CENTRAL RESEARCH LIBRARY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
NUCLEAR DIVISION

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

ORNL-MIT- 169

DATE: March 27, 1973

COPY NO. 38

SUBJECT: Energy Use Patterns in U.S. Manufacturing for the Period 1950 to 1970

AUTHOR: G.J. Goetz

Consultant: E.A. Hirst

OAK RIDGE NATIONAL LABORATORY
CENTRAL RESEARCH LIBRARY
DOCUMENT COLLECTION
LIBRARY LOAN COPY
DO NOT TRANSFER TO ANOTHER PERSON
If you wish someone else to see this document, send in name with document and the library will arrange a loan.
UCN-7969
(3 3-67)

ABSTRACT

The increasing concern toward the energy crisis in the United States has until recently focused mainly on the area of energy supply. This study approaches the problem somewhat differently and looks at the trends in energy demands by the U.S. manufacturing industries.

Methodology is presented for the determination of energy purchased by the manufacturing industries. Many inconsistences and misclassifications in the earlier Census years of 1947 and 1954 tend to complicate the problem greatly.

[redacted]

Oak Ridge Station
School of Chemical Engineering Practice
Massachusetts Institute of Technology

[redacted]

Released Per LRD 4/30/96 - Wanda Ber

UCN-7802
(3 11-66)

Contents

Page

1. Scope 4
2. Methodology 4
3. Results 10
   3.1 General Trends 10
   3.2 The Chemical and Primary Metals Industries - A Closer View 11
4. Conclusions 13
5. Recommendations 52
6. Acknowledgements 52
7. Appendix 53
   7.1 Calculation of Fuel Energy for 1947 53
   7.2 Calculation of Specific Fuel Costs for Census Years 53
   7.3 Revisions for Census Years 53
   7.4 Revisions for Annual Survey Years..... 67
   7.5 Calculation of Purchased Electrical Energy for 1950 67
   7.6 Energy Conversions, Efficiencies, and Cost Considerations 72
   7.7 Value Added Method 79
   7.8 Literature References 80

1. SCOPE

The increasing concern toward the energy crisis in the United States has until recently focused mainly on the area of energy supply. This study approaches the problem differently. Energy demand was studied, specifically the demand of the largest energy consumers in the U.S., the manufacturing industries.

A study of energy use patterns will determine the distribution of energy among the various industries and will provide a basis for predicting future energy demands. Determination of the major industrial consumers will indicate areas in which more efficient energy use will have the most impact on the energy situation of this nation.

The simplest classification of the manufacturing industries is that represented by the 2-digit Standard Industrial Classification (S.I.C.) numbers (Table 1). This study is devoted to the development of a methodology for studying energy use patterns for each of the twenty 2-digit manufacturing industries and the examination of the energy use patterns for each of these industries.

Results will be valuable in projecting future energy requirements. For example, energy suppliers (petroleum, coal, and utility companies) can use results in assessing the energy impact of an industry wishing to locate in a given area. Results can be correlated with economic and employment data in assessing the impact of energy utilization upon employment and industrial production (6).

No detailed study of the energy use patterns of the manufacturing industries has been performed. Previous studies of energy demand include that of Stanford Research Institute (7) which presented energy use patterns for the larger manufacturing industries. A study by Commoner (3) correlated the industrial use of electricity with employment data. Energy consumption by the primary metal industries was studied by Bravard and Portal (2).

Methodology is presented for the determination of energy purchased by the manufacturing industries. The total energy consumption for a given industry, i.e., the sum of the purchased energy and energy produced internally and consumed at the same establishment (for example, fuel oil used for energy purposes by a refinery), is beyond the scope of this study. Calculated total purchased energy values are presented for each of the twenty 2-digit manufacturing industries for the period 1950-1970.

2. METHODOLOGY

An assessment of data availability (Table 2) revealed that two sets of data were available: (1) detailed fuel and electric energy data provided in the "Census of Manufactures" for the years 1947 (15), 1954 (16), 1958 (17), and 1967 (18) and (2) estimated (based on a random sampling - typical

