

Energy Use in Manufacturing: 1994 to 1998¹

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Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

Manufacturing Indicators (Annualized Growth Rate Between 1994 and 1998)			
Industrial Production Index (1992 = 100)		Producer Price Index (1992 = 100)	
Manufacturing	+5.5	Materials	
Durables	+8.9	Intermediate	+0.9
Nondurables	+1.5	Crude	-1.3
<hr/>			
Real Gross Domestic Product (Chained 1996 Dollars)		Output per hour (All Persons) Productivity Index (1996 = 100)	
Manufacturing	+4.7	Manufacturing	+4.2
Durables	+8.0	Output per Unit of Capital Productivity Index (1996 = 100)	
Nondurables	+0.3		
<hr/>			
Employment Cost Index, Private Industry (1989=100)		Manufacturing	+0.3
<hr/>			
Total Compensation	+2.7	Wages and Salaries	+3.2

Sources: Industrial Production: Federal Reserve Board Statistical Release G-17. Online; Real Gross Domestic Product: U.S. Dept. of Commerce, Bureau of Economic Analysis. Online; Producer Price Index, Employment Cost Index, Output per Hour and per Unit of Capital Indices: U.S. Bureau of Labor Statistics Online.

Note: The Standard Industrial Classification (SIC) system has been replaced by the North American Industry Classification System (NAICS). Since the Bureau of the Census has collected the information necessary to classify establishments on both an NAICS and an SIC basis, the same 1998 data can be shown on both the old and the new basis in bridge tables that allow comparisons between the two systems. These data are hereby produced for the last time on an SIC basis for 1998 at the national level only.

Overview

In 1998, economic growth in the United States continued on its expansion path. Between 1994 and 1998, real Gross Domestic Product (GDP) for manufacturing grew at an annualized rate of 4.7 percent. Producer prices for intermediate materials used in manufacturing showed very little growth while producer prices for crude materials actually declined as the real price (chained 1992 dollars) of crude oil was 23 percent less in 1998 than in 1994. Labor costs also showed little growth—2.7 percent annually (employment cost index) while labor productivity grew by 4.2 percent (output per hour (all persons)). Between 1994 and 1998, capital productivity experienced little gain—less than 1 percent annually so the manufacturing growth seems to have been driven by the increase in labor productivity and a decrease in the cost of material inputs.

Most of the growth in the manufacturing sector was in the production of durables such as primary metals, vehicles, computers, and machinery of all types. Production of durable goods, as measured by the industrial production index, rose at an annualized rate of 8.7 percent while nondurables such as food, clothing, and paper products increased by only an annualized rate of 1.5 percent.

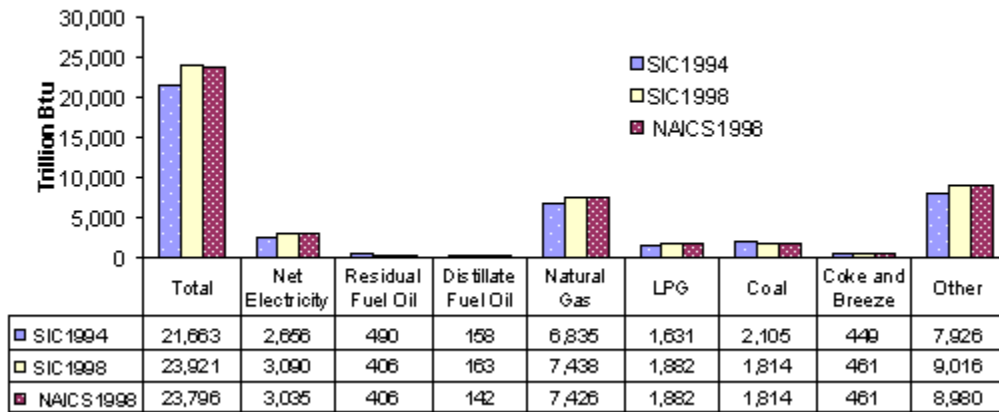
Interestingly, between 1994 and 1998, energy use did not keep up with production. Whether one uses the measure “First Use of Energy,” which includes feedstocks, or the measure “Fuel Consumption,” energy use grew annually 2.3 and 1.8 percent, respectively. In the past, arguments were heard that energy was such a small percentage of costs that manufacturers were not as concerned about the energy costs as they were about their other material inputs. One could argue that U.S. manufacturing became more energy efficient as manufacturers, reluctant to raise prices, looked everywhere to cut costs—even energy. As seen in the 1998 MECS, between 1994 and 1998 many manufacturers did replace equipment with energy-efficient replacements, and they also participated in Federal Government programs such as the Industries of the Future and the Motor and Steam Challenges sponsored by the U.S. Department of Energy.

Also during this time, there was a continuation of a structural change in manufacturing—from energy-intensive manufacturing to less energy intensive. While the nominal dollar value of durable goods, as measured by value of shipments, experienced twice the growth as nondurable goods—growth in the value of the mix within the durable goods sector favored less energy-intensive goods. As an example, between 1994 and 1998, the less energy-intensive computer and electronic products industry and the information technologies industries grew at a faster rate than did the more energy-intensive primary industries. (U.S. Census Bureau Annual Survey of Manufactures).

¹This analysis shows a comparison between the 1994 and 1998 (current) Manufacturing Energy Consumption Surveys.

First Use of Energy: Manufacturers Used 9.8 Percent More Energy in 1998 than in 1994

First Use of Energy for All Purposes, 1994 and 1998



Notes: The sum of all listed energy sources will not add to Total because Shipments sent to other establishments have already been subtracted from the Total; all of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

See [graph notes and data sources on next page](#).

- 14 % more net electricity was used in 1998 than in 1994.
- Use of fossil fuels such as residual fuel oil and coal declined between 1994 and 1998.
- Food, paper, chemical, petroleum, and primary metals industries continue to use most of the manufacturing energy--using 83% in 1998.
- Chemical and petroleum industries used approximately one half of the natural gas used in this sector.

First-Use Graph Notes and Data Sources

(a) **Total** is the sum of all of the listed energy sources, including **Other**, minus the shipments of energy sources produced onsite. It is the total amount of first use of energy for all (fuel and nonfuel) purposes.

(b) **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 that already has been included as generating fuel (for example, coal).

(c) **Distillate Fuel Oil** includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.

(d) **Natural Gas** includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any subsidiaries of utilities.

(e) Examples of **Liquefied Petroleum Gases** are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).

(f) **Other** includes net steam (the sum of purchases, generation from renewables, and net transfers), and other energy that respondents indicated was used to produce heat and power or as feedstock/raw material inputs.

(g) **Shipments of Energy Sources Produced Onsite** are those shipments produced or transformed onsite from the nonfuel use of other energy sources. For example, at an establishment that processes coal to make coke for later use, the entire quantity of coal is counted as first use. Any onsite consumption of coke is not counted as first use because it would duplicate the coal use. If some of the coke is then sold to another establishment, then that second establishment will consider this coke to be a shipment of an offsite-produced energy source. Hence, the second establishment will count this coke as its first use, thereby resulting in double counting. In order to eliminate the double counting, the energy equivalent of the coke shipment must be subtracted from first use.

(h) For the petroleum refining industry only, the feedstocks and raw material inputs for the production of nonenergy products (i.e., asphalt, waxes, lubricants, and solvents) and feedstock consumption at adjoining petrochemical plants are included in the **Other** column, regardless of type of energy. The remaining columns for the petroleum refining industry include only energy that was consumed for the production of heat and power. The **Other** column also includes net steam and other energy that respondents indicated was used in the production of heat and power. Those inputs and feedstocks that were converted to other energy products (e.g., crude oil converted to residual and distillate fuel oils) are excluded.

Notes: Totals may not equal sum of components because of independent rounding. The derived estimates presented in this graph are for the first use (formerly primary consumption) of energy for heat and power and as feedstocks or raw material inputs. **First use** is defined as the consumption of the energy that was originally produced offsite or was produced onsite from input materials not classified as energy. Examples of the latter are hydrogen produced from the electrolysis of brine, woodchips, bark, and woodwaste from wood purchased as a raw material input; and waste materials, such as wastepaper. **First use** excludes quantities of energy that are produced from other energy inputs and, therefore, avoids double counting.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys,' and Office of Oil and Gas, Petroleum Supply Division, Form EIA-810, 'Monthly Refinery Report' for 1994 and 1998.

