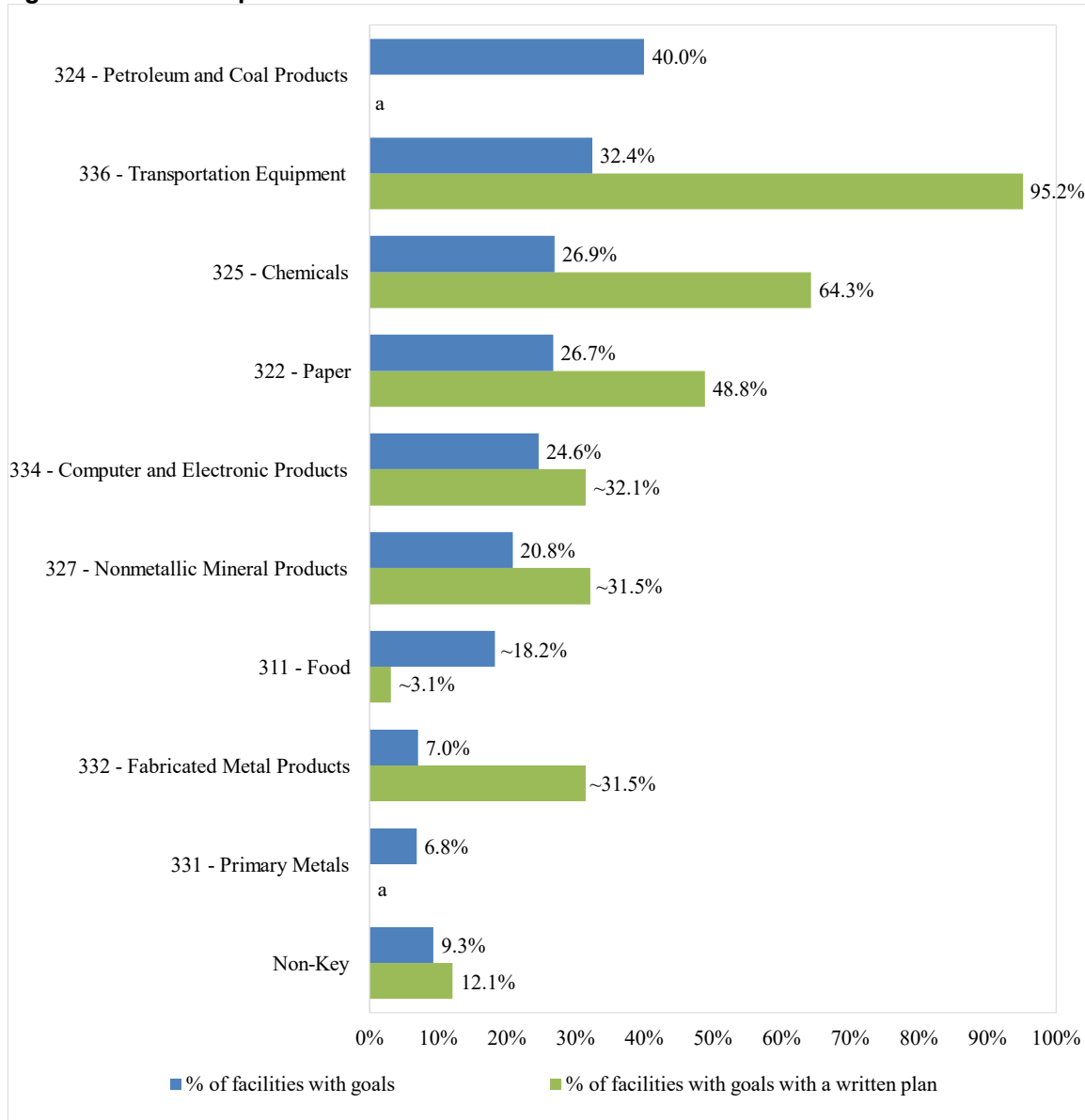
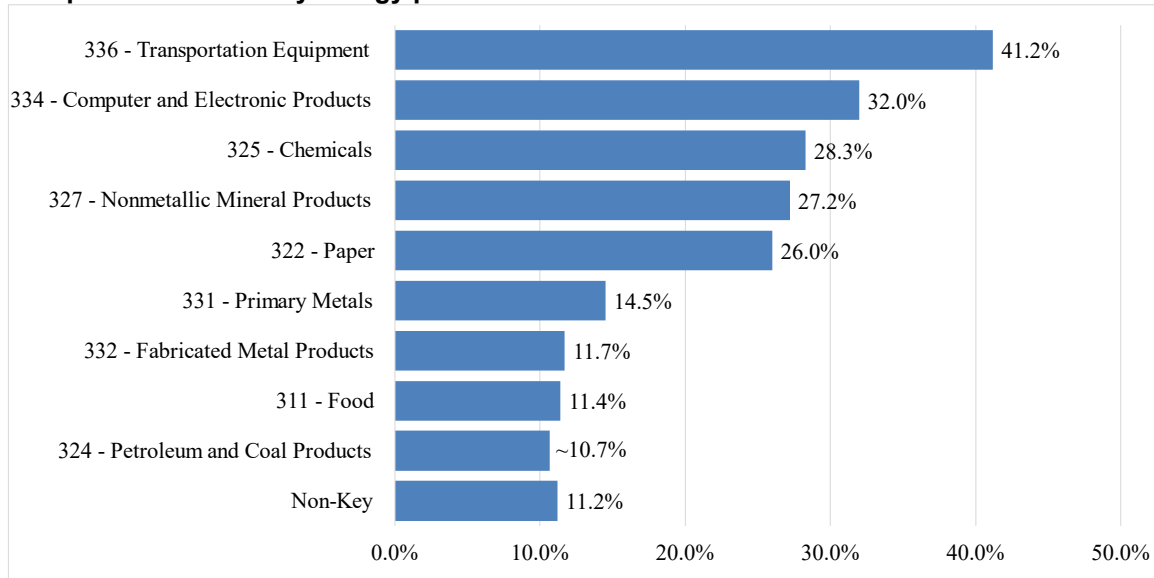


Table 3

For data and tier-level results, see Table A-97 and Table A-99.

Figure 3-32 shows the percentage of facilities by sub sector that have an energy manager. Transportation was the highest at 41% with computer and electronics being the second highest at 32%. In all subsectors, less than 50% of facilities reported having energy managers with responsibility for facility energy performance.

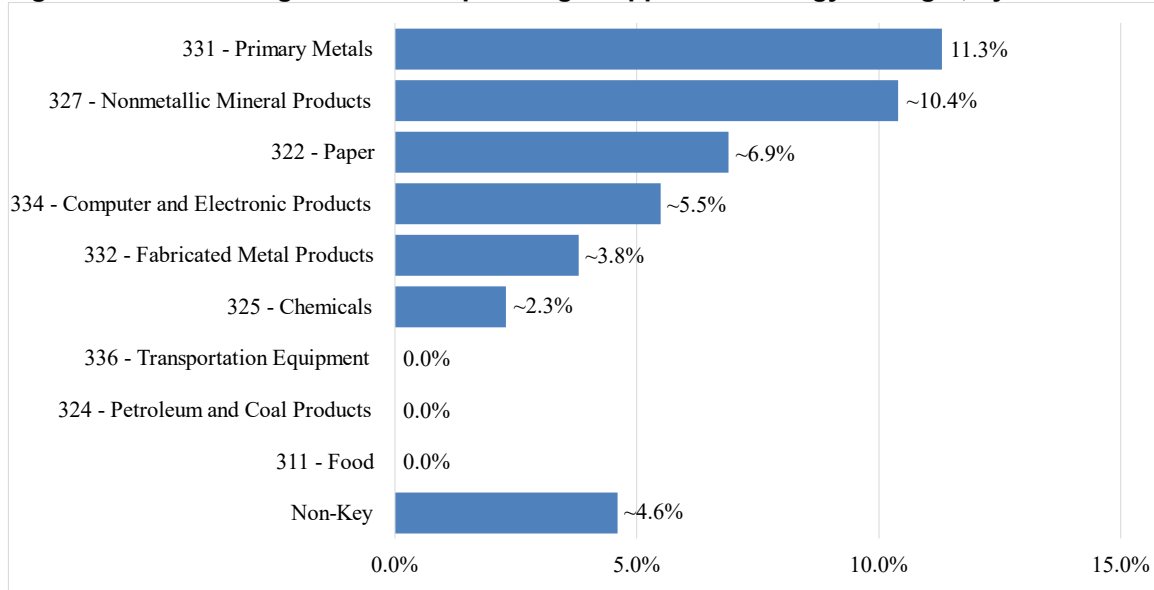
Figure 3-32. Percentage of facilities by subsector that have an energy manager with responsible for facility energy performance



For data and tier-level results, see Table A-101.

Following up on the facilities with an energy manager, Figure 3-33 shows the number of facilities planning to appoint an energy manager. Less than 15% of facilities in all subsectors answered that they were planning to appoint an energy manager.

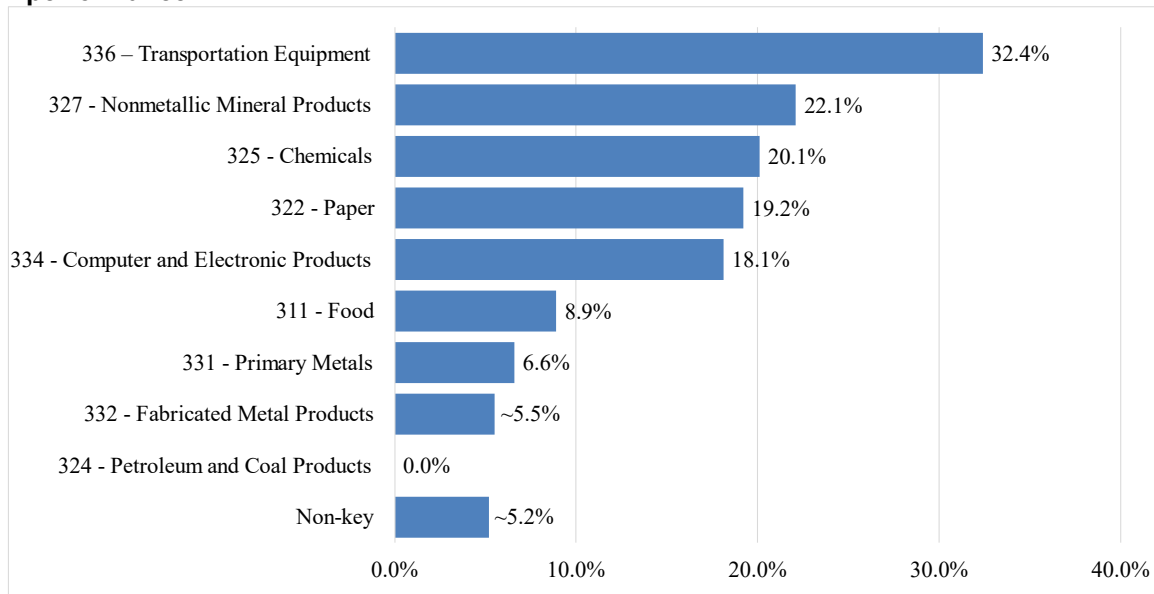
Figure 3-33. Percentage of facilities planning to appoint an energy manager, by subsector



For data and tier-level results, see Table A-103.

Some facilities have a team that has responsibility for energy performance rather than a single energy manager. Figure 3-34 shows those that answered yes to having a team. Transportation was the highest again at about 32% of the facilities having a team, while non-metallic mineral was the second highest at about 22%.

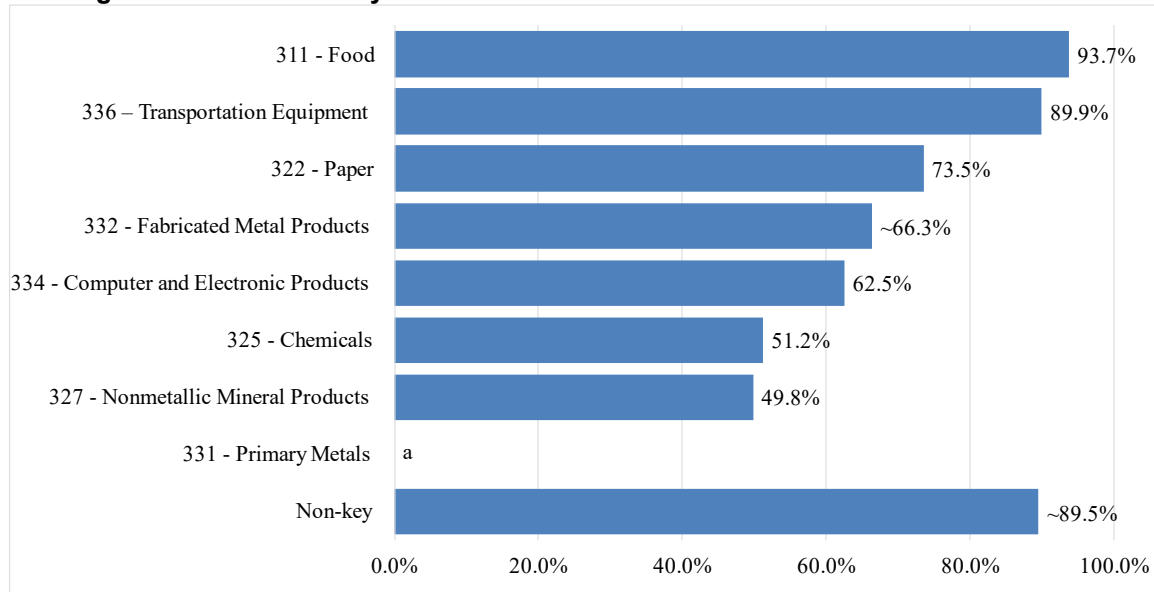
Figure 3-34. Percentage of facilities by subsector that have a team responsible for energy performance



For data and tier-level results, see Table A-105.

Figure 3-35 shows how many of those facilities that reported having a team also had a team leader by subsector.

Figure 3-35. For facilities with an energy management team, percentage with an energy management team leader by subsector



For data and tier-level results, see Table A-107.

The survey also asked whether the energy manager or energy management team leader was an employee or a contractor. Table 3-21 outlines by sub-sector and tier which option was chosen. In all three tiers, employees were much more likely to serve as energy managers than outside contractors.

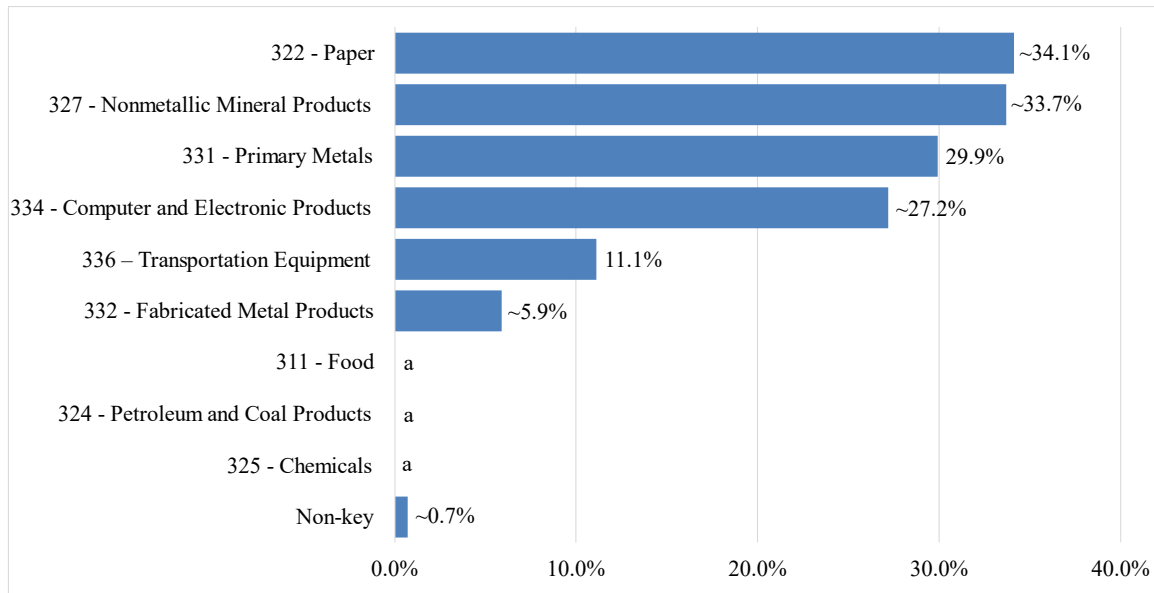
Table 3-21. Facilities by subsector and tier with an energy manager or energy management team leader, percentage of facilities using an employee vs. outside contractor

NAICS and Subsector Manufacturing Type	Tier 1		Tier 2		Tier 3	
	Employee	Outside Contractor	Employee	Outside Contractor	Employee	Outside Contractor
325 - Chemicals	100.0%	0.0%	a	a	a	a
327 - Nonmetallic Mineral Products	100.0%	0.0%	n	n	100.0%	0.0%
311 - Food	96.5%	0.0%	n	n	a	a
322 - Paper	87.3%	~12.7%	a	a	a	a
336 - Transportation Equipment	69.0%	31.0%	a	a	90.3%	~9.7%
332 - Fabricated Metal Products	n	n	~44.7%	~41.0%	76.6%	~23.4%
334 - Computer and Electronic Products	a	a	n	n	95.9%	0.0%
324 - Petroleum and Coal Products	a	a	n	n	n	n
331 - Primary Metals	a	a	a	a	a	a
Non-key	a	a	a	a	100.0%	0.0%
Overall	93.8%	5.2%	84.4%	~11.5%	94.5%	~5.2%

For precisions, see Table A-109.

Figure 3-36 shows the reported demand response participation by subsector. The subsector with the highest participation in demand response is paper, with about 34% of facilities reporting participation. This data was collected during the site visits.

Figure 3-36. Reported demand response participation by subsector



For data and tier-level results, see Table A-111.

3.4 Industrial tier level results compilation

This section of the report provides results at the tier level for key manufacturing facility characteristics. These have been compiled from appendix tables where precisions can be found for each reported primary result.

Table 3-22 provides a summary of key firmographic details for manufacturing facilities in New York by tier. Two percent (2%) of facilities are Tier 1 with 22% of manufacturing employees and 26% of square footage. Tier 3 has the most facilities and employees, but the lowest number of employees per facility. Manufacturing facilities occupy nearly 352 million square feet and employ nearly 330,000 people.

Table 3-22. Industrial firmographics tier-level summary

Industrial Firmographics	Tier 1	Tier 2	Tier 3	Total/Overall
Number of facilities (units)	172	142	7,463	7,777
Number of employees	72,517	23,358	231,747	327,622
Employees per facility	422	164	31	42
Total square footage (1,000s)	91,161	28,221	232,352	351,734

Table 3-23 presents energy consumption overall and per facility, employee, and square foot. Tier 1 facilities represent about 75% of that consumption, reflecting how important and large this collection of manufacturing customers is in the state. Tier 1 facilities also have significantly higher energy consumption across facilities, employees, and square feet.

Table 3-23. Industrial energy consumption summary

Industrial Energy Consumption	Tier 1	Tier 2	Tier 3	Total/Overall
Total consumption (MMBtu 1,000s)	111,697	8,384	28,652	148,733
Energy consumption per facility (MMBtu)	649,581	58,896	3,839	19,125
Energy consumption per employee (MMBtu)	1,540	359	124	454
Energy consumption per square foot (MMBtu/sf)	1.2	0.3	0.1	0.4

Table 3-24 and Table 3-25 are laid out the same way as the previous table but focus on net electricity consumption and non-electric fuel consumption, respectively. Tier 1 facilities continue to dominate these statistics and show how they can be the most impactful facilities to target with clean energy initiatives across the state.

Table 3-24. Industrial net electric energy consumption summary

Industrial Electric Consumption	Tier 1	Tier 2	Tier 3	Total
Total consumption (GWh)	10,573	782	3,435	14,790
Energy consumption per facility (MWh)	61,488	5,495	460	1,902
Energy consumption per employee (MWh)	146	33	15	45
Energy consumption per square foot (kWh/sf)	116	28	15	42

Table 3-25. Industrial non-electric energy consumption summary

Industrial Non-Electric Consumption	Tier 1	Tier 2	Tier 3	Total
Total consumption (MMBtu 1,000s)	75,622	6,543	16,932	98,270
Energy consumption per facility (MMBtu)	439,786	40,430	2,420	13,441
Energy consumption per employee (MMBtu)	1,043	248	77	311
Energy consumption per square foot (MMBtu/sf)	0.8	0.2	0.1	0.3

3.5 Greenhouse results

This study also investigated energy use and practices in greenhouses throughout the state. The following sections summarize the survey and onsite results completed for greenhouses.

3.5.1 Greenhouse firmographics

Table 3-26 provides a summary of key firmographic details for the greenhouse sector in New York. In total, there are approximately 340 greenhouses throughout the state, which employ over 6,400 people. These facilities occupy 39 million square feet and have 29.5 million square feet of greenhouse structure glass space.

Table 3-26. Greenhouse firmographics summary

Greenhouse Firmographics	
Number of facilities	344
Number of employees	6,427
Employee per facility	19
Total square footage (ft ²)	39,239,005
Square feet of glass (ft ²)	29,491,501

For precisions, see A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-113.

Three-hundred and forty facilities is substantially less (17%) than estimated in Phase One, likely because many of the facilities in the population developed in Phase One consisted of hoop houses which were excluded from the study due to the less permanent nature of the structures and their likely low energy use.

3.5.2 Greenhouse energy use

In total, it is estimated that the greenhouse sector in New York State consumes about 3.7 million MMBtu of energy. This is an average of almost 11,000 MMBtu per facility, nearly 600 MMBtu per employee and about 95,000 Btu per square foot. A summary of these numbers is provided in Table 3-27.

Table 3-27. Greenhouse energy consumption summary

Greenhouse Energy Consumption	
Total consumption (MMBtu)	3,740,279
Energy consumption per facility (MMBtu)	10,872
Energy consumption per employee (MMBtu)	582
Energy consumption per square foot (Btu/sf)	94,838

For precisions, see Table A-115.

3.5.2.1 Electric

This results section separates net electric consumption from the non-electric energy consumption provided in Table 3-28. These results are provided as net electric use¹⁵ consistent with the definition used by MECS. Net energy includes electricity purchased from a utility, generated onsite by non-combustible means, generated offsite by others minus that sold or transferred out, though in the greenhouse sector there is very little onsite generation and no notable exporting. Greenhouses consume about 290,000 MWh of electric energy throughout the state, averaging about 841,000 kWh/facility.

Table 3-28. Greenhouse net electric energy consumption summary

Greenhouse Electric Consumption	
Total consumption (MWh)	~289,198
Energy consumption per facility (kWh)	~840,622
Energy consumption per employee (kWh)	~44,998
Energy consumption per square foot (kWh/sf)	~7.3

For precisions, see Table A-117.

Greenhouses reported very little onsite generation, with the only type found from the surveys to be solar.

3.5.2.2 Non-electric

This results section separates the non-electric results from the electric results presented above for greenhouses.

Greenhouses consume about 2.8 million MMBtu of non-electric fuel throughout the state. This averages about 8,100 MMBtu per facility. Note that this table uses the information provided only on the top three fuels used by respondents.

¹⁵ Net electricity is obtained by summing purchases, transfers in, and generation from noncombustible renewable resources, minus quantities sold and transferred out. It does not include electricity inputs from onsite cogeneration or generation from combustible fuels because that energy has already been included as generating fuel (for example, coal).

Table 3-29. Greenhouse non-electric energy consumption summary

Greenhouse Non-Electric Consumption	
Total consumption (MMBtu)	2,753,536
Energy consumption per facility (MMBtu)	8,122
Energy consumption per employee (MMBtu)	429
Energy consumption per square foot (Btu/sf)	70,116

For precisions, see Table A-119.

Natural gas is the largest non-electric fuel type by consumption, making up about 33% of total non-electric consumption. This is followed by fuel oil and then diesel or motor gasoline.

Hydrogen was not reported as being consumed within the greenhouse sector.

Table 3-30. Greenhouse consumption by non-electric fuel type

Overall Non-Electric Consumption	MMBtu	% of total consumption
Natural gas	908,683	33.0%
Fuel oil, Kerosene, or Distillate	~518,480	~18.8%
Diesel or motor gasoline	~467,328	~17.0%
Propane or liquid gases	397,235	14.4%
Renewable Fuels	~353,110	~12.8%
Coal-based product	108,700	3.9%
Purchased hot water or steam	n	n
By-product of Recycled energy	n	n
Hydrogen	n	n
Don't Know	n	n
Total	2,753,536	100.0%

For precisions, see Table A-121.

3.5.2.3 Energy expenditures

Table 3-31 shows electric and non-electric energy expenditures for the greenhouse subsector. The costs used for each fuel unit in this analysis is provided in Appendix F. Originally all greenhouses in New York state were estimated to fall within the Tier 3 category, however there were three greenhouses identified that fell within Tier 1 and Tier 2. Overall, in New York the greenhouse sector spends about \$58 million per year on energy.

Table 3-31. Total greenhouse energy expenditures

Greenhouse Energy Expenditures	Energy Expenditures	
	(\$1,000)	% of total expenditures
Electric Expenditures	~\$18,277	32%
Non-electric Expenditures	\$39,474	68%
Total Expenditures	\$57,751	100%

For precisions, see Table A-123.

3.5.2.4 GHG analysis

Table 3-32 shows total emissions for the greenhouse subsector. Note that this only includes Scope 1 and Scope 2 emissions. In total, the greenhouse subsector emits about 340,000 metric tons of CO₂e. This is the equivalent of 75,660¹⁶ gas-powered vehicles driven for one year.

Table 3-32. Total greenhouse GHG emissions

Greenhouse GHG Emissions	
Total Emissions (MTCO ₂ e)	338,520
Emissions per facility (MTCO ₂ e)	984
Emissions per employee (MTCO ₂ e)	53
Emissions per square foot (MTCO ₂ e /sf)	0

For precisions, see Table A-125.

Table 3-33 shows the percentage of greenhouses that have completed GHG inventories. This sector has a very low number of facilities having completed this at only 1.4% overall and zero completing a Scope 3 inventory.

Table 3-33. Percentage of greenhouse facilities that have completed GHG inventories of reduction strategies

NAICS and subsector manufacturing type	Completed a GHG inventory	Completed a Scope 3 GHG inventory	Implemented a Strategy to reduce Scope 3 Emissions
	%	%	%
Greenhouses	~1.4%	0.0%	~1.4%

For precisions, see Table A-127.

3.5.3 Greenhouse end-use analysis

This section summarizes the end use breakdowns for greenhouses and provides equipment and process energy consumption within the greenhouse subsector.

3.5.3.1 Electric

Table 3-34 shows high-level electric end use breakdowns for the greenhouse subsector derived from the web survey, while Table 3-35 shows a more granular table derived from the virtual site visits. There is a significant difference between the onsite results and the web survey results in the electric energy reported being used for boilers and process heating onsite. This could be due to some level of sampling bias with respect to the virtual onsites completed as several of those sites reported higher electric consumption than reported by most of the web surveys for boilers and heating electric consumption.

¹⁶ Per: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Table 3-34. Percentage of greenhouse electricity by high-level end use

NAICS and subsector manufacturing type	Boilers or generators		Greenhouse lighting		Other Greenhouse Processes		Basic facility operations		Other		Don't know/Unknown		Total	
	MWh	%	MWh	%	MWh	%	MWh	%	MWh	%	MWh	%	MWh	%
Greenhouses	~17,846	~6.2%	~162,830	~56.3%	55,263	~19.1%	18,730	~6.5%	4,952	~1.7%	~29,577	~10.2	~289,198	100%

Boilers and generators - e.g., gas turbines, boilers, or combustion turbines used for energy transformation

Basic facility operations - e.g., lighting and HVAC

a indicates a result withheld due to data quality issues or to protect the identity of individual establishments

For precisions, see Table A-129.

Table 3-35. Detailed percentage of total electricity used for production and non-production end uses

NAICS and subsector manufacturing type	Production Use						Facility/Non-production Use					
	Boilers (%)	Heating (%)	Cooling and refrigeration (%)	Machine drive (%)	Electro-chemical processes (%)	Other (%)	HVAC (%)	Lighting (%)	Other facility support (%)	Onsite transportation (%)	Other facility use (%)	
Greenhouses	23.2%	~25.1%	~0.5%	~4.8%	0.0%	0.0%	~6.8%	~3.4%	~4.5%	0.0%	0.0%	

Boilers - includes the transformation of energy to another usable energy source, as in a boiler, gas turbine, or combustion turbine

Heating - e.g., kilns, furnaces, ovens, strip heater

Other facility support - cooking, water heating, office equipment

Onsite transportation - excluding highway use

For precisions, see Table A-131.

3.5.3.2 Non-electric

Table 3-36 shows high-level non-electric end use breakdowns for the greenhouse subsector derived from the web survey. Due to high variability in the values provided during the site visits, it is not possible to provide reliable high-level, or detailed, end use data from the site visits.

Table 3-36. Percentage of non-electric fuel consumption by high-level end use

NAICS and subsector manufacturing type	Boilers or generators		Greenhouse lighting		Other Greenhouse Processes		Basic facility operations		Other		Don't know/Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
Greenhouses	966,768	61.3%	0	0.0%	407,140	25.8%	36,681	2.3%	82,883	5.3%	~83,248	~5.3%	1,576,720	100.0%

Boilers and generators - e.g., gas turbines, boilers, or combustion turbines used for energy transformation

Basic facility operations - e.g., lighting and HVAC

For precisions, see Table A-133.

3.5.3.3 *Equipment summaries*

Greenhouses were asked what types of equipment they had, and how recently they had completed upgrades on that equipment. The most common equipment noted were fans, with over 78% of the facilities reporting having them. Next most common were other motors and process heating. Less than 10% of any individual equipment category had received an energy efficiency upgrade in the last three years. Fans and process heating equipment were reported as the highest, 8.7% had received an upgrade in the last three years

Table 3-37. Percentage of facilities with specific equipment types, with percentage that recently upgraded each equipment type

Equipment Type	% facilities with equipment	% facilities that received EE upgrades on equipment in last 3 years
Fans	78.3%	8.7%
Other motors	33.3%	~4.3%
Other process heating	29.0%	8.7%
Pumping	24.6%	5.8%
Refrigeration	18.8%	~2.9%
Air compressors	15.9%	~2.9%
Other	13.0%	5.8%
Process boiler	11.6%	~2.9%
Process cooling (above 40F)	7.2%	0.0%
Drying and curing	5.8%	0.0%
Humidification	~4.3%	0.0%

a indicates a result withheld due to data quality issues or to protect the identity of individual establishments
 For precisions, see Table A-137.

Table 3-38 shows how the facilities graded the efficiency level of their equipment. There were some responses in the high efficiency category, with 17.4% of the fans and 11.6% of the other process heating equipment considered to be high efficiency. However, more of the greenhouse equipment fell into the moderate efficiency category, with almost 41% of the fans, 13% of the process heating and 14.5% of the other motors reported as moderate efficiency. This suggests some room for improvement and the potential for energy efficiency gains.

Table 3-38. Percentage of facilities with specific equipment types, with percentage of facilities at different equipment efficiency levels

Equipment Type	% facilities with equipment	Equipment efficiency			
		Low %	Moderate %	High %	DK %
Fans	78.3%	10.1%	40.6%	17.4%	10.1%
Other motors	33.3%	a	14.5%	10.1%	a
Other process heating	29.0%	a	13.0%	11.6%	a
Pumping	24.6%		13.0%	10.1%	a
Refrigeration	18.8%	a	13.0%	a	a
Air compressors	15.9%	a	8.7%	a	a
Other	13.0%		a	a	a
Process boiler	11.6%	a	a	a	
Process cooling (above 40F)	7.2%	a	a		
Drying and curing	5.8%	a		a	a
Humidification	~4.3%		a		a

a indicates a result withheld due to data quality issues or to protect the identity of individual establishments
 For precisions, see Table A-138.

Table 3-39. Percentage of facilities by maintenance practices

NAICS	System	Regular Maintenance at specific times	No regular maintenance scheduled (as needed)	Do not know	N/A
Greenhouse	Facility Building	45%	52%	0%	3%
	Production Equipment	45%	46%	1%	7%
	Production Process	36%	48%	4%	12%

a indicates a result withheld due to data quality issues or to protect the identity of individual establishments
 For precisions, see Table A-140.

Table 3-40 shows the percentage of facilities that have completed process upgrades within the greenhouse subsector. Fourteen and a half percent (14.5%) of facilities reported having completed upgrades in the last three years, while 52.2% reported no plans in place.

Table 3-40. Percentage of facilities that have completed process upgrades

NAICS	Yes			No			Don't know	Total
	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place		
Greenhouse	14.5%	8.7%	0.0%	7.2%	8.7%	52.2%	8.7%	100.0%

For precisions, see Table A-142.

Table 3-41 provides a summary of the greenhouse sector’s awareness of and willingness to use various funding sources. Most facilities report self-funding or using commercial loans, while only 18.8% report using utility incentives and 13% report using state incentives. Fort-six percent (46%) are not aware of or have not used utility incentives, and 51% are not aware of or have not used state incentives.

Table 3-41. Percentage of facilities with barriers to funding sources for process upgrades by financing type

Finance type	Aware/have used	Aware/would consider using	Aware/won't use	Not aware/have not used	Did not answer	Total
Self—funding	71.0%	8.7%	5.8%	11.6%	2.9%	100.0%
Commercial lending (loans)	52.2%	14.5%	20.3%	13.0%	.	100.0%
On-bill financing	10.1%	11.6%	23.2%	53.6%	1.4%	100.0%
Energy-as-a-Service (EaaS)	.	11.6%	8.7%	78.3%	1.4%	100.0%
Utility Incentives	18.8%	29.0%	4.3%	46.4%	1.4%	100.0%
State Incentives	13.0%	29.0%	5.8%	50.7%	1.4%	100.0%
Other	.	.	.	.	100.0%	100.0%

For precisions, see Table A-144.

3.5.4 Greenhouse energy and climate practices and policies

Most greenhouses noted having no plans in place to establish an energy consumption baseline or an energy map identifying the top energy drivers and end uses in the facilities.

Table 3-42. Greenhouse baseline and mapping

Greenhouse Summary	Yes				No		Don't know
	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	
Facilities with established energy consumption baseline	~2.9%	~1.4%	~2.9%	0.0%	8.7%	73.9%	10.1%
Facilities with an energy map identifying the top energy drivers and end uses in the facility	~4.3%	~1.4%	5.8%	0.0%	8.7%	63.8%	15.9%

a indicates a result withheld due to data quality issues or to protect the identity of individual establishments

For precisions, see Table A-146.

Table 3-43 outlines the responses by greenhouse facilities for a variety of questions regarding energy management practices. Few facilities reported having a written energy policy or having calculated the portion of recycled content (4.3% in both cases). Less than 9% reported having defined energy performance goals, yet 23% reported having a staff person with formal responsibility for energy performance.

Table 3-43. Energy management practices

Energy management practice	% of facilities
Greenhouses that track energy use compared to a standard baseline	8.7%
Greenhouses with a written energy policy	~4.3%
Greenhouses with a climate action plan	0.0%
Greenhouses that have calculated portion of recycled content	~4.3%
Greenhouses that have defined energy performance goals	8.7%
Of those with goal, percent that have a written plan	50.0%
Greenhouses with a staff person with formal responsibility for energy performance	23.2%
Of those with no energy manager, percent that have plans to identify an energy manager	~4.2%
Greenhouses that have a team responsible for energy performance	5.8%
Of those facilities with an energy management team, percent with a team leader	a
Of those with an energy manager, percent that use an employee	94.1%
Of those with an energy manager, percent that use a contractor	0.0%

a indicates a result withheld due to data quality issues or to protect the identity of individual establishments
 For precisions, see Table A-148.

Appendix A Main report tables and relative precisions

The results in this appendix are for total NYS manufacturing and greenhouse populations, as determined based on eligibility for inclusion in the study. All precisions provided are relative at the 90% confidence interval.

This appendix has more granular annotations for the masking performed on the results than are used in the body of the report. The notations below provide the reasons a result was suppressed, in the order of their application to the results:

- ‘n’ indicates no responses for a particular result. No value will appear in the cell.
- ‘b’ indicates too few responses in a single cell (<5 responses). No value will appear in the cell.
- ‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.
- ‘∩’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.
- ‘c’ indicates RSE is greater than 100% and too variable to be reported. No value will appear in the cell.
- ‘m’ indicates complementary masking performed when a row or column in a sum table is masked to prevent backing out the masked value based on the totals. No value will appear in the cell.
- A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-1. Number of facilities by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	Facilities	% of total facilities	Tier 1	Tier 2	Tier 3
311 - Food	357	5%	m	b	300
322 - Paper	90	1%	32	11	m
324 - Petroleum and Coal Products	21	0%	b	.	m
325 - Chemicals	142	2%	m	b	106
327 - Nonmetallic Mineral Products	155	2%	m	b	130
331 - Primary Metals	74	1%	15	11	48
332 - Fabricated Metal Products	1,570	20%	6	14	1,549
334 - Computer and Electronic Products	196	3%	8	1	188
336 - Transportation Equipment	89	1%	10	11	68
Non-key	5,083	65%	27	47	5009
Total	7,777	100%	172	142	7,463

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'm' indicates complementary masking performed when a row or column in a sum table is masked to prevent backing out the masked value based on the totals. No value will appear in the cell.

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-2. Relative precision table for number of facilities by subsector and tier

NAICS and Subsector Manufacturing Type	Facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±4.3%	±27.0%	±161.4%	±14.1%
322 - Paper	±16.1%	±23.7%	±51.8%	±30.1%
324 - Petroleum and Coal Products	±29.7%	±131.8%	.	±36.8%
325 - Chemicals	±17.3%	±25.0%	±68.1%	±24.2%
327 - Nonmetallic Mineral Products	±12.9%	±40.8%	±66.9%	±15.5%
331 - Primary Metals	±15.6%	±19.3%	±53.0%	±23.6%
332 - Fabricated Metal Products	±2.2%	±35.6%	±58.7%	±2.1%
334 - Computer and Electronic Products	±9.7%	±27.0%	.	±10.1%
336 - Transportation Equipment	±15.1%	±24.9%	±43.5%	±21.0%
Non-Key	±0.9%	±37.3%	±55.7%	±1.0%
Total	±0.1%	±10.4%	±35.7%	±0.7%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-3. Number of employees by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	Employees	% of total employees	Tier 1	Tier 2	Tier 3
311 - Food	16,075	5%	8,396	b	m
322 - Paper	9,132	3%	5,727	784	2,621
324 - Petroleum and Coal Products	364	0%	b	.	m
325 - Chemicals	18,520	5.6%	^11,824	b	m
327 - Nonmetallic Mineral Products	7,058	2%	m	b	3,077
331 - Primary Metals	5,196	2%	3,162	819	1,215
332 - Fabricated Metal Products	85,473	26%	2,451	2,623	80,399
334 - Computer and Electronic Products	30,950	10%	10,116	.	20,835
336 - Transportation Equipment	16,445	5%	9,640	1,949	4,856
Non-key	138,405	42%	18,103	12,306	108,000
Total	327,622	100%	72,517	23,358	231,747

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'm' indicates complementary masking performed when a row or column in a sum table is masked to prevent backing out the masked value based on the totals. No value will appear in the cell.

'^' indicates a single weighted response represents more than 50% of a given aggregate calculation.

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-4. Relative precision table for number of employees by subsector

NAICS and Subsector Manufacturing Type	Employees	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±17.8%	±18.6%	±161.4%	±20.5%
322 - Paper	±17.6%	±26.0%	±65.0%	±38.8%
324 - Petroleum and Coal Products	±29.3%	±131.8%	.	±36.0%
325 - Chemicals	±48.3%	±70.7%	±110.3%	±54.8%
327 - Nonmetallic Mineral Products	±18.1%	±41.2%	±83.1%	±24.1%
331 - Primary Metals	±12.8%	±20.0%	±37.0%	±27.0%
332 - Fabricated Metal Products	±35.3%	±37.6%	±53.1%	±37.5%
334 - Computer and Electronic Products	±21.0%	±41.6%	.	±25.4%
336 - Transportation Equipment	±16.6%	±27.8%	±46.5%	±30.8%
Non-Key	±17.5%	±41.7%	±59.4%	±21.1%
Total	±12.3%	±17.3%	±35.8%	±16.5%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-5. Number of employees per facility by subsector and tier

NAICS and Subsector Manufacturing Type	Employees/Facility	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	45	268	b	21
322 - Paper	101	177	69	57
324 - Petroleum and Coal Products	17	b	.	17
325 - Chemicals	130	^529	b	39
327 - Nonmetallic Mineral Products	46	184	b	24
331 - Primary Metals	70	206	76	25
332 - Fabricated Metal Products	54	401	182	52
334 - Computer and Electronic Products	158	1264	.	111
336 - Transportation Equipment	184	924	183	71
Non-key	27	669	260	22
Overall	42	422	164	31

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.
 A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-6. Relative precision table for number of employees per facility by subsector and tier

NAICS and Subsector Manufacturing Type	Employees/Facility	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±17.1%	±22.2%	±0.0%	±22.1%
322 - Paper	±15.9%	±18.0%	±35.1%	±26.7%
324 - Petroleum and Coal Products	±29.9%	±0.0%	.	±33.6%
325 - Chemicals	±50.2%	±68.9%	±61.9%	±54.5%
327 - Nonmetallic Mineral Products	±17.7%	±30.5%	±43.5%	±19.3%
331 - Primary Metals	±16.1%	±15.9%	±20.0%	±23.5%
332 - Fabricated Metal Products	±35.2%	±7.7%	±13.2%	±37.4%
334 - Computer and Electronic Products	±19.4%	±33.8%	.	±22.4%
336 - Transportation Equipment	±21.6%	±23.1%	±17.7%	±33.1%
Non-Key	±17.5%	±26.8%	±30.4%	±21.0%
Overall	±12.3%	±15.8%	±27.4%	±16.5%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-7. Square footage estimate by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	Square Feet (1,000)	% of total square feet	Tier 1	Tier 2	Tier 3
311 - Food	15,335	4%	8,715	b	m
322 - Paper	19,206	6%	14,349	1,114	3,743
324 - Petroleum and Coal Products	900	0.3%	b	.	m
325 - Chemicals	17,591	5%	6,217	b	m
327 - Nonmetallic Mineral Products	20,511	6%	11,060	b	m
331 - Primary Metals	13,898	4%	10,591	1,539	1,769
332 - Fabricated Metal Products	90,785	26%	m	2,541	85,765
334 - Computer and Electronic Products	18,524	5%	7,613	.	10,911
336 - Transportation Equipment	18,093	5%	13,171	1,283	3,640
Non-Key	136,891	39%	16,568	^13,305	107,018
Total	351,734	100%	91,161	28,221	232,352

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'm' indicates complementary masking performed when a row or column in a sum table is masked to prevent backing out the masked value based on the totals. No value will appear in the cell.