Feedstock Energy: Coal Use Falls by 26 Percent as All Sources are 9 Percent Higher in 1998 than in 1994

Nonfuel (Feedstock) Use of Combustible Energy, 1994 and 1998 (Trillion Btu)														
	All Industries		Petroleum and Coal Products			Chemicals			Primary Metals			Other Industries		
	1994	1998	1994	1998		1994	1998		1994	1998		1994	1998	
			SIC	SIC	NAICS	SIC	SIC	NAICS	SIC	SIC	NAICS	SIC	SIC	NAICS
All Energy Sources	6,617	7,340	3,168	W	3,748	2,463	2,773	2,772	955	W	758	131		62
Other	3,505	4,048	3,167	3,730	3,730	162	222	221	62	53	54	114	43	43
LPG and NGL	1,532	1,746	W	*	*	1,531	1,745	1,745	W	*	*			
Natural Gas	683	782	W		Q	674	726	726	9	45	44			
Coal	907	671	0	W	12	37	16	16	870	W	642	0		1
Distillate/Residual Fuel Oil, Coke and Breeze	80	93	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

W = Withheld
 Q = Withheld because RSE greater than 50%
 N/A = Not Applicable
 * = Estimate less than 0.50
 Shaded Area = Not Calculated

Notes: Feedstock comparisons between SIC and NAICS show only small differences for most of the major energy-using industries. However comparisons are not necessarily perfect; all of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

See table notes and data sources on next page.

- Coal use as a feedstock falls as the electric arc process for the production of raw steel climbs 24 percent higher in 1998 than in 1994 and the basic oxygen process falls by 2 percent.*
- Over 50 percent of the feedstock is the "other" energy-source category--mainly crude oil used by the petroleum industry in the manufacturing of nonenergy products (i.e., asphalts, waxes, lubricants, and solvents) and some petrochemicals.
- "Other Industries" including food, wood, and paper are less comparable--however, as a group, their share of all feedstock energy is less than 2 percent.

* Annual Statistical Report, American Iron and Steel Institute

Feedstock Table Notes and Data Sources

(a) **Distillate Fuel Oil** includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.

(b) **Natural Gas** includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any marketing subsidiaries of utilities.

(c) Examples of **Liquefied Petroleum Gases** (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).

(d) Other includes energy that respondents indicated was used as feedstock/raw material inputs.

(d) For the petroleum refining industry only (NAICS 324110), the feedstocks and raw material inputs for the production of nonenergy products (i.e., asphalt, waxes, lubricants, and solvents) and feedstock consumption at adjoining petrochemical plants are included in the 'Other' column, regardless of type of energy. Those inputs and feedstocks that were converted to other energy products (e.g., crude oil converted to residual and distillate fuel oils) are excluded.

Notes: The derived estimates presented in this table are for the first use (formerly primary consumption) of energy as feedstocks or raw material inputs.

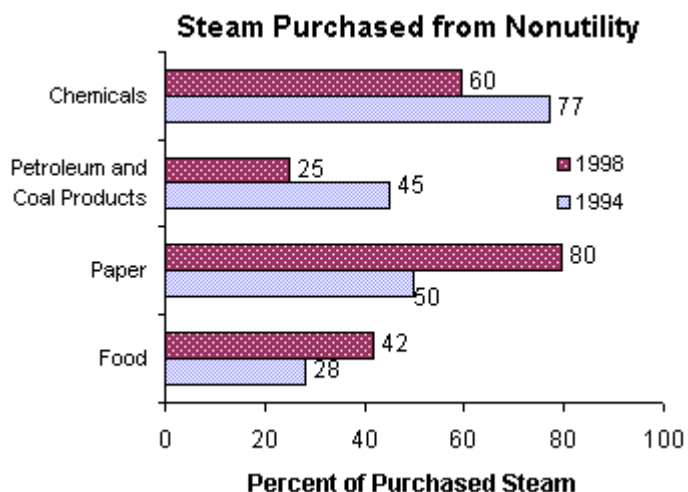
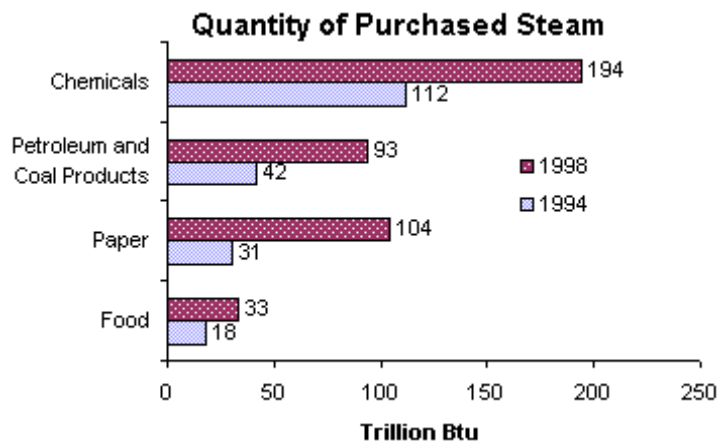
Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1998 Manufacturing Energy Consumption Survey,' and Office of Oil and Gas, Petroleum Supply Division, Form EIA-810, 'Monthly Refinery Report' for 1998.

First Use "Other" Energy Sources: Purchased Steam/Hot Water Use Soars and Biomass Use is 20 Percent Lower in 1998 Compared to 1994

Total First Use of Energy for All Purposes by Selected Other Sources, (trillion Btu)			
Energy Sources	1994	1998	Percent Change 1994 and 1998
All Other Energy Sources	7,926	8,980	13.3
Biomass Total	951	761	-20.0
Agricultural Waste	109	47	-56.9
Wood Harvested Directly from Trees	251	58	-76.9
Wood Residues and Byproducts from Mill Processing	540	639	18.3
Wood-Related and Paper-Related Refuse	51	17	-66.7
Net Steam/Hot Water	248	687	177.0

Notes: Comparisons between SIC and NAICS show only small differences for most of the major energy-using industries. However, comparisons are not necessarily perfect; although the Food Industry is shown on the graphs, a number of beverage establishments were switched to another NAICS category, thus affecting the results of the comparisons; all of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

Table and graph notes and data sources on next page.



- Affects of no growth in onsite electricity generation by manufacturers can be seen in the growth of purchased steam and reduced use of biomass. Outsourced onsite generation of electricity and steam--a growing trend-- is considered "purchased."
- As manufacturing onsite generation fell, steam purchases doubled from 243 billion Btu in 1994 and 490 billion Btu in 1998--MECS does not collect steam generated onsite.
- As the amount of purchased steam grew, the share purchased from all nonutilities did not grow, 60 percent in 1994 and 57 percent in 1998. The food and paper industries did purchase more nonutility steam--possibly from the outsourced site generator. The reader needs to remember that the 1994 data are not matched perfectly with the 1998 because of the reclassification from the SIC to the NAICS.

- Most agricultural wastes are used by the food industry--specifically by sugar cane mills. Assuming that most of the wastes are used for onsite electricity generation--mostly cogeneration, in 1998, sugar cane mills used significantly less agricultural wastes to generate electricity than in 1994.
- Cogeneration in the food industry was 32 percent lower in 1998 than in 1994--however, some of this decline may be to the reclassification of malt beverages out of the food industry.
- Some of the drop in the energy source "wood harvested from trees and the wood-related refuse" could be due to the affects of the logging industry's absence from the wood industry classification under NAICS. The logging industry is a user of this energy source.
- In 1994, the paper industry used 150 trillion Btu of "wood harvested from trees"--only 24 trillion Btu in 1998. Even though this was a significant drop, the 5 percent reduction in onsite generation was not found to be significant (NS). See Onsite Electricity Generation.

First Use "Other": Graph Notes and Data Sources

Other includes net steam (the sum of purchases, generation from renewables, and net transfers), and other energy that respondents indicated was used to produce heat and power or as feedstock/raw material inputs.

The Standard Industrial Classification (SIC) system has been replaced by the North American Industry Classification System (NAICS). Since the Bureau of the Census has collected the information necessary to classify establishments on both an NAICS and an SIC basis, the same 1998 data can be shown on both the old and the new basis in bridge tables that allow comparisons between the two systems. These data are hereby produced for the last time on an SIC basis for 1998 at the national level only.

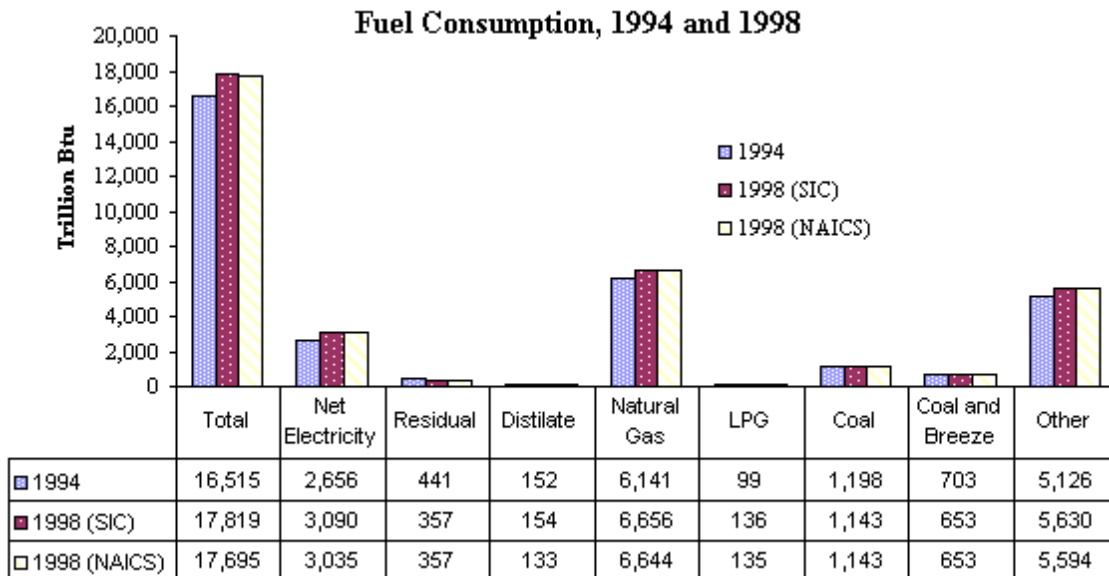
(a) **Purchased steam** excludes quantities delivered from any other establishment(s) in the company, quantities transferred from other establishments of the company for which payment was not made, quantities purchased centrally within the company but separate from the reporting establishment, and quantities for which payment was made in-kind.

(b) **Biomass Total** is the sum of the estimates for these four components: agricultural waste, wood harvested directly from trees, wood residues and byproducts from mill processing, and wood-related and paper-related refuse.

(c) **Biomass Total** does not include pulping liquor or black liquor.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy End Use and Integrated Statistics Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys.'

Fuel Consumption: Manufacturers Consumed Almost 18 Quads of Energy in 1998--A Quad Higher Than in 1994



Graph notes and data sources on next page.

- Fuel consumption of all energy sources was 7 percent higher in 1998 than in 1994 (8 percent SIC based).
- Driving this increase was net electricity (14.4 percent), natural gas (8.4 percent), LPG (36 percent), and other sources including net steam (9.1 percent) while manufacturers used less distillate and residual fuel oil, coal as an energy sources.
- LPG's increase must have come from the chemical industry since the industry could not have used more than an estimated 18 trillion Btu in 1994 and 51 trillion Btu in 1998 (NAICS and SIC).
- Even though lumber was reclassified out of the manufacturing sector in general and the wood industry, in specific, the 1998 wood industry's share of total fuel consumption for manufacturing was not significantly different when calculated using the SIC or the NAICS data--about 3 percent.
- The lumber reclassification may have affected the wood's share of distillate fuel oil, 21 percent in 1998 using the SIC data and 9 percent using NAICS data--however, since the quantities are small, this difference does not affect comparisons of total fuel consumption.

Fuel Consumption Graph Notes and Data Sources

The Standard Industrial Classification (SIC) system has been replaced by the North American Industry Classification System (NAICS). Since the Bureau of the Census has collected the information necessary to classify establishments on both an NAICS and an SIC basis, the same 1998 data can be shown on both the old and the new basis in bridge tables that allow comparisons between the two systems. These data are hereby produced for the last time on an SIC basis for 1998 at the national level only.

(a) **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).

(b) **Distillate Fuel Oil** includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.

(c) **Natural Gas** includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any marketing subsidiaries of utilities.

Examples of **Liquefied Petroleum Gases** (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).

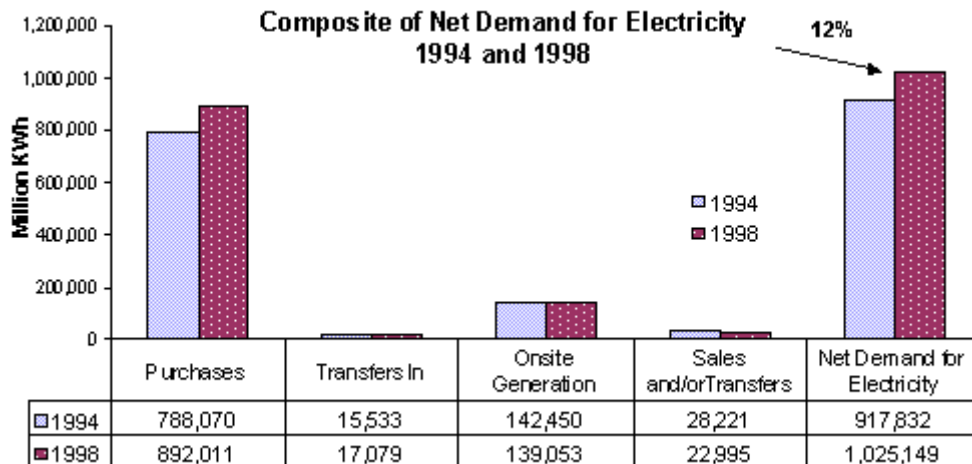
(d) **Other** includes net steam (the sum of purchases, generation from renewables, and net transfers), and other energy that respondents indicated was used to produce heat and power.

W=Withheld to avoid disclosing data for individual establishments.

Note: The **fuel consumption** estimates presented in this table are for the total consumption of energy (formerly total inputs of energy) for the production of heat, power, and electricity generation, regardless of where the energy was produced. Specifically, the estimates include the quantities of energy that were originally produced offsite and purchased by or transferred to the establishment, plus those that were produced onsite from other energy or input materials not classified as energy, or were extracted from captive (onsite) mines or wells. During manufacturing processes, it is possible that the thermal energy content of an energy input is not completely consumed for the production of heat, power, or electricity generation. Hence, residuals of that input may remain. Those residual leftovers may be subsequently consumed for fuel purposes, whether onsite or offsite at another manufacturing establishment (for example, blast furnace gas as a byproduct recovered from coke and other inputs that were not completely consumed). In such cases, double counting of inputs cannot be avoided, and the fuel consumption estimates will be inflated.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys,' and Office of Oil and Gas, Petroleum Supply Division, Form EIA-810, 'Monthly Refinery Report' for 1994 and 1998.

Offsite Produced Energy: While Total Offsite Energy was About 10 Percent Higher in 1998 Than in 1994, Electricity Use Displayed a Higher Growth Rate--13 Percent (NAICS)



Graph notes and data sources on next page.

- In 1998, natural gas--about one half of the offsite produced energy--was 9 percent higher than in 1994.
- LPG displayed the fastest growth--however, LPG use is very small--113 trillion Btu in 1998 and 69 trillion Btu in 1994.
- Most of the LPG is used by the chemical and petroleum industries.
- Under the NAICS, both residual and distillate fuel oil fell--however their use has diminished over times as cheaper and more reliable substitutes such as natural gas became available.
- The lumber industry, a user of distillate fuel oil, is no longer classified in the manufacturing sector--thus, affecting the data comparisons for manufacturing distillate fuel oil use.
- The "other" energy source grew 40 percent between 1994 and 1998--much of this growth was in the growth of purchased steam.

Offsite-Produced Energy Graph Notes and Data Sources

- (a) **Electricity** consists of quantities of electricity that were purchased or transferred in, and is equivalent to 'purchased electricity' as defined in the 'Annual Survey of Manufactures.'
- (b) **Distillate Fuel Oil** includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.
- (c) **Natural Gas** includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any marketing subsidiaries of utilities.
- (d) Examples of **Liquefied Petroleum Gases** (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).
- (e) Other includes all other energy that was purchased or transferred in and not shown elsewhere.

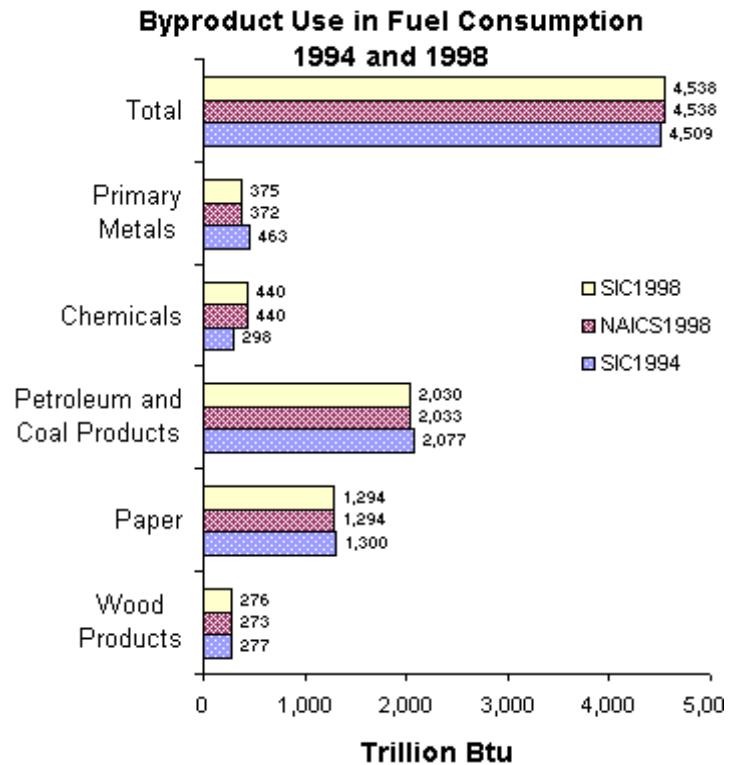
Notes: Totals may not equal sum of components because of independent rounding. The derived estimates presented in this table represent the consumption of energy originally **produced offsite**, acquired as a result of a purchase or transfer and consumed onsite for the production of heat and power. This definition is consistent with the definition of **purchased fuels** and electric energy used by the Bureau of the Census in the preparation of 'Fuels and Electric Energy Consumed,' of the 'Annual Survey of Manufactures,' for 1974 through 1981.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys,' and Office of Oil and Gas, Petroleum Supply Division, Form EIA-810, 'Monthly Refinery Report' for 1994 and 1998.