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-8. Relative precision table for square footage estimates by subsector and tier precision table

NAICS and Subsector Manufacturing Type	Overall NAICS	Tier		
	Square Feet	Tier 1	Tier 2	Tier 3
311 - Food	±22.0%	±28.6%	±161.5%	±35.3%
322 - Paper	±20.3%	±26.6%	±61.8%	±46.3%
324 - Petroleum and Coal Products	±60.7%	±131.8%	.	±64.6%
325 - Chemicals	±49.2%	±49.2%	±119.0%	±48.2%
327 - Nonmetallic Mineral Products	±34.8%	±56.4%	±91.0%	±53.6%
331 - Primary Metals	±14.1%	±18.5%	±34.1%	±32.1%
332 - Fabricated Metal Products	±30.6%	±48.0%	±80.0%	±32.3%
334 - Computer and Electronic Products	±24.2%	±36.9%	.	±33.2%
336 - Transportation Equipment	±23.5%	±33.1%	±52.5%	±28.2%
Non-Key	±24.2%	±45.9%	±83.9%	±28.8%
Total	±12.9%	±13.7%	±49.7%	±18.1%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-9. Square footage per facility by subsector and tier

NAICS and Subsector Manufacturing Type	Square Feet/Facility	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	43,848	278,146	b	20,858
322 - Paper	213,177	442,542	97,316	80,978
324 - Petroleum and Coal Products	41,992	b	.	26,201
325 - Chemicals	123,592	278,363	b	43,259
327 - Nonmetallic Mineral Products	143,190	664,929	b	70,367
331 - Primary Metals	191,263	690,719	142,023	38,039
332 - Fabricated Metal Products	59,438	405,270	176,449	56,916
334 - Computer and Electronic Products	100,043	951,625	.	61,589
336 - Transportation Equipment	202,440	1,262,684	120,234	53,312
Non-key	27,329	612,223	^281,009	21,687
Overall	46,096	530,151	198,239	31,759

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.
 A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-10. Relative precision table for square footage estimates per facility by subsector

NAICS and Subsector Manufacturing Type	Square Feet/Facility	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±20.1%	±21.7%	±0.0%	±35.7%
322 - Paper	±19.2%	±20.5%	±29.3%	±29.6%
324 - Petroleum and Coal Products	±57.3%	±0.0%	.	±49.8%
325 - Chemicals	±49.8%	±46.1%	±72.2%	±46.9%
327 - Nonmetallic Mineral Products	±35.0%	±46.8%	±58.8%	±49.0%
331 - Primary Metals	±18.9%	±18.3%	±31.6%	±27.9%
332 - Fabricated Metal Products	±30.5%	±15.1%	±25.7%	±32.2%
334 - Computer and Electronic Products	±22.7%	±30.7%	.	±30.1%
336 - Transportation Equipment	±26.9%	±29.9%	±38.7%	±27.5%
Non-Key	±24.2%	±24.0%	±56.3%	±28.8%
Overall	±12.9%	±10.9%	±45.1%	±18.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-11. Energy consumption by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	MMBtu	% of total MMBtu	Tier 1	Tier 2	Tier 3
311 - Food	14,382,126	10%	11,470,699	b	m
322 - Paper	30,193,506	20%	29,024,592	841,997	326,917
324 - Petroleum and Coal Products	500,542	0%	b	.	m
325 - Chemicals	25,360,873	17%	23,692,113	b	m
327 - Nonmetallic Mineral Products	7,513,926	5%	6,071,062	b	m
331 - Primary Metals	^15,542,029	^10.4%	^14,448,197	669,978	423,854
332 - Fabricated Metal Products	14,205,015	10%	m	814,993	9,221,167
334 - Computer and Electronic Products	^7,186,419	^4.8%	^5,710,738	.	1,475,681
336 - Transportation Equipment	^11,964,122	^8.0%	^10,400,919	712,329	850,874
Non-Key	21,884,521	15%	6,548,205	2,378,585	12,957,731
Total	148,733,079	100%	111,697,147	8,384,380	28,651,551

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 A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-12. Relative precision table for energy consumption estimates by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	MMBtu	% of total MMBtu	Tier 1	Tier 2	Tier 3
311 - Food	±33.3%	±33.1%	±36.7%	±161.4%	±41.5%
322 - Paper	±41.5%	±35.1%	±43.3%	±52.7%	±38.5%
324 - Petroleum and Coal Products	±54.9%	±56.6%	±131.8%	.	±68.1%
325 - Chemicals	±46.8%	±40.5%	±50.2%	±64.4%	±52.1%
327 - Nonmetallic Mineral Products	±28.0%	±30.3%	±34.3%	±71.1%	±55.3%
331 - Primary Metals	±38.0%	±36.7%	±40.9%	±59.1%	±38.5%
332 - Fabricated Metal Products	±20.1%	±23.1%	±11.6%	±56.6%	±30.3%
334 - Computer and Electronic Products	±59.0%	±57.9%	±74.0%	.	±30.9%
336 - Transportation Equipment	±59.9%	±56.6%	±68.8%	±44.4%	±58.9%
Non-Key	±16.6%	±20.1%	±33.3%	±57.2%	±21.0%
Total	±14.2%	±0.0%	±18.5%	±33.8%	±14.1%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-13. Energy consumption per facility by subsector and tier

NAICS and Subsector Manufacturing Type	MMBtu/ Facility	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	40,339	366,086	b	5,060
322 - Paper	335,133	895,160	73,565	7,072
324 - Petroleum and Coal Products	23,359	b	.	17,697
325 - Chemicals	178,179	1,060,841	b	6,136
327 - Nonmetallic Mineral Products	48,506	364,989	b	6,844
331 - Primary Metals	^209,320	^942,274	61,844	8,815
332 - Fabricated Metal Products	9,050	^681,557	56,597	5,953
334 - Computer and Electronic Products	^36,757	^713,842	.	7,870
336 - Transportation Equipment	^133,864	^997,159	66,781	12,462
Non-key	4,305	241,969	50,236	2,587
Overall	19,125	649,581	58,896	3,839

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 A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-14. Relative precision table for energy consumption estimates per facility by subsector and tier

NAICS and Subsector Manufacturing Type	MMBtu/ Facility	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±32.5%	±33.5%	±0.0%	±42.0%
322 - Paper	±42.8%	±39.6%	±11.4%	±36.0%
324 - Petroleum and Coal Products	±40.2%	±0.0%	.	±41.4%
325 - Chemicals	±49.7%	±48.2%	±12.2%	±51.4%
327 - Nonmetallic Mineral Products	±28.9%	±32.5%	±31.1%	±50.5%
331 - Primary Metals	±40.4%	±41.1%	±19.6%	±36.9%
332 - Fabricated Metal Products	±20.0%	±26.0%	±7.7%	±30.2%
334 - Computer and Electronic Products	±59.3%	±66.4%	.	±28.3%
336 - Transportation Equipment	±60.7%	±61.0%	±4.9%	±57.6%
Non-Key	±16.5%	±18.8%	±13.9%	±20.9%
Overall	±14.2%	±18.2%	±6.2%	±14.1%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-15. Consumption per employee by subsector and tier

NAICS and Subsector Manufacturing Type	MMBtu/ Employee	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	895	1,366	b	241
322 - Paper	3,306	5,068	1,074	125
324 - Petroleum and Coal Products	1,373	b	.	1,063
325 - Chemicals	1,369	^2,004	b	158
327 - Nonmetallic Mineral Products	1,065	1,988	b	288
331 - Primary Metals	^2,991	^4,570	818	349
332 - Fabricated Metal Products	166	^1,701	311	115
334 - Computer and Electronic Products	^232	~565	.	71
336 - Transportation Equipment	^728	^1,079	366	175
Non-key	158	362	193	120
Overall	454	1,540	359	124

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 A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-16. Relative precision table for consumption per employee by subsector and tier

NAICS and Subsector Manufacturing Type	MMBtu/ Employee	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±28.3%	±34.4%	±0.0%	±38.2%
322 - Paper	±37.2%	±35.2%	±38.0%	±39.3%
324 - Petroleum and Coal Products	±55.4%	±0.0%	.	±67.6%
325 - Chemicals	±29.7%	±37.8%	±73.2%	±22.3%
327 - Nonmetallic Mineral Products	±22.3%	±21.0%	±74.6%	±51.3%
331 - Primary Metals	±35.2%	±37.1%	±23.0%	±34.7%
332 - Fabricated Metal Products	±35.8%	±28.1%	±8.9%	±41.7%
334 - Computer and Electronic Products	±48.4%	±36.9%	.	±15.9%
336 - Transportation Equipment	±64.5%	±77.5%	±19.0%	±38.9%
Non-Key	±15.9%	±25.8%	±26.8%	±19.8%
Overall	±16.7%	±18.2%	±27.1%	±17.1%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-17. Consumption per square foot estimate by subsector and tier

NAICS and Subsector Manufacturing Type	MMBtu/ Square Foot	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	0.9	1.3	b	0.2
322 - Paper	1.6	2	0.8	0.1
324 - Petroleum and Coal Products	0.6	b	.	0.7
325 - Chemicals	1.4	3.8	b	0.1
327 - Nonmetallic Mineral Products	0.4	0.5	b	0.1
331 - Primary Metals	^1.1	^1.4	0.4	0.2
332 - Fabricated Metal Products	0.2	^1.7	0.3	0.1
334 - Computer and Electronic Products	^0.4	^0.8	.	0.1
336 - Transportation Equipment	^0.7	^0.8	0.6	0.2
Non-key	0.2	0.4	^0.2	0.1
Overall	0.4	1.2	0.3	0.1

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A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-18. Relative precision table for consumption per square foot by subsector

NAICS and Subsector Manufacturing Type	MMBtu/ Square Foot	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±33.7%	±39.3%	±0.0%	±45.3%
322 - Paper	±38.1%	±38.7%	±31.8%	±45.4%
324 - Petroleum and Coal Products	±38.5%	±0.0%	.	±53.2%
325 - Chemicals	±66.7%	±69.6%	±83.3%	±27.7%
327 - Nonmetallic Mineral Products	±26.2%	±29.5%	±83.3%	±55.4%
331 - Primary Metals	±33.0%	±34.6%	±43.8%	±25.2%
332 - Fabricated Metal Products	±22.4%	±39.8%	±30.4%	±25.0%
334 - Computer and Electronic Products	±47.8%	±38.8%	.	±17.8%
336 - Transportation Equipment	±67.6%	±80.3%	±41.8%	±36.6%
Non-Key	±19.2%	±22.8%	±43.6%	±23.0%
Overall	±17.4%	±20.1%	±43.3%	±14.2%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-19. Net electric consumption by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	MWh	% of total MWh	Tier 1	Tier 2	Tier 3
311 - Food	862,191,725	6%	674,050,820	b	m
322 - Paper	1,742,887,893	12%	1,644,452,699	33,354,640	65,080,554
324 - Petroleum and Coal Products	^26,526,525	^0.2%	b	.	m
325 - Chemicals	^1,678,400,934	^11%	^1,543,893,734	b	m
327 - Nonmetallic Mineral Products	457,593,322	3%	m	b	m
331 - Primary Metals	^2,952,456,139	^20%	^2,845,716,729	58,498,387	48,241,023
332 - Fabricated Metal Products	2,264,441,387	15%	^971,729,949	^143,990,628	1,148,720,810
334 - Computer and Electronic Products	^1,511,012,308	^10%	^1,255,841,669	.	255,170,640
336 - Transportation Equipment	601,475,270	4%	493,151,998	34,991,019	73,332,254
Non-Key	2,693,005,553	18%	802,108,567	374,918,885	1,515,978,101
Total	14,789,991,057	100%	10,572,939,758	782,298,873	3,434,752,426

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 A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-20. Relative precision table for net electric consumption by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	kWh	% of total kWh	Tier 1	Tier 2	Tier 3
311 - Food	±29.5%	±33.2%	±35.4%	±161.4%	±42.0%
322 - Paper	±59.4%	±55.1%	±63.2%	±66.9%	±42.6%
324 - Petroleum and Coal Products	±90.6%	±92.2%	±131.8%	.	±98.6%
325 - Chemicals	±86.8%	±78.4%	±94.4%	±105.6%	±67.8%
327 - Nonmetallic Mineral Products	±56.8%	±58.0%	±76.5%	±113.0%	±38.4%
331 - Primary Metals	±51.1%	±43.6%	±53.0%	±63.1%	±53.3%
332 - Fabricated Metal Products	±17.7%	±23.4%	±2.5%	±81.6%	±33.4%
334 - Computer and Electronic Products	±70.1%	±65.1%	±84.2%	.	±34.6%
336 - Transportation Equipment	±24.4%	±29.6%	±29.6%	±52.0%	±52.5%
Non-Key	±19.2%	±23.9%	±40.4%	±60.1%	±23.3%
Total	±18.0%	±0.0%	±24.7%	±35.4%	±15.6%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-21. Net electric consumption per facility by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Facility (kWh)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	2,418,264	21,512,260	b	490,948
322 - Paper	19,345,172	50,717,281	2,914,176	1,407,919
324 - Petroleum and Coal Products	^1,237,904	b	.	^1,288,042
325 - Chemicals	^11,792,044	^69,129,570	b	637,625
327 - Nonmetallic Mineral Products	2,953,981	^20,448,075	b	683,614
331 - Primary Metals	^39,763,719	^185,590,221	5,399,851	1,003,280
332 - Fabricated Metal Products	1,442,664	^158,865,932	^9,999,349	741,537
334 - Computer and Electronic Products	^7,728,493	^156,980,209	.	1,360,824
336 - Transportation Equipment	6,729,793	47,279,552	3,280,408	1,074,028
Non-key	529,812	29,639,541	7,918,397	302,679
Overall	1,901,760	61,487,560	5,495,210	460,257

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'^' indicates a single weighted response represents more than 50% of a given aggregate calculation.

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-22. Relative precision table for net electric consumption per facility by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Facility (kWh)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±28.6%	±25.7%	±0.0%	±43.1%
322 - Paper	±60.1%	±59.6%	±42.9%	±39.7%
324 - Petroleum and Coal Products	±80.2%	±0.0%	.	±85.9%
325 - Chemicals	±88.4%	±93.7%	±59.4%	±67.0%
327 - Nonmetallic Mineral Products	±57.4%	±72.0%	±93.2%	±31.7%
331 - Primary Metals	±53.2%	±54.7%	±47.8%	±51.5%
332 - Fabricated Metal Products	±17.5%	±34.5%	±26.8%	±33.3%
334 - Computer and Electronic Products	±70.3%	±76.8%	.	±31.6%
336 - Transportation Equipment	±28.2%	±26.0%	±41.4%	±53.8%
Non-Key	±19.1%	±28.1%	±23.8%	±23.2%
Overall	±18.0%	±24.9%	±27.2%	±15.6%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-23. Net electric consumption per employee by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Employee (kWh)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	53,635	80,279	b	23,380
322 - Paper	190,849	287,131	42,529	24,832
324 - Petroleum and Coal Products	^72,789	b	.	^77,363
325 - Chemicals	^90,625	^130,573	b	16,400
327 - Nonmetallic Mineral Products	64,832	^111,396	b	28,793
331 - Primary Metals	^568,254	^900,116	71,419	39,702
332 - Fabricated Metal Products	26,493	^396,490	^54,906	14,288
334 - Computer and Electronic Products	^48,820	^124,150	.	12,247
336 - Transportation Equipment	36,576	51,158	17,956	15,101
Non-key	19,457	44,308	30,467	14,037
Overall	45,143	145,800	33,492	14,821

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'^' indicates a single weighted response represents more than 50% of a given aggregate calculation.

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-24. Relative precision table for net electric consumption per employee by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Employee (MWh)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±21.8%	±21.1%	±0.0%	±34.7%
322 - Paper	±53.9%	±53.0%	±40.9%	±41.0%
324 - Petroleum and Coal Products	±84.5%	±0.0%	.	±90.2%
325 - Chemicals	±101.8%	±122.2%	±29.6%	±20.3%
327 - Nonmetallic Mineral Products	±49.0%	±52.6%	±107.4%	±30.5%
331 - Primary Metals	±49.3%	±51.0%	±56.5%	±49.2%
332 - Fabricated Metal Products	±34.0%	±36.1%	±36.5%	±41.3%
334 - Computer and Electronic Products	±59.3%	±46.9%	.	±17.5%
336 - Transportation Equipment	±16.9%	±18.9%	±30.3%	±31.4%
Non-Key	±19.4%	±44.3%	±40.1%	±22.2%
Overall	±20.5%	±27.4%	±23.8%	±17.5%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-25. Net electric consumption per square foot by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Square Foot (kWh)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	56	77	b	24
322 - Paper	91	115	30	17
324 - Petroleum and Coal Products	^30	b	.	^49
325 - Chemicals	^95	^248	b	15
327 - Nonmetallic Mineral Products	21	^31	b	8
331 - Primary Metals	^212	^269	38	26
332 - Fabricated Metal Products	25	^392	^57	13
334 - Computer and Electronic Products	^81	^165	.	23
336 - Transportation Equipment	33	37	27	20
Non-key	20	48	^28	14
Overall	42	116	28	15

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'^' indicates a single weighted response represents more than 50% of a given aggregate calculation.

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-26. Relative precision table for net electric consumption per square foot by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Square Foot (kWh)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±24.2%	±24.5%	±0.0%	±46.5%
322 - Paper	±55.8%	±58.0%	±44.9%	±49.1%
324 - Petroleum and Coal Products	±81.7%	±0.0%	.	±46.9%
325 - Chemicals	±98.3%	±106.9%	±38.9%	±45.2%
327 - Nonmetallic Mineral Products	±42.4%	±39.0%	±68.6%	±49.0%
331 - Primary Metals	±46.5%	±47.5%	±42.2%	±38.1%
332 - Fabricated Metal Products	±25.1%	±47.1%	±5.0%	±30.1%
334 - Computer and Electronic Products	±58.2%	±49.6%	.	±20.3%
336 - Transportation Equipment	±8.6%	±10.0%	±41.8%	±32.2%
Non-Key	±20.8%	±41.4%	±62.9%	±21.8%
Overall	±20.0%	±24.6%	±37.5%	±15.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-27. Net electric consumption by subsector and type of onsite generation

NAICS and Subsector Manufacturing Type	Electric Consumption (MWh)					
	CHP Cogen	Solar	Wind	Hydropower	Other	Total
311 - Food	0	0	0	0	^32	^32
322 - Paper	^118,527	^507	0	^19,137	0	^138,171
324 - Petroleum and Coal Products	0	0	0	0	0	0
325 - Chemicals	^1,086	^15	0	0	0	^1,101
327 - Nonmetallic Mineral Products	^2,546	^1,780	0	0	0	4,326
331 - Primary Metals	0	^153	0	0	0	^153
332 - Fabricated Metal Products	0	^2,333	0	0	0	^2,333
334 - Computer and Electronic Products	0	^6,154	0	0	^8	^6,163
336 - Transportation Equipment	0	^4,191	0	0	0	^4,191
Non-key	^6,939	4,680	^1,112	0	^28,430	^41,161
Total	129,099	19,813	^1,112	^19,137	^28,471	197,632

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-28. Relative precision table for net electric consumption by subsector and type of onsite generation

NAICS and Subsector Manufacturing Type	Electric Consumption (MWh)					
	CHP Cogen	Solar	Wind	Hydropower	Other	Total
311 - Food	.	.	.	.	±152.2%	±152.2%
322 - Paper	±0.0%	±0.0%	.	±14.6%	.	±2.0%
324 - Petroleum and Coal Products	.	.	.	.	.	.
325 - Chemicals	±124.6%	±146.7%	.	.	.	±122.9%
327 - Nonmetallic Mineral Products	±110.4%	±0.0%	.	.	.	±65.0%
331 - Primary Metals	.	±100.0%	.	.	.	±100.0%
332 - Fabricated Metal Products	.	±111.8%	.	.	.	±111.8%
334 - Computer and Electronic Products	.	±104.1%	.	.	±147.4%	±103.9%
336 - Transportation Equipment	.	±67.1%	.	.	.	±67.1%
Non-key	±137.4%	±66.5%	±136.8%	.	±157.4%	±111.8%
Total	±7.8%	±40.8%	±136.8%	±14.6%	±157.1%	±23.7%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-29. Net electric consumption by subsector and type of off-site generation

NAICS and Subsector Manufacturing Type	Electric Consumption (MWh)					
	CHP Cogen	Solar	Wind	Hydropower	Don't Know	Total
311 - Food	0	0	0	0	0	0
322 - Paper	0	0	0	0	0	0
324 - Petroleum and Coal Products	0	0	0	0	0	0
325 - Chemicals	0	0	0	0	0	0
327 - Nonmetallic Mineral Products	0	0	0	0	0	0
331 - Primary Metals	0	0	0	0	0	0
332 - Fabricated Metal Products	0	^11,990	^3,997	0	^3,997	^19,983
334 - Computer and Electronic Products	0	^556	0	0	0	^556
336 - Transportation Equipment	0	0	0	0	0	0
Non-key	0	0	0	0	0	0
Total	0	^12,545	^3,997	0	^3,997	^20,539

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-30. Relative precision table for net electric consumption by subsector and type of off-site generation

NAICS and Subsector Manufacturing Type	Electric Consumption (MWh)					
	CHP Cogen	Solar	Wind	Hydropower	Don't Know	Total
311 - Food
322 - Paper
324 - Petroleum and Coal Products
325 - Chemicals
327 - Nonmetallic Mineral Products
331 - Primary Metals
332 - Fabricated Metal Products	.	±162.8%	±162.8%	.	±162.8%	±162.8%
334 - Computer and Electronic Products	.	±131.8%	.	.	.	±131.8%
336 - Transportation Equipment
Non-key
Total	.	±155.7%	±162.8%	.	±162.8%	±158.4%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-31. Non-electric consumption by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	MMBtu (1,000s)	% of total MMBtu	Tier 1	Tier 2	Tier 3
311 - Food	11,440	11.6%	9,171	b	m
322 - Paper	24,247	24.7%	23,414	728	105
324 - Petroleum and Coal Products	410	0.4%	b	.	m
325 - Chemicals	19,634	20.0%	^18,424	b	m
327 - Nonmetallic Mineral Products	5,953	6.1%	4,911	b	m
331 - Primary Metals	5,468	5.6%	4,739	^470	259
332 - Fabricated Metal Products	6,479	6.6%	m	324	5,302
334 - Computer and Electronic Products	2,031	2.1%	1,426	.	605
336 - Transportation Equipment	^9,912	^10.1%	^8,718	593	601
Non-Key	12,696	12.9%	3,811	1,099	7,785
Total	98,270	100.0%	75,622	5,715	16,932

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.
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 'm' indicates complementary masking performed when a row or column in a sum table is masked to prevent backing out the masked value based on the totals. No value will appear in the cell.
 A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-32. Relative precision table for non-electric consumption by subsector and tier

NAICS and Subsector Manufacturing Type	Non-Electric Consumption (MMBtu)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±37.5%	±41.1%	±161.5%	±46.0%
322 - Paper	±38.1%	±39.6%	±54.5%	±43.3%
324 - Petroleum and Coal Products	±61.9%	±135.9%	.	±78.4%
325 - Chemicals	±56.8%	±60.6%	±63.4%	±49.4%
327 - Nonmetallic Mineral Products	±23.3%	±27.3%	±76.3%	±66.4%
331 - Primary Metals	±28.0%	±31.9%	±77.5%	±30.7%
332 - Fabricated Metal Products	±32.1%	±50.7%	±45.3%	±38.4%
334 - Computer and Electronic Products	±33.7%	±46.2%	.	±32.8%
336 - Transportation Equipment	±73.3%	±83.3%	±47.7%	±64.2%
Non-Key	±20.7%	±39.3%	±70.5%	±26.7%
Total	±17.5%	±22.3%	±40.6%	±17.8%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-33. MMBtu consumption by non-electric fuel type

Non-Electric Fuel Type	Consumption		Tier		
	MMBtu (1,000s)	% of total MMBtu	Tier 1	Tier 2	Tier 3
Natural gas	92,129	93.8%	72,954	5,367	13,809
Fuel oil, Kerosene, or Distillate	2,179	2.2%	920	^216	1,043
Propane or liquid gases	1,661	1.7%	597	95	969
Purchased hot water or steam	m	m	m	.	b
By-product of Recycled energy	76	0.1%	63	.	13
Renewable Fuels	580	0.6%	256	.	323
Coal-based product	b	b	b	.	b
Diesel or motor gasoline	1,068	1.1%	325	m	^707
Hydrogen	321	0.3%	256	b	m
Total	98,270	100.0%	75,622	5,715	16,932

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 A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-34. Relative precision table for MMBtu consumption by non-electric fuel type

NAICS and Subsector Manufacturing Type	MMBtu	Tier		
		Tier 1	Tier 2	Tier 3
Natural gas	±18.4%	±22.9%	±42.7%	±20.0%
Fuel oil, Kerosene, or Distillate	±25.4%	±29.6%	±108.6%	±56.0%
Propane or liquid gases	±27.8%	±54.0%	±60.0%	±34.4%
Purchased hot water or steam	.	.	.	.
By-product of Recycled energy	.	.	.	.
Renewable Fuels	±27.5%	.	.	.
Coal-based product	.	.	.	.
Diesel or motor gasoline	±79.0%	±27.3%	±72.1%	±119.6%
Hydrogen	.	.	.	.
Total	±17.4%	±22.2%	±40.5%	±17.8%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-35. Non-electric MMBtu consumption per facility by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Facility (MMBtu)	Tier		
		Tier 1	Tier 2	Tier 3
311 – Food	34,838	292,686	b	3,736
322 – Paper	292,436	722,113	63,622	2,686
324 - Petroleum and Coal Products	21,420	b	.	^15,106
325 – Chemicals	157,916	^824,971	b	4,770
327 - Nonmetallic Mineral Products	41,529	295,220	b	4,954
331 - Primary Metals	74,652	309,040	^47,835	5,392
332 - Fabricated Metal Products	4,395	^139,506	22,479	3,647
334 - Computer and Electronic Products	10,964	178,226	.	3,414
336 - Transportation Equipment	^110,902	^835,841	55,588	8,797
Non-key	2,650	140,839	23,219	1,650
Overall	13,441	439,786	40,430	2,420

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Table A-36. Relative precision table for non-electric MMBtu consumption per facility by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Facility (MMBtu)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±36.8%	±39.7%	±0.0%	±46.1%
322 - Paper	±38.3%	±35.3%	±16.9%	±40.0%
324 - Petroleum and Coal Products	±47.0%	±0.0%	.	±48.3%
325 - Chemicals	±57.7%	±58.9%	±32.5%	±44.0%
327 - Nonmetallic Mineral Products	±23.3%	±27.3%	±41.5%	±61.3%
331 - Primary Metals	±30.4%	±26.5%	±47.3%	±29.4%
332 - Fabricated Metal Products	±32.0%	±24.7%	±53.7%	±38.3%
334 - Computer and Electronic Products	±34.2%	±37.3%	.	±31.4%
336 - Transportation Equipment	±73.9%	±76.0%	±11.5%	±61.9%
Non-Key	±20.6%	±29.1%	±42.7%	±26.6%
Overall	±17.4%	±21.7%	±16.2%	±17.7%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-37. Non-electric MMBtu consumption per employee by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Employee (MMBtu)	Tier		
		Tier 1	Tier 2	Tier 3
311 – Food	742	1,092	b	180
322 – Paper	2,906	4,088	928	57
324 - Petroleum and Coal Products	1,169	b	.	^835
325 – Chemicals	1,066	^1558	b	104
327 - Nonmetallic Mineral Products	853	1,608	b	^195
331 - Primary Metals	1,128	1,499	^1,003	213
332 - Fabricated Metal Products	80	^348	123	69
334 - Computer and Electronic Products	66	141	.	29
336 - Transportation Equipment	^603	^904	304	124
Non-key	96	211	89	76
Overall	311	1,043	248	77

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Table A-38. Relative precision table for non-electric MMBtu consumption per employee by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Employee (MMBtu)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±33.5%	±41.3%	±0.0%	±43.7%
322 - Paper	±32.6%	±32.0%	±42.8%	±39.9%
324 - Petroleum and Coal Products	±64.5%	±0.0%	.	±80.7%
325 - Chemicals	±26.6%	±23.6%	±92.4%	±36.5%
327 - Nonmetallic Mineral Products	±19.8%	±23.6%	±81.9%	±63.6%
331 - Primary Metals	±23.0%	±23.8%	±31.6%	±27.6%
332 - Fabricated Metal Products	±45.6%	±26.9%	±44.7%	±51.2%
334 - Computer and Electronic Products	±25.0%	±17.2%	.	±25.5%
336 - Transportation Equipment	±78.4%	±92.5%	±26.4%	±45.3%
Non-Key	±19.8%	±23.1%	±41.9%	±26.1%
Overall	±19.5%	±20.2%	±37.2%	±21.3%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-39. Non-electric MMBtu consumption per square foot by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Square Foot (MMBtu)	Tier		
		Tier 1	Tier 2	Tier 3
311 – Food	0.8	1.1	b	0.2
322 – Paper	1.3	1.6	0.7	-
324 - Petroleum and Coal Products	0.5	b	.	^0.5
325 – Chemicals	1.1	^3.0	b	0.1
327 - Nonmetallic Mineral Products	0.3	0.4	b	0.0
331 - Primary Metals	0.4	0.4	^0.5	0.1
332 - Fabricated Metal Products	0.1	^0.3	0.1	0.1
334 - Computer and Electronic Products	0.1	0.2	.	0.0
336 - Transportation Equipment	^0.5	^0.7	0.5	0.2
Non-key	0.1	0.2	^0.1	0.1
Overall	0.3	0.8	0.2	0.1

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Table A-40. Relative precision table for non-electric MMBtu consumption per square foot by subsector and tier

NAICS and Subsector Manufacturing Type	Consumption/ Employee (MMBtu)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±38.8%	±46.1%	±0.0%	±41.0%
322 - Paper	±33.6%	±34.7%	±35.7%	±30.6%
324 - Petroleum and Coal Products	±48.2%	±0.0%	.	±78.8%
325 - Chemicals	±74.5%	±77.1%	±102.0%	±29.0%
327 - Nonmetallic Mineral Products	±28.9%	±37.1%	±99.1%	±65.2%
331 - Primary Metals	±24.4%	±26.7%	±69.6%	±21.4%
332 - Fabricated Metal Products	±30.4%	±32.6%	±78.2%	±34.5%
334 - Computer and Electronic Products	±23.9%	±11.1%	.	±23.1%
336 - Transportation Equipment	±81.7%	±95.6%	±46.9%	±42.4%
Non-Key	±23.7%	±21.7%	±39.8%	±30.7%
Overall	±20.6%	±24.2%	±52.1%	±18.9%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-41. Total energy expenditures by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	Total Energy Expenditures (\$1,000s)	% of total expenditures	Tier 1	Tier 2	Tier 3
311 - Food	\$152,192	8.5%	\$118,906	b	m
322 - Paper	\$309,313	17.3%	\$295,917	\$8,229	\$5,167
324 - Petroleum and Coal Products	\$6,938	0.4%	b	.	m
325 - Chemicals	\$268,539	15.0%	\$249,062	b	m
327 - Nonmetallic Mineral Products	\$84,800	4.7%	m	b	m
331 - Primary Metals	^\$235,872	^13.2%	^\$222,814	\$7,648	\$5,410
332 - Fabricated Metal Products	\$213,438	11.9%	^\$68,870	\$12,239	\$132,329
334 - Computer and Electronic Products	^\$113,073	^6.3%	^\$91,971	.	\$21,101
336 - Transportation Equipment	^\$119,080	^6.7%	^\$102,388	\$6,922	\$9,770
Non-key	\$285,390	16.0%	\$83,434	\$32,953	\$169,003
Total	\$1,788,634	100.0%	\$1,302,872	\$99,287	\$386,475

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Table A-42. Relative precision table for total energy expenditures by subsector and tier

NAICS and Subsector Manufacturing Type	Total Energy Expenditures (\$1,000s)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±29.9%	±33.9%	±161.4%	±36.9%
322 - Paper	±44.7%	±46.9%	±52.4%	±39.6%
324 - Petroleum and Coal Products	±60.8%	±131.8%	.	±69.7%
325 - Chemicals	±46.4%	±50.1%	±73.6%	±54.7%
327 - Nonmetallic Mineral Products	±31.7%	±40.7%	±67.3%	±46.3%
331 - Primary Metals	±43.0%	±45.6%	±52.2%	±42.2%
332 - Fabricated Metal Products	±20.7%	±6.8%	±66.2%	±32.7%
334 - Computer and Electronic Products	±63.9%	±78.4%	.	±32.4%
336 - Transportation Equipment	±48.2%	±56.0%	±43.1%	±54.8%
Non-Key	±16.1%	±33.6%	±56.7%	±19.9%
Total	±13.6%	±18.2%	±31.3%	±14.6%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-43. Electric energy expenditures by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	Electric Energy Expenditures (\$1,000s)	% of electric expenditures	Tier 1	Tier 2	Tier 3
311 - Food	\$54,686	5.9%	\$42,754	b	m
322 - Paper	\$108,338	11.6%	\$102,126	\$2,116	\$4,096
324 - Petroleum and Coal Products	^\$1,683	^0.2%	b	.	m
325 - Chemicals	^\$106,459	^11.4%	^\$97,928	b	m
327 - Nonmetallic Mineral Products	\$29,266	3.1%	m	b	m
331 - Primary Metals	^\$187,262	^20.1%	^\$180,501	\$3,710	^\$3,050
332 - Fabricated Metal Products	\$142,216	15.3%	^\$61,636	^\$9,133	\$71,447
334 - Computer and Electronic Products	^\$95,519	^10.2%	^\$79,653	.	\$15,866
336 - Transportation Equipment	\$37,885	4.1%	\$31,131	\$2,103	\$4,651
Non-key	\$168,762	18.1%	\$50,899	\$23,660	\$94,203
Total	\$932,076	100.0%	\$668,563	\$49,383	\$214,131

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Table A-44. Relative precision table for electric energy expenditures by subsector and tier

NAICS and Subsector Manufacturing Type	Electric Energy Expenditures (\$1,000s)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±29.5%	±35.4%	±161.4%	±42.0%
322 - Paper	±60.6%	±64.5%	±66.9%	±43.0%
324 - Petroleum and Coal Products	±90.6%	±131.8%	n	±98.6%
325 - Chemicals	±86.8%	±94.4%	±105.6%	±67.8%
327 - Nonmetallic Mineral Products	±56.1%	±75.3%	±113.0%	±38.4%
331 - Primary Metals	±51.1%	±53.0%	±63.1%	±53.4%
332 - Fabricated Metal Products	±17.9%	±2.5%	±81.6%	±34.0%
334 - Computer and Electronic Products	±70.3%	±84.2%	n	±35.2%
336 - Transportation Equipment	±24.6%	±29.7%	±53.0%	±52.5%
Non-Key	±19.3%	±40.4%	±60.3%	±23.7%
Total	±18.1%	±24.7%	±35.6%	±15.8%

'n' indicates no responses for a particular result. No value will appear in the cell.

Table A-45. Non-electric energy expenditures by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	Non-Electric Energy Expenditures (\$1,000s)	% of non-electric expenditures	Tier 1	Tier 2	Tier 3
311 - Food	\$97,506	11.4%	\$76,152	b	m
322 - Paper	\$200,975	23.5%	\$193,791	\$6,113	\$1,071
324 - Petroleum and Coal Products	^\$5,255	^0.6%	b	.	m
325 - Chemicals	\$162,080	18.9%	^\$151,135	b	m
327 - Nonmetallic Mineral Products	\$55,534	6.5%	\$44,751	b	m
331 - Primary Metals	\$48,610	5.7%	\$42,313	^\$3,937	\$2,359
332 - Fabricated Metal Products	\$71,222	8.3%	m	\$3,106	\$60,882
334 - Computer and Electronic Products	\$17,554	2.0%	\$12,319	.	\$5,235
336 - Transportation Equipment	^\$81,195	^9.5%	^\$71,257	\$4,819	\$5,119
Non-key	\$116,628	13.6%	\$32,535	\$9,294	\$74,799
Total	\$856,558	100.0%	\$634,309	\$49,904	\$172,344

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Table A-46. Relative precision table for non-electric energy expenditures by subsector and tier

NAICS and Subsector Manufacturing Type	Non-Electric Energy Expenditures (\$1,000s)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±35.9%	±40.5%	±161.5%	±39.7%
322 - Paper	±37.4%	±39.0%	±54.5%	±45.2%
324 - Petroleum and Coal Products	±72.3%	±135.9%	.	±74.0%
325 - Chemicals	±56.2%	±60.3%	±65.8%	±47.1%
327 - Nonmetallic Mineral Products	±23.6%	±28.9%	±72.2%	±57.8%
331 - Primary Metals	±26.5%	±30.2%	±76.8%	±32.0%
332 - Fabricated Metal Products	±47.1%	±50.4%	±45.0%	±54.8%
334 - Computer and Electronic Products	±33.0%	±44.9%	.	±35.3%
336 - Transportation Equipment	±72.7%	±82.7%	±47.7%	±60.8%
Non-Key	±19.5%	±38.5%	±70.5%	±24.5%
Total	±16.7%	±21.6%	±38.6%	±22.4%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-47. Total GHG emissions by subsector and tier

NAICS and Subsector Manufacturing Type	Overall NAICS		Tier		
	CO ₂ Equivalent Emissions (Metric Tons (1,000s))	% of total emissions	Tier 1	Tier 2	Tier 3
311 - Food	1,304	10.0%	1,041	b	m
322 - Paper	2,742	21.1%	2,638	78	26
324 - Petroleum and Coal Products	45	0.3%	b	.	m
325 - Chemicals	2,288	17.6%	2,140	b	m
327 - Nonmetallic Mineral Products	677	5.2%	548	b	m
331 - Primary Metals	^1,258	^9.7%	^1,162	59	37
332 - Fabricated Metal Products	1,183	9.1%	m	67	793
334 - Computer and Electronic Products	^560	^4.3%	^439	.	121
336 - Transportation Equipment	^1,084	^8.3%	^946	65	73
Non-Key	1,849	14.2%	537	198	1,114
Total	12,990	100.0%	9,788	739	2,462

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Table A-48. Relative precision table for total GHG emissions by subsector and tier

NAICS and Subsector Manufacturing Type	CO ₂ Equivalent Emissions (Metric Tons)	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±34.0%	±37.5%	±161.4%	±42.1%
322 - Paper	±40.8%	±42.5%	±52.9%	±38.2%
324 - Petroleum and Coal Products	±55.8%	±131.8%	.	±69.1%
325 - Chemicals	±47.9%	±51.3%	±63.6%	±51.3%
327 - Nonmetallic Mineral Products	±27.1%	±33.0%	±71.8%	±57.2%
331 - Primary Metals	±36.1%	±39.1%	±61.7%	±37.1%
332 - Fabricated Metal Products	±21.3%	±13.9%	±53.3%	±31.1%
334 - Computer and Electronic Products	±58.2%	±73.9%	.	±30.8%
336 - Transportation Equipment	±63.1%	±72.2%	±45.0%	±62.0%
Non-Key	±17.2%	±35.5%	±57.9%	±21.7%
Total	±14.6%	±18.9%	±34.7%	±14.5%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-49. Percentage of facilities that have completed any GHG inventory by subsector

NAICS and Subsector Manufacturing Type	Completed a GHG Inventory	Completed a Scope 3 GHG Inventory	Implemented a Strategy to Reduce Scope 3 Emissions
311 - Food	^10.6%	^0.8%	^5.5%
322 - Paper	22.2%	7.8%	7.8%
324 - Petroleum and Coal Products	^28.0%	0.0%	0.0%
325 - Chemicals	36.5%	^17.8%	27.2%
327 - Nonmetallic Mineral Products	7.1%	^1.9%	^1.9%
331 - Primary Metals	15.9%	^1.3%	^2.9%
332 - Fabricated Metal Products	5.0%	^1.8%	^2.2%
334 - Computer and Electronic Products	18.7%	10.8%	11.8%
336 - Transportation Equipment	28.8%	9.5%	9.7%
Non-Key	^4.9%	0.7%	0.9%
Total	6.8%	1.7%	2.4%

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-50. Relative precision table for percentage of facilities that have completed any GHG inventory by subsector

NAICS and Subsector Manufacturing Type	Completed a GHG Inventory	Completed a Scope 3 GHG Inventory	Implemented a Strategy to Reduce Scope 3 Emissions
311 - Food	±86.4%	±77.8%	±160.6%
322 - Paper	±43.8%	±69.3%	±69.3%
324 - Petroleum and Coal Products	±93.8%	.	.
325 - Chemicals	±36.0%	±85.9%	±61.2%
327 - Nonmetallic Mineral Products	±49.7%	±87.4%	±87.4%
331 - Primary Metals	±43.4%	±15.6%	±36.8%
332 - Fabricated Metal Products	±78.2%	±155.1%	±131.7%
334 - Computer and Electronic Products	±44.3%	±67.2%	±68.8%
336 - Transportation Equipment	±54.0%	±54.9%	±56.3%
Non-Key	±91.3%	±62.2%	±63.1%
Total	±45.5%	±42.2%	±37.7%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-51. Estimate GHG emissions by fuel and subsector

NAICS and Subsector Manufacturing Type	Electric	Natural Gas	Fuel Oil	Propane	Diesel	Total
311 - Food	5.8%	12.1%	b	4.9%	-10.9%	10.0%
322 - Paper	11.8%	25.5%	b	6.0%	-0.5%	21.1%
324 - Petroleum and Coal Products	^0.2%	b	b	0.0%	b	0.3%
325 - Chemicals	^11.3%	21.1%	b	1.9%	-5.1%	17.6%
327 - Nonmetallic Mineral Products	3.1%	5.9%	^0.5%	^23.2%	-7.7%	5.2%
331 - Primary Metals	^20.0%	5.7%	3.5%	2.3%	-11.4%	^9.7%
332 - Fabricated Metal Products	15.3%	5.7%	9.5%	19.4%	^49.8%	9.1%
334 - Computer and Electronic Products	^10.2%	1.8%	^0.4%	^6.7%	^0.9%	^4.3%
336 - Transportation Equipment	4.1%	^10.6%	0.6%	0.3%	-0.3%	^8.3%
Non-Key	18.2%	11.4%	42.0%	35.5%	10.2%	14.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Overall Fuel % of Total GHG Emissions	28.5%	67.5%	1.6%	1.2%	0.8%	99.6%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'^' indicates a single weighted response represents more than 50% of a given aggregate calculation.