Byproducts in Fuel Consumption: While Manufacturers Used the Same Amount in 1998 as in 1994--the Energy Mix Was Not the Same

Selected Byproducts in Fuel Consumption, 1994 and 1998 (Trillion Btu)		
	1994	1998
Total	4,509	4,538
Blast Furnace/Coke Oven Gases	452	369
Waste Gas	1,612	1,837
Petroleum Coke	802	703
Pulping Liquor/Black Liquor	882	903
Wood Chips/Bark	693	684
Oils, Tars, Waste Material	67	43

Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."
Table and graph notes and data sources on next page.



- In 1998, waste gas was 14 percent higher than in 1994--petroleum coke was 12 percent lower (NS) and blast furnace gas was 18 percent lower.
- Of all byproducts, waste gas was 40 percent of all the byproducts used in 1998--36 percent share in 1994.
- The petroleum industry uses more than half of the byproducts used as an energy source--most of the petroleum industry byproduct use was waste gas (1,399 trillion Btu in 1998).
- The chemical industry experienced the fastest growth in waste gas--267 trillion Btu in 1994 to 416 trillion Btu in 1998.
- In 1998, the paper industry used 29 percent of the byproducts--mainly pulping or black liquor and wood chips or bark--showing no growth in the use of byproducts since 1994.
- Although only a small percent of all byproduct use, softwood veneer and plywood manufacturers doubled their use of wood chips or bark (58 trillion Btu in 1994 and 122 trillion Btu in 1998).

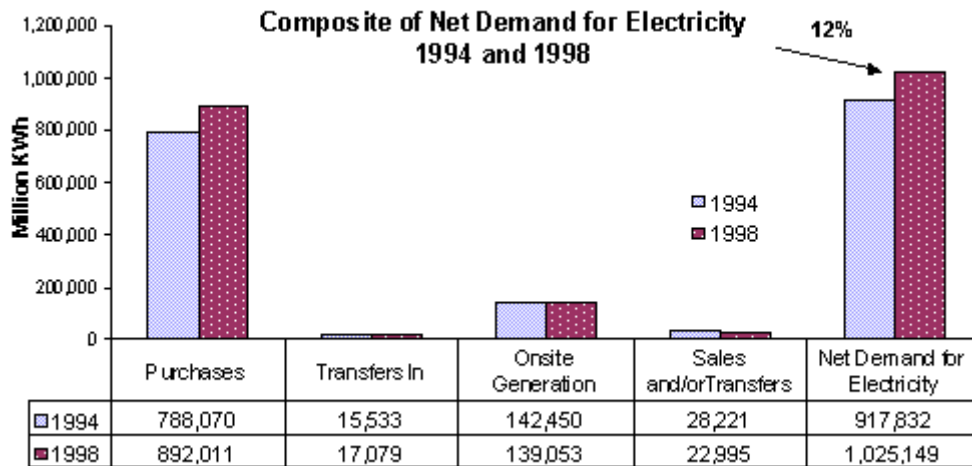
Byproducts Table Notes and Data Sources

The estimates presented in this table are for the total consumption of energy (formerly total inputs of energy) for the production of heat, power, and electricity generation, regardless of where the energy was produced. Specifically, the estimates include the quantities of energy that were originally produced offsite and purchased by or transferred to the establishment, plus those that were produced onsite from other energy or input materials not classified as energy, or were extracted from captive (onsite) mines or wells.

During manufacturing processes, it is possible that the thermal energy content of an energy input is not completely consumed for the production of heat, power, or electricity generation. Hence, residuals of that input may remain. Those residual leftovers may be subsequently consumed for fuel purposes, whether onsite or offsite at another manufacturing establishment (for example, blast furnace gas as a byproduct recovered from coke and other inputs that were not completely consumed). In such cases, double counting of inputs cannot be avoided, and the "Fuel Consumption" estimates will be inflated.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys.'

Net Electricity Demand: Manufacturers Used More than Trillion kWh of Electricity in 1998--12 Percent Higher Than in 1994



Notes: See fuel consumption for a comparison of net electricity using the 1998 SIC and NAICS classifications showing very little difference in the estimates; all of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

Graph notes and data sources on next page.

- Purchased electricity was 13 percent higher in 1998 than in 1994 (see Purchased Energy).
- In 1994, the paper, chemical, and primary metals industry used 52 percent of the electricity demand--almost the same share in 1998 (52 percent).
- As site electricity generation is lower in 1998, manufacturers also reduced the amount of electricity they sold or transferred offsite--28,221 million kWh in 1994 versus only 22,995 million kWh in 1998. Along with this, the electricity transferred in has increased. The chemical industry transferred in 3,959 million kWh of electricity in 1994--rising to 5,800 million kWh in 1998 (NS).

Net Electricity Demand Graph Notes and Data Sources

(a) **Transfers In** include quantities delivered from any other establishment(s) in the company, quantities transferred from other establishments of the company for which payment was not made, quantities purchased centrally within the company but separate from the reporting establishment, and quantities for which payment was made in kind.

(b) **Total Onsite Generation** includes cogeneration, generation by renewable energy sources, and conventional generation by combustible fuels.

(c) **Net Electricity Demand** is the sum of purchases, transfers in, and total onsite generation, minus sales and transfers offsite. It is the total amount of electricity used. It is not comparable to net electricity that excludes electricity generated onsite by combustible energy sources.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys.'

Onsite Electricity Generation: The Generation of Electricity by Manufacturers was Slightly Less in 1998 than in 1994 as Outsourcing of Onsite Generation Increased

Onsite Electricity Generation for Selected Industries, 1994 and 1998 (Million kWh)						
	Total		Paper		Chemicals	
	SIC 1994	NAICS 1998	SIC 1994	NAICS 1998	SIC 1994	NAICS 1998
Cogeneration	127,847	125,319	50,936	49,396	44,181	43,496
Renewable Energy*	2,952	3,378	2,480	2,481	0	28
Other	11,650	10,356	5,421	4,327	2,620	2,279
Total Onsite Generation	142,450	139,053	58,837	56,204	46,802	45,803
<small>*Excludes wood and other biomass Notes: See fuel consumption for a comparison of net electricity using the 1998 SIC and NAICS classifications showing very little difference in the estimates; all of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."</small>						
Table notes and data sources on the next page.						

- The two largest onsite generating industries, paper and chemicals, showed small reductions in 1998 as compared to 1994--4.5 percent and 2.1 percent, respectively (NS). In 1998, the share of these industries was 73 percent of all onsite generation undertaken by manufacturing establishments--down slightly from the 74 percent share in 1994.
- Led by the paper industry, which was 20 percent lower in 1998, the total "other" category, which includes diesel fuels used for generation, was 11 percent less in 1998 than in 1994.
- Although, in 1998, only 2 percent of all onsite-generated electricity was generated using renewables (other than wood or other biomass), onsite generation using renewables was 14 percent more in 1998 than in 1994 (NS).
- The number of establishments using cogeneration technology fell 16 percent between 1994 and 1998--2,109 establishments in 1994 as compared to 1,382 establishments in 1998 used cogeneration technology.

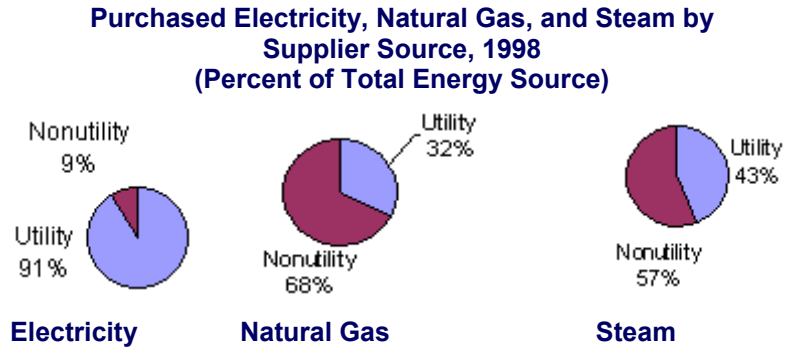
Onsite Generation of Electricity Table Notes and Data Sources

- (a) **Cogeneration** is the production of electrical energy and another form of useful energy, such as heat or steam, through the sequential use of energy. Cogeneration includes electricity generated from fossil fuels, such as natural gas, fuel oils, and coal; wood; and other biomass.
- (b) **Renewable Energy** is energy obtained from essentially inexhaustible sources. Noncombustible sources include solar power, wind power, hydropower, and geothermal power.
- (c) **Other** is that electricity obtained from a generator fueled by combustible energy sources, such as diesel fuels and other fuel oils.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys.'

Purchased Energy: In 1998, Total Energy Purchases Remained Flat. Electricity Purchases Climbed as Residual Fuel Oil, Coal, and "Other" Energy Source Purchases Fell

Quantity of Purchased Electricity by Supplier Source, 1994 - 1998 (Billion kWh)		
	1994	1998
Total Electricity	788	892
Utility Electricity	766	815
Nonutility Electricity	22	77



Quantity of Purchased Steam by Supplier Source, 1994 - 1998 (Trillion Btu)		
	1994	1998
Total Steam	243	490
Utility Steam	96	213
Nonutility Steam	147	277

Total Quantity of Purchased Energy Sources 1994 - 1998 (Btu or Physical Units)		
Energy Source	1994	1998
Total (trillion Btu)	16,605	16,281
Electricity (billion kWh)	788	892
Residual Fuel Oil (million bbl)	67	49
Distillate Fuel Oil (million bbl)	26	24
Natural Gas (billion cu ft)	6,490	6,817
LPG (million bbl)	328	471
Coal (million short tons)	87	78
Coke and Breeze (million short tons)	15	18
Other (trillion Btu)	3,025	1,812

- Purchased electricity was 13 percent higher in 1998 than it was in 1994. See Purchased Expenditures.
- Other energy sources such as wood waste, hydrogen, or waste oils and tars, were 40 percent lower in 1998 as compared to 1994. With the exception of the petroleum industry, the major industries--including food and primary metals--had large reductions in these energy sources.
- In 1998, almost one half (42 percent) of the utility-supplied electricity was purchased by only three manufacturing industries--paper, chemicals, and primary metals.

Notes: See fuel consumption for a comparison of net electricity using the 1998 SIC and NAICS classifications showing very little difference in the estimates; all of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

Table and graph notes and data source on next page.

- In 1994 the chemical industry purchased most of the nonutility supplied electricity (79%). In 1998, 90 percent of the nonutility supplied electricity was purchased by other industries as the chemical industry's share fell to 10 percent.
- Although electricity purchased from a nonutility was more than 3 times higher in 1998 than in 1994, it is still only 9 percent of the total.
- Natural gas purchases have been deregulated for several years--in 1998, 68 percent of purchases came from nonutilities.
- Steam purchases from nonutilities almost doubled--a growth in the outsourcing of onsite steam production may have assisted this increase.

Purchased Energy Table and Graph Notes and Data Sources

(a) **Distillate Fuel Oil** includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.

(b) **Natural Gas** includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any marketing subsidiaries of utilities.

Examples of **Liquefied Petroleum Gases** (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).

(c) **Other** energy sources include such combustible energy sources as wood waste, hydrogen, and waste oils and tars.

(d) A **Local Utility** is an entity that produces and/or delivers a particular energy source (for example, electricity, natural gas, steam) and is legally obligated to provide service to the general public within its franchise area.

(e) **Sources** Other than **Local Utility** include independent producers, brokers, marketers, and marketing subsidiaries of utilities; for the case of electricity sources, also include small power producers and cogenerators not located at the establishment site.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys.'

End Use of Energy: Most of All Major Energy Sources Used by Manufacturers can be Reported by End Use

Manufacturing End-Use Categories for Major Energy Sources 1994 and 1998* (Trillion Btu)														
	Total		Net Electricity		Residual Fuel Oil		Distillate and Diesel Fuel		Natural Gas		LPG		Coal	
	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998
Total Inputs	10,687	11,447	2,656	3,035	441	357	152	133	6,141	6,644	99	135	1,198	1,143
Indirect Uses-Boiler Fuel	3,669	3,635	28	19	313	246	42	38	2,396	2,538	15	24	875	770
Direct Uses-Total Process	5,460	6,325	2,075	2,408	106	103	51	37	2,872	3,361	54	78	302	338
Direct Uses-Total Nonprocess	1,279	1,330	457	538	14	8	49	52	726	673	25	29	8	30
End Use Not Reported	279	157	96	70	9	1	9	7	148	72	4	4	13	3
<small>Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS." *Does not include the Energy source. "Other" as end-use information was not obtained from manufacturers. "Other" includes net steam.</small>														
Table notes and data sources on the next page.														

- In 1998, less than 2 percent of all major energy sources was not reported by end use.
- Between 1994 and 1998, the percent of each of the major energy sources used for a particular end use has remained very stable.
- Comparing 1994 to 1998, electricity directly used for machine drives remained about 51 percent of all net electricity used by manufacturers (1,367 trillion Btu in 1994 and 1,560 trillion Btu in 1998).
- In 1998, the 2 main uses of natural gas by manufacturers are boiler fuel (38 percent) and process heating (49 percent).
- While boiler fuel and process heating are the largest end uses for residual fuel oil--96 percent of all manufacturing residual fuel oil--boiler fuel end use experienced a 21 percent decline between 1994 and 1998 as the use of residual fuel oil continues to diminish in the manufacturing sector.
- Most of the LPG is used for boiler fuel, process heating, and onsite transportation-- 60, 39, and 26 trillion Btu, respectively, in 1998.
- Coal use was 5 percent less in 1998 as compared to 1994 (NS)--mostly a drop in the coal used for boilers (12 percent). (Fuel use for cogeneration is reported as a boiler end use.)

End Use of Energy: Table Notes and Data Sources

(a) **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).

(b) **Distillate Fuel Oil** includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.

(c) **Natural Gas** includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any marketing subsidiaries of utilities.

(d) Examples of **Liquefied Petroleum Gases** (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).

(e) **Facility Heating, Ventilation, and Air Conditioning** (Facility HVAC) excludes steam and hot water.

Notes: The estimates presented in this table are for the total consumption of energy (formerly total inputs of energy) for the production of heat, power, and electricity generation, regardless of where the energy was produced. Specifically, the estimates include the quantities of energy that were originally produced offsite and purchased by or transferred to the establishment, plus those that were produced onsite from other energy or input materials not classified as energy, or were extracted from captive (onsite) mines or wells.

Allocations to specific end uses are made on the basis of reasonable approximations by respondents.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1998 Manufacturing Energy Consumption Survey.'

Wood and Wood Related Products: In 1998, Manufacturers Used 11 Percent Less Biomass in Fuel Consumption as Compared to 1994

Selected Wood and Wood-Related Products in Fuel Consumption in the United States (US), 1994 and 1998 (Trillion Btu)										
	US		Northeast		Midwest		South		West	
	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998
Pulping or Black Liquor	882	903	54	85	45	69	677	654	107	94
Biomass										
Agricultural Waste	101	43	0	0	Q	1	79	36	16	6
Wood Harvested from Trees	189	58	18	8	16	16	123	31	32	3
Wood and Byproducts from Mill Processing	504	626	22	49	48	61	336	405	99	111
Wood and Paper-Related Refuse	37	15	4	2	5	3	23	5	5	5
Q=Not published as the relative standard error is greater than 50 percent. Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."										
Table notes and data sources on the next page.										

- The paper industry, as the sole user, used almost the same amount of pulping or black liquor in 1998 as it did in 1994.
- Overall, mill processing produces the most biomass as an energy source--626 trillion Btu of wood and byproducts in 1998.
- Wood and byproducts from mill processing as an energy source, grew 24 percent between 1994 and 1998, mainly in the Northeast and the South.
- The South Census region--the largest user of wood and byproducts from mill processing experienced a 21 percent growth--mainly in the paper industry.
- In 1998, manufacturers, including the paper industry, located in the the South Census region used the most wood and wood-related products in fuel consumption--72 percent of the pulping or black liquor and 64 percent of the biomass.
- Use of agricultural waste and wood harvested from trees showed steep declines as an energy source. However this may be due to the NAICS classification of logging out of the manufacturing sector and into the agricultural sector.