'-' indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-52. Estimate GHG emissions by fuel and subsector relative precision

NAICS and Subsector Manufacturing Type	Total	Electric	Natural Gas	Fuel Oil	Propane	Diesel
311 - Food	±34.0%	±29.5%	±38.5%	±58.8%	±71.3%	±55.6%
322 - Paper	±40.8%	±59.4%	±39.9%	±34.9%	±46.8%	±44.1%
324 - Petroleum and Coal Products	±55.8%	±90.6%	±99.7%	±105.7%	±158.6%	±134.6%
325 - Chemicals	±47.9%	±86.8%	±57.4%	±0.0%	±48.7%	±57.3%
327 - Nonmetallic Mineral Products	±27.1%	±56.8%	±25.0%	±94.6%	±94.6%	±38.6%
331 - Primary Metals	±36.1%	±51.1%	±32.3%	±26.9%	±44.9%	±63.9%
332 - Fabricated Metal Products	±21.3%	±17.7%	±36.6%	±32.6%	±76.3%	±159.2%
334 - Computer and Electronic Products	±58.2%	±70.1%	±46.0%	±106.4%	±122.4%	±71.1%
336 - Transportation Equipment	±63.1%	±24.4%	±74.3%	±51.0%	±26.0%	±59.0%
Non-Key	±17.2%	±19.2%	±23.7%	±55.8%	±37.7%	±19.5%
Total	±14.6%	±18.0%	±18.7%	±26.7%	±30.6%	±80.1%

Table A-53. Percentage of net electricity consumption by high-level end use and subsector

NAICS and Subsector Manufacturing Type	Boilers or generators (GWh)	Boilers or generators (%)	Manufacturing or industrial production process (GWh)	Manufacturing or industrial production process (%)	Basic facility operations (GWh)	Basic facility operations (%)	Don't know Unknown (GWh)	Don't know Unknown (%)	Total (GWh)
311 - Food	141	16.4%	583	67.6%	127	14.8%	^10	^1.2%	862
322 - Paper	^64	^3.7%	^1,461	^83.9%	85	4.9%	^133	^7.6%	1,743
324 - Petroleum and Coal Products	~1	~3.0%	~23	^87.0%	^3	^10.0%	0	^0.0%	^27
325 - Chemicals	61	~3.6%	^1,474	^87.8%	116	^6.9%	^27	^1.6%	^1,678
327 - Nonmetallic Mineral Products	9	1.9%	331	72.3%	^116	^25.4%	^2	^0.4%	458
331 - Primary Metals	11	~0.4%	^2,601	^88.1%	^287	^9.7%	^55	^1.8%	^2,952
332 - Fabricated Metal Products	40	1.8%	1,379	60.9%	^547	^24.2%	^299	^13.2%	2,264
334 - Computer and Electronic Products	^181	~12.0%	~917	^60.7%	^411	^27.2%	~3	^0.2%	^1,511
336 - Transportation Equipment	10	1.6%	451	75.0%	121	20.1%	~20	^3.3%	601
Non-Key	^136	~5.1%	1,844	68.5%	499	18.5%	214	8.0%	2,693
Total MWh/Overall %	653	4.4%	11,064	74.8%	2,311	15.6%	763	5.2%	14,790

^'^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-54. Relative precision table for percentage of net electricity consumption by high-level end use and subsector

NAICS and Subsector Manufacturing Type	Basic Facility Operations (GWh)	Boilers or Generators (GWh)	Manufacturing or Industrial Production Process (GWh)	Don't Know /Unknown (GWh)	Total (GWh)
311 - Food	±28.7%	±48.9%	±34.8%	±90.9%	±30.0%
322 - Paper	±37.3%	±73.7%	±67.1%	±10.4%	±59.4%
324 - Petroleum and Coal Products	±90.6%	±111.1%	±94.1%	.	±90.6%
325 - Chemicals	±27.9%	±46.7%	±98.5%	±97.4%	±86.8%
327 - Nonmetallic Mineral Products	±87.9%	±38.9%	±49.6%	±94.0%	±56.8%
331 - Primary Metals	±52.7%	±38.6%	±52.3%	±78.4%	±51.1%
332 - Fabricated Metal Products	±12.9%	±46.1%	±14.5%	±110.3%	±17.7%
334 - Computer and Electronic Products	±65.2%	±88.9%	±69.1%	±98.4%	±70.1%
336 - Transportation Equipment	±35.5%	±50.4%	±24.5%	±65.3%	±24.4%
Non-Key	±17.3%	±67.7%	±23.7%	±54.6%	±19.2%
Total	±15.0%	±31.5%	±21.3%	±46.4%	±18.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-55. Detailed percentage of total electricity used for production and non-production end uses

NAICS and Subsector Manufacturing Type	Boilers (%)	Heating (%)	Cooling and refrigeration (%)	Machine drive (%)	Electrochemical processes (%)	Other production use (%)	HVAC (%)	Lighting (%)	Onsite transportation (%)	Other facility support (%)	Other facility use (%)
311 - Food	b	b	b	b	b	b	b	b	b	b	b
322 - Paper	0.0%	3.0%	0.4%	64.0%	0.0%	0.3%	3.8%	4.2%	0.0%	0.0%	0.0%
324 - Petroleum and Coal Products	b	b	b	b	b	b	b	b	b	b	b
325 - Chemicals	b	b	b	b	b	b	b	b	b	b	b
327 - Nonmetallic Mineral Products	0.0%	25.9%	0.0%	57.5%	0.0%	0.0%	7.5%	5.5%	0.0%	1.8%	1.7%
331 - Primary Metals	0.0%	11.7%	6.1%	62.9%	0.0%	0.0%	9.2%	6.6%	0.0%	1.5%	2.1%
332 - Fabricated Metal Products	0.0%	6.4%	11.9%	47.4%	0.1%	8.9%	14.5%	9.3%	0.0%	1.5%	0.1%
334 - Computer and Electronic Products	1.1%	4.2%	6.7%	40.0%	0.4%	6.3%	26.7%	-0.138	0.0%	0.5%	0.5%
336 - Transportation Equipment	0.0%	42.9%	2.5%	12.3%	0.0%	0.0%	3.1%	4.3%	0.0%	0.0%	0.0%
Non-Key	0.2%	5.2%	5.5%	52.5%	0.0%	3.2%	11.1%	8.8%	0.0%	2.1%	0.1%
Overall	0.2%	9.7%	10.5%	44.7%	0.1%	2.5%	11.6%	7.7%	0.0%	1.1%	0.3%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'-' indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-56. Detailed percentage of total electricity used for production and non-production end uses relative precision table

NAICS and Subsector Manufacturing Type	Boilers (%)	Heating (%)	Cooling and refrigeration (%)	Machine drive (%)	Electrochemical processes (%)	Other production use (%)	HVAC (%)	Lighting (%)	Onsite transportation (%)	Other facility support (%)	Other facility use (%)
311 - Food	.	±105.8%	.	±159.1%	±32.8%	±40.9%	±44.1%	.	±167.2%	.	±159.1%
322 - Paper	±161.2%	±106.6%	.	±0.0%	±53.3%	±79.9%	±98.9%	.	.	.	±114.7%
324 - Petroleum and Coal Products	.	.	.	±103.2%	±87.1%	±79.5%	±105.9%	.	.	.	.
325 - Chemicals	.	±160.6%	.	.	±154.8%	±146.0%	±142.2%	.	±152.9%	.	.
327 - Nonmetallic Mineral Products	.	.	.	±89.7%	±48.0%	±66.0%	±86.4%	.	±114.2%	±0.0%	.
331 - Primary Metals	.	±103.0%	.	±117.4%	±47.5%	±14.7%	±46.7%	.	±148.0%	±154.3%	.
332 - Fabricated Metal Products	.	±110.4%	±166.8%	±142.7%	±117.4%	±94.2%	±60.7%	.	±126.6%	±166.8%	±135.2%
334 - Computer and Electronic Products	±138.6%	±124.0%	±0.0%	±83.9%	±115.0%	±104.4%	±124.2%	.	±69.2%	±121.5%	±151.8%
336 - Transportation Equipment	.	±150.7%	.	±151.9%	±125.5%	±134.0%	±140.6%	.	.	±0.0%	.
Non-Key	±122.0%	±76.6%	.	±78.2%	±68.2%	±80.5%	±99.9%	±166.9%	±68.9%	±166.9%	±107.1%
Overall	±113.2%	±85.2%	±12.0%	±88.8%	±49.7%	±40.5%	±40.6%	±166.9%	±56.8%	±87.7%	±76.3%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-57. Percentage of facilities using electricity for manufacturing processes by end use

NAICS and Subsector Manufacturing Type	Process heating (%)	Process cooling and refrigeration (%)	Machine drive (%)	Electrochemical processes (%)	Other manufacturing or production process (%)	Don't Know (%)
311 - Food	52.4%	74.5%	79.1%	-4.8%	-4.8%	0.0%
322 - Paper	29.0%	23.3%	85.7%	^1.1%	^1.1%	0.0%
324 - Petroleum and Coal Products	26.0%	^15.3%	89.3%	^4.7%	^10.7%	0.0%
325 - Chemicals	37.7%	26.7%	76.8%	-7.3%	17.3%	0.0%
327 - Nonmetallic Mineral Products	64.4%	25.4%	88.8%	^6.5%	21.9%	0.0%
331 - Primary Metals	58.1%	21.0%	91.1%	13.8%	19.8%	0.0%
332 - Fabricated Metal Products	28.6%	16.1%	85.5%	8.1%	11.0%	^2.4%
334 - Computer and Electronic Products	47.5%	37.8%	73.0%	12.7%	30.0%	0.0%
336 - Transportation Equipment	41.4%	33.3%	78.6%	^3.3%	34.2%	0.0%
Non-Key	31.9%	30.2%	82.5%	1.1%	15.6%	0.0%
Total	33.6%	29.3%	82.9%	3.3%	14.8%	^0.5%

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-58. Relative precision table for percentage of facilities using electricity for manufacturing processes by end use

NAICS and Subsector Manufacturing Type	Process heating (%)	Process cooling and refrigeration (%)	Machine drive (%)	Electrochemical processes (%)	Other manufacturing or production process (%)	Don't Know (%)
311 - Food	±31.8%	±15.4%	±17.2%	±97.4%	±97.4%	.
322 - Paper	±38.0%	±41.9%	±12.4%	±16.1%	±16.1%	.
324 - Petroleum and Coal Products	±77.3%	±96.3%	±16.1%	±29.7%	±135.0%	.
325 - Chemicals	±40.4%	±34.8%	±22.2%	±86.4%	±65.4%	.
327 - Nonmetallic Mineral Products	±21.2%	±46.0%	±7.7%	±117.7%	±49.1%	.
331 - Primary Metals	±23.6%	±51.9%	±6.1%	±47.6%	±59.2%	.
332 - Fabricated Metal Products	±34.2%	±48.0%	±9.8%	±69.6%	±45.6%	±126.0%
334 - Computer and Electronic Products	±23.5%	±28.3%	±13.7%	±46.4%	±33.4%	.
336 - Transportation Equipment	±41.8%	±50.9%	±24.0%	±69.2%	±55.9%	.
Non-Key	±32.0%	±31.0%	±9.3%	±58.0%	±49.2%	.
Total	±20.9%	±21.7%	±6.5%	±37.6%	±34.8%	±126.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-59. Percentage of facilities using electricity for basic facility operations by end use

NAICS and Subsector Manufacturing Type	Basic equipment or appliances	HVAC	Lighting	Onsite transportation	Other use
311 - Food	83.2%	90.2%	92.1%	12.8%	0.0%
322 - Paper	75.4%	78.7%	85.7%	6.3%	0.0%
324 - Petroleum and Coal Products	70.7%	89.3%	100.0%	0.0%	0.0%
325 - Chemicals	86.2%	91.3%	91.3%	^11.5%	13.1%
327 - Nonmetallic Mineral Products	82.4%	79.6%	88.4%	^1.7%	^9.6%
331 - Primary Metals	84.8%	90.6%	96.5%	^5.7%	0.0%
332 - Fabricated Metal Products	74.4%	85.2%	90.8%	2.5%	^1.6%
334 - Computer and Electronic Products	85.0%	94.2%	96.2%	^4.6%	3.4%
336 - Transportation Equipment	84.2%	87.6%	84.2%	9.0%	^1.7%
Non-Key	79.6%	82.5%	91.8%	2.1%	2.2%
Total	79.1%	83.9%	91.5%	3.0%	2.3%

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-60. Percentage of facilities using electricity for basic facility operations by end use relative precision table

NAICS and Subsector Manufacturing Type	Basic equipment or appliances	HVAC	Lighting	Onsite transportation	Other use
311 - Food	±13.6%	±7.5%	±6.7%	±81.0%	.
322 - Paper	±15.3%	±14.8%	±12.4%	±71.9%	.
324 - Petroleum and Coal Products	±35.2%	±16.1%	±0.0%	.	.
325 - Chemicals	±14.6%	±12.3%	±12.3%	±101.7%	±56.0%
327 - Nonmetallic Mineral Products	±12.5%	±13.1%	±10.5%	±129.6%	±89.8%
331 - Primary Metals	±9.5%	±6.4%	±2.3%	±90.3%	.
332 - Fabricated Metal Products	±13.1%	±9.8%	±7.8%	±68.9%	±113.9%
334 - Computer and Electronic Products	±9.9%	±4.5%	±3.8%	±128.5%	±76.8%
336 - Transportation Equipment	±17.7%	±16.1%	±17.7%	±34.4%	±99.6%
Non-Key	±9.8%	±9.4%	±5.3%	±44.3%	±62.8%
Total	±7.0%	±6.4%	±3.8%	±29.1%	±43.5%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-61. Percentage of non-electric fuel consumption by high-level end-use

NAICS and Subsector Manufacturing Type	Basic facility operations (%)	Boilers or generators (%)	Manufacturing or industrial production process (%)	Don't Know/ Unknown (%)	Total (%)
311 - Food	6.9%	49.3%	^43.5%	0.4%	100.0%
322 - Paper	9.5%	71.0%	14.1%	^5.4%	100.0%
324 - Petroleum and Coal Products	^0.4%	^9.3%	90.3%	0.0%	100.0%
325 - Chemicals	^9.1%	^74.4%	^13.2%	^3.3%	100.0%
327 - Nonmetallic Mineral Products	19.2%	18.5%	61.0%	1.3%	100.0%
331 - Primary Metals	19.1%	4.9%	74.2%	^1.8%	100.0%
332 - Fabricated Metal Products	26.6%	6.9%	50.4%	16.1%	100.0%
334 - Computer and Electronic Products	30.5%	22.9%	^43.7%	3.0%	100.0%
336 - Transportation Equipment	^27.2%	^23.8%	^46.8%	^2.3%	100.0%
Non-Key	40.2%	39.7%	10.7%	9.4%	100.0%
Total	17.6%	47.9%	29.6%	4.8%	100.0%

^^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-62. Relative precision table for percentage of non-electric fuel consumption by high-level end-use

NAICS and Subsector Manufacturing Type	Basic facility operations (MMBtu)	Boilers or generators (MMBtu)	Manufacturing or industrial production process (MMBtu)	Don't Know/ Unknown (MMBtu)	Total (MMBtu)
311 - Food	±35.2%	±44.6%	±65.6%	±39.9%	±37.8%
322 - Paper	±53.9%	±53.4%	±53.4%	±122.8%	±37.8%
324 - Petroleum and Coal Products	±131.8%	±95.1%	±68.6%	.	±60.0%
325 - Chemicals	±77.5%	±80.9%	±66.0%	±20.6%	±57.9%
327 - Nonmetallic Mineral Products	±47.1%	±53.8%	±24.6%	±67.5%	±23.3%
331 - Primary Metals	±36.9%	±33.2%	±33.7%	±16.1%	±28.1%
332 - Fabricated Metal Products	±26.2%	±47.2%	±56.7%	±72.6%	±32.2%
334 - Computer and Electronic Products	±27.6%	±48.9%	±57.0%	±68.0%	±33.7%
336 - Transportation Equipment	±67.7%	±78.3%	±78.5%	±53.8%	±73.3%
Non-Key	±37.6%	±36.2%	±29.7%	±67.2%	±21.1%
Total	±19.5%	±33.0%	±20.4%	±41.8%	±17.7%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-63. Detailed percentage of total non-electric fuel used for production and non-production end uses

NAICS and Subsector Manufacturing Type	Boilers (%)	Process Heating (%)	Cooling and refrigeration (%)	Machine drive (%)	Electrochemical processes (%)	Other production use (%)	HVAC (%)	Lighting (%)	Onsite Transportation (%)	Other facility support (%)	Other facility use (%)
311 - Food	b	b	b	b	b	b	b	b	b	b	b
322 - Paper	72.8%	-26.9%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%
324 - Petroleum and Coal Products	b	b	b	b	b	b	b	b	b	b	b
325 - Chemicals	b	b	b	b	b	b	b	b	b	b	b
327 - Nonmetallic Mineral Products	b	b	b	b	b	b	b	b	b	b	b
331 - Primary Metals	0.0%	94.6%	0.0%	0.0%	0.0%	4.3%	1.0%	0.0%	0.1%	0.0%	0.0%
332 - Fabricated Metal Products	b	b	b	b	b	b	b	b	b	b	b
334 - Computer and Electronic Products	65.5%	1.5%	0.0%	0.0%	0.0%	0.5%	17.7%	0.0%	0.0%	0.1%	14.2%
336 - Transportation Equipment	b	b	b	b	b	b	b	b	b	b	b
Non-Key	34.6%	4.9%	0.0%	0.0%	0.0%	0.8%	53.4%	0.0%	0.0%	0.2%	0.5%
Overall	35.3%	37.8%	0.0%	0.0%	0.0%	6.1%	19.2%	0.0%	-0.2%	-0.1%	-1.1%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'-' indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-64. Detailed percentage of total non-electric fuel used for production and non-production end uses relative precision table

NAICS and Subsector Manufacturing Type	Boilers (%)	Process Heating (%)	Cooling and refrigeration (%)	Machine drive (%)	Electrochemical processes (%)	Other production use (%)	HVAC (%)	Lighting (%)	Onsite Transportation (%)	Other facility support (%)	Other facility use (%)
311 - Food	±157.8%	±160.4%	.	.	.	.	±154.3%	.	±160.4%	±160.4%	.
322 - Paper	±33.4%	±85.7%	.	.	.	.	±162.5%	.	.	±125.5%	.
324 - Petroleum and Coal Products	.	±85.1%	.	.	.	±155.5%	±155.5%	.	.	.	.
325 - Chemicals	±139.8%	.	.	.	.	.	±125.8%	.	±137.0%	±134.8%	±126.5%
327 - Nonmetallic Mineral Products	.	±23.6%	.	.	.	.	±8.7%	.	.	.	±0.0%
331 - Primary Metals	.	±143.9%	.	±159.4%	.	±151.9%	±71.4%	.	.	±152.0%	.
332 - Fabricated Metal Products	±0.0%	±0.5%	.	.	.	±0.5%	±21.7%	.	±168.1%	.	.
334 - Computer and Electronic Products	±137.1%	±161.9%	.	.	.	±122.7%	±119.3%	.	±161.9%	.	±156.5%
336 - Transportation Equipment	±155.5%	±155.5%	.	.	.	±0.0%	±26.3%	.	.	±0.0%	±165.3%
Non-Key	±152.9%	±111.8%	.	.	.	±140.3%	±50.4%	.	±104.2%	±163.7%	±160.9%
Overall	±37.3%	±34.7%	.	±159.1%	.	±8.3%	±16.6%	.	±91.2%	±94.5%	±95.7%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-65. Percentage of facilities using non-electric fuel for production processes by end use

NAICS and Subsector Manufacturing Type	Process heating	Process cooling and refrigeration	Machine drive	Electrochemical processes	Other manufacturing or production process
311 - Food	43.0%	^10.2%	11.3%	0.0%	14.9%
322 - Paper	23.3%	^2.6%	20.3%	0.0%	21.1%
324 - Petroleum and Coal Products	^34.0%	0.0%	^29.3%	0.0%	^44.7%
325 - Chemicals	21.1%	^3.5%	20.4%	5.4%	^6.8%
327 - Nonmetallic Mineral Products	36.0%	^0.6%	15.8%	^1.7%	34.4%
331 - Primary Metals	40.5%	^1.6%	17.6%	3.1%	26.5%
332 - Fabricated Metal Products	25.0%	^3.3%	23.1%	^1.8%	18.3%
334 - Computer and Electronic Products	15.0%	^0.5%	^1.4%	^2.2%	8.3%
336 - Transportation Equipment	27.7%	0.0%	15.1%	0.0%	8.3%
Non-Key	15.1%	1.4%	7.8%	^0.2%	19.1%
Total	19.5%	2.2%	11.7%	-0.7%	18.6%

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-66. Relative precision table for percentage of facilities using non-electric fuel for production processes by end use

NAICS and Subsector Manufacturing Type	Process heating	Process cooling and refrigeration	Machine drive	Electrochemical processes	Other manufacturing or production process
311 - Food	±41.0%	±117.9%	±45.3%	.	±74.8%
322 - Paper	±41.9%	±125.1%	±49.7%	.	±45.9%
324 - Petroleum and Coal Products	±80.1%	.	±84.8%	.	±60.5%
325 - Chemicals	±42.6%	±147.1%	±65.7%	±74.2%	±86.6%
327 - Nonmetallic Mineral Products	±32.0%	±12.9%	±64.6%	±129.6%	±31.6%
331 - Primary Metals	±23.6%	±64.0%	±65.6%	±42.1%	±33.2%
332 - Fabricated Metal Products	±36.8%	±133.6%	±42.2%	±161.8%	±43.0%
334 - Computer and Electronic Products	±53.4%	±9.7%	±131.8%	±92.0%	±56.4%
336 - Transportation Equipment	±56.1%	.	±53.6%	.	±41.0%
Non-Key	±50.5%	±75.0%	±60.8%	±157.4%	±47.7%
Total	±27.8%	±57.4%	±31.7%	±87.2%	±33.3%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-67. Percentage of non-electric fuel dedicated to boilers by temperature

NAICS and Subsector Manufacturing Type	Low Temp (<140C /280F) (%)	Med Temp (140C/280F & <300C/570F) (%)	High Temp (≥300C/570F) (%)	Don't Know/ Unknown (%)	Total (%)
311 - Food	^44.8%	40.6%	^14.3%	^0.3%	100.0%
322 - Paper	^2.7%	^53.8%	^15.5%	^28.0%	100.0%
324 - Petroleum and Coal Products	b	b	b	b	100.0%
325 - Chemicals	^57.4%	30.1%	^4.8%	^7.7%	100.0%
327 - Nonmetallic Mineral Products	^44.0%	11.6%	^1.5%	^43.0%	100.0%
331 - Primary Metals	m	^28.4%	m	^16.1%	100.0%
332 - Fabricated Metal Products	62.5%	^19.8%	^4.8%	^12.9%	100.0%
334 - Computer and Electronic Products	^78.2%	m	m	^15.0%	100.0%
336 - Transportation Equipment	^74.3%	^25.0%	^0.7%	m	100.0%
Non-Key	43.8%	39.2%	^4.4%	^12.6%	100.0%
Total	35.1%	40.0%	^9.4%	15.6%	100.0%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

^^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

'm' indicates complementary masking performed when a row or column in a sum table is masked to prevent backing out the masked value based on the totals. No value will appear in the cell.

Table A-68. Percentage of non-electric fuel dedicated to boilers by temperature relative precision table

NAICS and Subsector Manufacturing Type	Low Temp (<140C /280F) (%)	Med Temp (140C/280F & <300C/570F) (%)	High Temp (≥300C/570F) (%)	Don't Know/ Unknown (%)	Total (%)
311 - Food	±93.7%	±34.4%	±78.2%	±8.7%	±44.6%
322 - Paper	±92.1%	±99.1%	±4.5%	±29.4%	±53.4%
324 - Petroleum and Coal Products	±132.4%	±99.3%	.	.	±95.1%
325 - Chemicals	±114.2%	±70.5%	±0.0%	±117.7%	±80.9%
327 - Nonmetallic Mineral Products	±28.7%	±60.0%	±94.5%	±123.1%	±53.8%
331 - Primary Metals	±49.9%	±61.1%	.	±95.5%	±33.2%
332 - Fabricated Metal Products	±43.1%	±92.7%	±163.4%	±115.9%	±47.2%
334 - Computer and Electronic Products	±59.0%	±3.8%	.	±100.6%	±48.9%
336 - Transportation Equipment	±78.3%	±80.6%	±154.8%	±91.9%	±78.3%
Non-Key	±49.9%	±69.7%	±94.5%	±91.7%	±36.2%
Total	±61.0%	±52.5%	±14.0%	±29.0%	±33.0%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-69. Percentage of non-electric fuel dedicated to non-boiler process by temperature

NAICS and Subsector Manufacturing Type	Low Temp (<140C /280F) (%)	Med Temp (140C/280F & <300C/570F) (%)	High Temp (≥300C/570F) (%)	Don't Know/ Unknown (%)	Total (%)
311 - Food	^29.0%	^61.6%	^3.6%	^5.7%	100.0%
322 - Paper	^3.1%	^16.5%	^12.9%	^67.5%	100.0%
324 - Petroleum and Coal Products	^5.8%	0.0%	^73.9%	^20.4%	100.0%
325 - Chemicals	^40.2%	^34.5%	^23.6%	^1.6%	100.0%
327 - Nonmetallic Mineral Products	^11.0%	19.1%	^64.3%	^5.5%	100.0%
331 - Primary Metals	^30.5%	^0.7%	^35.3%	^33.5%	100.0%
332 - Fabricated Metal Products	16.7%	^41.3%	^7.6%	^34.5%	100.0%
334 - Computer and Electronic Products	^0.5%	^4.9%	^72.2%	^22.4%	100.0%
336 - Transportation Equipment	^91.6%	^1.1%	^3.8%	^3.5%	100.0%
Non-Key	30.1%	-24.0%	6.9%	39.1%	100.0%
Total	32.5%	23.2%	22.4%	21.8%	100.0%

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-70. Relative precision table for percentage of non-electric fuel dedicated to non-boiler process by temperature

NAICS and Subsector Manufacturing Type	Low Temp (<140C /280F) (%)	Med Temp (140C/280F & <300C/570F) (%)	High Temp (≥300C/570F) (%)	Don't Know/ Unknown (%)	Total (%)
311 - Food	±58.2%	±108.0%	±149.9%	±58.3%	±65.6%
322 - Paper	±113.7%	±103.5%	±16.9%	±76.9%	±53.4%
324 - Petroleum and Coal Products	±98.3%	.	±85.8%	±86.7%	±68.6%
325 - Chemicals	±108.5%	±79.8%	±68.5%	±104.6%	±66.0%
327 - Nonmetallic Mineral Products	±77.9%	±80.5%	±19.6%	±9.6%	±24.6%
331 - Primary Metals	±52.9%	±90.2%	±75.0%	±62.4%	±33.7%
332 - Fabricated Metal Products	±69.4%	±111.7%	±50.3%	±85.4%	±56.7%
334 - Computer and Electronic Products	±69.7%	±117.1%	±78.8%	±27.8%	±57.0%
336 - Transportation Equipment	±86.3%	±1.8%	±61.3%	±48.9%	±78.5%
Non-Key	±34.1%	±83.4%	±78.2%	±43.7%	±29.7%
Total	±43.1%	±52.2%	±21.7%	±35.2%	±20.4%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-71. Percentage of facilities with specific equipment types, with percentage of facilities that recently upgraded each equipment type

Equipment Type	% of facilities with equipment	% of facilities that received EE upgrades on equipment in last 3 years
Basic Oxygen Furnace	0.0%	0.0%
Blast Furnace	0.1%	0.0%
Carburizing furnace	^0.6%	-0.0%
Casting	0.2%	0.0%
Distillation	0.3%	-0.1%
Electric arc furnace	^0.1%	-0.1%
Drying and curing	6.4%	0.8%
Evaporators	0.0%	0.0%
Hot rolling	0.1%	-0.0%
Dry kiln	0.3%	0.0%
Wet kiln	^0.1%	0.0%
Kraft pulping	^0.0%	0.0%
Other process heating	4.4%	1.1%
Pasteurization and sterilization	1.6%	-0.3%
Process boiler	3.1%	-0.7%
Welding	12.4%	2.4%
Thermal Oxidizer	0.0%	0.0%
Process cooling (above 40F)	3.4%	1.2%
Refrigeration	6.8%	1.9%
Air compressors	22.4%	7.1%
Process Fans	4.8%	-0.6%
Process pumping	8.9%	2.1%
Material handling (e.g., conveyers, belts, materials movers)	46.7%	7.4%
Mechanical pulping	0.1%	-0.0%
Ball Mill	-0.1%	0.0%
Roller Mill	0.2%	0.0%
Tube Mill	0.0%	0.0%
Impact Mill	0.1%	0.0%
Other materials processing (e.g., grinding, agitating/ mixing, debarking, drilling, pressing)	55.0%	8.2%
Other process motors	0.0%	0.0%
Semiconductor manufacturing	0.2%	-0.0%
Other Electro-Chemical Processes	0.2%	-0.1%
Separators	0.0%	0.0%
Computer Assembly	0.5%	0.1%
Silicon Wafer Manufacturing	0.0%	0.0%
Other	35.9%	5.0%

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-72. Percentage of facilities with specific equipment types, with percentage of facilities that recently upgraded each equipment type relative precision table

Equipment Type	% of facilities with equipment	% of facilities that received EE upgrades on equipment in last 3 years
Basic Oxygen Furnace	±67.4%	.
Blast Furnace	±52.7%	±0.1%
Carburizing furnace	±138.2%	±91.4%
Casting	±54.3%	±63.4%
Distillation	±59.0%	±109.5%
Electric arc furnace	±118.8%	±146.7%
Drying and curing	±29.8%	±81.8%
Evaporators	.	.
Hot rolling	±51.8%	±100.0%
Dry kiln	±50.9%	.
Wet kiln	±144.1%	.
Kraft pulping	±87.6%	.
Other process heating	±23.4%	±60.1%
Pasteurization and sterilization	±50.1%	±131.5%
Process boiler	±29.2%	±83.9%
Welding	±16.8%	±60.8%
Thermal Oxidizer	.	.
Process cooling (above 40F)	±37.9%	±68.2%
Refrigeration	±20.8%	±51.9%
Air compressors	±10.5%	±26.6%
Process Fans	±39.1%	±106.2%
Process pumping	±24.7%	±46.5%
Material handling (e.g., conveyers, belts, materials movers)	±15.9%	±56.6%
Mechanical pulping	±60.2%	±124.8%
Ball Mill	±82.9%	.
Roller Mill	±70.3%	.
Tube Mill	.	.
Impact Mill	±79.9%	.
Other materials processing (e.g., grinding, agitating/mixing, debarking, drilling, pressing)	±13.3%	±41.6%
Other process motors	.	.
Semiconductor manufacturing	±57.2%	±95.1%
Other Electro-Chemical Processes	±46.8%	±82.4%
Separators	.	.
Computer Assembly	±45.5%	±78.4%
Silicon Wafer Manufacturing	±62.3%	.
Other	±20.2%	±61.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-73. Percentage of facilities with specific equipment types, with percentage of facilities at different equipment efficiency levels

Equipment Type	% of facilities with equipment	Low efficiency	Moderate efficiency	High efficiency	Don't Know
Basic Oxygen Furnace	0.0%	b	b		
Blast Furnace	0.1%	b	b		b
Carburizing furnace	^0.6%	b	b		b
Casting	0.2%		b		0.1%
Distillation	0.3%	b	b	b	b
Electric arc furnace	^0.1%			b	b
Drying and curing	6.4%	0.3%	2.9%	1.2%	1.9%
Evaporators	0.0%				
Hot rolling	0.1%		b	b	b
Dry kiln	0.3%	b	b	b	b
Wet kiln	^0.1%	b			
Kraft pulping	^0.0%		b		
Other process heating	4.4%	0.2%	2.2%	0.8%	1.3%
Pasteurization and sterilization	1.6%	b	0.9%	b	b
Process boiler	3.1%	0.3%	1.4%	1.0%	0.4%
Welding	12.4%	b	4.7%	3.7%	3.4%
Thermal Oxidizer	0.0%				
Process cooling (above 40F)	3.4%		1.6%	1.1%	-0.7%
Refrigeration	6.8%	b	4.0%	1.4%	0.9%
Air compressors	22.4%	-1.2%	10.6%	6.1%	4.5%
Process Fans	4.8%	-0.9%	2.7%	b	0.6%
Process pumping	8.9%	b	5.1%	1.6%	1.5%
Material handling (e.g., conveyers, belts, materials movers)	46.7%	1.7%	21.7%	9.4%	11.9%
Mechanical pulping	0.1%		b		
Ball Mill	-0.1%		b	b	b
Roller Mill	0.2%		b	b	b
Tube Mill	0.0%				
Impact Mill	0.1%		b	b	b
Other materials processing (e.g., grinding, agitating/mixing, debarking, drilling, pressing)	55.0%	4.0%	16.5%	14.5%	18.1%
Other process motors	0.0%				
Semiconductor manufacturing	0.2%		b	b	b
Other Electro-Chemical Processes	0.2%		b	b	b
Separators	0.0%				
Computer Assembly	0.5%		0.1%	0.2%	b
Silicon Wafer Manufacturing	0.0%				b
Other	35.9%	-3.6%	12.4%	7.4%	12.4%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'^' indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-74. Relative precision table for percentage of facilities with specific equipment types, with percentage of facilities at different equipment efficiency levels

Equipment Type	% of facilities with equipment	Low efficiency	Moderate efficiency	High efficiency	Don't Know
Basic Oxygen Furnace	±67.4%	±100.0%	±100.0%	.	.
Blast Furnace	±52.7%	±0.1%	±94.7%	.	±61.3%
Carburizing furnace	±138.2%	±162.8%	±57.1%	.	±70.0%
Casting	±54.3%	.	±92.6%	.	±65.9%
Distillation	±59.0%	±134.5%	±89.0%	±150.2%	±102.4%
Electric arc furnace	±118.8%	.	.	±146.7%	±62.3%
Drying and curing	±29.8%	±52.8%	±46.6%	±72.8%	±59.7%
Evaporators	.	.	.	.	.
Hot rolling	±51.8%	.	±130.3%	±100.0%	±27.6%
Dry kiln	±50.9%	±129.3%	±101.6%	±83.9%	±100.9%
Wet kiln	±144.1%	±144.1%	.	.	.
Kraft pulping	±87.6%	.	±87.6%	.	.
Other process heating	±23.4%	±55.8%	±32.6%	±73.4%	±40.4%
Pasteurization and sterilization	±50.1%	±135.0%	±68.8%	±93.3%	±109.4%
Process boiler	±29.2%	±80.7%	±46.3%	±63.3%	±60.9%
Welding	±16.8%	±135.2%	±35.1%	±50.4%	±46.9%
Thermal Oxidizer	.	.	.	.	.
Process cooling (above 40F)	±37.9%	.	±49.1%	±76.7%	±86.2%
Refrigeration	±20.8%	±149.5%	±36.0%	±57.4%	±60.8%
Air compressors	±10.5%	±83.6%	±23.0%	±30.1%	±37.8%
Process Fans	±39.1%	±107.2%	±57.5%	±144.4%	±67.8%
Process pumping	±24.7%	±112.5%	±37.4%	±51.1%	±52.4%
Material handling (e.g., conveyers, belts, materials movers)	±15.9%	±59.2%	±28.7%	±46.9%	±37.7%
Mechanical pulping	±60.2%	.	±71.1%	.	.
Ball Mill	±82.9%	.	±129.3%	±142.7%	±144.1%
Roller Mill	±70.3%	.	±86.2%	±142.7%	±144.1%
Tube Mill	.	.	.	.	.
Impact Mill	±79.9%	.	±129.3%	±129.3%	±144.1%
Other materials processing (e.g., grinding, agitating/mixing, debarking, drilling, pressing)	±13.3%	±43.3%	±16.2%	±39.6%	±34.2%
Other process motors	.	.	.	.	.
Semiconductor manufacturing	±57.2%	.	±57.1%	±95.1%	±80.8%
Other Electro-Chemical Processes	±46.8%	.	±75.2%	±67.1%	±100.0%
Separators	.	.	.	.	.
Computer Assembly	±45.5%	.	±54.8%	±64.9%	±117.7%
Silicon Wafer Manufacturing	±62.3%	.	.	.	±62.3%
Other	±20.2%	±84.3%	±41.8%	±46.0%	±45.2%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-75. Percentage of facilities with an established energy consumption baseline by subsector and tier

NAICS and Subsector Manufacturing Type	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	Don't know
311 - Food	4.1%	^7.0%	-3.9%	^6.1%	^4.3%	59.0%	15.7%
322 - Paper	19.2%	^1.1%	^6.9%	-5.2%	9.7%	35.9%	22.0%
324 - Petroleum and Coal Products	^23.3%	0.0%	0.0%	^10.7%	^23.3%	32.0%	^10.7%
325 - Chemicals	27.4%	0.0%	0.0%	^5.6%	5.6%	48.5%	^12.9%
327 - Nonmetallic Mineral Products	^5.1%	^1.3%	^5.3%	-3.4%	^7.5%	51.9%	25.5%
331 - Primary Metals	3.1%	^2.1%	^5.9%	^3.6%	18.1%	40.0%	27.2%
332 - Fabricated Metal Products	-6.9%	^2.7%	^1.4%	1.0%	14.8%	47.9%	25.3%
334 - Computer and Electronic Products	12.8%	3.5%	^5.8%	6.0%	-2.8%	52.7%	16.3%
336 - Transportation Equipment	25.8%	0.0%	^4.9%	0.0%	^7.1%	43.2%	19.1%
Non-Key	2.4%	1.9%	0.8%	^3.4%	12.9%	67.0%	11.7%
Total	4.7%	2.3%	1.4%	^3.2%	12.3%	60.7%	15.4%

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-76. Relative precision table for percentage of facilities with an established energy consumption baseline by subsector and tier

NAICS and Subsector Manufacturing Type	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	Don't know
311 - Food	±62.0%	±161.5%	±92.2%	±146.2%	±109.2%	±26.8%	±41.9%
322 - Paper	±40.4%	±16.1%	±100.9%	±86.7%	±80.4%	±33.2%	±51.9%
324 - Petroleum and Coal Products	±115.2%	.	.	±135.0%	±97.4%	±72.1%	±135.0%
325 - Chemicals	±60.4%	.	.	±105.0%	±57.2%	±30.0%	±96.6%
327 - Nonmetallic Mineral Products	±88.4%	±130.2%	±101.0%	±86.7%	±105.5%	±21.6%	±41.0%
331 - Primary Metals	±42.1%	±101.0%	±91.7%	±130.3%	±43.5%	±33.2%	±42.9%
332 - Fabricated Metal Products	±87.7%	±112.5%	±116.1%	±78.9%	±57.4%	±22.3%	±37.1%
334 - Computer and Electronic Products	±58.6%	±74.6%	±112.2%	±64.2%	±90.5%	±20.8%	±56.1%
336 - Transportation Equipment	±61.8%	.	±97.8%	.	±82.9%	±46.7%	±72.5%
Non-Key	±36.7%	±67.2%	±62.1%	±130.3%	±58.2%	±14.6%	±55.4%
Total	±30.4%	±51.5%	±37.7%	±93.4%	±42.1%	±11.2%	±30.4%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-77. Percentage of facilities that track energy use compared to an established baseline by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	^77.9%	100.0%	.	b
322 - Paper	71.8%	70.8%	b	b
324 - Petroleum and Coal Products	b	.	.	b
325 - Chemicals	94.0%	78.8%	b	b
327 - Nonmetallic Mineral Products	^38.5%	b	.	b
331 - Primary Metals	47.0%	b	b	b
332 - Fabricated Metal Products	29.9%	b	b	25.0%
334 - Computer and Electronic Products	83.9%	b	.	82.8%
336 - Transportation Equipment	89.1%	100.0%	b	b
Non-Key	57.8%	83.0%	^45.4%	57.2%
Total	58.5%	81.9%	57.2%	54.4%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'^' indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-78. Relative precision table for percentage of facilities that track energy use compared to the established baseline by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±24.7%	±0.0%	.	±63.6%
322 - Paper	±26.1%	±31.4%	±93.1%	±0.0%
324 - Petroleum and Coal Products	±0.0%	.	.	±0.0%
325 - Chemicals	±8.3%	±33.3%	±0.0%	±0.0%
327 - Nonmetallic Mineral Products	±71.9%	±79.5%	.	±111.1%
331 - Primary Metals	±59.2%	±0.0%	.	.
332 - Fabricated Metal Products	±38.3%	.	±0.0%	±50.5%
334 - Computer and Electronic Products	±17.8%	±0.0%	.	±19.3%
336 - Transportation Equipment	±0.7%	±0.0%	.	±0.0%
Non-Key	±34.5%	±17.7%	±83.9%	±42.5%
Total	±14.4%	±9.3%	±43.7%	±21.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-79. Percentage of facilities with a written energy policy by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	^4.5%	^24.5%	b	^2.8%
322 - Paper	15.6%	43.4%	0.0%	0.0%
324 - Petroleum and Coal Products	0.0%	b	.	0.0%
325 - Chemicals	-11.7%	38.8%	b	^7.5%
327 - Nonmetallic Mineral Products	^1.9%	^18.0%	b	0.0%
331 - Primary Metals	3.1%	15.2%	0.0%	0.0%
332 - Fabricated Metal Products	5.6%	^16.3%	^25.7%	5.4%
334 - Computer and Electronic Products	15.0%	25.0%	.	14.5%
336 - Transportation Equipment	15.9%	52.7%	^28.1%	8.3%
Non-Key	2.1%	63.3%	^18.0%	1.6%
Overall	3.7%	35.7%	^10.7%	2.8%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'^' indicates a single weighted response represents more than 50% of a given aggregate calculation.

'-' indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-80. Relative precision table for percentage of facilities with a written energy policy by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±97.1%	±104.3%	.	±155.3%
322 - Paper	±45.6%	±38.0%	.	.
324 - Petroleum and Coal Products	.	.	.	.
325 - Chemicals	±82.8%	±51.4%	.	±156.0%
327 - Nonmetallic Mineral Products	±87.4%	±87.2%	.	.
331 - Primary Metals	±42.1%	±42.5%	.	.
332 - Fabricated Metal Products	±74.6%	±35.6%	±85.8%	±78.7%
334 - Computer and Electronic Products	±54.9%	±27.0%	.	±59.0%
336 - Transportation Equipment	±38.6%	±35.0%	±122.1%	±43.6%
Non-Key	±53.9%	±30.1%	±138.5%	±68.9%
Overall	±31.4%	±20.9%	±91.1%	±41.9%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-81. Percentage of facilities with an energy map identifying the top energy drivers and end uses in the facility by subsector

NAICS and Subsector Manufacturing Type	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	Don't know
311 - Food	0.0%	0.0%	^2.5%	^2.9%	8.9%	79.0%	6.7%
322 - Paper	12.3%	^2.5%	^2.6%	^4.4%	13.0%	51.9%	13.3%
324 - Petroleum and Coal Products	0.0%	0.0%	0.0%	0.0%	^15.3%	66.0%	^18.7%
325 - Chemicals	-12.9%	^1.6%	^1.6%	^3.5%	6.8%	71.9%	^1.6%
327 - Nonmetallic Mineral Products	^4.9%	^1.3%	^7.3%	0.0%	16.2%	45.8%	24.4%
331 - Primary Metals	9.0%	4.3%	0.0%	^1.3%	9.4%	50.2%	25.8%
332 - Fabricated Metal Products	0.8%	^0.6%	^2.8%	1.4%	10.8%	64.9%	18.7%
334 - Computer and Electronic Products	7.5%	^1.9%	^4.4%	6.5%	8.8%	59.8%	11.0%
336 - Transportation Equipment	13.5%	^3.4%	0.0%	^1.5%	9.3%	56.0%	16.3%
Non-Key	1.8%	^0.8%	^0.8%	^3.5%	13.1%	70.2%	9.8%
Overall	2.2%	0.8%	1.5%	^3.0%	12.2%	68.2%	11.9%

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

- indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-82. Percentage of facilities with an energy map identifying the top energy drivers and end uses in the facility by subsector relative precision table

NAICS and Subsector Manufacturing Type	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	Don't know
311 - Food	.	.	±120.3%	±127.0%	±65.6%	±8.7%	±79.3%
322 - Paper	±67.8%	±122.2%	±125.1%	±142.3%	±51.2%	±23.9%	±62.9%
324 - Petroleum and Coal Products	.	.	.	.	±96.3%	±37.6%	±122.9%
325 - Chemicals	±83.9%	±125.8%	±125.8%	±147.1%	±59.7%	±17.6%	±125.8%
327 - Nonmetallic Mineral Products	±150.4%	±130.2%	±111.7%	.	±55.7%	±25.8%	±42.5%
331 - Primary Metals	±76.9%	±68.9%	.	±15.6%	±60.3%	±25.8%	±45.2%
332 - Fabricated Metal Products	±74.4%	±156.1%	±156.4%	±69.1%	±60.7%	±16.0%	±44.7%
334 - Computer and Electronic Products	±58.5%	±141.2%	±135.0%	±63.7%	±57.1%	±18.3%	±70.9%
336 - Transportation Equipment	±42.7%	±135.4%	.	±92.5%	±79.0%	±19.1%	±42.4%
Non-Key	±57.2%	±119.7%	±115.2%	±127.9%	±57.0%	±14.0%	±65.0%
Overall	±33.3%	±76.4%	±72.8%	±97.4%	±41.6%	±9.9%	±37.9%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-83. Energy performance tracking by subsector

NAICS and Subsector Manufacturing Type	% of Facilities that Conduct Energy Performance Tracking	% of Facilities that Utilize an EMS	% of Facilities with an Individual or Team Responsible for Energy Performance	% of Facilities with Standard Maintenance Schedules
311 - Food	b	b	b	b
322 - Paper	^18.2%	0.0%	-36.5%	100.0%
324 - Petroleum and Coal Products	b	b	b	b
325 - Chemicals	b	b	b	b
327 - Nonmetallic Mineral Products	0.0%	^1.6%	^37.2%	^71.5%
331 - Primary Metals	0.0%	0.0%	0.0%	75.1%
332 - Fabricated Metal Products	^0.6%	0.0%	-11.3%	-15.7%
334 - Computer and Electronic Products	^1.0%	^40.5%	^52.1%	66.4%
336 – Transportation Equipment	11.1%	11.1%	11.1%	^30.2%
Non-key	^0.9%	1.2%	5.7%	22.4%
Overall	1.1%	2.5%	9.0%	23.4%

‘b’ indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-84. Relative precision table for energy performance tracking by subsector

NAICS and Subsector Manufacturing Type	% of Facilities that Conduct Energy Performance Tracking	% of Facilities that Utilize an EMS	% of Facilities with an Individual or Team Responsible for Energy Performance	% of Facilities with Standard Maintenance Schedules
311 - Food	.	±156.7%	±156.7%	±156.7%
322 - Paper	±135.2%	.	±85.5%	±0.0%
324 - Petroleum and Coal Products	±144.6%	.	±144.6%	±0.0%
325 - Chemicals	.	±182.1%	±182.1%	±182.1%
327 - Nonmetallic Mineral Products	.	±182.6%	±134.9%	±62.2%
331 - Primary Metals	.	.	.	±41.3%
332 - Fabricated Metal Products	±176.5%	.	±124.6%	±105.4%
334 - Computer and Electronic Products	±167.0%	±81.5%	±55.1%	±36.3%
336 – Transportation Equipment	±81.9%	±81.9%	±81.9%	±104.5%
Non-key	±72.6%	±54.1%	±54.8%	±41.0%
Overall	±49.5%	±53.8%	±39.5%	±33.5%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-85. Percentage of facilities using different maintenance schedules by location

NAICS and Subsector Manufacturing Type	System	Regular Maintenance at specific times	No regular maintenance scheduled (as needed)	Don't know	N/A
311 - Food	Facility Building	58.3%	32.1%	-5.3%	^4.3%
	Production Equipment	82.0%	-11.1%	^1.9%	^5.0%
	Production Process	75.5%	20.2%	^1.9%	^2.4%
322 - Paper	Facility Building	58.9%	27.7%	13.4%	0.0%
	Production Equipment	73.6%	20.1%	6.3%	0.0%
	Production Process	69.2%	21.9%	8.9%	0.0%
324 - Petroleum and Coal Products	Facility Building	26.0%	40.0%	^23.3%	^10.7%
	Production Equipment	78.7%	-21.3%	0.0%	0.0%
	Production Process	74.0%	26.0%	0.0%	0.0%
325 - Chemicals	Facility Building	61.4%	38.6%	0.0%	0.0%
	Production Equipment	66.5%	24.4%	0.0%	^9.1%
	Production Process	51.3%	32.6%	0.0%	^16.2%
327 - Nonmetallic Mineral Products	Facility Building	55.6%	37.9%	6.5%	0.0%
	Production Equipment	66.9%	27.3%	5.8%	0.0%
	Production Process	57.7%	32.6%	7.1%	^2.6%
331 - Primary Metals	Facility Building	59.4%	39.1%	^1.6%	0.0%
	Production Equipment	75.9%	22.6%	^1.6%	0.0%
	Production Process	71.0%	25.3%	^3.7%	0.0%
332 - Fabricated Metal Products	Facility Building	54.1%	41.6%	^1.8%	-2.5%
	Production Equipment	68.6%	28.9%	0.0%	~2.5%
	Production Process	52.6%	39.1%	^4.4%	3.9%
334 - Computer and Electronic Products	Facility Building	67.7%	29.4%	0.0%	-2.8%
	Production Equipment	75.6%	19.6%	0.0%	^4.8%
	Production Process	58.2%	19.2%	^3.9%	18.7%
336 - Transportation Equipment	Facility Building	66.9%	31.4%	^1.7%	0.0%
	Production Equipment	77.0%	21.3%	^1.7%	0.0%
	Production Process	72.1%	~13.8%	^1.7%	^12.3%
Non-Key	Facility Building	38.0%	47.4%	^4.4%	10.2%
	Production Equipment	56.7%	37.7%	1.6%	^4.0%
	Production Process	42.4%	44.2%	7.8%	-5.7%
Total	Facility Building	44.4%	44.2%	3.9%	7.5%
	Production Equipment	61.8%	33.2%	1.4%	-3.6%
	Production Process	47.8%	40.2%	6.5%	5.5%

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘~’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-86. Relative precision table for percentage of facilities using different maintenance schedules by location

NAICS and Subsector Manufacturing Type	System	Regular Maintenance at specific times	No regular maintenance scheduled (as needed)	Don't know	N/A
311 - Food	Facility Building	±30.9%	±54.9%	±90.1%	±109.2%
	Production Equipment	±14.7%	±92.8%	±151.9%	±110.1%
	Production Process	±16.8%	±59.2%	±151.9%	±154.7%
322 - Paper	Facility Building	±21.1%	±43.4%	±62.4%	.
	Production Equipment	±16.3%	±57.8%	±71.9%	.
	Production Process	±17.4%	±51.6%	±61.0%	.
324 - Petroleum and Coal Products	Facility Building	±77.3%	±65.3%	±115.2%	±135.0%
	Production Equipment	±24.9%	±92.0%	.	.
	Production Process	±27.2%	±77.3%	.	.
325 - Chemicals	Facility Building	±28.5%	±45.2%	.	.
	Production Equipment	±23.5%	±53.3%	.	±144.2%
	Production Process	±28.0%	±53.0%	.	±101.7%
327 - Nonmetallic Mineral Products	Facility Building	±21.9%	±31.1%	±73.0%	.
	Production Equipment	±13.7%	±31.4%	±80.9%	.
	Production Process	±17.5%	±31.0%	±69.4%	±142.8%
331 - Primary Metals	Facility Building	±22.7%	±34.5%	±64.0%	.
	Production Equipment	±17.2%	±57.9%	±64.0%	.
	Production Process	±18.5%	±51.5%	±65.0%	.
332 - Fabricated Metal Products	Facility Building	±19.2%	±25.4%	±161.8%	±90.1%
	Production Equipment	±14.6%	±34.1%	.	±90.1%
	Production Process	±20.8%	±27.2%	±108.2%	±67.6%
334 - Computer and Electronic Products	Facility Building	±15.8%	±35.8%	.	±90.5%
	Production Equipment	±13.4%	±48.1%	.	±102.7%
	Production Process	±16.0%	±48.2%	±152.8%	±50.9%
336 - Transportation Equipment	Facility Building	±17.6%	±38.1%	±99.6%	.
	Production Equipment	±15.3%	±55.7%	±99.6%	.
	Production Process	±16.8%	±99.7%	±99.6%	±112.2%
Non-Key	Facility Building	±26.9%	±22.9%	±103.7%	±72.7%
	Production Equipment	±19.1%	±28.4%	±68.1%	±115.2%
	Production Process	±24.9%	±24.5%	±80.7%	±83.5%
Total	Facility Building	±15.9%	±16.9%	±79.1%	±65.3%
	Production Equipment	±12.0%	±22.0%	±53.8%	±84.2%
	Production Process	±15.2%	±18.5%	±65.3%	±57.1%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-87. Percentage of facilities that have completed process upgrades

NAICS and Subsector Manufacturing Type	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	Don't know
311 - Food	32.7%	^3.5%	-4.1%	^2.9%	^2.7%	43.1%	11.0%
322 - Paper	44.4%	-5.2%	^6.9%	0.0%	7.7%	19.1%	16.7%
324 - Petroleum and Coal Products	^10.7%	^18.7%	0.0%	0.0%	^4.7%	32.0%	^34.0%
325 - Chemicals	34.2%	^3.7%	-14.3%	^5.2%	^12.2%	30.4%	0.0%
327 - Nonmetallic Mineral Products	28.7%	^4.1%	10.7%	7.5%	14.4%	21.1%	13.6%
331 - Primary Metals	41.5%	^3.8%	^1.3%	9.4%	0.0%	26.9%	16.9%
332 - Fabricated Metal Products	19.7%	-5.6%	5.9%	^5.3%	10.9%	34.8%	17.8%
334 - Computer and Electronic Products	18.4%	10.3%	10.2%	9.1%	8.0%	38.6%	-5.4%
336 - Transportation Equipment	41.0%	^1.7%	^3.4%	0.0%	^5.1%	40.2%	8.6%
Non-Key	22.0%	^5.1%	^4.1%	10.7%	6.4%	35.8%	15.9%
Overall	22.9%	5.2%	4.9%	8.8%	7.4%	35.4%	15.4%

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

- indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-88. Percentage of facilities that have completed process upgrades relative precision table

NAICS and Subsector Manufacturing Type	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	Don't know
311 - Food	±50.6%	±106.4%	±93.0%	±127.0%	±155.9%	±38.9%	±64.0%
322 - Paper	±27.6%	±86.7%	±100.9%	.	±70.6%	±57.9%	±57.6%
324 - Petroleum and Coal Products	±135.0%	±122.9%	.	.	±29.7%	±72.1%	±80.1%
325 - Chemicals	±39.4%	±94.3%	±100.5%	±108.2%	±102.0%	±51.6%	.
327 - Nonmetallic Mineral Products	±46.0%	±100.6%	±59.4%	±68.2%	±68.8%	±51.6%	±67.3%
331 - Primary Metals	±30.7%	±131.4%	±15.6%	±61.8%	.	±47.3%	±45.2%
332 - Fabricated Metal Products	±36.5%	±96.2%	±81.8%	±99.3%	±68.0%	±30.7%	±45.7%
334 - Computer and Electronic Products	±36.5%	±71.6%	±79.0%	±51.8%	±72.7%	±28.3%	±83.7%
336 - Transportation Equipment	±42.0%	±99.6%	±135.4%	.	±96.0%	±44.7%	±62.4%
Non-Key	±39.0%	±91.9%	±110.6%	±59.7%	±74.4%	±29.4%	±52.9%
Overall	±25.5%	±62.7%	±64.0%	±49.3%	±47.1%	±20.6%	±37.3%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-89. Facility energy efficiency improvements

NAICS	% of Facilities With Equipment, Process or Supply Chain Improvements in Last 3 Years	% of Facilities With Facility Expansions in Last 3 Years	% of Facilities with Recent Energy Efficiency Upgrades	% of Facilities with Planned Expansions in Next 1-3 Years	% of Facilities with Planned Equipment, Process or Supply Chain Improvements in Next 1-3 Years
311 – Food	b	b	b	b	b
322 - Paper	-31.8%	0.0%	47.6%	0.0%	^20.6%
324 - Petroleum and Coal Products	b	b	b	b	b
325 - Chemicals	b	b	b	b	b
327 - Nonmetallic Mineral Products	^15.4%	^15.4%	77.5%	0.0%	^15.4%
331 - Primary Metals	-37.6%	^16.3%	54.8%	^16.3%	66.5%
332 - Fabricated Metal Products	-13.6%	^4.3%	^95.4%	^0.6%	^10.6%
334 - Computer and Electronic Products	^32.1%	^5.9%	84.0%	^12.1%	^50.4%
336 – Transportation Equipment	-42.1%	^5.5%	^36.6%	0.0%	-42.1%
Non-key	^40.3%	^2.5%	25.0%	58.9%	^50.2%
Overall	^32.5%	3.4%	41.7%	40.2%	-39.1%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'^' indicates a single weighted response represents more than 50% of a given aggregate calculation.

'-' indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-90. Relative precision table for facility energy efficiency improvements

NAICS	% of Facilities With Equipment, Process or Supply Chain Improvements in Last 3 Years	% of Facilities With Facility Expansions in Last 3 Years	% of Facilities with Recent Energy Efficiency Upgrades	% of Facilities with Planned Expansions in Next 1-3 Years	% of Facilities with Planned Equipment, Process or Supply Chain Improvements in Next 1-3 Years
311 – Food	±156.7%	±222.6%	±156.7%	±222.6%	±156.7%
322 - Paper	±98.1%	.	±69.4%	.	±119.9%
324 - Petroleum and Coal Products	±144.6%	.	±0.0%	±144.6%	±144.6%
325 - Chemicals	±182.1%	±182.1%	±182.1%	.	±182.1%
327 - Nonmetallic Mineral Products	±115.4%	±115.4%	±42.8%	.	±115.4%
331 - Primary Metals	±94.2%	±164.7%	±67.4%	±164.7%	±50.9%
332 - Fabricated Metal Products	±115.9%	±160.9%	±7.5%	±176.5%	±133.2%
334 - Computer and Electronic Products	±104.8%	±152.3%	±17.7%	±120.5%	±54.0%
336 – Transportation Equipment	±129.6%	±173.8%	±142.1%	.	±129.6%
Non-key	±116.2%	±105.3%	±40.8%	±4.9%	±95.2%
Overall	±98.5%	±66.8%	±29.4%	±18.3%	±84.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-91. Percentage of facilities with awareness and usage of funding sources for process upgrades by financing type

Funding Type	Aware have used	Aware would consider using	Aware won’t use	Not aware have not used	Did not answer
Self-funding	60.7%	5.9%	4.5%	26.4%	-2.5%
Commercial lending (loans)	41.0%	14.6%	23.7%	20.0%	0.8%
On-bill financing	7.4%	9.9%	22.4%	59.2%	1.1%
Energy-as-a-service (EaaS)	-2.6%	6.3%	13.1%	77.1%	1.0%
Utility Incentives	21.7%	24.3%	5.7%	47.7%	0.6%
State Incentives	19.5%	24.0%	3.8%	52.0%	0.7%
Other			b	0.2%	99.7%

‘b’ indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-92. Relative precision table for percentage of facilities with awareness and usage of funding sources for process upgrades by financing type

Funding Type	Aware have used	Aware would consider using	Aware won't use	Not aware have not used	Did not answer
Self-funding	±12.2%	±30.9%	±72.0%	±26.4%	±119.2%
Commercial lending (loans)	±17.9%	±35.6%	±27.8%	±29.5%	±62.8%
On-bill financing	±57.1%	±36.3%	±28.3%	±12.3%	±47.7%
Energy-as-a-service (EaaS)	±112.6%	±30.2%	±39.4%	±7.7%	±52.2%
Utility Incentives	±21.9%	±25.0%	±56.8%	±14.9%	±64.4%
State Incentives	±27.5%	±25.0%	±38.1%	±13.7%	±58.9%
Other	.	.	±157.4%	±53.8%	±0.2%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-93. Percentage of facilities that have calculated the proportion of materials used in manufacturing that contain recycled content by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	^13.6%	53.2%	b	^10.6%
322 - Paper	41.8%	60.7%	39.3%	29.1%
324 - Petroleum and Coal Products	^38.7%	b	n	^31.3%
325 - Chemicals	16.4%	^10.4%	b	^12.3%
327 - Nonmetallic Mineral Products	19.2%	^6.0%	b	22.1%
331 - Primary Metals	23.8%	28.3%	^23.8%	22.4%
332 - Fabricated Metal Products	12.3%	^47.7%	32.6%	12.0%
334 - Computer and Electronic Products	^6.9%	25.0%	n	^6.2%
336 - Transportation Equipment	25.2%	71.9%	56.3%	13.2%
Non-Key	14.0%	30.1%	14.5%	13.9%
Overall	14.2%	38.9%	22.9%	13.5%

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‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-94. Relative precision table for percentage of facilities that have calculated the proportion of materials used in manufacturing that contain recycled content by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±87.8%	±49.3%	.	±127.3%
322 - Paper	±28.4%	±26.6%	±68.5%	±64.1%
324 - Petroleum and Coal Products	±69.3%	±0.0%	.	±91.3%
325 - Chemicals	±71.5%	±123.8%	±61.6%	±111.8%
327 - Nonmetallic Mineral Products	±54.5%	±40.8%	.	±56.3%
331 - Primary Metals	±37.3%	±47.2%	±70.2%	±54.7%
332 - Fabricated Metal Products	±59.5%	±38.6%	±67.5%	±62.0%
334 - Computer and Electronic Products	±88.8%	±27.0%	.	±104.1%
336 - Transportation Equipment	±34.8%	±22.5%	±36.5%	±63.7%
Non-Key	±47.0%	±60.1%	±80.7%	±48.0%
Overall	±32.4%	±18.7%	±44.3%	±35.5%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-95. Waste capture and recyclable content by subsector

NAICS	% of Facilities that Have Waste Capture or Recycling Processes	% of Input Materials that are From Recycled Sources	% of Materials Obtained Domestically
311 - Food	b	b	b
322 - Paper	100.0%	52.2%	96.7%
324 - Petroleum and Coal Products	b	b	b
325 - Chemicals	b	b	b
327 - Nonmetallic Mineral Products	^43.9%	^15.0%	58.9%
331 - Primary Metals	100.0%	b	68.0%
332 - Fabricated Metal Products	-31.4%	^4.4%	^90.8%
334 - Computer and Electronic Products	68.1%	^0.9%	61.9%
336 – Transportation Equipment	-42.1%	b	b
Non-key	58.0%	2.5%	84.8%
Overall	50.5%	4.0%	86.4%

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‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-96. Relative precision table waste capture and recyclable content by subsector

NAICS	% of Facilities that Have Waste Capture or Recycling Processes	% of Input Materials that are From Recycled Sources	% of Materials Obtained Domestically
311 - Food	±222.6%	.	±0.2%
322 - Paper	±0.0%	±57.4%	±3.3%
324 - Petroleum and Coal Products	±72.3%	±134.0%	±44.7%
325 - Chemicals	±56.0%	±56.5%	±0.0%
327 - Nonmetallic Mineral Products	±105.7%	±151.7%	±28.8%
331 - Primary Metals	±0.0%	±159.5%	±49.5%
332 - Fabricated Metal Products	±157.3%	±204.6%	±12.6%
334 - Computer and Electronic Products	±36.5%	±163.9%	±27.7%
336 – Transportation Equipment	±129.6%	±54.1%	±3.4%
Non-key	±82.3%	±63.3%	±11.0%
Overall	±68.8%	±68.0%	±8.1%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-97. Percentage of facilities that have defined energy performance goals by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	-18.2%	37.2%	b	~17.7%
322 - Paper	26.7%	56.9%	^40.2%	^2.2%
324 - Petroleum and Coal Products	40.0%	b	.	~32.8%
325 - Chemicals	26.9%	59.7%	b	-18.9%
327 - Nonmetallic Mineral Products	20.8%	57.8%	b	17.4%
331 - Primary Metals	6.8%	22.8%	^14.6%	0.0%
332 - Fabricated Metal Products	7.0%	^19.6%	50.0%	-6.5%
334 - Computer and Electronic Products	24.6%	62.5%	.	23.0%
336 - Transportation Equipment	32.4%	85.1%	56.3%	^20.6%
Non-Key	9.3%	75.2%	^22.9%	8.8%
Overall	10.7%	54.8%	24.7%	9.4%

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A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-98. Relative precision table for facilities that have defined energy performance goals by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±82.8%	±70.3%	.	±97.2%
322 - Paper	±31.9%	±29.0%	±69.8%	±30.1%
324 - Petroleum and Coal Products	±65.3%	±0.0%	.	±83.1%
325 - Chemicals	±53.7%	±32.6%	±104.1%	±93.2%
327 - Nonmetallic Mineral Products	±49.6%	±39.5%	.	±67.6%
331 - Primary Metals	±39.4%	±32.1%	±100.7%	.
332 - Fabricated Metal Products	±77.2%	±63.4%	±59.0%	±83.5%
334 - Computer and Electronic Products	±39.7%	±31.0%	.	±44.2%
336 - Transportation Equipment	±48.3%	±15.1%	±36.5%	±91.6%
Non-Key	±67.7%	±21.2%	±109.7%	±72.4%
Overall	±40.5%	±13.7%	±50.2%	±47.9%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-99. For those facilities with a goal, percentage of facilities that have a written plan to achieve that goal by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	^3.1%	b	.	b
322 - Paper	48.8%	50.9%	b	b
324 - Petroleum and Coal Products	b	b	.	b
325 - Chemicals	64.3%	-35.0%	b	b
327 - Nonmetallic Mineral Products	^32.1%	b	.	^33.9%
331 - Primary Metals	b	b	b	n
332 - Fabricated Metal Products	^31.5%	b	b	^32.9%
334 - Computer and Electronic Products	^31.5%	b	.	^30.5%
336 - Transportation Equipment	95.2%	100.0%	a	^90.2%
Non-Key	12.1%	55.8%	a	7.9%
Overall	22.4%	47.1%	72.1%	16.6%

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A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-100. Relative precision table for those facilities with a goal, percentage of facilities that have a written plan to achieve that goal by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier		
		Tier 1	Tier 2	Tier 3
311 - Food	±152.8%	±170.1%	.	.
322 - Paper	±46.3%	±52.0%	±107.6%	.
324 - Petroleum and Coal Products	±160.4%	±0.0%	.	.
325 - Chemicals	±36.5%	±86.6%	±0.0%	±48.4%
327 - Nonmetallic Mineral Products	±38.2%	±137.9%	.	±17.7%
331 - Primary Metals	±126.0%	±126.0%	.	.
332 - Fabricated Metal Products	±28.2%	.	±130.6%	±28.7%
334 - Computer and Electronic Products	±91.2%	±43.3%	.	±104.9%
336 - Transportation Equipment	±5.7%	±0.0%	±0.0%	±11.1%
Non-Key	±51.2%	±56.5%	±0.0%	±70.2%
Overall	±19.1%	±26.1%	±25.0%	±26.2%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-101. Percentage of facilities by subsector and tier that have an energy manager responsible for facility energy performance

NAICS and Subsector Manufacturing Type	% of facilities	Tier 1	Tier 2	Tier 3
311 - Food	11.4%	59.6%	b	-7.3%
322 - Paper	26.0%	49.6%	^20.5%	^10.8%
324 - Petroleum and Coal Products	^10.7%	b	.	0.0%
325 - Chemicals	28.3%	55.2%	a	-21.7%
327 - Nonmetallic Mineral Products	27.2%	47.8%	a	26.4%
331 - Primary Metals	14.5%	^17.9%	^24.6%	11.1%
332 - Fabricated Metal Products	11.7%	0.0%	84.7%	11.1%
334 - Computer and Electronic Products	32.0%	^31.3%	.	32.1%
336 - Transportation Equipment	41.2%	71.9%	56.3%	34.1%
Non-key	11.2%	32.7%	^24.9%	11.0%
Overall	13.0%	45.9%	28.1%	12.0%

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A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-102. Relative precision table for percentage of facilities by subsector and tier that have an energy manager responsible for facility energy performance

NAICS	% of facilities	Tier 1	Tier 2	Tier 3
311 - Food	±51.1%	±43.8%	.	±86.9%
322 - Paper	±38.2%	±33.4%	±110.3%	±115.6%
324 - Petroleum and Coal Products	±135.0%	±0.0%	.	.
325 - Chemicals	±58.7%	±35.9%	±104.1%	±94.6%
327 - Nonmetallic Mineral Products	±46.5%	±50.4%	.	±55.8%
331 - Primary Metals	±46.9%	±60.7%	±106.9%	±81.2%
332 - Fabricated Metal Products	±58.9%	.	±12.1%	±62.9%
334 - Computer and Electronic Products	±33.6%	±53.1%	.	±34.9%
336 – Transportation Equipment	±36.1%	±22.5%	±36.5%	±54.9%
Non-key	±45.8%	±63.7%	±103.1%	±47.4%
Overall	±28.2%	±16.7%	±48.0%	±31.9%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-103. Percentage of facilities planning to appoint an energy manager, by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier 1	Tier 2	Tier 3
311 - Food	0.0%	0.0%	b	0.0%
322 - Paper	^6.9%	0.0%	b	^12.3%
324 - Petroleum and Coal Products	0.0%	.	.	0.0%
325 - Chemicals	^2.3%	^23.3%	a	0.0%
327 - Nonmetallic Mineral Products	^10.4%	b	b	^11.2%
331 - Primary Metals	11.3%	38.4%	b	^7.5%
332 - Fabricated Metal Products	^3.8%	b	b	^3.7%
334 - Computer and Electronic Products	−5.5%	b	.	−5.7%
336 – Transportation Equipment	0.0%	b	b	0.0%
Non-key	^4.6%	^18.0%	0.0%	^4.6%
Overall	^4.3%	11.9%	^1.4%	^4.2%

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Table A-104. Relative precision table for percentage of facilities planning to appoint an energy manager, by subsector and tier

NAICS	% of facilities	Tier 1	Tier 2	Tier 3
311 - Food	.	.	.	.
322 - Paper	±149.2%	.	.	±150.5%
324 - Petroleum and Coal Products	.	.	.	.
325 - Chemicals	±144.6%	±132.6%	.	.
327 - Nonmetallic Mineral Products	±124.9%	±87.6%	.	±140.2%
331 - Primary Metals	±76.5%	±62.5%	.	±131.4%
332 - Fabricated Metal Products	±154.7%	.	±53.0%	±159.0%
334 - Computer and Electronic Products	±84.8%	.	.	±84.2%
336 – Transportation Equipment	.	.	.	.
Non-key	±124.1%	±129.1%	.	±126.3%
Overall	±93.2%	±61.7%	±126.5%	±97.4%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-105. Percentage of facilities by subsector and tier that have a team responsible for energy performance

NAICS and Subsector Manufacturing Type	% of facilities	Tier 1	Tier 2	Tier 3
311 - Food	8.9%	74.5%	b	^2.8%
322 - Paper	19.2%	36.2%	^40.2%	^2.2%
324 - Petroleum and Coal Products	0.0%	b	.	0.0%
325 - Chemicals	20.1%	25.4%	b	^14.2%
327 - Nonmetallic Mineral Products	22.1%	60.1%	b	18.6%
331 - Primary Metals	6.6%	15.2%	^23.8%	0.0%
332 - Fabricated Metal Products	−5.5%	^28.6%	^34.7%	^5.2%
334 - Computer and Electronic Products	18.1%	25.0%	.	17.8%
336 – Transportation Equipment	32.4%	52.7%	56.3%	25.5%
Non-key	^5.2%	41.9%	^22.9%	^4.9%
Overall	6.9%	42.8%	26.0%	5.7%

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Table A-106. Relative precision table for percentage of facilities by subsector and tier that have a team responsible for energy performance

NAICS and Subsector Manufacturing Type	% of facilities	Tier 1	Tier 2	Tier 3
311 - Food	±49.0%	±17.6%	.	±155.3%
322 - Paper	±40.4%	±44.6%	±69.8%	±30.1%
324 - Petroleum and Coal Products	.	.	.	.
325 - Chemicals	±68.2%	±67.5%	±61.6%	±116.6%
327 - Nonmetallic Mineral Products	±46.0%	±33.0%	.	±61.6%
331 - Primary Metals	±40.1%	±42.5%	±70.2%	.
332 - Fabricated Metal Products	±95.1%	±79.0%	±100.4%	±102.7%
334 - Computer and Electronic Products	±51.9%	±27.0%	.	±55.0%
336 - Transportation Equipment	±31.6%	±35.0%	±36.5%	±44.4%
Non-key	±86.2%	±50.0%	±109.7%	±93.9%
Overall	±46.2%	±15.7%	±50.6%	±58.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-107. For facilities with an energy management team, percentage with an energy management team leader by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier 1	Tier 2	Tier 3
311 - Food	93.7%	91.4%	n	b
322 - Paper	73.5%	80.0%	b	b
325 - Chemicals	51.2%	b	b	b
327 - Nonmetallic Mineral Products	49.8%	b	.	^48.3%
331 - Primary Metals	b	b	b	n
332 - Fabricated Metal Products	^66.3%	b	b	^65.6%
334 - Computer and Electronic Products	62.5%	b	.	60.3%
336 - Transportation Equipment	89.9%	b	b	91.1%
Non-key	^89.5%	78.0%	a	^89.5%
Overall	78.9%	78.8%	81.5%	78.7%

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‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-108. Relative precision table for facilities with an energy management team, percentage of facilities with an energy management team leader by subsector and tier

NAICS and Subsector Manufacturing Type	% of facilities	Tier 1	Tier 2	Tier 3
311 - Food	±9.4%	±13.3%	.	±0.0%
322 - Paper	±34.6%	±36.3%	±108.7%	±0.0%
325 - Chemicals	±0.0%	±0.0%	±61.4%	±109.1%
327 - Nonmetallic Mineral Products	±46.4%	±83.4%	.	±55.8%
331 - Primary Metals	±0.0%	±0.0%	±0.0%	.
332 - Fabricated Metal Products	±4.5%	.	±0.0%	±1.7%
334 - Computer and Electronic Products	±61.3%	±0.0%	.	±67.0%
336 – Transportation Equipment	±11.5%	±46.4%	±0.0%	±14.6%
Non-key	±7.9%	±20.0%	±0.0%	±8.0%
Overall	±6.1%	±12.4%	±14.3%	±6.8%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-109. Facilities with an energy manager or energy management team leader, percentage of facilities using an employee vs. outside contractor by subsector and tier

NAICS and Subsector Manufacturing Type	Tier 1		Tier 2		Tier 3	
	Employee	Outside Contractor	Employee	Outside Contractor	Employee	Outside Contractor
311 - Food	96.5%	0.0%	n	n	b	b
322 - Paper	87.3%	^12.7%	b	b	b	b
324 - Petroleum and Coal Products	b	b	.	.	.	.
325 - Chemicals	100.0%	0.0%	b	b	b	b
327 - Nonmetallic Mineral Products	100.0%	0.0%	.	.	100.0%	0.0%
331 - Primary Metals	b	b	b	b	b	b
332 - Fabricated Metal Products	.	.	-44.7%	^41.0%	76.6%	^23.4%
334 - Computer and Electronic Products	b	b	.	.	95.9%	0.0%
336 – Transportation Equipment	69.0%	31.0%	b	b	90.3%	^9.7%
Non-key	b	b	b	b	100.0%	0.0%
Overall	93.8%	5.2%	84.4%	^0.115	94.5%	^5.2%

‘b’ indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-110. Relative precision table for facilities with an energy manager or energy management team leader, percentage of facilities using an employee vs. outside contractor by subsector and tier

NAICS and Subsector Manufacturing Type	Tier 1		Tier 2		Tier 3	
	Employee	Outside Contractor	Employee	Outside Contractor	Employee	Outside Contractor
311 - Food	±1.1%	.	.	.	±73.1%	±163.4%
322 - Paper	±21.3%	±146.2%	±0.0%	.	±0.0%	.
324 - Petroleum and Coal Products	±0.0%	.	.	.	.	.
325 - Chemicals	±0.0%	.	±0.0%	.	±0.0%	.
327 - Nonmetallic Mineral Products	±0.0%	.	.	.	±0.0%	.
331 - Primary Metals	±0.0%	.	±0.0%	.	±0.0%	.
332 - Fabricated Metal Products	.	.	±84.4%	±101.7%	±42.3%	±138.5%
334 - Computer and Electronic Products	±0.0%	.	.	.	±6.7%	.
336 – Transportation Equipment	±36.0%	±80.1%	±0.0%	.	±16.0%	±148.2%
Non-key	±0.0%	.	±0.0%	.	±0.0%	.
Overall	±4.5%	±81.1%	±20.6%	±145.7%	±6.5%	±117.9%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-111. Demand response participation by subsector

NAICS and Subsector Manufacturing Type	% of Facilities that Participate in Demand Response
311 - Food	b
322 - Paper	−34.1%
324 - Petroleum and Coal Products	b
325 - Chemicals	b
327 - Nonmetallic Mineral Products	^37.2%
331 - Primary Metals	29.9%
332 - Fabricated Metal Products	^5.9%
334 - Computer and Electronic Products	^27.2%
336 – Transportation Equipment	11.1%
Non-key	^0.7%
Overall	3.6%

‘b’ indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘−’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-112. Demand response participation by subsector

NAICS and Subsector Manufacturing Type	% of Facilities that Participate in Demand Response
311 - Food	.
322 - Paper	±91.4%
324 - Petroleum and Coal Products	.
325 - Chemicals	.
327 - Nonmetallic Mineral Products	±134.9%
331 - Primary Metals	±71.0%
332 - Fabricated Metal Products	±176.8%
334 - Computer and Electronic Products	±127.3%
336 – Transportation Equipment	±81.9%
Non-key	±164.3%
Overall	±73.4%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-113. Greenhouse firmographics

Greenhouse Firmographics	
Number of facilities	344
Number of employees	6,427
Employee per facility	19
Total square footage (ft ²)	39,239,005
Square feet of glass (ft ²)	29,491,501

Table A-114. Relative precision table for greenhouse firmographics

Greenhouse Firmographics	
Number of facilities	±0.0%
Number of employees	±35.9%
Employee per facility	±35.9%
Total square footage (ft ²)	±64.4%
Square feet of glass (ft ²)	±72.9%

Table A-115. Greenhouse energy consumption

Greenhouse Energy Consumption	
Total consumption (MMBtu)	3,740,279
Energy consumption per facility (MMBtu)	10,872
Energy consumption per employee (MMBtu)	582
Energy consumption per square foot (Btu/sf)	94,838

Table A-116. Relative precision table for greenhouse energy consumption

Greenhouse Energy Consumption	
Total consumption (MMBtu)	±61.6%
Energy consumption per facility (MMBtu)	±61.6%
Energy consumption per employee (MMBtu)	±40.2%
Energy consumption per square foot (Btu/sf)	±29.2%

Table A-117. Greenhouse net electric energy consumption

Greenhouse Electric Consumption	
Total consumption (MWh)	^289,198
Energy consumption per facility (kWh)	^840,622
Energy consumption per employee (kWh)	^44,998
Energy consumption per square foot (kWh/sf)	^7.3

^^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-118. Relative precision table for greenhouse net electric energy consumption

Greenhouse Electric Consumption	
Total consumption (MWh)	±90.8%
Energy consumption per facility (kWh)	±90.8%
Energy consumption per employee (kWh)	±66.3%
Energy consumption per square foot (kWh/sf)	±35.7%

Table A-119. Greenhouse non-electric MMBtu consumption

Greenhouse Non-Electric Consumption	
Total consumption (MMBtu)	2,753,536
Energy consumption per facility (MMBtu)	8,122
Energy consumption per employee (MMBtu)	429
Energy consumption per square foot (Btu/sf)	70,116

Table A-120. Relative precision table for greenhouse non-electric MMBtu consumption

Greenhouse Non-Electric Consumption	
Total consumption (MMBtu)	±54.8%
Energy consumption per facility (MMBtu)	±54.7%
Energy consumption per employee (MMBtu)	±37.5%
Energy consumption per square foot (Btu/sf)	±38.9%

Table A-121. Greenhouse consumption by non-electric fuel type

Overall non-electric consumption	MMBtu	% of total consumption
Natural gas	908,683	33.0%
Fuel oil, Kerosene, or Distillate	^518,480	^18.8%
Propane or liquid gases	397,235	14.4%
Purchased hot water or steam	.	.
By-product of Recycled energy	.	.
Renewable Fuels	-353,110	-12.8%
Coal-based product	108,700	3.9%
Diesel or motor gasoline	^467,328	^17.0%
Hydrogen	.	.
Don't Know	.	.
Total	2,753,536	100.0%

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

^ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-122. Relative precision table for greenhouse consumption by non-electric fuel type

Overall non-electric Consumption	MMBtu
Natural gas	±47.8%
Fuel oil, Kerosene, or Distillate	±117.4%
Propane or liquid gases	±51.9%
Purchased hot water or steam	.
By-product of Recycled energy	.
Renewable Fuels	±166.7%
Coal-based product	±59.6%
Diesel or motor gasoline	±98.9%
Hydrogen	.
Don't Know	.
Total	±54.7%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-123. Greenhouse total energy expenditures

Greenhouse Energy Expenditures	Energy Expenditures
	(\$1,000)
Electric Expenditures	^18,277
Non-electric Expenditures	39,474
Total Expenditures	57,751

^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-124. Relative precision table for greenhouse total energy expenditures

Greenhouse Energy Expenditures	Energy Expenditures
	(\$1,000)
Electric Expenditures	±91.3%
Non-electric Expenditures	±58.9%
Total Expenditures	±65.5%

Table A-125. Total greenhouse GHG emissions

Greenhouse GHG Emissions	
Total Emissions (CO2e)	338,520
Emissions per facility (CO2e)	984
Emissions per employee (CO2e)	53
Emissions per square foot (CO2e /sf)	0

Table A-126. Relative precision table for total greenhouse GHG emissions

Greenhouse GHG Emissions	
Total Emissions (CO2e)	±59.5%
Emissions per facility (CO2e)	±59.5%
Emissions per employee (CO2e)	±39.1%
Emissions per square foot (CO2e /sf)	±31.5%

Table A-127. Greenhouse facilities that have completed GHG inventories of reduction strategies

NAICS and subsector manufacturing type	Completed a GHG inventory	Completed a Scope 3 GHG inventory	Implemented a Strategy to reduce Scope 3 Emissions
	%	%	%
Greenhouses	^1.4%	0.0%	^1.4%

^^ indicates a single weighted response represents more than 50% of a given aggregate calculation.