Wood and Wood-Related Products Table Notes and Data Sources

(a) Four components of **Biomass** are collected: agricultural waste, wood harvested directly from trees, wood residues and byproducts from mill processing, and wood-related and paper-related refuse. The 'Biomass Total' does not include pulping liquor or black liquor.

(b) **Agricultural Waste** includes bagasse, rice hulls, nut shells, and orchard prunings.

(c) **Wood Harvested Directly from Trees** includes roundwood, wood chips, and tree bark.

(d) **Wood Residues and Byproducts from Mill Processing** include sawdust, shavings, and slabs.

(e) **Wood-Related and Paper-Related Refuse** includes scrap, wastepaper, wood pallets, and packing materials.

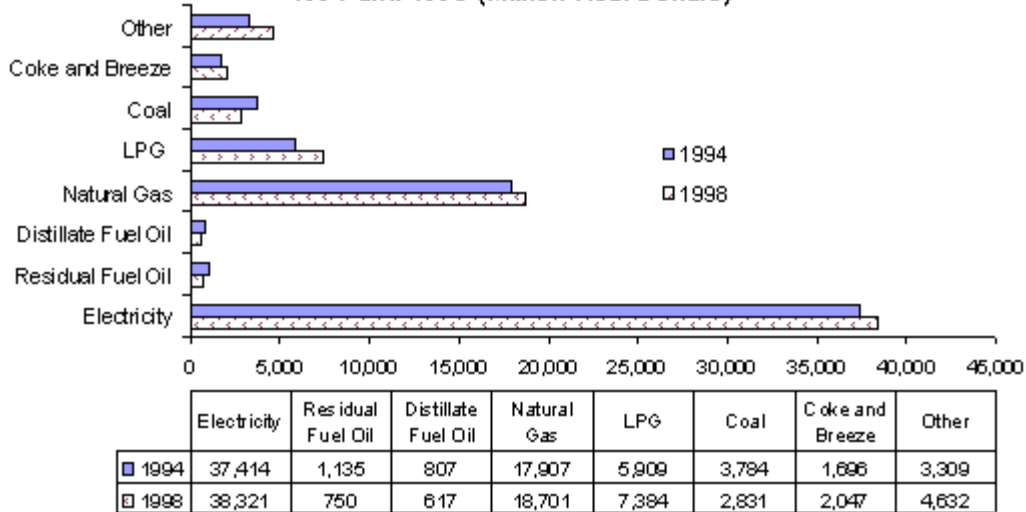
Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1998 Manufacturing Energy Consumption Survey.'

Purchased Energy Expenditures: In 1998 Manufacturers Spend More Dollars on Total Energy than in 1994--Dollars Spent on Fuel Oil and Coal Declined by 24 Percent or More

Expenditures for Purchased Electricity and Steam by Supplier Source, 1994 and 1998 (Million Dollars)				
	1994		1998	
	Nominal	Real	Nominal	Real
Utility Electricity	35,340	36,759	37,021	35,992
Nonutility Electricity	630	655	2,396	2,329
Utility Steam	322	335	659	641
Nonutility Steam	454	472	946	920

Expenditures for Purchased Electricity and Steam by Industry, 1994 and 1998 (Million Dollars)				
	1994		1998	
	Nominal	Real	Nominal	Real
Electricity				
All Industries	35,970	37,414	39,417	38,321
Paper	2,951	3,069	2,880	2,800
Chemical	5,373	5,589	6,132	5,962
Steam				
All Industries	776	807	1,605	1,560
Paper	98	102	405	394
Chemical	319	332	707	687

Expenditures for Purchased Energy, 1994 and 1998 (Million Real Dollars)



Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

Table and graph notes and data sources are on the next page.

- Manufacturers spend 12 percent more nominal and 5 percent more real dollars on energy in 1998 than in 1994.
- Spending on most energy sources rose with the exception of fuel oil and coal. In real terms, dollars spent on residual fuel oil was 34 percent less in 1998 than spent in 1994; dollars spent on distillate was 24 percent less, and dollars spent on coal was 25 percent less.
- In 1998, while spending on electricity was more one-half of all spending on energy, spending, in real dollars, on both residual and distillate fuel oil and coal was less than six percent of all the dollars spent on energy by manufacturers.
- Manufacturer purchases of electricity from nonutilities grew substantially between 1994 and 1998 (255 percent)--however, the 2,329 million real dollars spent on nonutility electricity in 1998 was only six percent of all spending on electricity.
- Although manufacturers purchased almost the same percent of nonutility steam in 1994 as 1998 (59 percent in 1998), the amount of dollars spent on purchased steam from any source was 93 percent higher in 1998 than in 1994 as more establishments outsourced the onsite cogeneration.
- While the two industries, paper and chemical, accounted for 54 percent of the purchased steam expenditures in 1994, these industries accounted for 69 percent of the purchased steam expenditures in 1998--possibly due to the outsourcing of their on-site generation of electricity. See the onsite generation section for more information.

Purchased Energy Expenditures Table and Graph Notes and Data Sources

(a) **Distillate Fuel Oil** includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.

(b) **Natural Gas** includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any marketing subsidiaries of utilities.

(c) Examples of **Liquefied Petroleum Gases** (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).

(d) Other energy sources include such combustible energy sources as wood waste, hydrogen, and waste oils and tars.

Notes: Nominal dollars are deflated using Gross National Product chain-type indices (1996=100). Totals may not equal sum of components because of independent rounding. To reduce respondent burden, quantities of petroleum-based products (for example, LPG and residual and distillate fuel oil) purchased, and associated expenditures, were not collected from Petroleum Refineries, NAICS 324110. These products are produced by petroleum refineries, rather than purchased by them.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1998 Manufacturing Energy Consumption Survey.'

Average Energy Prices: While Natural Gas Prices Were 6 Percent Higher in 1998 than in 1994, Most Energy Sources Were Priced Lower in 1998

Average Prices of Purchased Energy Sources, 1994 and 1998 (Nominal Dollars per Physical Units)												
Subsector and Industry	Coal (short tons)		Electricity (kWh)		Distillate (gallons)		Residual (gallons)		LPG (gallons)		Natural Gas (1000 cu ft)	
	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998
Food	32.21	31.78	0.054	0.051	0.76	0.46	0.42	0.40	0.62	0.64	2.93	3.03
Paper	40.77	38.87	0.041	0.039	0.64	0.56	0.37	0.35	0.66	0.67	2.61	2.78
Petroleum	26.97	W	0.043	0.039	0.62	0.53	0.45	W	0.50	0.40	2.26	2.54
Chemicals	37.34	37.05	0.034	0.036	0.67	0.58	0.37	0.40	0.40	0.38	2.22	2.44
Nonmetallic Mineral	36.56	35.54	0.048	0.045	0.76	0.60	0.42	0.44	0.64	0.74	2.91	3.03
Primary Metals	47.98	37.28	0.034	0.032	0.63	0.61	0.39	0.33	0.61	0.65	2.80	2.96
Total	41.85	37.14	0.046	0.044	0.71	0.56	0.39	0.37	0.41	0.38	2.65	2.82
W=Withheld Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."												
Table notes and data sources on the next page.												

- Although distillate fuel oil prices were 21 percent lower in 1998, demand for this energy source was about the same as it was in 1994. See Purchased Energy.
- Even though the average price of natural gas was not significantly higher in 1998 than in 1994, in 1998, manufacturers purchasing their natural gas from nonutilities paid the average price of \$2.66 per 1000 cubic feet while manufacturers purchasing their gas from utilities paid the average price of \$3.16 per 1000 cubic feet.
- Manufacturers, on average, paid about the same for electricity in 1998 as in 1994. However, those manufacturers purchasing their electricity paid substantially less when the source was a nonutility. Manufacturers purchasing from a utility paid on average 4.5 cents per kWh while those purchasing from a nonutility paid an average of 3 cents per kWh.
- Most of the establishments in the Primary Metals Industry purchased their electricity from a nonutility at a substantial discount--less than 3 cents a kWh in 1998. However, it seems that their utility steam purchases were cheaper than nonutility steam--2.87 dollars per million Btu versus 4.16 dollars per million Btu.

Average Energy Prices Table Notes and Data Sources

(a) A **Local Utility** is an entity that produces and/or delivers a particular energy source (for example, electricity, natural gas, steam) and is legally obligated to provide service to the general public within its franchise area.

(b) **Sources Other than Local Utility** include independent producers, brokers, marketers, and marketing subsidiaries of utilities; for the case of electricity sources, also include small power producers and cogenerators not located at the establishment site.

(c) Examples of **Liquefied Petroleum Gases** (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).

(d) Four components of **Biomass** are collected: agricultural waste, wood harvested directly from trees, wood residues and byproducts from mill processing, and wood-related and paper-related refuse. The average price of **Biomass Total** is computed as the sum of the dollar expenditures for those four components divided by the sum of the Btu quantities purchased of those four components. The 'Biomass Total' does not include pulping liquor or black liquor.