Table A-128. Relative precision table for percentage of greenhouse facilities that have completed GHG inventories of reduction strategies

NAICS and subsector manufacturing type	Completed a GHG inventory	Completed a Scope 3 GHG inventory	Implemented a Strategy to reduce Scope 3 Emissions
	%	%	%
Greenhouses	±149.6%	.	±149.6%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-129. Greenhouse electricity by high-level end use

NAICS and subsector manufacturing type	Boilers or generators		Greenhouse lighting		Other Greenhouse Processes		Basic facility operations		Other		Don't know/Unknown		Total	
	MWh	%	MWh	%	MWh	%	MWh	%	MWh	%	MWh	%	MWh	%
Greenhouses	^17,846	^6.2%	^162,830	^56.3%	55,263	^19.1%	18,730	^6.5%	4,952	^1.7%	-29,577	^10.2	^289,198	100.0%

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-130. Relative precision table for greenhouse electricity by high-level end use

NAICS and subsector manufacturing type	Boilers or generators (kWh)	Greenhouse lighting (kWh)	Other Greenhouse Processes (kWh)	Basic facility operations (kWh)	Other (kWh)	Don't know/Unknown (kWh)	Total (kWh)
Greenhouses	±92.7%	±136.3%	±43.6%	±49.8%	±68.7%	±89.9%	±90.8%

Table A-131. Detailed percentage of total electricity used for production and non-production end uses

NAICS and subsector manufacturing type	Production Use						Facility/Non-production Use					Over-all (%)
	Boilers (%)	Heating (%)	Cooling and refrigeration (%)	Machine drive (%)	Electro-chemical processes (%)	Other (%)	HVAC (%)	Lighting (%)	Other facility support (%)	Onsite transportation (%)	Other facility use (%)	
Greenhouses	23.2%	25.1%	0.5%	4.8%	0.0%	0.0%	6.8%	3.4%	4.5%	0.0%	0.0%	100.0%

Table A-132. Relative precision table for detailed percentage of total electricity used for production and non-production end uses

NAICS and subsector manufacturing type	Production Use						Facility/Non-production Use					Over-all (%)
	Boilers (%)	Heating (%)	Cooling and refrigeration (%)	Machine drive (%)	Electro-chemical processes (%)	Other (%)	HVAC (%)	Lighting (%)	Other facility support (%)	Onsite transportation (%)	Other facility use (%)	
Greenhouses	±93.1%	±144.3%	±199.8%	±131.7%	.	.	±162.7%	±101.6%	±163.8%	.	.	±61.6%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-133. Percentage of non-electric fuel consumption by high-level end use

NAICS and subsector manufacturing type	Boilers or generators		Greenhouse lighting		Other Greenhouse Processes		Basic facility operations		Other		Don't know/ Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
Greenhouses	966,768	61.3%	0	0.0%	407,140	25.8%	36,681	2.3%	82,883	5.3%	^83,248	^5.3%	1,576,720	100.0%

Table A-134. Relative precision table for percentage of non-electric fuel consumption by high-level end use

NAICS and subsector manufacturing type	Boilers or generators (MMBtu)	Greenhouse lighting (MMBtu)	Other Greenhouse Processes (MMBtu)	Basic facility operations (MMBtu)	Other (MMBtu)	Don't know/ Unknown (MMBtu)	Total (MMBtu)
Greenhouses	±60.9%	.	±36.4%	±70.2%	±78.9%	±88.4%	±38.9%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-135. Relative precision table for detailed percentage of total non-electric fuels used for production and non-production end uses

NAICS and subsector manufacturing type	Production Use						Facility/Non-production Use					Overall (%)
	Boilers (%)	Heating (%)	Cooling and refrigeration (%)	Machine drive (%)	Electro-chemical processes (%)	Other (%)	HVAC (%)	Lighting (%)	Other facility support (%)	Onsite transportation (%)	Other facility use (%)	
Greenhouses	±231.3%	±213.8%	.	.	.	.	.	.	.	±231.3%	.	±205.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-136. Percentage of facilities with specific equipment types, with percentage of facilities that recently upgraded each equipment type

Equipment Type	% facilities with equipment	% facilities that received EE upgrades on equipment in last 3 years
Drying and curing	5.8%	0.0%
Other process heating	29.0%	8.7%
Process boiler	11.6%	-2.9%
Process cooling (above 40F)	7.2%	0.0%
Refrigeration	18.8%	-2.9%
Humidification	-4.3%	0.0%
Air compressors	15.9%	-2.9%
Fans	78.3%	8.7%
Pumping	24.6%	5.8%
Other motors	33.3%	-4.3%
Other	13.0%	5.8%

'-' indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-137. Relative precision table for percentage of facilities with specific equipment types, with percentage of facilities that recently upgraded each equipment type

Equipment Type	% facilities with equipment	% facilities that received EE upgrades on equipment in last 3 years
Drying and curing	±73.1%	.
Other process heating	±28.4%	±58.8%
Process boiler	±50.1%	±105.0%
Process cooling (above 40F)	±64.9%	.
Refrigeration	±37.7%	±105.0%
Humidification	±85.1%	.
Air compressors	±41.7%	±105.0%
Fans	±9.6%	±58.8%
Pumping	±31.7%	±73.1%
Other motors	±25.7%	±85.1%
Other	±46.8%	±73.1%

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-138. Percentage of facilities with specific equipment types, with percentage of facilities at different equipment efficiency levels

Equipment Type	% facilities with equipment	Equipment efficiency			
		Low %	Moderate %	High %	DK %
Drying and curing	5.8%	b		b	b
Other process heating	29.0%	b	13.0%	11.6%	b
Process boiler	11.6%	b	b	b	
Process cooling (above 40F)	7.2%	b	b		
Refrigeration	18.8%	b	13.0%	b	b
Humidification	-4.3%		b		b
Air compressors	15.9%	b	8.7%	b	b
Fans	78.3%	10.1%	40.6%	17.4%	10.1%
Pumping	24.6%		13.0%	10.1%	b
Other motors	33.3%	b	14.5%	10.1%	b
Other	13.0%		b	b	b

‘b’ indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-139. Relative precision table for percentage of facilities with specific equipment types, with percentage of facilities at different equipment efficiency levels

Equipment Type	% facilities with equipment	Equipment efficiency			
		Low %	Moderate %	High %	DK %
Drying and curing	±73.1%	±149.6%	.	±149.6%	±105.0%
Other process heating	±28.4%	±149.6%	±46.8%	±50.1%	±105.0%
Process boiler	±50.1%	±105.0%	±73.1%	±105.0%	.
Process cooling (above 40F)	±64.9%	±149.6%	±73.1%	.	.
Refrigeration	±37.7%	±105.0%	±46.8%	±149.6%	±149.6%
Humidification	±85.1%	.	±149.6%	.	±105.0%
Air compressors	±41.7%	±149.6%	±58.8%	±85.1%	±149.6%
Fans	±9.6%	±54.0%	±22.0%	±39.5%	±54.0%
Pumping	±31.7%	.	±46.8%	±54.0%	±149.6%
Other motors	±25.7%	±105.0%	±44.1%	±54.0%	±73.1%
Other	±46.8%	.	±85.1%	±73.1%	±105.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-140. Percentage of facilities by maintenance practices

NAICS	System	Regular Maintenance at specific times	No regular maintenance scheduled (as needed)	Do not know	N/A
Greenhouse	Facility Buildings	44.9%	52.2%	0.0%	-2.9%
	Production Equipment	44.9%	46.4%	^1.4%	7.2%
	Production Process	36.2%	47.8%	-4.3%	11.6%

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-141. Relative precision table percentage of facilities by maintenance practices

NAICS	System	Regular Maintenance at specific times	No regular maintenance scheduled (as needed)	Do not know	N/A
Greenhouse	Facility Buildings	±20.1%	±17.4%	.	±105.0%
	Production Equipment	±20.1%	±19.5%	±149.6%	±64.9%
	Production Process	±24.1%	±19.0%	±85.1%	±50.1%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-142. Percentage of facilities that have completed process upgrades

NAICS	Yes				No		
	Completed in the last three years	More than three years ago	Completed (don’t know when)	In process now	Planning to within the next three years	No plans in place	Don’t know
Greenhouse	14.5%	8.7%	0.0%	7.2%	8.7%	52.2%	8.7%

Table A-143. Relative precision table of percentage of facilities that have completed process upgrades

NAICS	Yes				No		
	Completed in the last three years	More than three years ago	Completed (don’t know when)	In process now	Planning to within the next three years	No plans in place	Don’t know
Greenhouse	±44.1%	±58.8%	.	±64.9%	±58.8%	±17.4%	±58.8%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-144. Percentage of facilities with barriers to funding sources for process upgrades by financing type

Finance type	Aware/have used	Aware/would consider using	Aware/won’t use	Not aware/have not used	Did not answer	Total
Self-funding	71.0%	8.7%	b	11.6%	b	100.0%
Commercial lending (loans)	52.2%	14.5%	20.3%	13.0%		100.0%
On-bill financing	10.1%	11.6%	23.2%	53.6%	b	100.0%
Energy-as-a-Service (EaaS)		11.6%	8.7%	78.3%	b	100.0%
Utility Incentives	18.8%	29.0%	b	46.4%	b	100.0%
State Incentives	13.0%	29.0%	b	50.7%	b	100.0%
Other					100.0%	100.0%

*b’ indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

Table A-145. Relative precision table of percentage of facilities with barriers to funding sources for process upgrades by financing type

Finance type	Aware/have used	Aware/would consider using	Aware/won't use	Not aware/have not used	Did not answer
Self-funding	±11.6%	±58.8%	±73.1%	±50.1%	±105.0%
Commercial lending (loans)	±17.4%	±44.1%	±36.0%	±46.8%	.
On-bill financing	±54.0%	±50.1%	±33.0%	±16.9%	±149.6%
Energy-as-a-Service (EaaS)	.	±50.1%	±58.8%	±9.6%	±149.6%
Utility Incentives	±37.7%	±28.4%	±85.1%	±19.5%	±149.6%
State Incentives	±46.8%	±28.4%	±73.1%	±17.9%	±149.6%
Other	.	.	.	.	±0.0%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-146. Greenhouse baseline and mapping

Greenhouse Summary	Yes				No		Don't know
	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	
Facilities with established energy consumption baseline	-2.9%	^1.4%	-2.9%	0.0%	8.7%	73.9%	10.1%
Facilities with an energy map identifying the top energy drivers and end uses in the facility	-4.3%	^1.4%	5.8%	0.0%	8.7%	63.8%	15.9%

‘^’ indicates a single weighted response represents more than 50% of a given aggregate calculation.

‘-’ indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-147. Relative precision table for greenhouse baseline and mapping

Greenhouse Summary	Yes				No		Don't know
	Completed in the last three years	More than three years ago	Completed (don't know when)	In process now	Planning to within the next three years	No plans in place	
Facilities with established energy consumption baseline	±105.0%	±149.6%	±105.0%	.	±58.8%	±10.8%	±54.0%
Facilities with an energy map identifying the top energy drivers and end uses in the facility	±85.1%	±149.6%	±73.1%	.	±58.8%	±13.7%	±41.7%

A period (“.”) in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Table A-148. Energy management practices

Energy management practice	% of facilities
Greenhouses that track energy use compared to a standard baseline	8.7%
Greenhouses with a written energy policy	-4.3%
Greenhouses with a climate action plan	0.0%
Greenhouses that have calculated portion of recycled content	-4.3%
Greenhouses that have defined energy performance goals	8.7%
Of those with goal, percent that have a written plan	50.0%
Greenhouses with a staff person with formal responsibility for energy performance	23.2%
Of those with no energy manager, percent that have plans to identify an energy manager	-4.2%
Greenhouses that have a team responsible for energy performance	5.8%
Of those facilities with an energy management team, percent with a team leader	b
Of those with an energy manager, percent that use an employee	94.1%
Of those with an energy manager, percent that use a contractor	0.0%

'b' indicates too few responses in a single cell (<5 responses). No value will appear in the cell.

'-' indicates RSE is greater than 50% but less than 100%. These values exhibit greater variability and should be used with caution.

Table A-149. Relative precision table of energy management practices

Energy management practice	% of facilities
Greenhouses that track energy use compared to a standard baseline	±58.8%
Greenhouses with a written energy policy	±85.1%
Greenhouses with a climate action plan	.
Greenhouses that have calculated portion of recycled content	±85.1%
Greenhouses that have defined energy performance goals	±58.8%
Of those with goal, percent that have a written plan	±89.3%
Greenhouses with a staff person with formal responsibility for energy performance	±33.0%
Of those with no energy manager, percent that have plans to identify an energy manager	±109.1%
Greenhouses that have a team responsible for energy performance	±73.1%
Of those facilities with an energy management team, percent with a team leader	±135.1%
Of those with an energy manager, percent that use an employee	±10.6%
Of those with an energy manager, percent that use a contractor	.

A period (".") in a given cell of a relative precision table indicates there was not a result to calculate a precision.

Appendix B Subsector analysis details

B.1 Subsector analyses

This appendix provides key research findings for the top five energy-consuming (in MMBtu) subsectors. These subsectors are Paper, Food, Primary Metals, Chemicals, and Fabricated Metals.

B.1.1 Paper Manufacturing

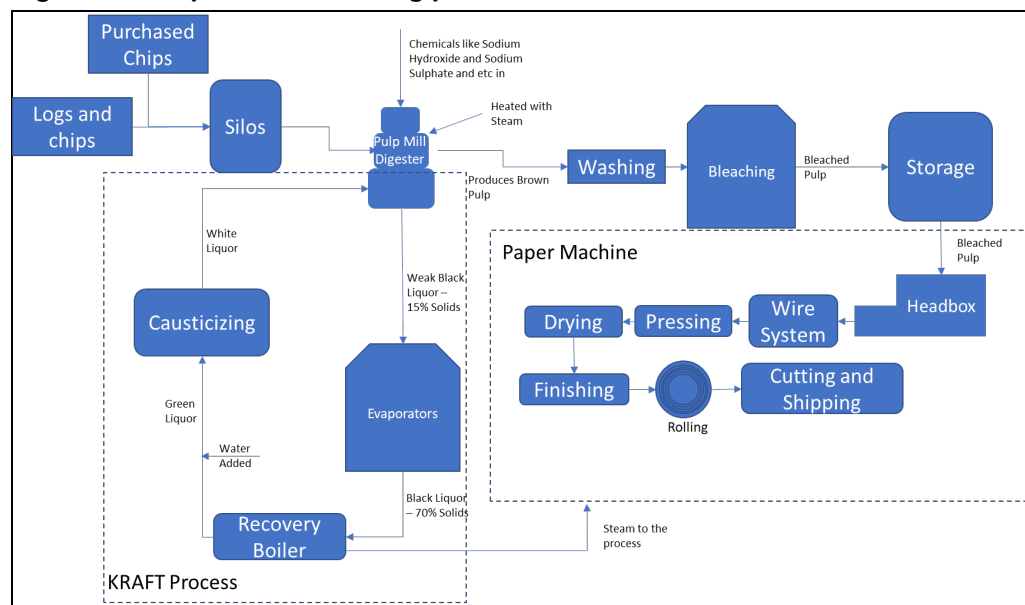
Below is a summary of the key sector indices for the paper manufacturing sector in New York State. Paper is the second largest consumer of energy within the state, just behind food manufacturing; however, it has the highest total energy consumption per facility within the state. Table B-1 summarizes some of the key metrics for the paper sector in the state. There are approximately 90 paper facilities, comprising a little over 19 million square feet.

Table B-1. Paper manufacturing summary

Key Metrics	Value
Number of facilities	90
Total square footage (1,000 ft ²)	19,206
Total employment	9,132
Total electric consumption (MWh)	1,742,888
Total non-electric fuel consumption (1,000 MMBtu)	24,247
Total GHG emissions (1,000 MT CO ₂ e)	2,742

Figure B-1 shows an example of the process flow in the pulp and paper manufacturing sector developed as part of this study.

Figure B-1. Paper manufacturing process flow



B.1.1.1 Electric

Most of the electric energy consumption within the paper sector is utilized in Tier 1 facilities (94%). Of the total paper electric consumption, over 80% is used in the manufacturing process, or 1,461.5 GWh for the paper manufacturing sector in total.

Table B-2. Percentage of electricity consumption by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
1	57.4	3.5%	1,385.4	84.2%	69.4	4.2%	132.4	8.1%	1,644.5	100.0%
2	3.4	10.2%	26.2	78.7%	3.7	15.7%	0.0	0.0%	33.4	100.0%
3	3.0	4.6%	49.9	76.6%	11.6	18.9%	-0.64	-1.0%	65.1	100.0%
Total	63.8	3.7%	1,461.5	83.9%	84.6	4.9%	133	7.6%	1,742.9	100.0%

Within the production process use, 86% of facilities reported using electricity for machine drives. Process heating was the next highest, with 29% of facilities reporting electric use for that purpose.

Table B-3. Percentage of facilities using electricity for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	24.5%	32.0%	89.7%	^3.1%	^3.1%	0.0%
2	^19.7%	0.0%	100.0%	0.0%	0.0%	0.0%
3	34.5%	22.9%	79.4%	0.0%	0.0%	0.0%
Total	29.0%	23.3%	85.7%	^1.1%	^1.1%	0.0%

a. e.g., kilns, furnaces, ovens, strip heaters

b. e.g., motors, pumps, etc. associated with manufacturing process equipment

c. e.g., reduction process

Of the non-process categories, lighting and HVAC were the most commonly reported electric end uses, at 86% and 79% respectively.

Table B-4. Percentage of facilities using electricity for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	89.7%	89.7%	75.2%	0.0%	0.0%	0.0%
2	79.5%	100.0%	80.3%	0.0%	0.0%	0.0%
3	70.8%	79.4%	74.4%	12.3%	0.0%	0.0%
Total	78.7%	85.7%	75.4%	6.3%	0.0%	0.0%

a e.g., cooking appliances, water heating, office equipment

b excluding highway use

B.1.1.2 Non-electric

Ninety-seven percent of the non-electric energy is consumed in Tier 1 facilities. Of that non-electric consumption, over 70% is consumed by boilers or generators, about 17 million MMBtu of the total of almost 24 million MMBtus consumed. An additional 14% of the total consumption is for other manufacturing processes.

Table B-5. Percentage of non-electric fuel by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	16,520,984	71%	3,331,230	14%	2,225,907	10%	^1,268,366	^5.4%	23,346,487	100%
2	b	b	b	b	b	b	b	b	b	100%
3	m	m	m	m	m	m	m	m	m	100%
Total	17,023,887	71%	3,373,798	14%	2,285,591	10%	^1,288,966	^5.4%	23,972,243	100%

Within the process use, 23% of facilities reported using non-electric fuels for process heating and 20% reported using non-electric fuels for machine drive processes.

Table B-6. Percentage of facilities using non-electric fuel for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	42.4%	-7.2%	17.6%	0.0%	32.0%	0.0%
2	-19.7%	0.0%	0.0%	0.0%	-19.7%	0.0%
3	-10.8%	0.0%	27.3%	0.0%	-13.7%	0.0%
Total	23.3%	-2.6%	20.3%	0.0%	21.1%	0.0%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Table B-7 and Table B-8 show the distribution of boiler and non-boiler process temperatures.

Table B-7. Percentage of non-electric fuel dedicated to boilers by temperature range

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/ Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^314,218	^1.9%	^9,012,269	^54.6%	^2,546,000	^15.4%	^4,648,497	^28.1%	16,520,984	100.0%
2	b	b	b	b	b	b	b	b	b	100.0%
3	b	b	b	b	b	b	b	b	m	100.0%
Total	^455,663	^2.7%	^9,154,884	^53.8%	^2,641,918	^15.5%	^4,771,423	^28.0%	17,023,887	100.0%

Table B-8. Percentage of non-electric fuel dedicated to non-boiler process by temperature

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^101,968	^3.1%	^550,328	^16.5%	^436,294	^13.1%	^2,242,639	^67.3%	3,331,230	100.0%
2	b	b	b	b	b	b	b	b	b	100.0%
3	m	m	m	m	m	m	m	m	m	100.0%
Total	^103,918	^3.1%	^555,410	^16.5%	^436,294	^12.9%	^2,278,175	^67.5%	3,373,798	100.0%

Table B-9 shows the percentage of facilities that use non-electric fuel for facility operations by end use. The highest category for this non-electric use is for HVAC which consumes 45%, more than four times basic equipment at 10.3%

Table B-9. Percentage of facilities using non-electric fuel for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	53.8%	0.0%	21.7%	0.0%	0.0%	0.0%
2	39.3%	0.0%	-19.7%	-20.5%	0.0%	0.0%
3	40.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	45.0%	0.0%	10.3%	-2.6%	0.0%	0.0%

a e.g., cooking appliances, water heating, office equipment
 b excluding highway use

Table B-10 shows the percentage of facilities that reported having a number of different equipment types. Within the paper sector, the most common reported equipment was material handling, with 77% of facilities stating they had it. Next was air compressors.

Of that equipment, air compressors had received the most recent energy efficiency upgrades, with 18% reporting they had been upgraded within the last three years.

Table B-10. Percentage of facilities with specific equipment types with percentage of facilities that recently upgraded each equipment type

Equipment Type	% facilities with equipment				% facilities that received EE upgrades in last 3 years			
	Tier 1	Tier 2	Tier 3	Total	Tier 1	Tier 2	Tier3	Total
Material handling (e.g., conveyers, belts, materials movers)	86%	61%	76%	77%	-7.2%	0%	-18.6%	12%
Air compressors	78%	41%	31%	49%	29%	-20.5%	-8.7%	18%
Other materials processing (e.g., grinding, agitating/ mixing, debarking, drilling, pressing)	42%	^20.5%	27%	32%	0%	0%	0%	0%
Process boiler	64%	^40.2%	0%	28%	-7.2%	-20.5%	0%	-5.2%
Drying and curing	47%	^40.2%	12%	28%	18%	-20.5%	2%	10%
Process pumping	50%	^20.5%	0%	21%	0%	0%	0%	0%
Other process heating	35%	^20.5%	^9.9%	20%	-7.2%	-20.5%	0%	-5.2%
Mechanical pulping	25%	0%	0%	9%	-7.2%	0%	0%	-2.6%
Kraft pulping	^10.3%	0%	0%	^3.7%	0%	0%	0%	0%
Other	^3.1%	0%	20%	11%	0%	0%	-8.7%	-4.4%
Material handling (e.g., conveyers, belts, materials movers)	86%	61%	76%	77%	-7.2%	0%	-18.6%	12%

B.1.2 311 – Food

Below is a summary of the key sector indices for the food manufacturing sector in New York State. Food manufacturing is the fifth largest consumer of energy within the state. Table B-11 summarizes some of the key metrics for the food sector in the state. There are an estimated 357 facilities comprising a little over 15 million square feet.

Table B-11. Food manufacturing summary

Key Metrics	Value
Number of facilities	357
Total square footage (1,000 ft ²)	15,335
Total employment	16,075
Total electric consumption (MWh)	862,192
Total non-electric fuel consumption (1,000 MMBtu)	11,440
Total GHG emissions (1,000 MT CO ₂ e)	1,304

The food manufacturing sector is highly varied in terms of the processes that occur from one facility to another. There are, however, some energy intensive processes and equipment that are common throughout the industry. Refrigeration being one of the most common with over 80% of facilities overall reporting having refrigeration and machine drive and process heating also being widely used.

B.1.2.1 *Electric*

Most of the electric energy consumption within the food sector is utilized in Tier 1 facilities (78%). Of that electric consumption 70% is used through the manufacturing process, about 471 GWh for the food manufacturing sector.

Table B-12. Percentage of electricity consumption by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
1	122	18.1%	471	69.9%	81	12.0%	m	m	674	100.0%
2	b	b	b	b	b	b	b	b	b	100.0%
3	m	m	m	m	m	m	-10	m	147	100.0%
Total	141	16.4%	583	67.6%	127	14.8%	-10	-1.2%	862	100.0%

Within the process use, 79% of facilities reported using electricity for machine drive uses. Process cooling was the next highest at 75% of facilities reporting electric use for that purpose.

Table B-13. Percentage of facilities using electricity for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	41.5%	87.2%	100.0%	^6.4%	^6.4%	0.0%
2	b	b	b	b	b	b
3	49.5%	71.0%	75.2%	^5.1%	^5.1%	0.0%
Total	52.4%	74.5%	79.1%	~4.8%	~4.8%	0.0%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Of the non-process categories, lighting, HVAC, and basic equipment/appliance were the most commonly reported electric end uses at 92%, 90%, and 83% respectively.

Table B-14. Percentage of facilities using electricity for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	93.6%	93.6%	93.6%	12.8%	0.0%	0.0%
2	b	b	b	b	b	b
3	89.0%	91.2%	80.7%	-13.9%	0.0%	0.0%
Total	90.2%	92.1%	83.2%	12.8%	0.0%	0.0%

a e.g., cooking appliances, water heating, office equipment

b excluding highway use

B.1.2.2 Non-electric

Of the non-electric energy consumption within the food sector, 92% is utilized in Tier 1 facilities. Of that non-electric consumption almost 50% is consumed by boilers or generators.

Table B-15. Percentage of non-electric fuel by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	4,562,672	49.8%	^4,021,761	^43.9%	563,764	6.1%	^22,641	^0.2%	9,170,838	100.0%
2	n	n	n	n	n	n	n	n	n	100.0%
3	^382,871	^44.5%	337,801	39.2%	127,889	14.8%	-12,757	-1.5%	861,318	100.0%
Total	4,945,543	49.3%	^4,359,562	^43.5%	691,654	6.9%	35,398	0.4%	10,032,156	100.0%

Within the process use, 23% of facilities reported using non-electric fuels for process heating and 11% reported using non-electric fuels for machine drive purposes.

Table B-16. Percentage of facilities using non-electric fuel for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	71.3%	6.4%	25.5%	0.0%	-6.4%	0.0%
2	b	b	b	b	b	b
3	43.7%	-11.5%	10.7%	0.0%	17.1%	0.0%
Total	43.0%	-10.2%	11.3%	0.0%	14.9%	0.0%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Table B-17 and Table B-18 show the distribution of boiler and non-boiler process temperatures.

Table B-17. Percentage of non-electric fuel dedicated to boilers by temperature range

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^2,075,769	^45.5%	1,786,187	39.1%	^686,861	^15.1%	^13,855	^0.3%	4,562,672	100.0%
2	n	n	n	n	n	n	n	n	n	100.0%
3	138,929	-36.3%	^222,781	^58.2%	^20,099	^5.2%	^1,063	^0.3%	-382,871	100.0%
Total	^2,214,698	^44.8%	2,008,969	40.6%	^706,959	^14.3%	^14,917	^0.3%	4,945,543	100.0%

Table B-18. Percentage of non-electric fuel dedicated to non-boiler process by temperature

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	1,165,073	29%	^2,589,777	^64.4%	^157,020	^3.9%	^109,892	^2.7%	^4,021,761	100.0%
2	n	n	n	n	n	n	n	n	n	100.0%
3	^101,200	^30.0%	^97,839	^29.0%	0	0.0%	-138,762	-41.1%	337,801	100.0%
Total	1,266,272	29.0%	^2,687,616	^61.6%	^157,020	^3.6%	248,654	^5.7%	^4,359,562	100.0%

Table B-19 shows the percentage of facilities that use non-electric fuel for facility operations by end use. The highest category for this non-electric use is for HVAC.

Table B-19. Percentage of facilities using non-electric fuel for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	62.8%	9.6%	38.3%	25.5%	-6.4%	0.0%
2	b	b	b	b	b	b
3	32.3%	0.0%	25.0%	10.1%	0.0%	0.0%
Total	32.8%	0.8%	24.4%	10.8%	-0.6%	0.0%

a e.g., cooking appliances, water heating, office equipment
 b excluding highway use

Table B-20 shows the percentage of facilities that reported having a number of different equipment types. Within the food sector, the most common reported equipment was other materials processing (e.g., grinding, agitating/ mixing), with 90% of facilities stating they had it. Next was refrigeration.

Of that equipment air compressors had received the most recent energy efficiency upgrades, with 30% reporting they had been upgraded within the last three years.

Table B-20. Percentage of facilities with specific equipment types with percentage of facilities that recently upgraded each equipment type

Equipment Type	% facilities with equipment			% facilities that received EE upgrades in last 3 years		
	Tier 1	Tier 3	Total	Tier 1	Tier 3	Total
Other materials processing (e.g., grinding, agitating/ mixing, debarking, drilling, pressing)	60%	92%	90%	13%	23%	20%
Refrigeration	81%	80%	82%	3%	28%	24%
Material handling (e.g., conveyers, belts, materials movers)	97%	67%	72%	13%	9%	9%
Air compressors	100%	58%	64%	52%	30%	30%
Process pumping	79%	34%	42%	19%	-13.2%	20%
Other process heating	72%	40%	40%	0%	-13.4%	-11.3%
Process boiler	94%	28%	31%	3%	-10.6%	-9.2%
Process cooling (above 40F)	53%	28%	28%	16%	-8.3%	-8.4%
Drying and curing	56%	27%	28%	13%	0%	1%
Pasteurization and sterilization	66%	18%	21%	0%	-8.2%	-6.9%
Other	13%	18%	16%	0%	9%	8%

B.1.3 331 – Primary Metals

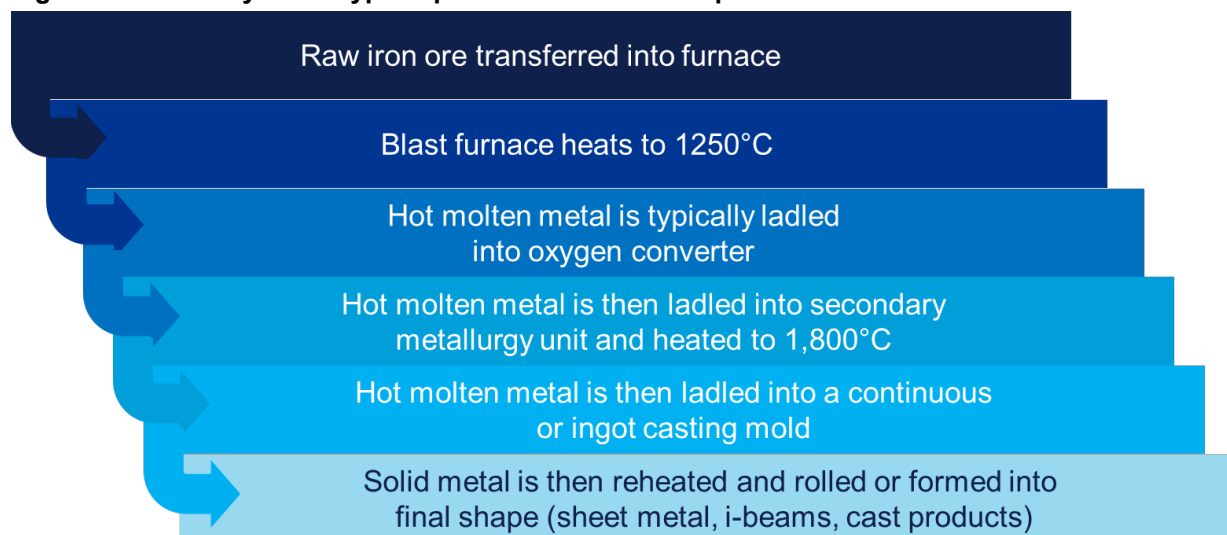
Below is a summary of the key sector indices for the primary metals sector in New York State. Primary metal manufacturing is the third largest consumer of energy within the state among the key subsectors and has the second highest total energy consumption per facility and per employee within the state, both just behind paper manufacturing. Table B-21 summarizes some of the key metrics for the primary metals sector in the state. There are an estimated 74 facilities comprising a little under 14 million square feet.

Table B-21. Primary metal manufacturing summary

Key Metrics	Value
Number of facilities	74
Total square footage (1,000 ft ²)	13,898
Total employment	5,196
Total electric consumption (MWh)	2,952,456
Total non-electric fuel consumption (1,000 MMBtu)	5,468
Total GHG emissions (1,000 MT CO ₂ e)	1,258

Figure B-2 shows an example of the process flow in the primary metal manufacturing sector.

Figure B-2. Primary metal typical process flow for steel production



B.1.3.1 Electric

Most of the electric energy consumption within the primary metals sector is utilized in Tier 1 facilities (96%). Of that electric consumption, 89% is used through the manufacturing process, about 2,520,770 GWh for the primary metals sector.

Table B-22. Percentage of electricity consumption by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
1	^8,023	^0.3%	^2,520,770	^88.6%	^274,135	^9.6%	^42,788	^1.5%	^2,845,717	100.0%
2	^2,467	^4.2%	^35,586	^60.8%	8,621	14.7%	^11,824	^20.2%	58,498	100.0%
3	^13	^0.0%	44,220	91.7%	4,008	8.3%	0	0.0%	48,241	100.0%
Total	10,502	^0.4%	^2,600,576	^88.1%	^286,765	^9.7%	^54,612	^1.8%	^2,952,456	100.0%

Within the process use, 91% of facilities reported using electricity for machine drive uses. Process heating was the next highest, with 58% of facilities reporting electric use for that purpose.

Table B-23. Percentage of facilities using electricity for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	61%	36%	82%	26%	28%	0%
2	63%	^25%	91%	0%	0%	0
3	56%	^15%	94%	13%	-22%	0%
Total	58%	21%	91%	14%	20%	0%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Of the non-process categories, lighting, HVAC, and basic equipment/appliance were the most commonly reported electric end uses, at 97%, 91%, and 85% respectively.

Table B-24. Percentage of facilities using electricity for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	90%	90%	90%	0%	0%	0%
2	91%	91%	63%	0%	0%	0%
3	91%	100%	88%	^9%	0%	0%
Total	91%	97%	85%	^6%	0%	0%

a e.g., cooking appliances, water heating, office equipment

b excluding highway use

B.1.3.2 Non-electric

Of the non-electric energy consumption within the primary metals sector, 87% is utilized in Tier 1 facilities. Of that non-electric consumption, over 70% is consumed by manufacturing or industrial production processes, about 4 million MMBtu of the total 5.4 million MMBtu consumed. An additional 19% of the total consumption is for basic facility operations.

Table B-25. Percentage of non-electric fuel by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	248,162	5.3%	3,739,210	79.3%	714,360	15.2%	^12,163	^0.3%	4,713,896	100.0%
2	^18,293	^3.9%	^116,151	^24.7%	^266,338	^56.6%	^69,600	^14.8%	^470,382	100.0%
3	2,462	1.0%	179,177	70.5%	57,964	22.8%	^14,689	^5.8%	254,292	100.0%
Total	268,918	4.9%	4,034,538	74.2%	1,038,662	19.1%	^96,452	^1.8%	5,438,569	100.0%

Within the process use, 41% of facilities reported using non-electric fuels for process heating and 27% reported using non-electric fuels for other manufacturing or production processes.

Table B-26. Percentage of facilities using non-electric fuel for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	64.1%	-7.6%	-7.6%	15.2%	25.5%	0.0%
2	-14.6%	0.0%	0.0%	0.0%	81.5%	0.0%
3	38.8%	0.0%	24.8%	0.0%	14.4%	0.0%
Total	40.5%	-1.6%	17.6%	3.1%	26.5%	0.0%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Table B-27 and Table B-28 show the distribution of boiler and non-boiler process temperatures.

Table B-27. Percentage of non-electric fuel dedicated to boilers by temperature range

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^130,460	^52.6%	^74,538	^30%	0	0.0%	^43,164	^17.4%	248,162	100.0%
2	b	b	b	b	b	b	b	b	-18,293	100.0%
3	b	b	b	b	b	b	b	b	2,462	100.0%
Total	^149,386	^55.6%	^76,368	^28.4%	0	0.0%	^43,164	^16.1%	268,918	100.0%

Table B-28. Percentage of non-electric fuel dedicated to non-boiler process by temperature

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^1,217,213	^32.6%	m	m	^1,203,025	^32.2%	^1,317,731	35.2%	3,739,210	100.0%
2	b	b	b	b	b	b	b	b	^116,151	100.0%
3	m	m	27,758	15.5%	m	m	m	m	179,177	100.0%
Total	^1,231,923	^30.5%	28,999	0.7%	1,423,124	35.3%	1,350,492	33.5%	4,034,538	100.0%

Table B-29 shows the percentage of facilities that use non-electric fuel for facility operations by end use. The highest category for this non-electric use is for HVAC.

Table B-29. Percentage of facilities using non-electric fuel for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	82.1%	0.0%	48.9%	28.3%	-7.6%	0.0%
2	81.5%	0.0%	-24.6%	0.0%	0.0%	0.0%
3	74.5%	-5.5%	13.2%	-10.1%	0.0%	0.0%
Total	77.1%	-3.6%	22.2%	-12.3%	-1.6%	0.0%

a e.g., cooking appliances, water heating, office equipment
 b excluding highway use

Table B-30 shows the percentage of facilities that reported having a number of different equipment types. Within the primary metals sector, the most common reported equipment was other materials processing (e.g., grinding, agitating/mixing), with 90% of facilities stating they had it. Next was air compressors. Of that equipment air compressors had received the most recent energy efficiency upgrades, with 13% reporting they had been upgraded within the last three years.

Table B-30. Percentage of facilities with specific equipment types with percentage of facilities that recently upgraded each equipment type

Equipment Type	% facilities with equipment				% facilities that received EE upgrades in last 3 years			
	Tier 1	Tier 2	Tier 3	Total	Tier 1	Tier 2	Tier 3	Total
Basic Oxygen Furnace	^10%	^15%	0%	4%	0%	0%	0%	0%
Blast Furnace	0%	^9%	13%	10%	0%	9%	0%	1%
Casting	23%	0%	24%	20%	-8%	0%	-3%	4%
Electric arc furnace	^8%	0%	^10%	^8%	0%	0%	-10%	-7%
Hot rolling	26%	0%	^8%	10%	-10%	0%	0%	-2%
Other process heating	54%	^24%	^11%	22%	-10%	9%	-6%	7%
Process boiler	33%	0%	^3%	9%	-8%	0%	0%	-2%
Air compressors	61%	58%	50%	53%	18%	9%	-11%	13%
Material handling (e.g., conveyers, belts, materials movers)	72%	33%	32%	40%	0%	9%	14%	11%
Other materials processing (e.g., grinding, agitating/mixing, debarking, drilling, pressing)	64%	^34%	55%	54%	0%	9%	-5%	-5%
Other Electro-Chemical Processes	15%	0%	^3%	5%	0%	0%	0%	0%
Other	33%	66%	^16%	27%	18%	42%	-10%	16%

B.1.4 325 – Chemical

Below is a summary of the key sector indices for the chemical manufacturing sector in New York State. Chemical manufacturing is the second largest subsector by consumption of energy within the state, behind paper manufacturing. Table B-31 summarizes some of the key metrics for the chemical manufacturing sector in the state. There are an estimated 142 facilities comprising a little over 17 million square feet.

Table B-31. Chemical manufacturing summary

Key Metrics	Result
Number of facilities	142
Total square footage (1,000 ft ²)	17,591
Total employment	18,520
Total electric consumption (MWh)	1,678,401
Total non-electric fuel consumption (1,000 MMBtu)	19,634
Total GHG emissions (1,000 MT CO ₂ e)	2,288

Chemical manufacturing in New York is also varied in terms of the processes that occur within different facilities. Products include but are not limited to plastics, rubber products, pharmaceuticals, and petrochemicals.

B.1.4.1 *Electric*

Most of the electric energy consumption within the chemical sector is utilized in Tier 1 facilities (92%). Of that electric consumption 91% is used through the manufacturing process, about 1,413 GWh for the chemical manufacturing sector.

Table B-32. Percentage of electricity consumption by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
1	46	^3.0%	^1,413	^91.5%	71	^4.6%	^14	^0.9%	^1,544	100.0%
2	b	b	b	b	b	b	b	b	b	100.0%
3	m	m	m	m	m	m	m	m	m	100.0%
Total	61	^3.6%	^1,474	^87.8%	116	^6.9%	^27	^1.6%	^1,678	100.0%

Within the process use 77% of facilities reported using electricity for machine drive uses. Process heating was the next highest at 38% of facilities reporting electric use for that purpose.

Table B-33. Percentage of facilities using electricity for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	64%	75%	100%	^10%	25%	0%
2	b	b	b	b	b	b
3	29%	15%	69%	^5%	^10%	0%
Total	38%	27%	77%	-7%	17%	0%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Of the non-process categories, lighting, HVAC, and basic equipment/appliance were the most commonly reported electric end uses at 91%, 91%, and 86%, respectively.

Table B-34. Percentage of facilities using electricity for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	90%	90%	79%	^5%	^24%	0%
2	b	b	b	b	b	b
3	91%	91%	86%	^15%	13%	0%
Total	91%	91%	86%	^12%	13%	0%

a e.g., cooking appliances, water heating, office equipment

b excluding highway use

B.1.4.2 Non-electric

Of the non-electric energy consumption within the chemical sector, 95% is utilized in Tier 1 facilities. Of that non-electric consumption over 74% is consumed by boilers or generators, about 14 million MMBtu of the total of almost 19 million MMBtu consumed. An additional 13% of the total consumption is for other manufacturing processes as well.

Table B-35. Percentage of non-electric fuel by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^13,737,570	^74.7%	^2,495,429	^13.6%	^1,615,498	^8.8%	^548,726	^3.0%	^18,397,223	100.0%
2	b	b	b	b	b	b	b	b	b	100.0%
3	m	m	m	m	m	m	m	m	m	100.0%
Total	^14,371,947	^74.4%	^2,554,929	^13.2%	^1,748,881	^9.1%	^632,380	^3.3%	19,308,137	100.0%

Within the process use 21% of facilities reported using non-electric fuels for process heating and 20% reported using non-electric fuels for machine drive purposes.

Table B-36. Percentage of facilities using non-electric fuel for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	49.3%	0.0%	25.4%	20.9%	-10.4%	0.0%
2	b	b	b	b	b	b
3	10.4%	0.0%	-16.4%	0.0%	-6.9%	0.0%
Total	21.1%	-3.5%	20.4%	5.4%	-6.8%	0.0%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Table B-37 and Table B-38 show the distribution of boiler and non-boiler process temperatures.

Table B-37. Percentage of non-electric fuel dedicated to boilers by temperature range

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^8,036,321	^58.5%	^3,949,720	^28.8%	^690,826	^5.0%	^1,060,703	^7.7%	-13,737,570	100.0%
2	b	b	b	b	b	b	b	b	b	100.0%
3	m	m	m	m	m	m	m	m	m	100.0%
Total	^8,255,989	^57.4%	4,322,046	30.1%	690,826	^4.80%	^1,103,085	^7.7%	14,371,947	100.0%

Table B-38. Percentage of non-electric fuel dedicated to non-boiler process by temperature

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^977,107	0%	-879,758	^35.3%	^603,861	^24.2%	^34,703	^1.4%	^2,495,429	100.0%
2	b	b	b	b	b	b	b	b	b	100.0%
3	m	m	m	m	m	m	m	m	m	100.0%
Total	^1,028,090	0%	881,130	^34.5%	^603,861	^23.6%	^41,849	^1.6%	^2,554,929	100.0%

Table B-39 shows the percentage of facilities that use non-electric fuel for facility operations by end use.

The highest category for this non-electric use is for HVAC.

Table B-39. Percentage of facilities using non-electric fuel for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	55.2%	-10.4%	-10.4%	55.2%	-10.4%	0.0%
2	b	b	b	b	b	b
3	63.2%	15.1%	44.7%	7.2%	-17.0%	0.0%
Total	61.4%	12.9%	38.4%	14.1%	-14.3%	0.0%

a e.g., cooking appliances, water heating, office equipment

b excluding highway use

Table B-40 shows the percentage of facilities that reported having a number of different equipment types. Within the chemical sector, the most common reported equipment was other materials processing (e.g., grinding, agitating/ mixing), with 71% of facilities stating they had it. Next was material handling.

Of that equipment air compressors had received the most recent energy efficiency upgrades, with 34% reporting they had been upgraded within the last three years.

Table B-40. Percentage of facilities with specific equipment types with percentage of facilities that recently upgraded each equipment type

Equipment Type	% facilities with equipment				% facilities that received EE upgrades in last 3 years			
	Tier 1	Tier 2	Tier 3	Total	Tier 1	Tier 2	Tier 3	Total
Distillation	^18%	b	^7%	11%	-2%	-13%	b	0%
Drying and curing	49%	b	13%	20%	-2%	-13%	b	0%
Other process heating	39%	b	29%	34%	-9%	-13%	b	-9%
Process boiler	36%	b	-6%	12%	0%	0%	b	0%
Process cooling (above 40F)	49%	b	^3%	10%	-4%	24%	b	0%
Refrigeration	28%	b	^10%	14%	-4%	24%	b	0%
Air compressors	70%	b	37%	43%	17%	34%	b	-13%
Material handling (e.g., conveyers, belts, materials movers)	90%	b	34%	47%	11%	31%	b	0%
Other materials processing (e.g., grinding, agitating/ mixing, debarking, drilling, pressing)	79%	b	68%	71%	-7%	-10%	b	-7%
Other	^15%	b	^8%	^8%	0%	0%	b	0%
Other Electro-Chemical Processes	21%	b	0%	8%	3%	21%	b	0%

B.1.5 332 – Fabricated Metals

Below is a summary of the key sector indices for the fabricated metals sector in New York State.

Fabricated metal manufacturing is the fifth largest consumer of energy within the state among the key subsectors. Table B-41 summarizes some of the key metrics for the fabricated metals sector in the state.

There are an estimated 1,570 facilities comprised of a little over 90 million square feet.

Table B-41. Fabricated metals manufacturing summary

Key Metrics	Value
Number of facilities	1,570
Total square footage (1,000 ft ²)	90,784
Total employment	85,473
Total electric consumption (MWh)	2,264,441
Total non-electric fuel consumption (1,000 MMBtu)	6,478
Total GHG emissions (1,000 MT CO ₂ e)	1,182

Fabricated metal manufacturing produces a wide range of products, typically requiring metal manipulation and finishing. The manipulation could include shaping, grinding, stamping, cutting, etc. while the finishing involves applying a coating or polish to the product.

B.1.5.1 Electric

Most of the electric energy consumption within the fabricated metals sector is utilized in Tier 1 and Tier 3 facilities (42% and 50%, respectively). This is consistent with the industrial sector overall with respect to electric consumption. Here we see about 6.3% of the electric consumption being in Tier 2, while the manufacturing sector overall was a little over 5% of the net electric consumption happening in Tier 2. Of the total fabricated metal electric consumption 60% is used through the manufacturing process, about 1,379 GWh for the fabricated metal manufacturing sector.

Table B-42. Percentage of electricity consumption by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
1	^6	^0.7%	^636	^65.4%	^330	^33.9%	0	0.0%	^972	100.0%
2	^10	^6.9%	99	^68.5%	^35	^24.6%	0	0.0%	^144	100.0%
3	23	2.0%	644	56.1%	182	15.8%	^299	^26.0%	1,149	100.0%
Total	40	1.8%	1,379	60.9%	^547	^24.2%	^299	^13.2%	2,264	100.0%

Within process use, 86% of facilities reported using electricity for machine drive uses. Process heating was the next highest at 29% of facilities reporting electric use for that purpose.

Table B-43. Percentage of facilities using electricity for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	100.0%	83.7%	100.0%	^35.4%	0.0%	0.0%
2	32.6%	^12.2%	100.0%	^6.9%	^20.5%	0.0%
3	28.3%	15.8%	85.3%	8.0%	11.0%	^2.4%
Total	28.6%	16.1%	85.5%	8.1%	11.0%	^2.4%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Of the non-process categories, lighting, HVAC, and basic equipment/appliance were the most commonly reported electric end uses at 91%, 85%, and 74% respectively.

Table B-44. Percentage of facilities using electricity for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	100%	100%	100%	0%	0%	0%
2	100%	100%	100%	^60%	0%	0%
3	85%	91%	74%	2%	^1.6%	0%
Total	85%	91%	74%	3%	^1.6%	0%

a e.g., cooking appliances, water heating, office equipment

b excluding highway use

B.1.5.2 Non-electric

Of the non-electric energy consumption within the fabricated metals sector, 82% is utilized in Tier 3 facilities. Of that non-electric consumption 45% is consumed by manufacturing or industrial production process, about 2.4 million MMBtu of the total of 5.2 million MMBtu consumed.

Table B-45. Percentage of non-electric fuel by high-level end use

Tier	Boilers or generators		Manufacturing or industrial production process		Basic facility operations		Don't Know /Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	^72,017	^8.4%	^722,469	^84.7%	^30,861	^3.6%	^27,945	^3.3%	^ 853,292	100.0%
2	^3,069	^1.0%	^113,717	^36.3%	131,951	42.1%	^64,655	^20.6	313,392	100.0%
3	371,689	7.0%	2,410,808	45.7%	1,548,659	29.4%	943,272	17.9%	5,274,428	100.0%
Total	446,774	6.9%	3,246,994	50.4%	1,711,471	26.6%	1,035,872	16.1%	6,441,112	100.0%

Within the process use 25% of facilities reported using non-electric fuels for process heating and 23% reported using non-electric fuels for machine drive purposes.

Table B-46. Percentage of facilities using non-electric fuel for production processes by end use

Tier	Process heating ^a	Process cooling and refrigeration	Machine drive ^b	Electrochemical processes ^c	Other manufacturing or production process	Don't Know
	%	%	%	%	%	%
1	83.7%	19.6%	19.1%	0.0%	19.1%	0.0%
2	20.5%	-12.2%	0.0%	0.0%	84.7%	0.0%
3	24.8%	-3.2%	23.3%	-1.8%	17.7%	0.0%
Total	25.0%	-3.3%	23.1%	-1.8%	18.3%	0.0%

a e.g., kilns, furnaces, ovens, strip heaters

b e.g., motors, pumps, etc. associated with manufacturing process equipment

c e.g., reduction process

Table B-47 and Table B-48 show the distribution of boiler and non-boiler process temperatures.

Table B-47. Percentage of non-electric fuel dedicated to boilers by temperature range

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/ Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	b	b	b	b	b	b	b	b	-72,017	100.0%
2	b	b	b	b	b	b	b	b	3,069	100.0%
3	214,918	57.8%	^85,490	^23.0%	^21,286	^5.7%	^49,995	^13.5%	371,689	100.0%
Total	279,135	62.5%	^88,514	^19.8%	^21,286	^4.8%	^57,840	^12.9%	446,774	100.0%

Table B-48. Percentage of non-electric fuel dedicated to non-boiler process by temperature

Tier	Low Temp (<140°C/280°F)		Med Temp (>140°C/280°F & <300°C/570°F)		High Temp (>300°C/570°F)		Don't know/ Unknown		Total	
	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%	MMBtu	%
1	b	b	b	b	b	b	b	b	^722,469	100%
2	m	m	m	m	m	m	m	m	^113,717	100%
3	467,267	19.4%	^1,072,359	^44.5%	-10,358	-0.4%	^860,824	^35.7%	2,410,808	100%
Total	543,307	16.7%	^1,339,391	^41.3%	^245,657	^7.6%	^1,118,639	^34.5%	3,246,994	100%

Table B-49 shows the percentage of facilities that use non-electric fuel for facility operations by end use. The highest category for this non-electric use is for HVAC.

Table B-49. Percentage of facilities using non-electric fuel for facility operations by end use

Tier	HVAC	Lighting	Basic equipment or appliances ^a	Onsite transportation ^b	Other use	Don't Know
	%	%	%	%	%	%
1	38.7%	0.0%	67.3%	28.6%	0.0%	0.0%
2	53.1%	0.0%	27.4%	-12.2%	8.3%	0.0%
3	64.4%	-4.3%	24.1%	-4.5%	-0.9%	0.0%
Total	64.2%	-4.2%	24.3%	-4.7%	-1.0%	0.0%

a e.g., cooking appliances, water heating, office equipment
 b excluding highway use

Table B-50 shows the percentage of facilities that reported having a number of different equipment types. Within the fabricated metal sector, the most common reported equipment was other materials processing (e.g., grinding, agitating/ mixing), with 79% of facilities stating they had it. Next was air compressors with 74%.

Of that equipment air compressors had received the most recent energy efficiency upgrades, with 21% reporting they had been upgraded within the last three years.

Table B-50. Percentage of facilities with specific equipment types with percentage of facilities that recently upgraded each equipment type

Equipment Type	% facilities with equipment				% facilities that received EE upgrades in last 3 years			
	Tier 1	Tier 2	Tier 3	Total	Tier 1	Tier 2	Tier 3	Total
Other materials processing (e.g., grinding, agitating/ mixing, debarking, drilling, pressing)	80.9%	65.3%	78.7%	78.6%	0.0%	29.5%	13.1%	13.2%

Air compressors	83.7%	82.6%	74.0%	74.1%	38.7%	32.6%	20.4%	20.6%
Welding	100.0%	74.3%	59.2%	59.5%	0.0%	-12.2%	11.8%	11.7%
Material handling (e.g., conveyers, belts, materials movers)	64.0%	87.8%	41.5%	42.0%	0.0%	8.3%	-4.2%	-4.2%
Process Fans	83.7%	^53.8%	21.7%	22.2%	19.1%	0.0%	-2.6%	-2.7%
Drying and curing	64.0%	^12.2%	20.1%	20.2%	0.0%	0.0%	-2.8%	-2.8%
Other	^28.6%	^12.2%	18.3%	18.3%	0.0%	-12.2%	-1.3%	-1.4%
Process pumping	64.0%	a	13.6%	14.1%	19.1%	a	a	a
Carburizing furnace	^35.4%	0.0%	^2.7%	^2.8%	0.0%	0.0%	0.0%	0.0%

Appendix C Methodology: Population development, screening, sampling, weighting

This appendix reviews the development of the manufacturing and greenhouse sample frames for Phase Two of the NYSERDA Statewide Industrial Facilities Stock study, the initial and revised sample designs developed to direct the required survey and onsite research for the study, adjustments to the sample frames following screening carried out during the survey research, post-stratification to adjust for change in qualitative descriptions of energy expenditure size and industrial subsector based on findings from the survey and onsite research, and the weighting of the survey and onsite results to represent the overall population of manufacturing and greenhouse facilities in New York State.

C.1 Population frame development

The development of manufacturing and greenhouse sample frames for this research was a primary goal of Phase One of this study. Through that work, manufacturing facility information was aggregated from a propriety Data Axle listing of companies with industrial NAICS codes, FW Dodge new construction data, and EPA FLIGHT facilities emissions data to produce a comprehensive list of likely manufacturing facilities in New York State. This list was then screened using data previously collected by NYSERDA over the course of three of their CEI Market Evaluations to remove facilities that were involved in the manufacturing industry, but that did not actually manufacture anything at the indicated site. Full details of this process are available in Section 2 of the Industrial Facilities Stock Assessment: Phase One Final Report.¹⁷

To develop a frame of greenhouse facilities, the Phase One study simply used the full list of greenhouse sites provided in the licensed Nursery Growers and Greenhouse file available from Open Data NY as provided by the New York State Department of Agriculture and Markets.¹⁸

These manufacturing and greenhouse sample frames were used in the development of sample designs to direct the survey and onsite research for the current phase of the study, as described in the following section.

¹⁷ <https://www.nysERDA.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/Matter-No-1602180NYSERDAIndustrial-Facilities-Stock-Study-Phase-One-Report-March-2023.pdf>

¹⁸ [Nursery Growers and Greenhouse | State of New York \(ny.gov\)](#)

C.2 Sample designs

C.2.1 Initial sample design

Using the screened manufacturing and greenhouse frames developed in Phase One of this study, the study team developed initial ideal sample designs for manufacturing and greenhouses as shown in Table C-1 and Table C-2. For the manufacturing sample, facilities were grouped into “key” and “non-key” categories based on scoring conducted during Phase One of the study. Those manufacturing subsectors identified as key (9 subsectors) were assigned their own sample targets, while the non-key manufacturing subsectors (12 subsectors) were assigned sample targets as an overall group. Sample targets were assigned by tier based on the proportion of estimated total energy expenditures each tier represented within a given subsector, so that when the sample for each tier was aggregated, the overall expected precision at the 90% confidence level assuming a CV of 0.5 would be 10%. For any calculated metrics that ended up having CVs higher than 0.5, the final calculated precisions could be substantially higher than indicated by the initial sample designs.

No separate onsite samples were developed for manufacturing or greenhouses. It was expected that the study would be able to follow up with onsites to 15% of the manufacturing facilities and 15% of the greenhouses onsite that completed web surveys (roughly 200 manufacturing sites and 10 greenhouse sites). Actual onsite completes were 100 for manufacturing facilities and 12 for greenhouses.

Table C-1. Initial manufacturing sample design – precisions at 90% confidence level

NAICS Subsector	Facility Counts			Target Completes				Estimated Precision (FPC)			
	Tier 1	Tier 2	Tier 3	Tier 1	Tier 2	Tier 3	Total	Tier 1	Tier 2	Tier 3	Overall
311 Food manufacturing	21	19	3,094	11	10	40	61	18%	18%	13%	10%
322 Paper mfg	66	37	138	27	19	21	67	12%	13%	17%	10%
324 Petroleum and coal products	43	10	81	22	7*	21	50	12%	18%	16%	10%
325 Chemical mfg	26	35	432	13	18	57	88	16%	14%	10%	10%
327 Nonmetallic mineral product mfg	32	14	365	17*	8*	52	77	14%	20%	11%	10%
331 Primary metals	31	24	116	18*	12	22	52	13%	17%	16%	10%
332 Fabricated metal product mfg	6	14	2,541	5*	8*	48	59	16%	20%	12%	10%
334 Computer and electronic product mfg	16	18	666	9*	9	77	95	19%	20%	9%	10%
336 Transportation Equipment	14	13	307	10*	8	41	59	14%	19%	12%	10%
Minor Non Key Manufacturing	43	65	10,340	22	33	630	685	12%	10%	3%	3%
Major Key Manufacturing Total	255	184	7,740	130	99	379	610	5%	6%	4%	3%
All Manufacturing Total	298	249	18,080	154	132	1,009	1,295	5%	5%	3%	2%

Table C-2. Initial greenhouse sample design – precisions at 90% confidence level

NAICS Subsector	Facility Counts			Target Completes				Estimated Precision (FPC)			
	Tier 1	Tier 2	Tier 3	Tier 1	Tier 2	Tier 3	Total	Tier 1	Tier 2	Tier 3	Overall
All Greenhouse Total	N/A	N/A	1,990	N/A	N/A	68	68	N/A	N/A	10%	10%

Based on prior experience conducting survey research with manufacturing facilities in New York, it was expected that the study could reasonably achieve a survey response rate of approximately 50% among medium and large (Tier 2 and Tier 1) facilities and expected a lower response rate of approximately 20% among small facilities (Tier 3). Given the size of the Tier 1 and Tier 2 populations, this meant trying to reach all facilities to achieve the desired sample targets. Tier 3 facilities were randomly sampled for

surveys within their tier and subsector strata, since achieving the target number of completes was not expected to require calling all available facilities for all subsectors except petroleum and coal products.

The initial manufacturing sample design shown in Table C-1 denotes with asterisks where a response rate of greater than 50% would be required to achieve the desired precisions. For petroleum and coal products, nonmetallic mineral product manufacturing, primary metals, fabricated metal product manufacturing, computer and electronic product manufacturing, and transportation equipment, achieving a response rate of greater than 50% was not possible due to budget and schedule constraints, as well as the practical difficulty of securing that level of facility participation in the study.

For the greenhouse survey, all facilities were assumed to be in Tier 3 with no subsectors, requiring only a simple random sample. Achieve the target number of completes required a response rate of approximately 3.5%, well within the expected range for recruitment.

C.2.2 Sample design revisions

Through the course of conducting the surveys and completing the additional screening with manufacturing facilities, it became apparent that many of the potential manufacturing facilities did not actually perform manufacturing at the sampled site. This reduction in eligible population meant a reduction in the sample of sites that could practically be recruited from all tiers. Given these eligibility adjustments, all the Tier 1 and Tier 2 sample targets were reduced to match 50% of the revised estimated eligible population, while 7 out of 9 key subsectors had their Tier 3 samples capped at 20% of the revised estimated eligible population to match the likely response rate for that population, essentially shifting most of Tier 3 from a stratified random sample to a census attempt. Table C shows the last revisions to eligibility adjustments and sample targets prior to closing the survey and calculating final values for population eligibility and number of survey completes in each sample cell, which will be discussed in the next section.

Table C.2. Revised manufacturing sample targets, precision at 90% confidence level

NAICS Subsector	Facility Counts			Target Completes				Estimated Precision (FPC)			
	Tier 1	Tier 2	Tier 3	Tier 1	Tier 2	Tier 3	Total	Tier 1	Tier 2	Tier 3	Overall
311 Food manufacturing	18	17	730	9	8	46	63	20%	22%	12%	10%
322 Paper mfg	57	27	39	28	13	8	49	11%	17%	26%	10%
324 Petroleum and coal products	19	3	2	9	2	1	12	20%	41%	82%	20%
325 Chemical mfg	20	25	135	10	12	27	49	19%	17%	14%	14%
327 Nonmetallic mineral product mfg	27	12	152	13	6	30	49	17%	25%	13%	13%
331 Primary metals	27	16	45	13	8	9	30	17%	21%	25%	15%
332 Fabricated metal product mfg	6	14	1,808	5	7	55	67	16%	23%	11%	9%
334 Computer and electronic product mfg	13	15	190	6	7	38	51	26%	24%	12%	18%
336 Transportation Equipment	11	13	59	5	6	12	23	28%	26%	21%	23%
Minor Non Key Manufacturing	31	56	5,367	15	28	200	243	16%	11%	6%	6%
Major Key Manufacturing Total	198	142	3,160	98	69	226	393	8%	10%	7%	6%
All Manufacturing Total	229	198	8,527	113	97	426	636	8%	8%	5%	5%

Table C shows adjusted Tier 1 and Tier 2 populations that are on average 79% of initial estimates, while Tier 3 adjusted populations are on average 34% of initial estimates. The effect is that the anticipated number of completed surveys decreased from 1,295 to 636, with corresponding decreases in expected precision at the 90% confidence level for metrics with a Coefficient of Variation (CV) of 0.5 (larger precision estimates) for all subsectors except fabricated metal product manufacturing. The reduction in target sample sizes also meant a corresponding reduction in likely onsite completes, from approximately 200 to approximately 100.

For the greenhouse survey, no sample design adjustments were made while conducting the survey despite substantial population adjustments due to on-target response rates, such that recruitment for that survey was able to achieve its initial goals.

C.2.3 Frame adjustments – eligibility and qualitative reclassification

The manufacturing survey was closed with 607 completes, achieving approximately 95% of the revised sample target based on the final adjusted sample target of 636; however, since the final eligible manufacturing population was determined to be 7,777 as shown in Table C, versus the 8,954 facilities assumed in the adjusted sample, it is likely an additional sample revision would have suggested a lower target.

Prior to final analysis of the data, the study team determined that several of the surveyed facilities reported being in a fuel expenditure tier or NAICS subsector different from that suggested by the sample frame. To avoid assigning what were determined to be unreasonably large weights to some facilities, the survey completes were partially post stratified such that facilities originally assigned to Tier 3 but determined to be in Tier 1 were assigned to Tier 1 for weighting, and that facilities assigned to non-key manufacturing but that were determined to be in the one of the key manufacturing subsectors were assigned to that subsector for weighting.

Table C provides a breakdown of the originally assigned expenditure tier as compared to the final revised expenditure tier. Table C provides a breakdown of the originally assigned NAICS subsector as compared to the final revised NAICS subsector. In both tables, the highlighted cells indicate the number of surveyed facilities where the originally assigned description matches the final revised description.

Examining the tier reassignments in Table C, 96% of facilities remained in their original tier. Among sampled Tier 3 facilities, 11 were determined to belong to Tier 1 and 3 to Tier 2. Among Tier 2 facilities, two were determined to belong to Tier 1 and 7 to Tier 3. Among Tier 1 facilities, one was determined to belong to Tier 2 and one to Tier 3.

Table C-4. Matrix of frame vs. final expenditure tier assignments

Original Tier	Revised Tier		
	Tier 1	Tier 2	Tier 3
Tier 1	111	1	1
Tier 2	2	71	7
Tier 3	11	3	400

Examining the NAICS subsector reassignments in Table C-5, 89% of facilities remained in their original NAICS subsector classification, with most of the reclassification happening for facilities originally classified as non-key. Of the 217 non-key survey completes, five shifted to transportation equipment, eight to computer and electronic products, 34 to fabricated metal products, six to primary metals, two to nonmetallic mineral products, five to chemicals, one to petroleum and coal products, and four to paper. The only other reclassification was in the computer and electronic products subsector, where a single facility was reclassified as fabricated metal products.

Table C-5. Matrix of frame vs. final manufacturing subsector assignments

Original NAICS Subsector	Revised NAICS Subsector									
	311 - Food	322 - Paper	324 - Petroleum and Coal Products	325 - Chemicals	327 - Nonmetallic Mineral Products	331 - Primary Metals	332 - Fabricated Metal Products	334 - Computer and Electronic Products	336 - Transportation Equipment	Non-Key Manufacturing
311 - Food	41									
322 - Paper		43								
324 - Petroleum and Coal Products			9							
325 - Chemicals				35						
327 - Nonmetallic Mineral Products					39					
331 - Primary Metals						34				
332 - Fabricated Metal Products							66			
334 - Computer and Electronic Products							1	54		
336 - Transportation Equipment									28	
Non-Key Manufacturing		4	1	5	2	6	34	8	5	192

Table C-6. Final manufacturing population adjustment and completed surveys

Sample Strata	Original Population	Revised Population	Revised Sample Targets	Survey Completes	Poststratified Survey Completes	Survey Response Rate	Survey Complete Percent of Targets	Poststratified Survey Complete Percent of Targets
311 - Food - Tier 1	23	20	9	9	11	45%	100%	122%
311 - Food - Tier 2	19	17	8	3	3	18%	38%	38%
311 - Food - Tier 3	3,092	27	46	29	27	9%	63%	59%
322 - Paper - Tier 1	67	56	28	25	25	45%	89%	89%
322 - Paper - Tier 2	37	27	13	12	12	44%	92%	92%
322 - Paper - Tier 3	142	37	8	6	10	16%	75%	125%
324 - Petroleum and Coal Products - Tier 1	43	20	9	8	8	40%	89%	89%
324 - Petroleum and Coal Products - Tier 2	10	3	2	1	1	33%	50%	50%
324 - Petroleum and Coal Products - Tier 3	82	3	1	0	1	0%	0%	100%
325 - Chemicals - Tier 1	30	24	10	8	12	33%	80%	120%
325 - Chemicals - Tier 2	36	27	12	8	9	30%	67%	75%
325 - Chemicals - Tier 3	432	131	27	19	19	15%	70%	70%
327 - Nonmetallic Mineral Products - Tier 1	34	28	13	10	12	36%	77%	92%
327 - Nonmetallic Mineral Products - Tier 2	14	12	6	4	4	33%	67%	67%
327 - Nonmetallic Mineral Products - Tier 3	365	122	30	25	25	20%	83%	83%
331 - Primary Metals - Tier 1	32	26	13	17	18	65%	131%	138%
331 - Primary Metals - Tier 2	26	18	8	6	8	33%	75%	100%
331 - Primary Metals - Tier 3	119	48	9	11	14	23%	122%	156%
332 - Fabricated Metal Products - Tier 1	8	8	5	5	7	63%	100%	140%
332 - Fabricated Metal Products - Tier 2	16	15	7	7	9	47%	100%	129%
332 - Fabricated Metal Products - Tier 3	2,572	1,557	55	54	85	3%	98%	155%
334 - Computer and Electronic Products - Tier 1	17	14	6	9	10	64%	150%	167%
334 - Computer and Electronic Products - Tier 2	18	15	7	6	6	40%	86%	86%
334 - Computer and Electronic Products - Tier 3	672	189	38	40	46	21%	105%	121%
336 - Transportation Equipment - Tier 1	16	13	5	7	9	54%	140%	180%
336 - Transportation Equipment - Tier 2	14	14	6	8	9	57%	133%	150%

Sample Strata	Original Population	Revised Population	Revised Sample Targets	Survey Completes	Poststratified Survey Completes	Survey Response Rate	Survey Complete Percent of Targets	Poststratified Survey Complete Percent of Targets
336 - Transportation Equipment - Tier 3	309	68	12	13	15	19%	108%	125%
Non-Key Manufacturing - Tier 1	40	29	15	15	12	52%	100%	80%
Non-Key Manufacturing - Tier 2	54	45	28	25	14	56%	89%	50%
Non-Key Manufacturing - Tier 3	10,289	4,864	200	217	166	4%	109%	83%
Total	18,628	7,777	636	607	607	8%	95%	95%

As noted above, Table C provides an overview of the original sample frame population, the revised population based on eligibility adjustments, the number of completes for each stratum, and the number of completes for each stratum after post-stratification based on the reclassification of sites following the survey. The revised population estimates were developed based on the screening of facilities during survey recruitment, where potential respondents were categorized as “eligible” (manufacturing occurs at the address in the sample) or “ineligible” (no manufacturing occurs at the address in the sample). Of the 18,628 facilities in the sample frame, 7,869 were screened and positively identified as being eligible or ineligible for the survey. For the 10,759 facilities that were not screened, the population was adjusted based on the proportion of screened facilities in each expenditure tier and NAICS subsector that were found to be eligible. These final tier and NAICS population estimates were used to develop weights for the survey and onsite analyses.

C.2.4 Survey and onsite weights

Table C-7 shows the breakout of average weights by NAICS subsector and tier for the manufacturing survey. These are case weights, meaning they are the weight used to represent other facilities in their tier and subsector. The weights are labeled as averages because the actual weight assigned to any facility within each tier and subsector may differ to account for large variations in facility size. For example, several Tier 1 facilities are assigned a weight of 1, since they were identified as probably the only facility in the population of their size. Failing to account for this would likely lead to an overestimate of population totals in the analysis. Table C-8 shows the breakout of average weights by NAICS subsector and tier for the manufacturing onsite effort, and Table C-9 shows the weights for the greenhouse survey and onsite efforts. The greenhouse table is simplified, since that sample was not stratified and did not require poststratification.

Table C-7. Manufacturing survey weights

Sample Strata	Revised Population	Poststratified Survey Completes	Average Weight
311 - Food - Tier 1	20	11	1.82
311 - Food - Tier 2	17	3	5.67
311 - Food - Tier 3	327	27	12.11
322 - Paper - Tier 1	56	25	2.24
322 - Paper - Tier 2	27	12	2.25
322 - Paper - Tier 3	37	10	3.70
324 - Petroleum and Coal Products - Tier 1	20	8	2.50
324 - Petroleum and Coal Products - Tier 2	3	1	3.00
324 - Petroleum and Coal Products - Tier 3	3	1	3.00
325 - Chemicals - Tier 1	24	12	2.00
325 - Chemicals - Tier 2	27	9	3.00
325 - Chemicals - Tier 3	131	19	6.89
327 - Nonmetallic Mineral Products - Tier 1	28	12	2.33
327 - Nonmetallic Mineral Products - Tier 2	12	4	3.00
327 - Nonmetallic Mineral Products - Tier 3	122	25	4.88
331 - Primary Metals - Tier 1	26	18	1.44
331 - Primary Metals - Tier 2	18	8	2.25
331 - Primary Metals - Tier 3	48	14	3.43
332 - Fabricated Metal Products - Tier 1	8	7	1.14
332 - Fabricated Metal Products - Tier 2	15	9	1.67
332 - Fabricated Metal Products - Tier 3	1,557	85	18.32
334 - Computer and Electronic Products - Tier 1	14	10	1.40
334 - Computer and Electronic Products - Tier 2	15	6	2.50
334 - Computer and Electronic Products - Tier 3	189	46	4.11
336 - Transportation Equipment - Tier 1	13	9	1.44
336 - Transportation Equipment - Tier 2	14	9	1.56
336 - Transportation Equipment - Tier 3	68	15	4.53
Non-Key Manufacturing - Tier 1	29	12	2.42
Non-Key Manufacturing - Tier 2	45	14	3.21
Non-Key Manufacturing - Tier 3	4,864	166	29.30

Table C-8. Manufacturing onsite weights

Sample Strata	Revised Population	Poststratified Onsite Completes	Average Weight
311 - Food - Tier 1	20	2	10.00
311 - Food - Tier 2	17	1	17.00
311 - Food - Tier 3	327	1	327.00
322 - Paper - Tier 1	56	10	5.60
322 - Paper - Tier 2	27	1	27.00
322 - Paper - Tier 3	37	0	N/A
324 - Petroleum and Coal Products - Tier 1	20	4	5.00
324 - Petroleum and Coal Products - Tier 2	3	0	N/A
324 - Petroleum and Coal Products - Tier 3	3	0	N/A
325 - Chemicals - Tier 1	24	2	12.00
325 - Chemicals - Tier 2	27	1	27.00
325 - Chemicals - Tier 3	131	2	65.50
327 - Nonmetallic Mineral Products - Tier 1	28	3	9.33
327 - Nonmetallic Mineral Products - Tier 2	12	0	N/A
327 - Nonmetallic Mineral Products - Tier 3	122	4	30.50
331 - Primary Metals - Tier 1	26	5	5.20
331 - Primary Metals - Tier 2	18	2	9.00
331 - Primary Metals - Tier 3	48	3	16.00
332 - Fabricated Metal Products - Tier 1	8	1	8.00
332 - Fabricated Metal Products - Tier 2	15	0	N/A
332 - Fabricated Metal Products - Tier 3	1,557	7	222.43
334 - Computer and Electronic Products - Tier 1	14	2	7.00
334 - Computer and Electronic Products - Tier 2	15	1	15.00
334 - Computer and Electronic Products - Tier 3	189	11	17.18
336 - Transportation Equipment - Tier 1	13	2	6.50
336 - Transportation Equipment - Tier 2	14	1	14.00
336 - Transportation Equipment - Tier 3	68	1	68.00
Non-Key Manufacturing - Tier 1	29	2	14.50
Non-Key Manufacturing - Tier 2	45	5	9.00
Non-Key Manufacturing - Tier 3	4,864	26	187.08

Table C-9. Greenhouse survey and onsite weights

Greenhouse Research Effort	Revised Population	Completes	Average Weight
Greenhouse - Survey	354	71	4.99
Greenhouse - Onsite	354	12	29.50

Appendix D Methodology: Analysis including imputation and variance estimation

This appendix reviews key features of the analysis presented in the body of the report, including the general imputation of ratio scale values from categorical responses (i.e., ranges of values), the imputation of consumption and expenditure values when only one was provided, the imputation of greenhouse gas emissions values, the imputation of other missing or unknown values, the difference between overall and net electric usage, the adjustment of reported energy usage values to account for energy used as a feedstock, and a statement of the variance methods used to estimate the sampling error for the metrics provided in the body of the report and in Appendix A.

It is important to note that results in this report were suppressed or should be used with caution according to the following conditions dependent on its relative standard error (RSE). A 100% RSE threshold used to suppress results in this report. This differs from that used by Manufacturing Energy Consumption Survey (MECS), which suppresses results with RSE above 50%. The sample size in this study is lower than MECs and has an accompanying wider variability than MECs. In consultation with NYSERDA it was decided that it was valuable to reporting estimated values up to 100% RSE, even though the higher RSE values express greater uncertainty and should be used with caution.

D.1 Imputation

D.1.1 Imputation of ratio scale values from categorical response

Several of the questions in the manufacturing and greenhouse surveys allowed facility respondents to select from a range of closed responses to certain questions attempting to gather numeric information if the respondent was unable to provide a specific value. For example, if a respondent was unable to indicate how many employees worked at their facility, they would be asked a follow-up question placing numbers of employees into bins to select from, e.g., 1-10 employees, 11-25 employees, 26-50 employees. When a respondent provided one of these answers, the midpoint of the range indicated by the categorical response was used to impute a response to the question (for example, 11-25 employees would become 18 employees in the analysis).

D.1.2 Imputation of consumption and expenditure values

To capture energy expenditure and usage information, survey respondents were asked to provide either their energy expenditures or their usage information for each of the top three non-electric fuels they indicated using, along with expenditure or usage information for electricity.

For respondents that provided consumption information and not expenditure information, expenditures were calculated using New York State average industrial electricity and non-electric fuel prices based on 2022 data provided by NYSERDA. If a respondent indicated that some of their consumption was non-purchased (e.g., electricity generated onsite by renewables), that portion of consumption was excluded from the conversion to ensure that only purchased energy was reflected in total expenditures.

For respondents that provided expenditure information and not consumption information, consumption was similarly calculated using the relevant fuel prices as multipliers. If a respondent indicated that some of their consumption was non-purchased, the consumption values for that fuel were inflated after conversion from the expenditure values to account for the percentage of consumption the respondent indicated had not been purchased.

D.1.3 Imputation of additional non-electric fuel values

For respondents who indicated their facility used more than three fuels, they were only asked to provide consumption or expenditure information for the top three during the survey. Out of the 607 respondents to the survey, 21 indicated using more than three fuels, which required an imputation for those usage values to avoid underestimating facility consumption.

To impute values for the additional fuels, the study calculated a ratio of the indicated non-electric fuel consumption to electricity consumption for facilities that had provided consumption or expenditure information for that fuel within each subsector. That ratio was then applied to the electric consumption values for those facilities requiring imputation to arrive at a new estimated usage value for each fuel outside of the top three.

Estimating usage values outside of the top three consumed based on usage values from among the top three consumed creates potential that this imputation process could overestimate non-electric fuel usage for these facilities. However, this is of limited concern, since the greatest amount of non-electric fuel usage is typically represented by natural gas, with other fuels representing a small minority of consumption. Since natural gas does not appear outside of the top three fuels used for any facilities, the missing values are being filled based on fuels that represent a

minority of consumption for the facilities at which they appear, which should limit substantially overestimation of total facility consumption.

D.1.4 Imputation of missing values

For facilities missing a response to the question of how many employees they had (4 out of 607 responses), these values were filled with an average number of employees by NAICS subsector and expenditure tier before carrying out additional imputations of other values.

For respondents that were unable to provide either a ratio scale or categorical response to the other firmographic or energy consumption or expenditure questions that the analysis required to estimate population totals, we imputed a value based on the ratio of the metric in question per employee within each NAICS subsector and expenditure tier, applying that ratio to the number of employees at the facility missing a response.

Survey and onsite questions regarding non-firmographic or energy/expenditure facility characteristics (e.g., presence of a GHG emissions reduction plan, a breakout of energy consumption by end use, or any other metric that did not result in calculating a population total) did not receive imputations. Facilities missing responses were excluded from the analysis of these metrics, while “don’t know” responses were reported as a separate category in the analysis results.

D.1.5 Imputation of greenhouse gas emissions values

Scope 2 greenhouse gas emissions were estimated for each facility based on their energy consumption and were not collected as direct responses from survey or onsite respondents. To make these conversions, we used factors from two sources: NYSERDA’s Projected Emissions Factors for New York Grid Electricity whitepaper¹⁹ and NYSERDA’s Fossil and Biogenic Fuel Greenhouse Gas Emission Factors whitepaper²⁰. These provided gross CO₂e emissions factors for industrial electricity and several industrial non-electric fuels (natural gas, renewable natural gas, coal, diesel, distillate, renewable diesel, kerosene, LPG, petroleum coke, residual fuel, and wood). The CO₂e emissions represent a combination of CO₂, CH₄, and N₂O, with a 20-year global warming potential assumed for the non-CO₂ fuels as specified by the New York GHG inventory accounting rules.

¹⁹ <https://www.nysesda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/22-18-Projected-Emission-Factors-for-New-York-Grid-Electricity.pdf>

²⁰ <https://www.nysesda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/22-23-Fossil-and-Biogenic-Fuel-Greenhouse-Gas-Emission-Factors.pdf>

D.1.6 Net-electric usage

To avoid the double-counting or overestimate of energy consumption at a particular facility, where some electricity may be produced onsite using fossil or other non-electric fuels, or when some generated or purchased electricity is transferred offsite to other facilities, this study reports all electricity values as net-electric usage. Net-electric usage is calculated in a manner consistent with MECS, where values are obtained by summing purchases, transfers in, and generation from noncombustible renewable resources, minus quantities sold and transferred out. It excludes electricity inputs from onsite cogeneration or generation from combustible fuels because that energy has already been included in the non-electric fuel metrics (for example, natural gas or coal).

A breakdown of electric usage components for each subsector, arriving at the final net-electric usage value, is provided in the body of the report in Table 3-3.

D.1.7 Feedstock adjustments

This study's original manufacturing survey did not ask respondents to split energy between that used as a fuel and that used as a feedstock. The results from the 2018 MECS indicate that nationally, a substantial amount of energy is consumed as a feedstock by the chemical, primary metal, and petroleum and coal manufacturing subsectors, although the amount is much smaller when looking at the Northeast region alone. To ensure the analysis was not including any energy being used as a feedstock, we attempted follow-up surveys with the 75 survey respondents in those sectors and were able to complete follow-ups with 57 respondents. Of those, only three respondents indicated using energy as a feedstock, and energy used as a feedstock only represented a substantial amount of overage energy used for 1 respondent. All confirmed feedstock energy was removed from each site's reported energy values prior to further analysis.

D.2 Variance estimation

All variance calculations were performed with the SURVEYMEANS and SURVEYFREQ procedures through SAS/STAT in SAS 9.4 using Taylor series variance estimation methods. Note that the indicated standard errors and precision estimates in this report only reflect the error inherent in taking a random sample from a target population. Any error in the estimates from over- or under-coverage of the sample frame relative to the target population, non-response bias, or response errors from the survey and onsite respondents are either unquantifiable or were outside the scope of this research to determine and are not presented.

Appendix E Methodology: Web survey and onsite procedures

E.1 Web surveys

This appendix shares the industrial and greenhouse web survey methods.

E.1.1 Survey development (Industrial survey)

The industrial survey instrument was developed to collect information about facility energy uses and practices, including the types of fuels used, the amount used in the last 12 months, the end uses for each fuel, and energy management practices and protocols used or being considered. The survey included the following sections:

- Introduction
- Screening Questions
- Facility Background Information
- Facility Electricity Consumption
- Facility Non-Electric Fuel Consumption
- Greenhouse Gas (GHG) and Energy Management Practices
- Barriers to Energy Efficiency
- Site Visit and Billing Data Request

To develop survey questions, questions were reviewed from other relevant surveys collecting similar information from the target population, including the Manufacturing Energy Consumption Survey (MECS) conducted by the Energy Information Administration (EIA) and the NYSERDA Continuous Energy Improvement surveys conducted in 2017, 2019, and 2021.

Two surveys were developed to collect the information contained in this report: the Manufacturing Survey (Appendix G) and the Greenhouse Survey (Appendix H). To ensure the surveys worked for different types of industrial facilities and respondents, both surveys underwent several iterations of review and testing. In February 2023, the Manufacturing Survey was pretested with a small sample of industrial facilities provided by NYSERDA. Following this pretest soft launch, minor revisions were made to improve the survey instrument. In addition, small changes were made to survey language following the soft launch.

The Manufacturing Survey was designed as a mixed mode survey where respondents could participate in one of two ways: online using their computer or device, or via telephone with an interviewer. The Qualtrics survey platform was used to administer the survey. Both respondents who completed online and the interviewers who conducted telephone interviews used the Qualtrics platform. Each sampled case was assigned a unique Access Code that was required to begin the survey in Qualtrics. The Access Code

allowed verification of each respondent, and it allowed respondents to begin the survey and return to it later, or to share the survey with a colleague better suited to answer specific questions.

E.1.2 Survey development (Greenhouse survey)

The Greenhouse Survey instrument was created to closely match the Manufacturing Survey, but to have adjusted language and revised screening questions for the greenhouse facility population. The Greenhouse Survey was programmed in the Qualtrics Platform using the same approach as the Manufacturing Survey. The Greenhouse Survey was pretested with a greenhouse grower who had participated in a NYSERDA program and minor revisions were made prior to survey fielding.

E.1.3 Eligibility rates

The Manufacturing Survey included screening criteria to determine eligibility. Reasons for ineligibility included: the facility was not a location where manufacturing or industrial activity took place; the facility reached was not selected to be part of the sample; the facility was not in operation, it went out of business or closed the location; the facility had already completed a Manufacturing Survey in the sample; or the facility did not directly manage its energy usage.

All cases were classified as either 1) eligible or likely eligible, 2) ineligible, or 3) unknown (not screened). A portion of cases had unknown eligibility because the respondent could not be reached or refused to participate, and information available from online research could not adequately confirm eligibility as a manufacturing facility. The eligibility rates by tier and sector are presented in Table E-1. The eligibility rate was calculated as follows:

$$\frac{\text{Number Eligible or Likely Eligible}}{(\text{Number Eligible or Likely Eligible} + \text{Number Ineligible})} \times 100\%$$

Eligibility varied widely by tier and sector - ranging from a high of 100% for Tier 2 Transportation Equipment Manufacturing to a low of 3% for Tier 3 Petroleum and Coal Products. Overall, the estimated eligibility rate for Tier 1 was 75%; the estimated eligibility rate for Tier 2 was 80%; and the estimated eligibility rate for Tier 3 was 42%.

Table E-1. Manufacturing Survey eligibility rates by Tier and Subsector

Sector	Tier 1	Tier 2	Tier 3	Total
311 Food Manufacturing	83%	89%	15%	18%
322 Paper Manufacturing	83%	74%	24%	51%
324 Petroleum and Coal Products	45%	33%	3%	18%
325 Chemical Manufacturing	75%	73%	29%	35%
327 Nonmetallic Mineral Product Manufacturing	80%	85%	33%	39%
331 Primary Metal Manufacturing	86%	68%	39%	53%
332 Fabricated Metal Product Manufacturing	100%	93%	70%	72%
334 Computer & Electronic Products	79%	82%	27%	29%
336 Transportation Equipment Manufacturing	77%	100%	21%	27%
Other (Non-Key)	74%	86%	51%	51%
Total (All Subsectors)	75%	80%	42%	44%

The Greenhouse Survey also included screening questions to determine eligibility for the survey. Reasons for ineligibility included determining that the facility was not a location with a greenhouse, the greenhouse facility was a hoop house only (no fixed walls or cultivation under glass), the company went out of business or was closed for the season, the facility characteristics has already been included in completed survey, or the facility did not pay energy costs or manage energy usage. In addition, a portion of the sample had unknown eligibility because the respondent could not be reached or refused to participate, and information available from online research could not confirm eligibility.

Table E-2 provides a summary of the sample frame, sample selected, and eligibility rate for the Greenhouse Survey.

Table E-2. Greenhouse Survey sample frame, sample selected, and eligibility rate

Statistic	Number
Total Cases in Sample Frame	2,054
Total Sample Selected	1,400
Eligibility Rate	13%

E.1.4 Outreach procedures, protocols, and recruitment

The outreach procedures for Tier 1 and Tier 2 differed from Tier 3 because high response rates are needed among the largest facilities to meet the survey objectives. The following outreach steps were implemented for Tier 1 and Tier 2 facilities:

- **Assigned Staff Portfolio of Facilities** – Each interviewer was assigned specific facilities to research, contact, screen, and recruit. This allowed interviewers to build knowledge about facilities assigned to

them and establish rapport during outreach by having the same individual contact the facility each time.

- **Conducted Advance Research** – Interviewers used the sample list information and online resources to research assigned facilities to help understand the type of work each facility did, identify potential respondents, and find information relevant for determining eligibility. This helped improve the efficiency of outreach efforts and targeting.
- **Contacted Facility and Screened for Correct Contact** – Interviewers contacted facilities and worked to identify or confirm the appropriate respondent by speaking with gatekeepers and explaining the purpose of the outreach.
- **Contacted and Recruited Respondent** – Once the correct respondent for the survey was identified, each interviewer worked to contact the respondent by making multiple contact attempts at different times of the day over several weeks. Once the respondent was reached, the interviewer explained the survey and emphasized the importance of participation.

Revised outreach procedures were implemented for the smaller Tier 3 facilities, which had a higher ineligibility rate. These procedures were designed to meet study schedule objectives and to quickly identify and reach likely eligible facilities. The following outreach approaches were used for Tier 3:

- **Conducted advance prescreening to identify eligible cases** – Staff used online resources to prescreen sampled cases for eligibility and identify cases that were clearly ineligible.
- **Mailed NYSERDA survey invitation letter** – Facilities that were determined to be likely eligible and not clearly ineligible were sent NYSERDA invitation letters explaining the survey and requesting that they complete the survey online.
- **Contacted non-responding facilities** – facilities in key sectors were contacted by telephone if they did not complete the survey after receiving the letter.