(e) The price estimates for coal in NAICS 3313 and 331312 include anthracite coal for the production of carbon anodes. Due to the high cost of transporting anthracite from the East Coast to the South and West, the prices of coal in those regions are relatively high.

Notes: Totals may not equal sum of components because of independent rounding.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys.'

Number of Establishments: The Number of Energy-Using Establishments Were 8 Percent Lower in 1998 than in 1994

Number of Establishments by Selected Energy Sources and Industries, 1994 and 1998												
	Food		Paper		Petroleum		Chemicals		Nonmetallic Mineral Products		Primary Metals	
	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998	1994	1998
Any Energy	14,698	16,553	5,582	4,676	1,971	1,756	9,565	8,962	11,866	11,333	5,171	3,830
Net Electricity	14,637	16,526	5,547	4,676	1,960	1,755	9,555	8,890	11,815	11,333	5,117	3,830
Residual	575	178	382	278	117	92	340	258	76	16	88	41
Distillate	3,249	2,107	878	695	783	701	2,541	1,806	3,829	4,148	1,287	1,116
Natural Gas	11,042	13,536	4,290	3,865	1,148	1,193	6,723	6,688	6,990	6,312	4,652	3,472
LPG	3,873	3,589	2,321	2,622	675	518	2,768	2,686	2,320	3,135	2,259	1,866
Coal	173	105	173	124	15	W	125	102	233	208	78	41
Coke/Breeze	31	19	0	0	W	0	3	W	43	24	230	255
Other	1,952	2,673	807	768	436	334	1,955	1,574	2,047	2,804	1,537	1,364
Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."												

Number of Establishments by Fuel Consumption, 1994 and 1998		
Energy Sources	All Establishments	
	1994	1998
Any Energy Used	246,925	226,737
Net Electricity	243,452	226,500
Residual Fuel Oil	3,080	2,517
Distillate Fuel Oil	35,920	27,218
Natural Gas	158,773	150,816
LPG	56,438	63,592
Coal	1,397	1,080
Coke/Breeze	380	316
Other	35,002	38,282
W=Withheld to avoid disclosure Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."		
Table notes and data sources on the next page.		

- In 1998, while the number of establishments using residual, distillate fuel oil, and coal (NS) were dramatically less for most industries as compared to 1994, the number of establishments using LPG were 13 percent higher and 9 percent higher for "Other" which includes net steam.
- Most all manufacturing establishments use electricity, however, in 1994 only 64 percent used natural gas-- increasing slightly to 66 percent in 1998.
- The number of establishments using natural gas fell by 5 percent between 1994 and 1998 as 13 percent more establishments used LPG--implying a potential switch in energy sources.
- As the total number of establishments were 16 percent fewer in the paper industry in 1998, establishments using residual fuel oil fell by 27 percent--continuing the decline in the use of residual fuel oil in manufacturing.

- The number of establishments in the primary metals industry dropped by 26 percent between 1994 and 1998 as companies disappeared for a variety of reasons including bankruptcy, consolidation, closing unprofitable plants, and mergers.
- Establishments using residual fuel oil were 53 percent fewer in 1998 than in 1994--although the absolute number using this energy source fell from only 88 establishments using 43 trillion Btu of residual to 41 establishments using 30 trillion Btu of residual.

Number of Establishment Table Notes and Data Sources

(a) MECS covers only 98 percent of the payroll in manufacturing. The remaining 2 percent of the payroll accounts for about 40 percent of the establishments according to the 1997 Census of Manufacturing (Appendix C) fielded by the U.S. Census Bureau.

(b) **Any Energy Source** represents the non-duplicative total of establishments identified with any of the listed energy sources. This count includes only those establishments that reported this activity in 1998.

(c) **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).

(d) **Distillate Fuel Oil** includes Nos. 1, 2, and 4 fuel oils and Nos. 1, 2, and 4 diesel fuels.

(e) **Natural Gas** includes natural gas obtained from utilities, local distribution companies, and any other supplier(s), such as independent gas producers, gas brokers, marketers, and any marketing subsidiaries of utilities.

(f) Examples of **Liquefied Petroleum Gases** (LPG) are ethane, ethylene, propane, propylene, normal butane, butylene, ethane-propane mixtures, propane-butane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw **Natural Gas Liquids** (NGL).

(g) Other includes net steam (the sum of purchases, generation from renewables, and net transfers), and other energy that respondents indicated was used to produce heat and power.

(h) W=Withheld to avoid disclosing data for individual establishments.

Notes: The estimated number of establishments presented in this table are for the total consumption of energy (formerly total inputs of energy) for the production of heat, power, and electricity generation, regardless of where the energy was produced. Specifically, the estimated number of establishments include the quantities of energy that were originally produced offsite and purchased by or transferred to the establishment, plus those that were produced onsite from other energy or input materials not classified as energy, or were extracted from captive (onsite) mines or wells.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1998 Manufacturing Energy Consumption Survey,' and Office of Oil and Gas, Petroleum Supply Division, Form EIA-810, 'Monthly Refinery Report' for 1994 and 1998.

Floorspace: Total Floorspace Shows Little Growth as Energy-Using Industries Reduce Floorspace

Enclosed Floorspace and Number of Establishments, 1994 and 1998

	Enclosed Floorspace of All Establishments (million sq ft)		Number of Establishments		Enclosed Floorspace per Establishment (1000 sq ft)	
	1994	1998	1994	1998	1994	1998
Food	1,083	800	14,698	16,553	80.8	65.1
Paper	707	601	5,582	4,676	134.3	156.3
Petroleum	245	88	1,971	1,756	136.4	77.3
Chemicals	808	1,237	9,565	8,962	91.2	182.4
Nonmetallic Mineral Products	612	435	11,970	11,333	57.3	57.9
Primary Metals	788	600	5,171	3,830	164.7	201.8
Total	12,329	12,836	247,199	226,813	55.2	71.3

Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

Table notes and data sources on the next page.

- In 1998, the total enclosed floorspace of all manufacturing establishments did not change significantly between 1994 and 1998--implying slightly larger establishments, on average, as the number of establishments fell by 8 percent.
- Between 1994 and 1998, most of the energy-using industries such as paper, petroleum, nonmetallic minerals including glass, and primary metals reduced floorspace substantially as the number of establishments were less for each industry.
- The food industry, the exception, had 26 percent less floorspace in 1998 than in 1994--possibly due to the removing of beverages from the food industry classification. However, the food industry had more establishments in 1998 than in 1994--implying smaller establishments. In 1994 the food industry had 80.8 thousand square feet per establishment falling to 65.1 thousand square feet per establishment in 1998--a 19 percent drop.
- While the chemical industry lost 6 percent of its establishments, it gained over 50 percent more floorspace-- the intensity (1000 square feet per establishment) doubled from 91 in 1994 to 182 in 1998. However, a contributing factor may be the change in the classification from SIC to NAICS. This resulted in the reclassification of other industries into the chemical industry such as photographic equipment and lead pencils and art goods.
- Between 1994 and 1998, the petroleum industry dramatically reduced floorspace-- from 245 million square feet to 88 million square feet. However, unlike the chemical industry, the reclassification of the petroleum industry had little effect other than the addition of coke ovens to the industry under the NAICS classification. Fuel consumption was 11 percent higher in 1998 than in 1994 as refinery capacity increased while the number of refineries declined.*

*Energy Information Administration, *U.S. Refineries and Refining Capacities, 1987-2001*

Floorspace Table Notes and Data Sources

The **Establishments** (counts) column includes those units which reported floorspace, plus those units where floorspace was not ascertained. To obtain the number of reporting establishments for any NAICS, divide the entry in the **Approximate Enclosed Floorspace** column by the corresponding entry in the **Average Enclosed Floorspace** column. For example, in the **Total** row, (12,836 million sq ft) divided by (71,257.0 sq ft) equals 180,137, which is the number of reporting establishments (weighted) of the 226,813 total establishments..

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1998 Manufacturing Energy Consumption Survey.'

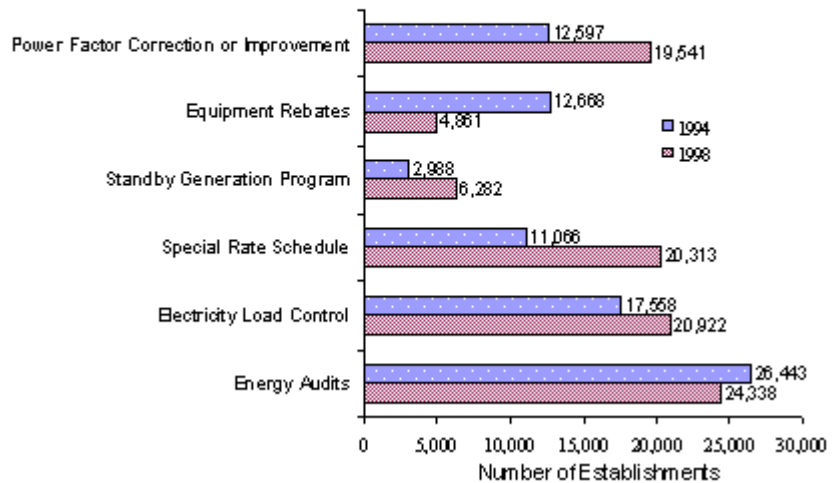
Energy Management Activities: Participation in at Least One Energy Management Activity Almost Doubled Between 1994 and 1998

Number of Establishments Participating in Federal Government Sponsored Programs, 1994 and 1998		
	1994	1998
U.S. Environmental Protection Agency's Energy Star Program	380	1,876
U.S. Environmental Protection Agency's Green Lights Program	1,639	2,150
U.S. Department of Energy's Motor Challenge Program	400	1,280

Note: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS."

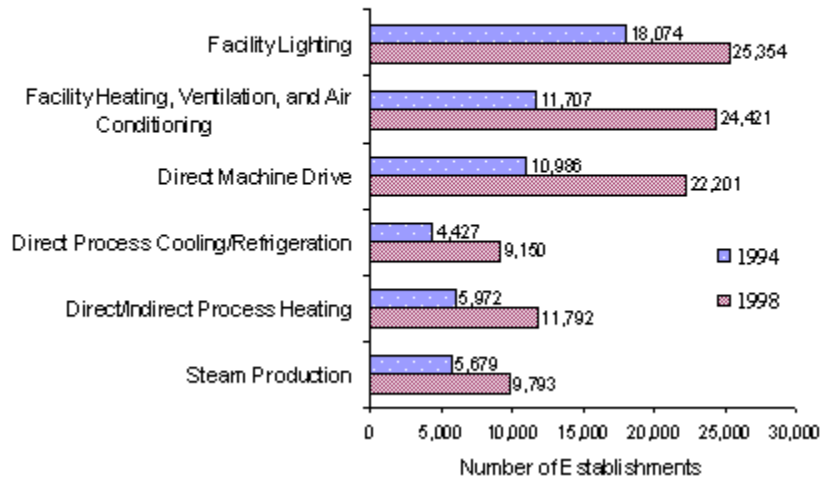
Notes for tables and graphs and data sources on next page.

Number of Establishments Participating in Specific Energy Management Programs, 1994 and 1998



Number of Establishments Participating in At Least One Energy Management Activity by U.S. Manufacturers, 1994 and 1998		
	1994	1998
All Industries	44,735	75,448
Food	4,369	7,303
Wood	2,944	3,917
Paper	1,803	2,350
Chemicals	528	878
Petroleum	3,456	4,370
Nonmetallic Mineral	2,133	3,512
Primary Metals	1,824	2,326

Number of Establishments Participating in Activities to Affect Energy Efficiency, 1994 and 1998



- Over 75 thousand manufacturing establishments participated in at least one energy management activity in 1998--up from 45 thousand in 1994 (Note: "1994" represents energy management activity during 1992 to 1994 but recorded on the 1994 MECS--"1998" represents 1998 activity).

- Although participation increased in 1998, the number of establishments participating was only 33 percent of all manufacturing establishments.
- In the 1994 MECS, the 45 thousand establishments undertaking energy management activities between 1992 and 1994 actually represents establishments using 76 percent of fuel consumption in 1994 and only 18 percent of all establishments. This suggests that more of the larger energy-consuming establishments are undertaking energy-management activities than are the smaller energy-using establishments. (Note: Energy use data for participants were not available in the 1998 MECS.)
- Standby generation programs showed the most increase in program participation (110 percent) while energy rebates decreased by 62 percent and energy audits by 8 percent--programs that in a totally regulated electricity sector were routinely offered by electricity utilities in their demand-side management programs.
- Federal Government-Sponsored Programs showed large increases in participation-- especially EPA's Energy Star Program where 4 times as many establishments participated in 1998 as in 1994.
- Manufacturers were actively engaged in activities to increase energy efficiency--especially in direct process cooling, HVAC, and direct machine drive.

Energy Management Table Notes and Data Sources

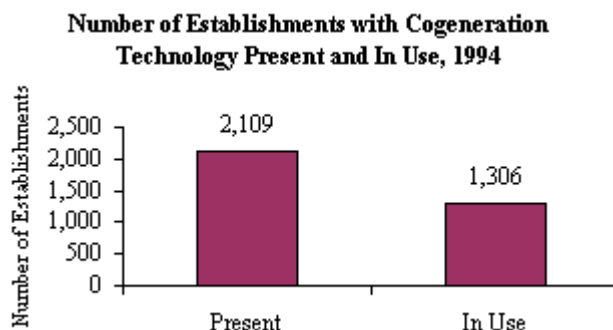
- (a) This count includes only those establishments that reported this activity in 1994 and 1998.
- (b) Examples of **Special Rate Schedules** are interruptible rates and time-of-use rates.
- (c) Some examples of **Steam Production** are boilers, burners, insulation, and piping.
- (d) Some examples of **Direct Process Heating** are compressors, sizing, and leak reduction.
- (e) Some examples of **Direct Machine Drives** are adjustable-speed drives, motors, and pumps.
- (f) **Facility Heating, Ventilation, and Air Conditioning** (Facility HVAC) excludes steam and hot water.

Notes: Totals may not equal sum of components because of independent rounding.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys.'

Cogeneration Technologies: In 1998, the Number of Manufacturing Establishments Using Cogeneration Technologies Did Not Significantly Change--Possibly Due to Outsourcing of the Cogeneration to Another Party

Number of Establishments with Cogeneration Technologies by Selected Industries and All Industries, 1994 and 1998			
Cogeneration Technology	All Industries		
	1994		1998
	Present	In Use	In Use
Any Cogeneration Technology	2,109	1,306	1,382
Steam Turbine Supplied by Conventional or Fluidized Bed Boilers	1,315	490	859
Conventional Combustion Turbine	375	81	304
Combined-Cycle Combustion Turbine	80	8	84
Internal Combustion Engine w/ Heat Recovery	370	69	290
Steam Turbine Supplied by Heat Recovered from High Temperature Processes	456	64	290
Other	NC	228	NC
Unknown/Unreported	NC	122	NC
<small>NC=Not Collected Notes: All of the 1994-1998 comparisons are statistically significant. Exceptions are noted by "NS"; in 1998 manufacturers had to choose the technology. This may have affected the comparisons of the individual technologies.</small>			
<small>Data sources on the next page.</small>			



- In 1994, manufacturing establishments had more cogeneration technologies present than actually in use--only 62 percent in use in 1994--possibly using the technologies as backups. (Note: MECS did not collect this data in 1998.)
- Although the number of establishments with the different cogeneration technologies seems to have risen between 1994 and 1998, during the 1994 MECS, respondents could answer "other" and "unknown". Some of the technology reported in these two categories may actually belong in one of the other categories. These categories were not present in the 1998 MECS. When reviewing data, it is important to understand the differences in the data.
- In 1994, all establishments had cogenerated 127.8 trillion kWh of electricity --125.3 trillion kWh of electricity had been cogenerated in 1998--although the difference is not statistically significant (NS).

- In 1998, waste gas was 14 percent higher than in 1994--petroleum coke was 12 percent lower (NS) and blast furnace gas was 18 percent lower.
- Of all byproducts, waste gas was 40 percent of all the byproducts used in 1998--36 percent share in 1994.
- The petroleum industry uses more than half of the byproducts used as an energy source--most of the petroleum industry byproduct use was waste gas (1,399 trillion Btu in 1998).

- The chemical industry experienced the fastest growth in waste gas--267 trillion Btu in 1994 to 416 trillion Btu in 1998.
- In 1998, the paper industry used 29 percent of the byproducts--mainly pulping or black liquor and wood chips or bark--showing no growth in the use of byproducts since 1994.
- Although only a small percent of all byproduct use, softwood veneer and plywood manufacturers doubled their use of wood chips or bark (58 trillion Btu in 1994 and 122 trillion Btu in 1998).

Cogeneration Technologies Data Sources

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy Consumption Division, Form EIA-846, '1994 and 1998 Manufacturing Energy Consumption Surveys.'

**For specific questions about "Energy Use in Manufacturing, 1994 to 1998,"
please contact:**

Stephanie J. Battles
stephanie.battles@eia.doe.gov
Phone: 202-586-7237
Fax: 202-586-0018

**For specific questions about the Manufacturing Energy
Consumption Survey, please contact:**

Robert Adler, Survey Manager
robert.adler@eia.doe.gov
Phone: 202-586-1134
Fax: 202-586-0018

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