A sample management database was used to allow interviewers to document research and outreach notes, record the disposition of each case, track all contact attempts and communication outcomes, manage their assigned portfolio of cases, and conduct screening to verify eligibility for the survey. Once a facility was confirmed as eligible and the respondent was ready to complete the survey, the interviewer would either begin the survey on the telephone or email the respondent a link to the survey.

Interviewers were prepared with training materials that explained the purpose of the survey, listed the different disposition codes, and defined any key or unfamiliar terms that were used in or applicable to the survey. All interviewers were trained and practiced administering the survey and using the Qualtrics platform and survey management database.

For mail outreach, NYSERDA envelopes and letterhead were used. The survey letter was drafted with NYSERDA and explained the research purpose and conveyed the importance of responding soon (beginning of Appendix G). In total, the study team mailed 4,396 letters to sampled cases for the Manufacturing Survey.

All survey interviews were completed in English. For telephone and email outreach, the interviewers contacted facilities during daytime hours between 8 AM and 5 PM. If respondents requested a specific time or day to complete the interview via telephone, interviewers would schedule an appointment with the respondent. Interviewers would also send follow-up emails as required, containing information to complete the survey online. Interviewers would leave voice messages with each telephone attempt, and voicemail messages changed and were customized as facilities received additional outreach attempts.

The contact listed in the sample was usually an employee in senior-level management, but interviewers often found that the most qualified person to complete the survey was someone at the facility-level, such as a facility manager or plant manager. Oftentimes, it took interviewers several attempts to identify the correct contact and to reach someone knowledgeable about the facility, its energy use, and company management practices. Sometimes this required speaking with operators or gatekeepers to be directed to a potential respondent, while other times it required being referred to someone else from a targeted respondent the interviewer had been trying to reach. Once the correct contact was identified, interviewers would adhere to the following calling protocol: Tier 1 cases would be called at least 12 times, Tier 2 cases would be called at least 10 times, and Tier 3 key sector cases would be called up to 8 times. Once this calling protocol was met, interviewers would review the record and confirm it unlikely for the contact to respond, and then retire the case.

If a company had multiple facilities in the sample and an interview was completed with a respondent at a particular facility, interviewers would ask them if they were familiar with other facilities in the study sample. If they were familiar with another facility in the sample, the interviewer would ask if they would be willing to complete the survey for that facility. If they were not familiar with another facility, the interviewer would ask them if they could refer us to a contact who was familiar with the other facility.

Additional specialized efforts were also made to contact hard-to-reach cases and to increase response rates. These included the following:

- **Soft refusal conversion attempts** – For Tier 1 and Tier 2 and for Tier 3 key sectors, interviewers reattempted soft refusal cases that initially declined several weeks or months earlier. This effort resulted in the conversion of several respondents that agreed to participate.
- **Special letters to Tier 1 and Tier 2 cases** – The study team sent NYSERDA letters to Tier 1 and Tier 2 cases that were non-responsive or hard to reach. These letters resulted in additional survey responses from facilities that were not responsive to phone or email outreach.
- **Assistance from NYSERDA program staff** – NYSERDA was provided multiple lists during fielding of cases that were hard to reach or had no valid contact information. NYSERDA assisted with providing contact information for several of those facilities.
- **Commercial database contact information** – Commercial datasets were used to obtain additional contact information for outreach.

- **Coordinating meetings and non-disclosure agreements (NDAs)** – For companies with multiple large facilities, the study team scheduled meetings with corporate management and NYSERDA to discuss the study and coordinate signing non-disclosure agreements.

The following outreach protocols were implemented for the Greenhouse Survey:

- **Conducted advance Prescreening to Identify Eligible Cases** – Staff used online resources to prescreen sampled cases for eligibility and identify cases that were clearly ineligible.
- **Mailed NYSERDA Survey Invitation Letter** – Facilities that were determined to be likely eligible and not clearly ineligible were sent NYSERDA invitation letters explaining the survey and requesting that they complete the survey online. Approximately 575 greenhouse facilities were sent NYSERDA letters.
- **Contacted Non-responding Facilities** – The study team contacted facilities by telephone that did not complete the survey after receiving the letter.

The study team used the same sample management database and general outreach guidelines for the Greenhouse Survey as for the Manufacturing Survey. Survey outreach took place between July and September 2023.

E.1.5 Survey results and dispositions

In total, 608 facilities completed the Manufacturing Survey.²¹ Based on the survey completions and the sample eligibility rates, the estimated response rates were calculated as follows:²²

$$\frac{\text{Number of Completes}}{[\text{Number Eligible or Likely Eligible} + (\text{Eligibility Rate} * \text{Number Unknown Eligibility})]} \times 100\%$$

Overall, the target response rate for Tier 1 was 50%, the estimated response rate for Tier 2 was 40%, and the estimated response rate for Tier 3 key sectors was 20%.

Table E-3 through Table E-5 show the final number of completed survey interviews, the final target goals, and the percentage of the target goals reached by sector for each tier. For Tier 1 and Tier 2, the survey team attempted to obtain as many survey interviews as possible from all sectors during the survey fielding period. For Tier 3, the survey team focused on obtaining as many completes as possible from the key sectors and ceased outreach to the non-key sector once the target non-key goal had been exceeded.

²¹ One pretest case was provided by NYSERDA and completed the survey. Although this case was not identified in the sample frame it was decided to use them as a pre-test as they were confirmed as a manufacturing facility working with paper products. Because it was not in the sample frame and did not receive the final survey, it is not shown in the tables presented below.

²² This calculation is based on the American Association of Public Opinion Research (AAPOR) Response Rate #3.

Table E-3. Manufacturing Survey completed interviews, target goals, and percentage of target reached by sector for Tier 1

Sector	Number of Completed Surveys	Target Goal	Percent of Target Reached
334 Computer & Electronic Products	9	6	150%
336 Transportation Equipment Manufacturing	7	5	140%
331 Primary Metal Manufacturing	17	13	131%
332 Fabricated Metal Product Manufacturing	5	5	100%
311 Food Manufacturing	9	9	100%
Other (Non-Key)	15	15	100%
324 Petroleum and Coal Products	8	9	89%
322 Paper Manufacturing	24	28	86%
325 Chemical Manufacturing	8	10	80%
327 Nonmetallic Mineral Product Manufacturing	10	13	77%
Total (All Sectors)	112	113	99%

Table E-4. Manufacturing Survey completed interviews, target goals, and percentage of target reached by sector for Tier 2

Sector	Number of Completed Surveys	Target Goal	Percent of Target Reached
336 Transportation Equipment Manufacturing	8	6	133%
332 Fabricated Metal Product Manufacturing	7	7	100%
322 Paper Manufacturing	12	13	92%
Other (Non-Key)	25	28	89%
334 Computer & Electronic Products	6	7	86%
331 Primary Metal Manufacturing	6	8	75%
325 Chemical Manufacturing	8	12	67%
327 Nonmetallic Mineral Product Manufacturing	4	6	67%
324 Petroleum and Coal Products	1	2	50%
311 Food Manufacturing	3	8	38%
Total (All Sectors)	80	97	82%

Table E-5. Manufacturing Survey completed interviews, target goals, and percentage of target reached by sector for Tier 3

Sector	Number of Completed Surveys	Target Goal	Percent of Target Reached
331 Primary Metal Manufacturing	11	9	122%
Other (Non-Key)	217	200	109%
336 Transportation Equipment Manufacturing	13	12	108%
334 Computer & Electronic Products	40	38	105%
332 Fabricated Metal Product Manufacturing	54	55	98%
327 Nonmetallic Mineral Product Manufacturing	25	30	83%
322 Paper Manufacturing	6	8	75%
325 Chemical Manufacturing	20	27	74%
311 Food Manufacturing	29	46	63%
324 Petroleum and Coal Products	0	1	0%
Total (All Sectors)	415	426	97%

Table E-6 shows the final disposition outcomes for the Manufacturing Survey.

Table E-6. Final disposition outcomes for Manufacturing Survey

	Tier 1		Tier 2		Tier 3		Total	
Sample Released	298	100%	249	100%	8,620	100%	9,167	100%
Not Screened								
Left Message / No Answer / Busy / Not Available	9	3%	8	3%	764	9%	781	9%
Non-Working or Wrong Number	4	1%	2	1%	201	2%	207	2%
Hard Refusal		0%	1	<1%	12	<1%	13	<1%
Soft Refusal		0%	3	1%	95	1%	98	1%
Gatekeeper Refusal	2	1%	1	<1%	103	1%	106	1%
Unable to Direct to Right Contact	1	<1%	2	1%	12	<1%	15	<1%
Customer Service Number/Automated Number	3	1%		0%	33	<1%	36	<1%
Max Attempts to General Number	4	1%	2	1%	30	<1%	36	<1%
Max Attempts to Specific Contact		0%	3	1%	4	<1%	7	<1%
Ineligible								
Company does not have facilities at listed address	6	2%	7	3%	1,040	12%	1,053	11%
No Industrial/Manufacturing Facilities at address	43	14%	29	12%	2,579	30%	2,651	29%
Out of Business	6	2%	4	2%	602	7%	612	7%
Wrong Company		0%		0%	7	<1%	7	<1%
Duplicate (same facility)	13	4%	5	2%	18	<1%	36	<1%
Does No Manage /Pay for Energy for Site		0%		0%	34	<1%	34	<1%
Screened and Eligible								
Non-Key Cases Sent Mailing (Closed Sector)		0%		0%	1,596	19%	1,596	17%
Left Message / No Answer / Busy / Not Available	40	13%	32	13%	495	6%	567	6%
Non-Working Number		0%		0%	24	<1%	24	<1%
Hard Refusal		0%	2	1%	37	<1%	39	<1%
Soft Refusal	14	5%	11	4%	100	1%	125	1%
Gatekeeper Refusal	3	1%	4	2%	55	1%	62	1%
Unable to Direct to Right Contact	2	1%	6	2%	22	<1%	30	<1%
Customer Service Number/Automated Number		0%		0%	6	<1%	6	<1%
Max Attempts to General Number	1	<1%	5	2%	21	<1%	27	<1%
Max Attempts to Specific Contact	9	3%	28	11%	11	<1%	48	1%
Sent Link (No Promise to Complete)	11	4%	5	2%	257	3%	273	3%
Promised to Complete Online	12	4%	9	4%	37	<1%	58	1%
Partial Complete (In Progress or Dropped Off)	3	1%		0%	10	<1%	13	<1%
Completed Interview	112	38%	80	32%	415	5%	607	7%
Completed Online	94	32%	65	26%	368	4%	527	6%
Completed Over Phone	18	6%	15	6%	47	1%	80	1%
Eligibility Rate	75%		80%		42%		44%	
Response Rate	50%		40%		11%		15%	

In total, 71 facilities completed the Greenhouse Survey. Based on the survey completions and the sample eligibility rates, the response rate was 39%. The final number of completions met and exceeded the survey target of 68. Table E-7 shows the final disposition outcomes for the Greenhouse Survey.

Table E-7. Final disposition outcomes for Greenhouse Survey

	Total	
Sample Released	1,400	100%
Not Screened		
Left Message / No Answer / Busy / Not Available	145	10%
Non-Working Number	25	2%
Wrong Number	2	<1%
Hard Refusal	5	<1%
Soft Refusal	20	1%
Gatekeeper Refusal	12	1%
Unable to Direct to Right Contact	1	<1%
Max Attempts to General Number	18	1%
Max Attempts to Specific Contact	7	1%
Ineligible		
Company does not have location at listed address	6	<1%
Company does not grow/cultivate in greenhouses at address	369	26%
Greenhouses are hoop houses only	530	38%
Duplicate (Same Site)	4	<1%
Does No Manage /Pay for Energy for Site	2	<1%
Wrong Company	2	<1%
Out of Business	68	5%
Closed for the Season	33	2%
Screened and Eligible		
Left Message / No Answer / Busy / Not Available	25	2%
Hard Refusal	3	<1%
Soft Refusal	10	1%
Gatekeeper Refusal	4	<1%
Max Attempts to General Number	2	<1%
Max Attempts to Specific Contact	2	<1%
Sent Link (No Promise to Complete)	24	2%
Promised to Complete Online	7	1%
Partial Complete (In Progress or Dropped Off)	3	<1%
Completed Interview	71	5%
Completed Online	57	4%
Completed Over Phone	14	1%
Eligibility Rate	13%	
Response Rate	39%	

Coding facility manufacturing type. In the survey, respondents were asked to confirm which manufacturing type best describes the work done at the facility. The survey included key manufacturing types that were matched to NAICS codes. For facilities that did not fall within these key sectors, an “other-specify” option was available to type in a description. Study team staff reviewed all cases where the “other-specify” option was selected and coded responses to the available NAICS code categories or a general Miscellaneous category.

Verifying use of feedstocks and renewable fuels. The study team recontacted selected facilities to verify the use of feedstocks (material inputs to the manufacturing process) or renewable fuels based on the facility's sector and survey responses. In total, about 71% of cases targeted for this follow-up effort responded and provided clarification.

E.2 Site visits

The following outlines the study team's approach to customer recruitment and conducting the onsite surveys.

E.2.1 Customer recruitment

At the end of the web/phone survey described above, Tier 1 and Tier 2 manufacturing respondents were invited to participate in a virtual or in-person site visit, and Tier 3 manufacturing respondents and all greenhouses were invited to participate in a virtual site visit. Study team staff promptly contacted each respondent as surveys were completed. With this approach, the study team conducted the phone/web surveys and site visits in parallel, with a one- to two-week lead for the survey effort.

The study recruiter explained how participating in a site visit and the survey research benefited the facility, and why it was important for facilities to be represented in the aggregated survey results. They also offered a \$200 Tango gift card that could either be donated to a charity of their choice or provided as a gift card to the site directly (the latter was not initially offered, but was added partway through the research) and an inventory summary site report. This site report provided a simple summary of the inventory observed onsite.

Site recruitment for participation in the study was conducted by a dedicated internal team. The recruiters highlighted the professionalism and confidentiality with which the visit would be completed and provided a copy of the signed non-disclosure agreement on request. Initial recruitment determined if the site was suitable for a virtual visit and if the facility staff preferred that, or if the site required an onsite visit.

In total almost 18% of the facilities that completed the phone/web survey allowed us to visit their site and more than 100 site visits were completed, 34 of which consisted of virtual site visits. The final site visit completions and targets are presented in Table E-8.

Table E-8. Final industrial onsite survey targets and completions

NAICS	Subsector	Tier 1		Tier 2		Tier 3		Total	
		Target	Complete	Target	Complete	Target	Complete	Target	Complete
311	Food Manufacturing	2	2	1	1	2	1	5	4
322	Paper Manufacturing	9	10	3	3	1	1	13	14
324	Petroleum and Coal Pds	6	5	0	0	0	0	6	5
325	Chemical Manufacturing	4	3	1	1	2	2	7	6
327	Nonmetallic Minerals	1	1	0	0	6	6	7	7
331	Primary Metal Manufacturing	4	4	2	2	3	3	9	9
332	Fabricated Metals	1	1	0	0	3	6	4	7
334	Computer & Electronic Products	1	1	1	1	8	10	10	12
336	Transportation EQT	3	3	1	1	0	0	4	4
N/A	Other (non-Key)	2	2	4	6	29	33	35	41
Total		33	32	13	15	54	62	100	109

E.2.2 Conducting site visits

Data collection points were prioritized to ensure the data could be collected in the limitations of this study. These limitations were generally due to the availability of site staff to give the time needed to collect the full detailed information that was initially targeted.

Those initial targets included two people for one day per Tier 1 onsite, one person for one day per Tier 2 and Tier 3 onsites, and virtual visits that take no more than three hours for Tier 2 and two hours for Tier 3. In reality, engineering teams were generally able to get one to four hours at individual sites. With that time restriction, the data collection priority used was as shown in Table E-9.

Table E-9. Onsite data collection

Minimum Data Collected
Who the manufacturer is and what they are producing at the site
Energy consumption for all fuels at the site (annual)
Understanding at a high level of the process flow
Energy end use breakdown (12 categories – 7 process and 5 facility/non-process)
Some approximation of their production (what is the main product and an estimation of how much)
Clean energy goals/commitments
Next, we tried to get...
A more detailed breakdown of where their energy is going (focus on process)
As much equipment information as possible
Approximation for how efficient the facility is overall
If we had time, we asked about...
GHG tracking
Waste capture and recycling
DR participation
Planned improvements

The engineering team developed a data collection template used by field staff to ensure that all information was covered as completely as possible during the site visit. This template was developed in Excel but the data was then transferred into Qualtrics after the site visits. During the site visit recruitment, field staff attempted to identify and collect available documentation (including but not limited to) inventories, blueprints, and metering data to support the assessment. The onsite and virtual surveys included questions and observations on process and supply chain upgrades made in the prior three years. To the extent practical, before the site visit the survey form was prepopulated with information collected through the web survey and any other discussions with facility staff. Quality control and assessment of the data was performed in the office by senior technical staff.

E.2.3 Virtual visit approach

Site-based data collection was also conducted via virtual visit when an onsite visit was not possible or practical. The study team used a mobile device populated with the onsite data collection tool while the cooperating site representative did a walk-through with a remote auditor, providing pictures and close-ups of equipment on request. This approach used a remote/virtual inspection platform called Blitzz for all virtual site visits. This tool is a fully featured field service management software developed by Blitzz. It is a smart, mobile platform that quickly deploys a high-quality video powered service and collaboration application, without any technical development. It provides a secure, streamlined, and feature-rich solution for conducting virtual site visits. Blitzz records videos, captures photos, transcribes image text, and optimizes in-call notes, all can be saved on a secure Azure server for later use. The tool does not require any new application downloads on the facility staff member’s mobile device.

This approach avoided the need for facilities to provide physical access to a visitor, reduced time required by the facility representative who would otherwise be accompanying the auditor and eliminated travel time and costs. The study team primarily used this option with Tier 3 sites, but performed a few Tier 2 sites remotely as well.

In total, almost 18% of the facilities that completed the phone/web survey allowed us to visit their site and more than 100 site visits were completed, 34 of which consisted of virtual site visits. The final site visit completions and targets are presented in Table E-10.

Table E-10. Final industrial onsite survey targets and completions

Subsector	Tier 1		Tier 2		Tier 3		Total	
	Target	Complete	Target	Complete	Target	Complete	Target	Complete
311 Food Manufacturing	2	2	1	1	2	1	5	4
322 Paper Manufacturing	9	10	3	3	1	1	13	14
324 Petroleum and Coal Products	6	5	0	0	0	0	6	5
325 Chemical Manufacturing	4	3	1	1	2	2	7	6
327 Nonmetallic Minerals	1	1	0	0	6	6	7	7
331 Primary Metal Manufacturing	4	4	2	2	3	3	9	9
332 Fabricated Metals	1	1	0	0	3	6	4	7
334 Computer & Electronic Products	1	1	1	1	8	10	10	12
336 Transportation Equipment	3	3	1	1	0	0	4	4
Other (non-Key)	2	2	4	6	29	33	35	41
Total	33	32	13	15	54	62	100	109

E.3 Phase Two site data analysis

Upon completion of onsite or virtual visits, engineers completed the data entry for the information gathered for each site and conduct additional research on specific equipment needing further detail. This included entering all information collected into a Qualtrics database. Additional post-visit activities included:

- Looking up nameplate data for identified equipment to get capacity, efficiency, age
- Estimating efficiency of inventoried equipment and end uses
- Analyzing metered data or survey data (including from EMS systems) to get EFLH and process-related parameters
- Assessing manufacturing inputs to determine embodied energy content of inputs
- Assessing manufacturing outputs to determine total embodied energy content of manufactured products

- Scaling up results for sites that require a sampled approach. For example, if only a sample of the motor inventory on site could be collected, this needs to be scaled up to capture the total facility motor energy use.
- Estimating total facility energy usage and GHG emissions based on collected utility data and other energy usage
- Identifying de-carbonization opportunities for each end use
- Other analyses required to complete database questions for each facility

Appendix F Expenditure and emissions assumptions

Fuel prices for the expenditure analyses include those in the table below.

Table F-1. Industrial fuel prices for New York (Nominal \$/MMBtu)²³

Year	Coal	Distillate Fuel Oil	Natural Gas	Electricity	Residual Fuel Oil	Kerosene	Propane
2011	4.74	23.61	7.97	22.96	17.41	24.56	28.47
2012	4.73	24.89	6.7	19.62	18.36	25.67	21.95
2013	4.37	24.2	7.19	19.3	16.84	26.03	21.57
2014	4.24	22.79	7.87	19.28	14.75	24.64	22.99
2015	4.02	15.05	6.41	18.49	7.83	14.41	12.65
2016	3.6	11.28	5.74	17.67	6.1	11.28	11.71
2017	4.08	14.71	6.98	17.36	7.8	14.29	16.45
2018	4.48	17.33	7.58	17.64	10.26	17.92	18.02
2019	3.42	14.67	7.46	16.45	9.78	16.96	13.71
2020	3.67	10.47	6.77	16.25	7.72	12.53	12.47
2021	3.36	14.39	8.12	18.59	11.49	16.61	20.95

Other fuels included in the expenditure analysis but not in the table above include:

- Fuel oil, Kerosene, or Distillate: \$14.16 per MMBtu²⁴
- Purchased hot water or steam: \$7.51 per MMBtu²⁵
- By-product of Recycled energy: \$0 (assumes all comes from onsite activity)
- Renewable Fuels: \$0 for now (assumes all onsite)
- Diesel or motor gasoline: \$34.38 per MMBtu²⁶
- Hydrogen: \$13.05 per MMBtu²⁷

Emissions assumptions used for each fuel in this report are in the tables below. The first table has emissions for non-electric fuels while the second has prices for electricity according to facility location. These factors are based upon NYSERDA greenhouse gas emissions studies.²⁸

²³ U.S. Energy Information Administration (USEIA). 2023. State Energy Data System (SEDS) 1960-2021 (Complete): New York. June. Available online: <https://www.eia.gov/state/seds/seds-data-complete.php?sid=NY>.

²⁴ Average of these values in the Industrial Fuel Prices for New York (Nominal \$/MMBtu) table above.

²⁵ MECs Table 7.3 Prices of Purchased Electricity, Natural Gas, and Steam, 2018. Average Northeast steam prices. Available online: <https://www.eia.gov/consumption/manufacturing/data/2018/>

²⁶ AAA gas prices on September 19, 2023. Available online: <https://gasprices.aaa.com/?state=NY>

²⁷ MECs Table 7.2 Average Prices of Purchased Energy Sources, 2018. Available online: <https://www.eia.gov/consumption/manufacturing/data/2018/>

²⁸ <https://www.nyscrda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Greenhouse-Gas-Emissions#other>

Table F-2. New York State non-electric emissions factors

Fuel	Metric Tons / MMBtu			
	CO ₂	CH ₄	N ₂ O	Total CO _{2e}
Natural Gas	0.065000	0.000358	0.000000	0.095137
Renewable Natural Gas	0.052900	0.000001	0.000000	0.053017
Coal	0.098900	0.000375	0.000002	0.130844
Diesel or Distillate	0.089300	0.000124	0.000001	0.099952
Renewable Diesel	0.074100	0.000003	0.000001	0.074534
Kerosene	0.083300	0.000112	0.000001	0.092920
Liquified Petroleum Gas (LPG)	0.080200	0.000122	0.000000	0.090547
Petroleum Coke	0.114000	0.000115	0.000001	0.123880
Residual Fuel	0.086900	0.000114	0.000001	0.096694
Wood	0.093900	0.000032	0.000004	0.097677

Table F-3. New York State electric emissions factors

Electricity	Metric Tons / MWh			
	CO ₂	CH ₄	N ₂ O	Total CO _{2e}
Electricity – Statewide	0.171000	0.000945	0.000001	0.250697
Electricity – Upstate	0.040000	0.000222	0.000000	0.058723
Electricity – Downstate	0.382000	0.002110	0.000003	0.559950

Appendix G Manufacturing introductory letter and survey instrument



KATHY HOCHUL
Governor

RICHARD L. KAUFFMAN
Chair

DOREEN M. HARRIS
President and CEO

ATTN: <<RESPONDENT NAME>>
<<COMPANY NAME>>
<<ADDRESS>>
<<CITY>>, NY <<ZIP>>

Dear <<NAME>>:

The New York State Energy Research and Development Authority (NYSERDA) is conducting an important survey to better understand New York State’s manufacturing and industrial sectors. This study includes a survey to learn more about how energy is used at facilities in New York State where industrial or manufacturing work takes place.

Your company has been selected to complete a short survey based on the work done at your facility located in **(FacilityCity)**, NY. Your company’s participation is critical to ensure this survey includes representation from different types of facilities and businesses throughout New York State. The information collected from this study will be used to help develop state-wide programs and support for New York’s industrial sector.

This survey should be completed by someone who is familiar with the energy uses and types of industrial equipment used at the facility identified above. The survey takes approximately 15 to 20 minutes to complete. Please complete the survey by June 30, 2023. You can complete the survey online or by telephone:

- Option 1. Complete the survey online at: www.tinyurl.com/nyfacilitysurvey
To begin the survey, enter your unique Access Code: **[ACCESS CODE]**
- Option 2. To complete the survey over the telephone or schedule a time to do so, call 609-252-9009 and ask for Claire.

NYSERDA is sponsoring this research and has engaged DNV and APPRISE to conduct this survey. The information you provide will be kept confidential to the extent permitted by law including under the Freedom of Information Law (FOIL). The final report will use only aggregated, summary level data and will not identify specific industrial facilities or individuals.

Thank you in advance for your time and participation as we work to support New York’s industrial sector. If you have any questions about this survey, please email me.

Sincerely,

Marsha Walton, Ph.D.
Advisor, NYSERDA
P: 518-862-1090 x3271 | E: marsha.walton@nyserdera.ny.gov

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Introduction

Welcome to the New York Industrial Study survey!

This survey is being conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA) as part of a first ever important study of industrial and manufacturing facilities in New York State.

This survey should take about 20 to 30 minutes to complete depending on facility size. Your participation by completing the survey will help New York State better understand industrial energy use and energy efficiency opportunities for your facility and help to improve state-wide offerings, programs and support for the industrial sector.

The information you provide will be used only in aggregation with other responses for purposes of planning energy-related services, programs, and policy in New York state. Specific data uses may include

Tracking changes in equipment, practices, and decision-making in the industrial sector

Identifying strategies for engaging different types of industrial facilities and processes

Developing inputs for industrial sector energy, economic, and emissions modelling.

- Tracking progress and projecting the potential for progress toward New York State’s Climate Leadership and Community Protection Act (CLCPA) goals.

NYSERDA is sponsoring this research and has engaged DNV and APPRISE to conduct this survey. The information you provide will be kept confidential to the extent permitted by law including under the Freedom of Information Law (FOIL). The final report will use only aggregated, summary level data and will not identify specific industrial facilities or individuals.

If you start the survey and need to return later to finish it, you can do so by returning to this website. If you have any problems, please email Daniel-Bausch@appriseinc.org for assistance.

In filling out this web survey, please use the NEXT and BACK buttons until the survey is completed.

If you have questions about this effort or the validity of this survey, please contact Marsha Walton (marsha.walton@nyserda.ny.gov).

To begin the survey, click the arrow

- **OR**

To begin the survey, please enter the PIN code provided in your invitation letter, then click “NEXT”

Industry Specific End Use	Sector Applicability									
	Paper Manuf.	Chemical Manuf.	Food Manuf.	Primary Metal Manuf.	Petroleum and Coal Prod.	Computer & Electronic Prod. Manuf.	Fabricated Metal Product Manuf.	Nonmetallic Mineral Prod. Manuf.	Trans. Equip.	All Others
Air compressors	✓	✓	✓	✓			✓		✓	✓
Basic oxygen furnace				✓						
Blast furnace				✓						
Distillation		✓								
Drying			✓							
Electric arc furnace				✓						
Evaporators			✓							
Fans	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Feedstock		✓		✓	✓					
Grinders								✓		
Kilns								✓		
Mills								✓		
Onsite Transportation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Other major process equipment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Other process heating or direct gas process use	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Other Process motors and drives	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pasteurization and sterilization			✓							
Process boiler	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Process cooling		✓	✓			✓				✓
Process motors and drives	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Process pump/pumping	✓	✓	✓		✓	✓	✓		✓	✓
Refrigeration and process cooling	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Process Electrochemical	✓	✓	✓	✓	✓	✓		✓	✓	✓
Silicon wafer manufacturing						✓				
Sintering								✓		
Thermal Oxidizer					✓					
Welding							✓		✓	

1.2 Screening Questions

- S1. According to our records, your company has a manufacturing or industrial facility located at the address below.

[STREET]
[CITY], NY

Is this correct?

[SINGLE RESPONSE]

1	Yes	Go to S4
2	No – Our facility at this address does not have any industrial or manufacturing activity	Go to 0
3	No – Our company does not have a facility at this address	Go to 0

- S2. [IF 0=2 or 3] Does your company have an industrial or manufacturing facility in or near [CITY], New York? This could include a facility where at least some manufacturing or industrial activity takes place.

1. No
2. Yes

[TERMINATE IF S2=1]

- S3. [IF S2=2] Please enter the correct address of the nearby facility where manufacturing or industrial activity takes place.

A	Street address
b	City
c	Zip

[If S1=2 then <address> = <site address>, else <address> = S3]

- S4. [IF 0=1] Are you familiar with the energy use and manufacturing or production equipment used at the facility address you just confirmed?

[SINGLE RESPONSE]

1	Yes	Go to S7
2	No	Go to 0

- S5. [IF 0 is shown] Are you familiar with the energy use and manufacturing or production equipment used at the facility address you just entered?

1	Yes	Go to 0
2	No	Go to 0

S6. [IF 0=2 or 0=2, IN PAGE]

Please refer us to a person familiar with the general energy use and production equipment used at the facility? It is important that your facility be included in the survey results.

A	Name
b	Email
c	Phone number

T2: Thank you in advance for answering the following questions in this survey. Questions are designed to be answered by a facility employee familiar with the equipment used at your facility. We will reach out to the contact you suggested is knowledgeable about the facility's equipment.

[TERMINATE SURVEY]

SHOW ALL: For the remainder of the survey, **please answer all questions specifically about the facility you just confirmed (shown below)**, even if you have other similar facilities elsewhere in New York. Your best estimates are fine and we encourage you to answer as best you can.

Street Address

City, NY

S7. [ASK IF INDUSTRY_LISTED IS NOT "OTHER"]. Is <Industry listed> the correct general manufacturing type for this facility?

[SINGLE RESPONSE]

1	Yes	Go to 0
2	No	Go to 0

S8. [ASK IF S7 = No OR INDUSTRY_LISTED=OTHER] Which of the following general manufacturing types best describes this facility?

[SINGLE REPONSE]

1	Paper manufacturing	Go to 0
2	Chemical manufacturing	
3	Food manufacturing	
4	Primary metal manufacturing	
5	Petroleum and Coal Product manufacturing	
6	Computer & electronic product manufacturing	
7	Fabricated metal product manufacturing	
8	Nonmetallic mineral product manufacturing	
9	Transportation Equipment manufacturing	
10	Other, please specify:	

[If 0=1 then <Industry> = <Industry listed>, else <Industry> = S8]

S9. What is the approximate square footage of the facility? Your best estimate is fine.

1	OPEN ENDED NUMERIC BOX	Go to 0
-98	Don't know	Go to 0

S10. [IF 0=Don't know] What range best represents the square footage of the facility? Your best estimate is fine.

[DROP DOWN MENU, SINGLE RESPONSE]

1	Less than 20,000 square feet	Go to S10
2	20,000 to less than 40,000 square feet	
3	40,000 to less than 80,000 square feet	
4	80,000 to less than 150,000 square feet	
5	150,000 square feet or larger	
--- 98	Don't know	

S11. Approximately how many employees work at this facility currently? This number should include full and part time employees. Your best estimate is fine.

[SINGLE RESPONSE]

1	OPEN ENDED NUMERIC BOX	Go to 0
2	Don't know	Go to [0]

S12. [IF 0= 2] What range best represents how many employees work at the facility?

[SINGLE RESPONSE]

1	Less than 10	Go to E1
2	10 - 24	
3	25 - 49	
4	50 - 99	
5	100 - 249	
6	250 or more	
7	Don't know	

1.3 Facility Energy Consumption

1. The next questions ask about the electricity usage in the facility.

Overall, about how much total electricity (kWh) did the facility use or consume in the last 12 months? Your best estimate is fine.

Enter Amount (kWh): _____

Don't Know - Need Ranges

E1b. [IF 0=DON'T KNOW] What range best represents how much your facility spent on electricity in the last 12 months? Dollar amounts are provided to assist you.

1. Less than \$10,000
2. \$10,000 to less than \$50,000
3. \$50,000 to less than \$100,000
4. \$100,000 to less than \$500,000
5. \$500,000 to less than \$1 Million
6. About \$1 Million or more
7. Don't Know

E1c. From which of the following sources did your facility obtain electricity in the past 12 months? Please select all that apply.

1. The electric utility company (standard electricity provider)
2. Onsite generation, such as cogeneration or rooftop solar panels
3. Off-site generation owned by your company
4. Off-site generation provided by a 3rd party (not the electric utility company)
5. Don't Know

E1d. [SHOW IF MORE THAN 1 ITEM IN E1c is PICKED] Please report the estimated percent of electricity (kWh) the facility used during the last 12 months from the different sources you just reported. Your best estimate is fine. (The sum should add to 100%)

[SHOW ONLY RELEVANT ITEMS PICKED FROM E1c]

a.	Electricity purchased from electric utility	%
b.	Electricity generated onsite	%
c.	Electricity generated off-site by your company	%
d.	Electricity generated off-site by 3 rd parties	%
	Don't Know / Unknown	%
	TOTAL ELECTRICITY USE	[SUM OF A, B, C, D]%

Don't Know

E2. [ASK IF E1c = 2 ("Onsite generation")]

You indicated that some electricity was generated *onsite*. From which of the following sources did your facility obtain the onsite electricity in the past 12 months? Please select all that apply.

1. Combined heat and power / Cogeneration
2. Solar
3. Wind
4. Hydropower
5. Geothermal
6. Other
7. Don't Know

E2b. [SHOW IF MORE THAN 1 ITEM IN E2 IS PICKED] Please report the estimated percent of the total onsite electricity the facility used during the last 12 months from each type of onsite generation you reported. Your best estimate is fine. (The sum should add to 100%)

[SHOW ONLY RELEVANT ITEMS PICKED FROM E2]

a	Combined heat and power/Cogeneration	%
b	Solar	
c	Wind	
d	Hydropower	
e	Geothermal	
f	Other	
g	Don't Know / Unknown	
	TOTAL [SUM TO EQUAL 100]	

Don't Know

E3. [ASK IF E1c=3 or 4]

You indicated that some electricity was generated *off-site* by your company or a third-party other than your utility company. From which of the following sources did your facility obtain the offsite electricity in the past 12 months? Please select all that apply.

1. Combined heat and power / Cogeneration
2. Solar
3. Wind
4. Hydropower
5. Geothermal
6. Other
7. Don't Know

E3b. [SHOW IF MORE THAN 1 ITEM IN E3 IS PICKED] Please estimate the percent of the total off-site electricity the facility used during the last 12 months

from each type of off-site generation you reported. Your best estimate is fine.
 (The sum should add to 100%)

[SHOW ONLY RELEVANT ITEMS PICKED FROM E3]

a	Combined heat and power/Cogeneration	%
b	Solar	
c	Wind	
d	Hydropower	
e	Geothermal	
f	Other	
g	Don't Know / Unknown	
	TOTAL [SUM TO EQUAL 100]	

Don't Know

E4. Please select all of the following technologies that were utilized by the facility in the last 12 months.

a	Photovoltaic panels
b	Wind turbines
c	Energy storage
d	Electric charging stations
e	None of the above

E5. [ASK IF E1d option b>0%]

Please estimate the amount or percent of electricity (kWh) sold or transferred out of this facility in the last 12 months (e.g., electricity generated, but not used by the facility). You can provide a kilowatt hour amount, a dollar amount, or a percent.

Enter Amount (kWh)

Enter Amount (\$)

Enter Percent

Don't Know

E6. The next questions ask about the different ways electricity may have been used in the facility.

First, please estimate the percent of *total* electricity (kWh) that this facility used for in the last 12 months for each of the following purposes. Your best estimate is fine. (The sum should add to 100 percent.)

		Percent
a	Boilers or generators (such as gas turbines, boilers, or combustion turbines used for energy transformation)	___%
b	Manufacturing or industrial production processes	___%
c	Basic facility operations (such as lighting and HVAC)	___%
d	Don't Know / Unknown	___%
	TOTAL	100%

Don't Know

E6b. [IF E6 option B >0%] You indicated that some electricity was used for manufacturing or industrial production processes. Which of the following production processes in your facility used electricity in the past 12 months? Please select all that apply.

1. Process heating (e.g., kilns, furnaces, ovens, strip heaters)
2. Process cooling and refrigeration
3. Machine drive (e.g., motors, pumps, etc. associated with manufacturing process equipment)
4. Electrochemical processes (e.g., reduction process)
6. Other manufacturing or production process (please describe)
7. Don't know

E6c. [IF E6 option C >0%] You indicated that some electricity was used for basic facility operations (such as lighting and HVAC). For which of the following basic uses was electricity used in your facility in the past 12 months? Please select all that apply.

1. Facility heating, ventilation, air conditioning (HVAC)
2. Facility lighting
3. Basic facility equipment or appliances (cooking appliances, water heating, office equipment)
4. Onsite transportation, excluding highway use
5. Other basic facility use (please describe)
6. Don't know

E7. Has this facility used any of the following energy sources, fuels, or feedstocks in the past 12 months? Please select all that apply.

1. Natural Gas
2. Fuel oil, Kerosene, or Distillate
3. Propane or liquid gases (butane, ethane, LPG or NGL, acetylene, Naphtha, etc.)
4. Purchased industrial hot water or purchased steam
5. By-product or recycled energy (waste products, blast furnace gas, pulping liquor, byproduct steam or hot water)
6. Renewable fuels (biomass, biofuel, wood from trees)
7. Coal-based products (coal, coke, breeze, etc.)
8. Diesel or Motor gasoline (excluding off-site highway use)
9. Hydrogen
10. Don't Know

E8. [IF MORE THAN 3 PICKED IN E7] Please rank the top three fuels or feedstocks you picked that were used the most in the last 12 months.

[SHOW ONLY THOSE PICKED]

1. Natural Gas
2. Fuel oil, Kerosene, or Distillate
3. Propane or liquid gases (butane, ethane, LPG or NGL, acetylene, Naphtha, etc.)
4. Purchased industrial hot water or purchased steam
5. By-product or recycled energy (waste products, blast furnace gas, pulping liquor, byproduct steam or hot water)
6. Renewable fuels (biomass, biofuel, wood from trees)
7. Coal-based products (coal, coke, breeze, etc.)
8. Diesel or Motor gasoline (excluding off-site highway use)
9. Hydrogen

E9. Has this facility used any additional fuels or fuel stock not included in the previous question?

1	Yes, please specify:
2	No

3	Don't Know
---	------------

E10. [If site uses hydrogen] What is the hydrogen type consumed at the facility – gray, blue, green? (Gray hydrogen is conventionally produced from natural gas or other hydrocarbons; blue hydrogen is conventionally produced hydrogen paired with carbon capture and storage; green hydrogen is produced from electrolysis using renewable electricity.)

1. Gray hydrogen
2. Blue hydrogen
3. Green hydrogen

NON ELECTRIC ENERGY LOOP START

[REPEAT LOOP FOR EACH FUEL AFFIRMED IN 0 OR E8 TOP 3 RESPONSES.
 LOOP ONLY ASKED FOR TOP 3]

The next questions ask about the [FUEL] used in the facility.

E11. In general, what unit do you use to measure the amount of <fuel> used or purchased?

1. Therms
2. Decatherms
3. Mcf
4. CCf
5. MMBtu
6. Tons
7. Short tons
8. Pounds
9. Barrels
10. Gallons
11. Other (please describe)
12. Don't know

E12. [ASK IF E11 ANSWERED (not don't know or skipped)] How much <fuel> in <E11 response> would you say was purchased during the last 12 months for the facility? Your best estimate is fine.

[OPEN ENDED NUMERIC BOX WITH DON'T KNOW]

E12b. [IF 01 OR E12=DON'T KNOW OR SKIPPED] What range best represents how much your facility spent on [fuel] in the last 12 months? Dollar amounts are provided to assist you.

1. Less than \$10,000
2. \$10,000 to less than \$50,000
3. \$50,000 to less than \$100,000
4. \$100,000 to less than \$500,000
5. \$500,000 to less than \$1 Million
6. About \$1 Million or more
7. Don't Know

E13a. Please report the estimated percent of *total* <fuel> that this facility used in the last 12 months for the following purposes. Your best estimate is fine. (The sum should add to 100 percent.)

		Percent
a	Percent used for boilers or generators (such as gas turbines, boilers, or combustion turbines used for energy transformation)	___%
b	Percent used for manufacturing or industrial production processes	___%
c	Percent used for basic facility operations (such as lighting and HVAC)	___%
c	Don't Know / Unknown	___%
	TOTAL	100%

d. Don't Know

E13b. [IF E13a option A >0%] Thinking about the <fuel> used for boilers or generators, what percentage of the total boiler output serves loads in the temperature ranges indicated in the following table:

		Percent of load served by boiler(s) by temperature:
a.	Low Temp : <140C / 280F	
b.	Med Temp : 140C/280F < 300C/570F	
c.	High Temp : Above 300C/300C/570F	
d.	Don't Know / Unknown	
		Adds to 100%

Don't Know

E14. [IF E13a option B >0%] Thinking about the <fuel> used for non-boiler processes, what percentage of the total non-boiler heat output serves loads in the temperature ranges indicated in following table:

		Percent of process load served by non-boiler(s) by temperature:
a.	Low Temp : <140C / 280F	
b.	Med Temp : 140C/280F < 300C/570F	
c.	High Temp : Above 300C/300C/570F	
d.	Don't Know / Unknown	
		Adds to 100%

Don't know

E11b. [IF E13a option B >0%] For which of the following production uses was <fuel> used for in your facility in the past 12 months? Please select all that apply.

1. Process heating (e.g., kilns, furnaces, ovens, strip heaters, dryers)
2. Process cooling and refrigeration
3. Machine drive (e.g., motors, pumps, etc. associated with manufacturing process equipment)
4. Electrochemical processes (e.g., reduction process)
6. Other manufacturing or production process (please describe)
7. Don't Know

E11c. [IF E13a option C >0%] For which of the following basic uses was <fuel> used for in your facility in the past 12 months? Please select all that apply.

1. Facility heating, ventilation, air conditioning (HVAC)
2. Facility lighting
3. Basic facility equipment or appliances (cooking appliances, water heating, office equipment)
4. Onsite transportation, excluding highway use
5. Other basic facility use (please describe)
6. Don't Know

NON-ELECTRIC ENERGY LOOP END

[REPEAT LOOP FOR EACH INDUSTRY INDICATED IN THE DATA, OR AFFIRMED IN 0]

E15. Which types of equipment or processes are used in the facility for [TYPE], if any? Please select all that apply.

[INCLUDE DON'T KNOW]

[Programming instructions: For each Manufacturing Type listed in the Table 44, use the matching Manufacturing Type ID to show only the Equipment Type relevant, as identified in

Table 44

Manufacturing Type	Manufacturing Type ID
Paper Manufacturing	A
Chemical Manufacturing	B
Food Manufacturing	C
Primary Metal Manufacturing	D
Petroleum and Coal Products	E
Computer & Electronic Product Manufacturing	F
Fabricated Metal Product Manufacturing	G
Non-metallic Mineral Product Manufacturing	H
Transportation	I
Other	J

[FORE15. PIPE IN INDUSTRY SPECIFIC EQUIPMENT OUTLINED IN PROGRAMMING INSTRUCTIONS]
Table 45

Type ID	Use	Equipment Type	A	B	C	D	E	F	G	H	I	J	
1	Process Heating	Basic oxygen furnace				X						X	
2		Blast furnace				X							
3		Carburizing furnace						X	X		X	X	
4		Casting				X						X	
5		Distillation		X	X								X
6		Electric arc furnace				X							X
7		Drying and curing		X	X	X				X	X		X
8		Evaporators											X
9		Hot rolling					X						X
10		Dry kiln									X		X
11		Wet kiln									X		
12		Kraft pulping		X									
13		Other process heating		X	X	X	X	X			X	X	X
14		Pasteurization and sterilization				X							X
15		Process boiler		X	X	X	X	X			X		X
16		Welding								X		X	X
17		Thermal Oxidizer						X					
18	Process Cooling and Refrigeration	Process cooling (above 40F)		X	X			X				X	
19		Refrigeration		X	X							X	
20	Machine Drive	Air compressors	X	X	X	X			X		X	X	
21		Process Fans							X		X	X	
22		Process pumping	X		X			X	X	X	X	X	X
23		Material handling (e.g., conveyers, belts, materials movers)	X	X	X	X		X	X	X	X	X	X
24		Mechanical pulping	X										
25		Ball Mill									X		
26		Roller Mill									X		
27		Tube Mill									X		
28		Impact Mill									X		
29		Other materials processing (e.g., grinding, agitating/ mixing, debarking, drilling, pressing)	X	X	X	X		X	X	X	X	X	X
30		Other process motors											X
31	Electro-Chem Processes	Semiconductor manufacturing						X				X	
32		Other Electro-Chemical Processes		X		X						X	
33	Other Process Use	Separators										X	
34		Computer Assembly						X					
35		Silicon Wafer Manufacturing						X					
36	Other major end uses	Please specify:	X	X	X	X	X	X	X	X	X	X	

E16. [IF E15 has no selected choices OR E15 = Don't Know] Please describe any other types of manufacturing or industrial processes that occur in your facility but were not mentioned previously. Please indicate the types of equipment used for these processes.

E17. [IF E15 has no selected choices OR E15 = Don't Know] You indicated the following types of process equipment were used in the facility. Please indicate if any equipment listed below has received an energy efficiency upgrade in the past three years, and how efficient you think the equipment you have (whether it has received upgrades or not) is compared to the most efficient equipment available. “

	Has this equipment received energy efficiency upgrades in the past 3 years?	How efficient is your equipment?
{0 /ChoiceGroup/SelectedChoices}	Yes / No / Don't Know	Low / Moderate / High / DK
{0 /ChoiceGroup/SelectedChoices}		
{0 /ChoiceGroup/SelectedChoices}		

1.4 GHG and Energy Management

GE1. Has the facility completed a Greenhouse Gas (GHG) inventory? A GHG Inventory is a list of emission sources and the associated emissions produced as part of the production process.

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE2. [ASK IF GE1=1 to 4] Has the facility completed a Scope 3 Greenhouse Gas (GH) inventory?

Scope 3 GHG emissions are from sources not owned or directly controlled by the facility, often called “value chain emissions.” These include emissions associated with waste disposal, transportation of purchased fuels, and employee commuting.

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

[IF 0=1-4]

GE3. Has the facility implemented a strategy for reducing Scope 3 emissions?

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE4. Has the facility established an energy consumption baseline?

An energy consumption baseline is an analysis of your facility's energy usage and types of energy consumption, and it is used to measure potential impacts from changes in production or equipment that may impact energy usage.

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE5. [IF 0=1-3] Does your facility update and track your energy use compared to this baseline on a recurring schedule?

1	Yes, please specify:
2	No

[TEXT] The next questions pertain to your facility's energy management practices; they focus on energy management practices and opportunities for improvements in these practices.

[MATRIX, WITH OPTIONS YES, NO, DON'T KNOW, CHECKBOX IN EACH CELL]

Does your facility have any of the following?

GE6. A written energy policy that includes guiding principles for energy management?

GE7. "Defined energy performance goals?"

GE8. "One staff person with formal responsibility for energy performance (not a team)?"

GE9. A team with formal responsibility for energy performance (not one person)?

GE10. [IF GE7=YES] Do you have a written plan for how to achieve those energy performance goals?

[SINGLE RESPONSE]

1	Yes	
2	No	
-98	Don't know	

GE11. [IF GE8 =NO and GE9=NO] Does your company have plans to identify an energy manager?

[SINGLE RESPONSE]

1	Yes	
2	No	
-98	Don't know	

GE12. [IFGE9=YES] Does the team with responsibility for energy performance have a designated leader with primary responsibility for energy management?

[SINGLE RESPONSE]

1	Yes	
2	No	
-98	Don't know	

GE13. [IF GE8 or GE12=YES] Is this individual responsible for energy management a company employee or an outside consultant or contractor?

[SINGLE RESPONSE]

1	Employee	
2	Consultant or contractor, please specify firm: [TEXT BOX]	
-98	Don't know	

[IF GE6=YES ASK GE15-16]

GE16. Has the facility established an energy map to identify the top energy drivers and end uses in the facility?

An energy map is a breakdown of industrial processes from preparation of raw materials to the final product distribution, and all the energy end uses, such as lighting or hot water, required to produce the final product.

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE18. Has the facility calculated the proportion of materials used in manufacturing that contain recycled content?

GE20. Has the facility completed any process upgrades?

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE22. For each of the following, please indicate where maintenance is scheduled.

Check the box for the statement that best represents the maintenance schedule of the following options.

	Regular maintenance is scheduled for specific times	No regular maintenance is scheduled (maintenance occurs as needed)	Don't know	Not Applicable
Facility buildings				
Production equipment				
Production processes				

1.5 Barriers (S)

B1. Check the box for the statement that best represents your awareness and usage of the following finance options.

Financing type	Aware/have used	Aware/would consider using	Aware/won't use	Not aware/have not used
Self—funding				
Commercial lending (loans)				
On-bill financing				
Energy-as-a-Service (EaaS)				
Utility Incentives				
State Incentives				
Other				

B2. You indicated you were aware of, but will not use the following finance options, please indicate why:

[DRILL DOWN FINANCE TYPE IF AWARE/WON'T USE SELECTED in 0, OPEN-ENDED RESPONSE]

ONSITE VISIT REQUEST

ON-1. [TEXT] As part of this study, NYSERDA is conducting virtual or onsite visits to learn more about equipment used in facilities like yours. This site visit would include completing an equipment inventory that will be provided to each facility, and NYSERDA is also offering a \$200 gift card or charitable donation.

Are you the best person to contact with information about this research?

1	Yes
2	No

ON-2. [IF ON-1= Yes] Please confirm your name, title, and contact information.

A	Name	
B	Title	
C	Email	
D	Phone number	

ON-3. [IF ON-1 = No] Please provide contact information for the individual we should send the information to about this additional research? If you do not know, click "Next" below to continue.

A	Name	
B	Title	
C	Email	
D	Phone number	

1.6 Billing and Onsite Consent

CONSENT1. As part of this study, NYSERDA is also requesting your energy and utility data. This data will be used to understand the energy usage of industrial facilities across New York State, and the analysis will not identify individual companies or facilities.

NYSERDA is requesting that you upload recent bills for each fuel type used at the facility in the last 12 months. If possible, please upload all bills from the last 12 months.:

1	I have bills to upload	Go to BILLUPLOAD1
2	I am not the best person to fulfil this request	Go to CONSENT2
3	I do not have bills to upload at this time	Go to CONSENT3

BILLUPLOAD1 Please upload recent bills for fuel types used at the facility. If you do not have files, click "Next" to continue.

[Include method to upload files]

BILLUPLOAD2 Do you have more files to upload?

1	Yes	Go back to BILLUPLOAD1
2	No	Go to end of the survey

CONSENT2. [IF CONSENT1=2] Please provide contact information for the individual we should send this request to.

a	Name	
b	Title	
c	Email	
d	Phone number	

CONSENT3. [IF CONSENT1=2] Are you the individual authorized to provide consent for the utility accounts belonging to <address>?: [PIPE IN ADDRESS]

1	Yes	Go to 0
2	No	Go to 1

CONSENT4. [CONSENT3=2] Please provide the contact information for the person authorized to provide consent for the facility's utility accounts.

a	First, Last name	
b	Email Address	
c	Phone Number	

[TEXT: Thank you. We will reach out to the email address you provided to reach the person able to provide consent for the utility accounts at <address>] [Go to end of the survey]

CONSENT5. [IF CONSENT3=1] NYSERDA requests permission to access historic utility data for the accounts associated with the address provided. By selecting "I consent" below, I authorize the New York State Energy Research and Development Authority (NYSERDA), and its designated representatives DNV and APPRISE, to access energy billing and consumption data for the site identified. As an authorized representative of the site, I authorize NYSERDA, and its designated representatives, to access and use any available energy consumption information and data. I understand that NYSERDA is subject to the NYS Freedom of Information Law, Public Officers law, Article 6, and that NYSERDA cannot guarantee confidentiality of any information submitted.

1	I consent	Go to 0
2	I do not consent	Go to end of survey

CONSENT6. [IF 0=1] Who is your electric utility company?

1	Central Hudson Gas and Electric Company	0
2	Consolidated Edison Company of New York (ConEd)	0
3	National Grid	0
4	New York State Electric and Gas Company (NYSEG)	0
5	Orange & Rockland Utilities	0
6	Rochester Gas and Electric Corporation (RG&E)	0
7	New York Power Authority (NYPA)	CONSENT10
8	Other, please specify:	0
9	None/Don't Know	0

CONSENT7. [IF 0=8, 9] What is your electric account number? Please do not include spaces or dashes.

1. Enter Account Number: _____
2. Don't Know / Not Available

CONSENT8. [IF 0=3, 5] What is your \${CONSENT6} electric account number? Please note, \${CONSENT6} account numbers are 10 digits. [Verify the number entered is 10 digits.]

1. Enter Account Number: _____
2. Don't Know / Not Available

CONSENT9. [IF 0=1, 4, 6] What is your \${CONSENT6} electric account number? Please note, \${CONSENT6} account numbers are 11 digits. [Verify the number entered is 11 digits.]

1. Enter Account Number: _____
2. Don't Know / Not Available

CONSENT10. [IF 0=2, 7] What is your \${CONSENT10 } electric account number? Please note, \${CONSENT10 } account numbers are 15 digits. [Verify the number entered is 15 digits.]

1. Enter Account Number: _____
2. Don't Know / Not Available

CONSENT11. [IF 0=4,6] What is your \${CONSENT6} POD number? Please do not include spaces or dashes. Your POD number should be located on your utility bill and will be a 10 digit number. [Verify the number entered is 10 digits.]

1. Enter POD Number: _____
2. Don't Know / Not Available

CONSENT12. [IF 0=1] What is your \${CONSENT6} POD number? Please do not include spaces or dashes. Your POD number should be located on your utility bill and will be a letter followed by a 14 digit number. [Verify the number entered is 14 digits.]

1. Enter POD Number: _____
2. Don't Know / Not Available

CONSENT13a. Is gas used at this facility?

1	Yes	Go to CONSENT13b
2	No	Go to the end of the survey

CONSENT13b. [IF CONSENT13a = 1] Who is your natural gas utility company?

1	Central Hudson Gas and Electric Company	0
2	Consolidated Edison Company of New York (ConEd)	0
3	National Grid	0
4	New York State Electric and Gas Company (NYSEG)	0
5	Orange & Rockland Utilities	0
6	Rochester Gas and Electric Corporation (RG&E)	0
7	New York Power Authority (NYPA)	0
8	Other, please specify:	0
9	None/Don't Know	0

CONSENT14. [IF 0= 8, 9] What is your gas account number? This could be the same as your electric utility account number if you have the same provider. Please do not include spaces or dashes.

1. Enter Account Number: _____
2. Don't Know / Not Available

CONSENT15. [IF 0=3,5] What is your gas account number for \${CONSENT13}? This could be the same as your electric utility account number if you have the same provider. Please note, \${CONSENT13} account numbers are 10 digits. Do not include spaces or dashes.

1. Enter Account Number: _____
2. Don't Know / Not Available

CONSENT16. [IF 0=1,4,6] What is your gas account number for \${CONSENT13}? This could be the same as your electric utility account number if you have the same provider. Please note, \${CONSENT13} account numbers are 11 digits. Do not include spaces or dashes.

1. Enter Account Number: _____
2. Don't Know / Not Available

CONSENT17. [IF 0=2,7] What is your gas account number for \${CONSENT13}? This could be the same as your electric utility account number if you have the same provider. Please note, \${CONSENT13} account numbers are 15 digits. Do not include spaces or dashes.

1. Enter Account Number: _____
2. Don't Know / Not Available

CONSENT18. [IF 0=1] What is your POD number for \${CONSENT13}? Your POD number should be located on your \${CONSENT13} utility bill and will be a letter followed by a 14 digit number. Do not include spaces or dashes.

1. Enter POD Number: _____
2. Don't Know / Not Available

CONSENT19. [IF 0=4,6] What is your POD number for \${CONSENT13}? Your POD number should be located on your \${CONSENT13} utility bill and will be a letter followed by a 14 digit number. Do not include spaces or dashes.

1. Enter POD Number: _____
2. Don't Know / Not Available

CONSENT20. CONF. [IF ON-1= No] Finally, for verification purposes, please confirm your name, title, and contact information.

A	Name	
B	Title	
C	Email	
D	Phone number	

This concludes our survey. Thank you for your participation.

Appendix H Greenhouse survey instrument

Memo to: Marsha Walton, NYSERDA

From: Chris Zimbelman, DNV, Tom Ledyard, DNV, Kyle Bonus, DNV

Date: June 13, 2023

NYSERDA Industrial Stock Study Web Survey

Programming Instructions

Additional notes found within survey instrument.

Survey variable's coded within survey:

Survey Variable	Source
<Company>	Tracking
<Site address>	Tracking
<Address>	S1a
<Industry listed>	Tracking
<Industry>	Tracking
<fuel>	0

Survey Instrument

1.1 Introduction

Welcome to the NYSERDA Greenhouse Facility survey!

This survey is being conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA) as part of a first ever important study of industrial, manufacturing and greenhouse facilities in New York State.

This survey should take about 20 minutes to complete. Your participation by completing the survey will help New York State better understand greenhouses' energy use and energy efficiency opportunities and help to improve state-wide offerings, programs and support.

The information you provide will be used only in aggregation with other responses for purposes of planning energy-related services, programs, and policymaking in New York state. The data collected will help establish a baseline understanding of New York greenhouse operations and energy use and help

- Track changes in equipment, practices, and decision-making in the industrial sector over time

- Identify strategies for engaging different types of industrial facilities and processes
- Develop inputs for industrial sector energy, economic, and emissions modelling.
- Track progress and projecting the potential for progress toward New York State’s Climate Leadership and Community Protection Act (CLCPA) goals.

NYSERDA is sponsoring this research and has engaged DNV and APPRISE to conduct this survey. The information you provide will be kept confidential to the extent permitted by law including under the Freedom of Information Law (FOIL). The final report will use only aggregated, summary level data and will not identify specific greenhouse facilities or individuals.

If you start the survey and need to return later to finish it, you can do so by returning to this website. If you have any problems, please email Daniel-Bausch@appriseinc.org for assistance.

In filling out this web survey, please use the NEXT and BACK buttons until the survey is completed.

If you have questions about this study or the validity of this survey, please contact Marsha Walton (marsha.walton@nyserda.ny.gov).

To begin the survey, click the arrow

- OR

To begin the survey, please enter the PIN code provided in your invitation letter, then click “NEXT”

Industry Specific End Use	Greenhouses
Air compressors	✓
Fans	✓
Motors and drives	✓
Boiler	✓
Other space heating	✓
Humidification	✓
Cooling	✓
Pumps/pumping	✓
Refrigeration	✓

1.2 Screening Questions

S1. According to our records, your company has a location at the address below that includes one or more greenhouse facilities.

[STREET]
[CITY], NY

Is this correct?

[SINGLE RESPONSE]

1	Yes	Go to S3a
2	No – Our location at this address does not have any greenhouse facilities	Go to 0
3	No – Our company does not have a location at this address	Go to 0

S2. [IF 0=2 or 3] Does your company have a location with one or more greenhouses in or near [CITY], New York? This could include a greenhouse and an associated facility where there are other nongrowing activities being performed such as processing, packing, selling, etc.

1. No
2. Yes

[TERMINATE IF S2=1]

S3. [IF S2=2] Please enter the correct address of the nearby location with one or more greenhouse facilities.

A	Street address
b	City
c	Zip

[If S1=2 then <address> = <site address>, else <address> = S3]

GR. Which of the following best describes the greenhouse(s) at this location?

1. All hoop houses or structures without vertical walls (e.g., low technology)
2. Fixed building(s) with some automation and environmental control (e.g., medium technology)
3. Fixed buildings with a large amount of automation and advanced environmental control (e.g., high technology)

[TERMINATE IF GR=1]

S3a. Which of the following best describes your company's operations at the location you just confirmed?

1	The location is primarily focused on growing plants or vegetables in one or more greenhouses.	Go to S4
2	The location has greenhouses, but is focused primarily on other activities besides growing plants or vegetables in greenhouses (such as farming, animal production, processing or manufacturing products for market, etc.)	Go to 0

S4 . [IF 0=1] Are you familiar with the energy use and equipment used at the location you just confirmed?

[SINGLE RESPONSE]

1	Yes	Go to S7
2	No	Go to 0

S5. [IF 0 is shown] Are you familiar with the energy use and equipment used at the address you just entered?

1	Yes	Go to 0
2	No	Go to 0

S6. [IF 0=2 or 0=2, IN PAGE]

Please refer us to a person familiar with the general energy use and equipment used at the location. It is important that your site be included in the survey results.

A	Name
b	Email
c	Phone number

[TERMINATE SURVEY]

SHOW ALL: For the remainder of the survey, please answer all questions specifically about the location you just confirmed (shown below), even if you have other similar facilities elsewhere in New York. Your best estimates are fine, and we encourage you to answer as best you can.

Street Address

City, NY

S9. What is the approximate square footage of your facilities at this location? Please include square footage for all buildings, greenhouses, etc. Your best estimate is fine.

1	OPEN ENDED NUMERIC BOX	Go to 10a
-98	Don't know	Go to 0

S10. [IF 0=Don't know] What range best represents the square footage of your facilities at this location? Please include square footage for all buildings, greenhouses, etc.? Your best estimate is fine.

[DROP DOWN MENU, SINGLE RESPONSE]

1	Less than 20,000 square feet	Go to S10a
2	20,000 to less than 40,000 square feet	
3	40,000 to less than 80,000 square feet	
4	80,000 to less than 150,000 square feet	
5	150,000 square feet or larger	
--- 98	Don't know	

S10a. What is the approximate square footage of the greenhouse facilities only (e.g. the area for cultivation under glass)?

1	OPEN ENDED NUMERIC BOX	
-98	Don't know	

S10b. How many separate greenhouse structures are at this location?

1	OPEN ENDED NUMERIC BOX	Go to S11
2	Don't know	Go to [01]

S11. Approximately how many employees work at this location currently? This number should include full- and part-time employees. Your best estimate is fine.

[SINGLE RESPONSE]

1	OPEN ENDED NUMERIC BOX	Go to 0
2	Don't know	Go to [0]

S12. [IF 0= 2] What

range best represents how many employees work at the location?

[SINGLE RESPONSE]

1	Less than 10	Go to S13
2	10 - 24	
3	25 - 49	
4	50 - 99	
5	100 - 249	
6	250 or more	
7	Don't know	

S13. What types of plants are grown in the greenhouses?

[SINGLE RESPONSE]

1	OPEN ENDED TEXT BOX	Go to 0
2	Don't know	Go to [E1]

1.3 Facility Energy Consumption

E1. The next questions ask about the electricity usage in the location.

Overall, about how much total electricity (kWh) did the total location use or consume in the last 12 months? Your best estimate is fine.

Enter Amount (kWh): _____
 Don't Know

E1b. [IF 0=DON'T KNOW] What range best represents how much your location spent on electricity in the last 12 months? Dollar amounts are provided to assist you.

1. Less than \$10,000
2. \$10,000 to less than \$50,000
3. \$50,000 to less than \$100,000
4. \$100,000 to less than \$500,000
5. \$500,000 to less than \$1 Million
6. About \$1 Million or more
7. Don't Know

E1c. From which of the following sources did your location obtain electricity in the past 12 months? Please select all that apply.

1. The electric utility company (standard electricity provider)
2. Onsite generation, such as cogeneration or rooftop solar panels
3. Off-site generation owned by your company
4. Off-site generation provided by a 3rd party (not the electric utility company)
5. Don't Know

E1d. [SHOW IF MORE THAN 1 ITEM IN E1c is PICKED] Please report the estimated percent of electricity (kWh) the location used during the last 12 months from the different sources you just reported. Your best estimate is fine. (The sum should add to 100%)

[SHOW ONLY RELEVANT ITEMS PICKED FROM E1c]

a.	Electricity purchased from electric utility	%
b.	Electricity generated onsite	%
c.	Electricity generated off-site by your company	%
d.	Electricity generated off-site by 3 rd parties	%
	Don't Know / Unknown	%
	TOTAL ELECTRICITY USE	[SUM OF A, B, C, D]%

Don't Know

E2. [ASK IF E1c = 2 ("Onsite generation")]

You indicated that some electricity was generated *onsite*. From which of the following sources did your location obtain the onsite electricity in the past 12 months? Please select all that apply.

1. Combined heat and power / Cogeneration
2. Solar
3. Wind
4. Hydropower

- 5. Geothermal
- 6. Other
- 7. Don't Know

E2b. [SHOW IF MORE THAN 1 ITEM IN E2 is PICKED] Of the location's total electricity generated *onsite* AND consumed *onsite* during the last 12 months, please estimate the percentage provided by each source. Your best estimate is fine. (The sum should add to 100%)

[SHOW ONLY RELEVANT ITEMS PICKED FROM E2]

a	Combined heat and power/Cogeneration	%
b	Solar	
c	Wind	
d	Hydropower	
e	Geothermal	
f	Other	
g	Don't Know / Unknown	
	TOTAL [SUM TO EQUAL 100]	

Don't Know

E3. [ASK IF E1c=3 or 4] You reported that some electricity was generated *off-site* by your company or a third-party other than your utility company. From which of the following sources did your location obtain *off-site* electricity in the past 12 months? Please select all that apply.

- 1. Combined heat and power / Cogeneration
- 2. Solar
- 3. Wind
- 4. Hydropower
- 5. Geothermal
- 6. Other
- 7. Don't Know

E3b. [SHOW IF MORE THAN 1 ITEM IN E3 is PICKED] Of the total *off-site* electricity the location used during the last 12 months, please provide the percentage share obtained from each source. Your best estimate is fine. (The sum should add to 100%)

[SHOW ONLY RELEVANT ITEMS PICKED FROM E3]

a	Combined heat and power/Cogeneration	%
b	Solar	
c	Wind	
d	Hydropower	
e	Geothermal	
f	Other	
g	Don't Know / Unknown	
	TOTAL [SUM TO EQUAL 100]	

Don't Know

E4. Please select all of the following technologies used by the location in the last 12 months.

a	Photovoltaic panels
b	Wind turbines
c	Energy storage
d	Electric charging stations
e	None of the above

E5. [ASK IF E1d option b>0%]

Please estimate the amount or percent of electricity (kWh) sold by or transferred out of this location in the last 12 months (e.g., electricity generated, but not used by the location). You can provide a kilowatt hour amount, a dollar amount, or a percent.

Enter Amount (kWh)

Enter Amount (\$)

Enter Percent

Don't Know

E6. The next questions ask about the different ways electricity is used in the location.

First, please estimate the percent of *total* electricity (kWh) that this location used for in the last 12 months for each of the following purposes. Your best estimate is fine. (The sum should add to 100 percent.)

		Percent
a	Boilers or generators (such as gas turbines, boilers, or combustion turbines used for energy transformation)	___%
b	Greenhouse lighting	___%
c	Other greenhouse processes (used for greenhouse plant production such as heating, ventilation, refrigeration, dehumidification, and irrigation)	___%
D	Non-Greenhouse agricultural uses (outdoor farming, animal production, etc.)	
e	Basic location operations (such as lighting and HVAC for non-production spaces, such as offices)	___%
f	Other	___%
	Don't Know / Unknown	___%
	TOTAL	100%

Don't Know

E6a. What percent of the *total* electricity (kWh) used at this location in the last 12 months was used **directly by the greenhouse or greenhouses at this site**, rather than for other facilities or other activities at the location?

Enter Percent

Don't Know

E7. Has this location used any of the following energy sources, fuels, or feedstocks in the past 12 months? Please select all that apply.

1. Natural Gas
2. Fuel oil, Kerosene, or Distillate
3. Propane or liquid gases (butane, ethane, LPG or NGL, acetylene, Naphtha, etc.)
4. Purchased industrial hot water or purchased steam
5. By-product or recycled energy (waste products, blast furnace gas, pulping liquor, byproduct steam or hot water)
6. Renewable fuels (biomass, biofuel, wood from trees)
7. Coal-based products (coal, coke, breeze, etc.)
8. Diesel or Motor gasoline (excluding off-site highway use)
9. Hydrogen
10. Purchased liquid CO2
11. Don't Know

E8. [IF MORE THAN 3 PICKED IN E7] Please rank the top three fuels or feedstocks you picked that made up the majority of this location's energy spending in the last 12 months.

[SHOW ONLY THOSE PICKED]

1. Natural Gas
2. Fuel oil, Kerosene, or Distillate
3. Propane or liquid gases (butane, ethane, LPG or NGL, acetylene, Naphtha, etc.)
4. Purchased industrial hot water or purchased steam
5. By-product or recycled energy (waste products, blast furnace gas, pulping liquor, byproduct steam or hot water)
6. Renewable fuels (biomass, biofuel, wood from trees)
7. Coal-based products (coal, coke, breeze, etc.)
8. Diesel or Motor gasoline (excluding off-site highway use)
9. Hydrogen
10. Purchased liquid CO2

E9. Has this location used any additional fuels or fuel stock not included in the previous question?

1	Yes, please specify:
2	No
3	Don't Know

E10. [If site uses hydrogen] What is the hydrogen type consumed at the location – gray, blue, green? (Gray hydrogen is conventionally produced from natural gas or other hydrocarbons; blue hydrogen is conventionally produced hydrogen paired with carbon capture and storage; green hydrogen is produced from electrolysis using renewable electricity.)

1. Gray hydrogen
2. Blue hydrogen
3. Green hydrogen

NON ELECTRIC ENERGY LOOP START

[REPEAT LOOP FOR EACH FUEL AFFIRMED IN 0 OR E8 TOP 3 RESPONSES.

LOOP ONLY ASKED FOR TOP 3]

The next questions ask about the [FUEL] used in the location.

E11. In general, what unit do you use to measure the amount of <fuel> used or purchased?

1. Therms
2. Decatherms
3. Mcf
4. CCf
5. MMBtu
6. Tons
7. Short tons
8. Pounds
9. Barrels
10. Gallons
11. Other (please describe)
12. Don't know

E12. [ASK IF E11 ANSWERED (not don't know or skipped)] How much <fuel> in <E11 response> would you say was purchased during the last 12 months for the location? Your best estimate is fine.

[OPEN ENDED NUMERIC BOX WITH DON'T KNOW]

E12b. [IF 01 OR E12=DON'T KNOW OR SKIPPED] What range best represents how much your location spent on [fuel] in the last 12 months? Dollar amounts are provided to assist you.

1. Less than \$10,000
2. \$10,000 to less than \$50,000
3. \$50,000 to less than \$100,000
4. \$100,000 to less than \$500,000
5. \$500,000 to less than \$1 Million
6. About \$1 Million or more
7. Don't Know

E13a. Please report the estimated percent of *total* <fuel> that this location used in the last 12 months for the following purposes. Your best estimate is fine. (The sum should add to 100 percent.)

		Percent
a	Boilers or generators (such as gas turbines, boilers, or combustion turbines used for energy transformation)	___%
b	Greenhouse lighting	___%
c	Other greenhouse processes (used for greenhouse plant production such as heating, ventilation, refrigeration, dehumidification, and irrigation)	___%
D	Non-Greenhouse agricultural uses (outdoor farming, animal production, etc.)	
e	Basic location operations (such as lighting and HVAC for non-production spaces, such as offices)	___%
f	Other	___%
	Don't Know / Unknown	___%
	TOTAL	100%

d. Don't Know

E13b. What percent of the *total* <fuel> used at this location in the last 12 months was used **directly by the greenhouse or greenhouses at this site**, rather than for other facilities or other activities at the location?

Enter Percent

Don't Know

NON-ELECTRIC ENERGY LOOP END

[REPEAT LOOP FOR EACH INDUSTRY INDICATED IN THE DATA, OR AFFIRMED IN 0]

E15. Which types of equipment or processes are used in the greenhouse(s), if any? Please select all that apply.

[INCLUDE DON'T KNOW]

[Programming instructions: For each Manufacturing Type listed in the Table 44, use the matching Manufacturing Type ID to show only the Equipment Type relevant, as identified in the table below.

Table 46

Manufacturing Type	Manufacturing Type ID
Greenhouses	K

[FORE15. PIPE IN INDUSTRY SPECIFIC EQUIPMENT OUTLINED IN PROGRAMMING INSTRUCTIONS]

Table 47

Type ID	Use	Equipment Type	K
1	Process heating and cooling	Drying and curing	X
2		Other process heating	X
3		Process boiler	X
4		Process cooling (above 40F)	X
5		Refrigeration	X
6		Humidification	X
7	Motors	Air compressors	X
8		Fans	X
9		Pumping	X
10		Other motors	X
11	Other major end uses	Please specify:	X

E16. [IF E15 has no selected choices OR E15 = Don't Know] Please describe any other types of processes that occur in the greenhouse(s) but were not mentioned previously. Please indicate the types of equipment used for these processes.

E17. [IF E15 has no selected choices OR E15 = Don't Know] You indicated the following types of process equipment were used in your greenhouse(s). Please indicate if any equipment listed below has received an energy efficiency upgrade in the past three years, and how efficient (whether it has received upgrades or not) you think the equipment you have is compared to the most efficient equipment available. “

	Has this equipment received energy efficiency upgrades in the past 3 years?	How efficient is your equipment?
#{0 /ChoiceGroup/SelectedChoices}	Yes / No / Don't Know	Low / Moderate / High / DK
#{0 /ChoiceGroup/SelectedChoices}		
#{0 /ChoiceGroup/SelectedChoices}		

1.4 GHG and Energy Management

The next questions ask about energy tracking and management practices.

GE1. Has this location completed a Greenhouse Gas (GHG) inventory? A GHG Inventory is a list of emission sources and the associated emissions produced as part of the production process.

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE2. [ASK IF GE1=1 to 4] Has the location completed a Scope 3 Greenhouse Gas (GH) inventory?

Scope 3 GHG emissions are from sources not owned or directly controlled by the location, often called “value chain emissions.” These include emissions associated with the production and transportation of inputs obtain from third parties, waste disposal, transportation of purchased fuels, and employee commuting.

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

[IF 0=1-4]

GE3. Has the location implemented a strategy for reducing Scope 3 emissions?

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE4. Has the location established an energy consumption baseline?

An energy consumption baseline is an analysis of your location’s energy usage and types of energy consumption, and it is used to measure potential impacts from changes in production or equipment that may impact energy usage.

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE5. [IF 0=1-3] Does your location update and track your energy use compared to this baseline on a recurring schedule?

1	Yes, please specify:
2	No

[TEXT] The next questions pertain to your location’s energy management practices; they focus on energy management practices and opportunities for improvements in these practices.

[MATRIX, WITH OPTIONS YES, NO, DON’T KNOW, CHECKBOX IN EACH CELL]

Does your location have any of the following?

- GE6. A written energy policy that includes guiding principles for energy management?
- GE7. “Defined energy performance goals?”
- GE8. “One staff person with formal responsibility for energy performance (not a team)?”
- GE9. A team with formal responsibility for energy performance (not one person)?
- GE10. [IF GE7=YES] Do you have a written plan for how to achieve those energy performance goals?

[SINGLE RESPONSE]

1	Yes	
2	No	
-98	Don’t know	

GE11. [IF GE8 =NO and GE9=NO] Does your company have plans to identify an energy manager?

[SINGLE RESPONSE]

1	Yes	
2	No	
-98	Don’t know	

GE12. [IFGE9=YES] Does the team with responsibility for energy performance have a designated leader with primary responsibility for energy management?

[SINGLE RESPONSE]

1	Yes	
2	No	
-98	Don’t know	

GE13. [IF GE8 or GE12=YES] Is this individual responsible for energy management a company employee or an outside consultant or contractor?

[SINGLE RESPONSE]

1	Employee	
2	Consultant or contractor, please specify firm: [TEXT BOX]	
-98	Don't know	

[IF GE6=YES ASK GE15-16]

GE16. Has this location established an energy map to identify the top energy drivers and end uses in the location?

An energy map is a breakdown of industrial processes from preparation of raw materials to the final product distribution, and all the energy end uses, such as lighting or hot water, required to produce the final product.

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE18. Has the location calculated the proportion of materials used in manufacturing that contain recycled content?

GE20. Has the location completed any equipment upgrades?

1	Yes – Completed in the last three years
2	Yes – More than three years ago
3	Yes – Completed (don't know when)
4	Yes – In process now
5	No – Planning to within the next three years
6	No – No plans in place
-98	I don't know

GE22. For each of the following, please indicate where maintenance is scheduled.

Check the box for the statement that best represents the maintenance schedule of the following options.

	Regular maintenance is scheduled for specific times	No regular maintenance is scheduled (maintenance occurs as needed)	Don't know	Not Applicable
Greenhouse Buildings				
Production equipment				
Production processes				

1.5 Barriers (S)

B1. Check the box for the statement that best represents your awareness and usage of the following finance options.

Financing type	Aware/have used	Aware/would consider using	Aware/won't use	Not aware/have not used
Self-funding				
Commercial lending (loans)				
On-bill financing				
Energy-as-a-Service (EaaS)				
Utility Incentives				
State Incentives				

B2. You indicated you were aware of, but will not use the following finance options, please indicate why:

[DRILL DOWN FINANCE TYPE IF AWARE/WON'T USE SELECTED in 0, OPEN-ENDED RESPONSE]

SITE VISIT REQUEST

ON-1. [TEXT] As part of this study, NYSERDA is conducting virtual site visits to learn more about equipment used in greenhouse facilities like yours. NYSERDA's contractor will complete an equipment inventory for your location (that will be provided to your location). For completed site visits, NYSERDA will provide a \$200 gift card or charitable donation.

Are you the best person to contact with information about this site visit?

1	Yes
2	No

ON-2. [IF ON-1= Yes] Please confirm your name, title, and contact information.

A	Name	
B	Title	
C	Email	
D	Phone number	

ON-3. [IF ON-1 = No] Please provide contact information for the individual we should send the information about this site visit? If you do not know, click “Next” below to continue.

A	Name	
B	Title	
C	Email	
D	Phone number	

1.6 Billing and Onsite Consent

CONSENT1. As part of this study, NYSERDA is also requesting your energy and utility data. This data will be used to understand the energy usage of industrial facilities across New York State, and the analysis will not identify individual companies or facilities.

NYSERDA is requesting that you upload recent bills for each fuel type used at the location in the last 12 months. If possible, please upload all bills from the last 12 months.

1	I have bills to upload	Go to BILLUPLOAD1
2	I am not the best person to fulfil this request	Go to CONSENT2
3	I do not have bills to upload at this time	Go to CONSENT3

BILLUPLOAD1 Please upload recent bills for fuel types used at the location. If you do not have files, click "Next" to continue.

[Include method to upload files]

BILLUPLOAD2 Do you have more files to upload?

1	Yes	Go back to BILLUPLOAD1
2	No	Go to end of the survey

CONSENT2. [IF CONSENT1=2] Please provide contact information for the individual we should send this request to.

a	Name	
b	Title	
c	Email	
d	Phone number	

CONSENT3. [IF CONSENT1=2] Are you the individual authorized to provide consent for the utility accounts belonging to <address>?: [PIPE IN ADDRESS]

1	Yes	Go to 0
2	No	Go to 1

CONSENT4. [CONSENT3=2] Please provide the contact information for the person authorized to provide consent for the location’s utility accounts.

a	First, Last name	
b	Email Address	
c	Phone Number	

[TEXT: Thank you. We will use the email address you provided to reach the person able to provide consent for this location’s utility accounts at <address>] [Go to end of the survey]

CONSENT5. [IF CONSENT3=1] NYSERDA requests permission to access historic utility data for the accounts associated with the address provided. By selecting "I consent" below, I authorize the New York State Energy Research and Development Authority (NYSERDA), and its designated representatives DNV and APPRISE, to access energy billing and consumption data for the site identified. As an authorized representative of the site, I authorize NYSERDA, and its designated representatives, to access and use any available energy consumption information and data. I understand that NYSERDA is subject to the NYS Freedom of Information Law, Public Officers law, Article 6, and that NYSERDA cannot guarantee confidentiality of any information submitted.

1	I consent	Go to 0
2	I do not consent	Go to end of survey

CONSENT6. [IF 0=1] Who is your electric utility company?

1	Central Hudson Gas and Electric Company	0
2	Consolidated Edison Company of New York (ConEd)	0
3	National Grid	0
4	New York State Electric and Gas Company (NYSEG)	0
5	Orange & Rockland Utilities	0
6	Rochester Gas and Electric Corporation (RG&E)	0
7	New York Power Authority (NYPA)	CONSENT10
8	Other, please specify:	0
9	None/Don't Know	0

CONSENT7. [IF 0=8, 9] What is your electric account number? Please do not include spaces or dashes.

- 3. Enter Account Number: _____
- 4. Don't Know / Not Available

CONSENT8. [IF 0=3, 5] What is your \${CONSENT6} electric account number? Please note, \${CONSENT6} account numbers are 10 digits. [Verify the number entered is 10 digits.]

- 3. Enter Account Number: _____
- 4. Don't Know / Not Available

CONSENT9. [IF 0=1, 4, 6] What is your \${CONSENT6} electric account number? Please note, \${CONSENT6} account numbers are 11 digits. [Verify the number entered is 11 digits.]

- 3. Enter Account Number: _____
- 4. Don't Know / Not Available

CONSENT10. [IF 0=2, 7] What is your \${CONSENT10} electric account number? Please note, \${CONSENT10} account numbers are 15 digits. [Verify the number entered is 15 digits.]

- 3. Enter Account Number: _____
- 4. Don't Know / Not Available

CONSENT11. [IF 0=4,6] What is your \${CONSENT6} POD number? Please do not include spaces or dashes. Your POD number should be located on your utility bill and will be a 10 digit number. [Verify the number entered is 10 digits.]

- 3. Enter POD Number: _____
- 4. Don't Know / Not Available

CONSENT12. [IF 0=1] What is your \${CONSENT6} POD number? Please do not include spaces or dashes. Your POD number should be located on your utility bill and will be a letter followed by a 14 digit number. [Verify the number entered is 14 digits.]

- 3. Enter POD Number: _____
- 4. Don't Know / Not Available

CONSENT13a. Is gas used at this location?

1	Yes	Go to CONSENT13b
2	No	Go to the end of the survey

CONSENT13b. [IF CONSENT13a = 1] Who is your natural gas utility company?

1	Central Hudson Gas and Electric Company	0
2	Consolidated Edison Company of New York (ConEd)	0
3	National Grid	0
4	New York State Electric and Gas Company (NYSEG)	0
5	Orange & Rockland Utilities	0
6	Rochester Gas and Electric Corporation (RG&E)	0
7	New York Power Authority (NYPA)	0
8	Other, please specify:	0
9	None/Don't Know	0

CONSENT14. [IF 0= 8, 9] What is your gas account number? This could be the same as your electric utility account number if you have the same provider. Please do not include spaces or dashes.

- 3. Enter Account Number: _____
- 4. Don't Know / Not Available

CONSENT15. [IF 0=3,5] What is your gas account number for \${CONSENT13}? This could be the same as your electric utility account number if you have the same provider. Please note, \${CONSENT13} account numbers are 10 digits. Do not include spaces or dashes.

- 3. Enter Account Number: _____

4. Don't Know / Not Available

CONSENT16. [IF 0=1,4,6] What is your gas account number for \${CONSENT13}? This could be the same as your electric utility account number if you have the same provider. Please note, \${CONSENT13} account numbers are 11 digits. Do not include spaces or dashes.

- 3. Enter Account Number: _____
- 4. Don't Know / Not Available

CONSENT17. [IF 0=2,7] What is your gas account number for \${CONSENT13}? This could be the same as your electric utility account number if you have the same provider. Please note, \${CONSENT13} account numbers are 15 digits. Do not include spaces or dashes.

- 3. Enter Account Number: _____
- 4. Don't Know / Not Available

CONSENT18. [IF 0=1] What is your POD number for \${CONSENT13}? Your POD number should be located on your \${CONSENT13} utility bill and will be a letter followed by a 14 digit number. Do not include spaces or dashes.

- 3. Enter POD Number: _____
- 4. Don't Know / Not Available

CONSENT19. [IF 0=4,6] What is your POD number for \${CONSENT13}? Your POD number should be located on your \${CONSENT13} utility bill and will be a letter followed by a 14 digit number. Do not include spaces or dashes.

- 3. Enter POD Number: _____
- 4. Don't Know / Not Available

CONSENT20. CONF. [IF ON-1= No] Finally, for verification purposes, please confirm your name, title, and contact information.

A	Name	
B	Title	
C	Email	
D	Phone number	

This concludes our survey. Thank you for your participation.