Table 1. Standard Industrial Classifications
Two-Digit Manufacturing Industries

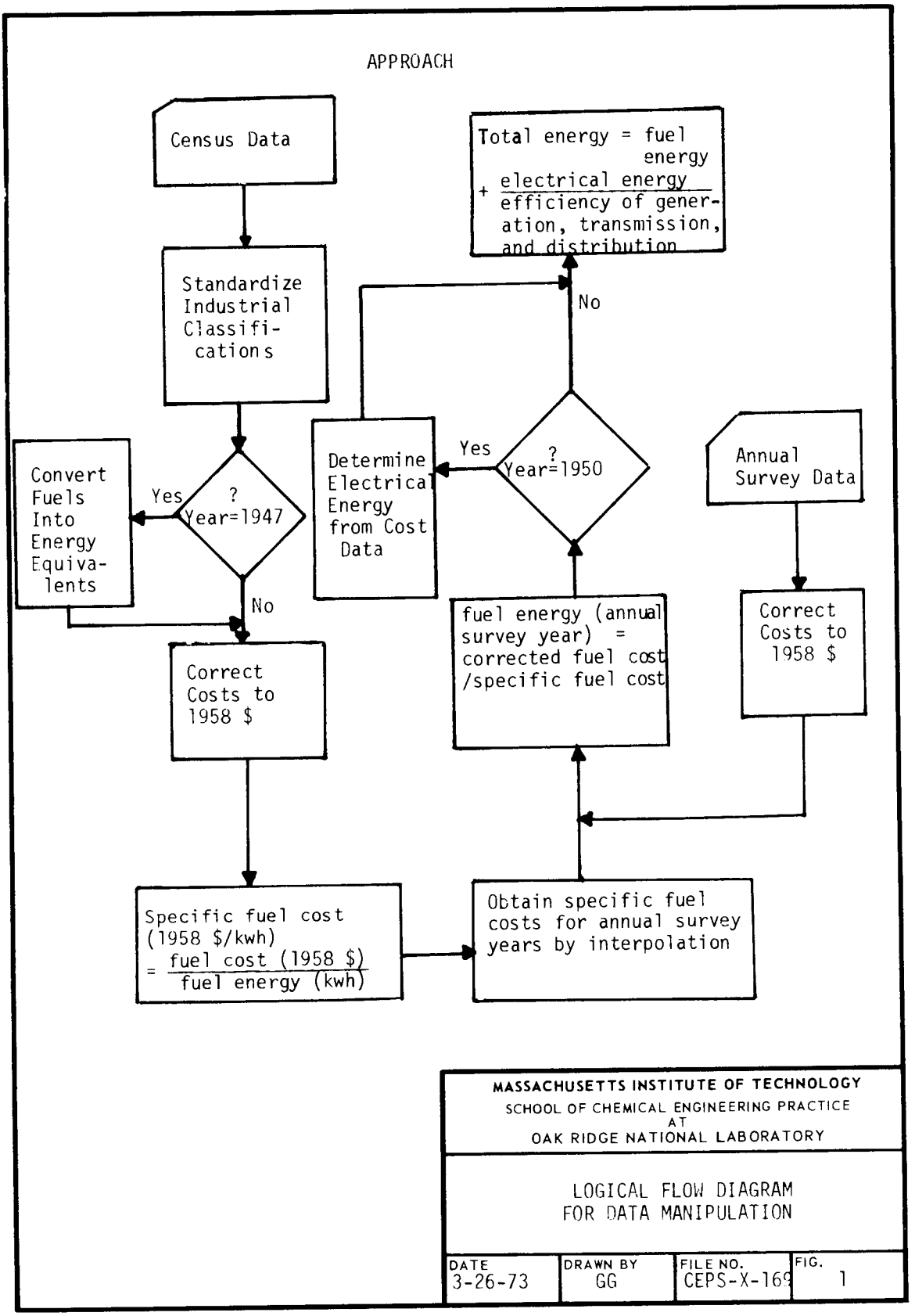
20.	Food and Kindred Products
21.	Tobacco Manufactures
22.	Textile Mill Products
23.	Apparel and Related Products
24.	Lumber and Wood Products
25.	Furniture and Fixtures
26.	Paper and Allied Products
27.	Printing and Publishing
28.	Chemicals and Allied Products
29.	Petroleum and Coal Products
30.	Rubber and Plastic Products
31.	Leather and Leather Products
32.	Stone, Clay, and Glass Products
33.	Primary Metal Industries
34.	Fabricated Metal Products
35.	Machinery, Excepting Electrical
36.	Electrical Equipment and Supplies
37.	Transportation Equipment
38.	Instruments and Related Products
39 & 19.	Miscellaneous and Ordnance

Table 2. Availability of Data

Census Year	Fuel Energy	Electrical Energy	Fuel Quantities	Fuel Cost	Electrical Energy Cost	Listing of 3 & 4-Digit Industries
1947		x	x	x	x	x
1954	x	x	x	x	x	x
1958	x	x	x	x	x	x
1962	x	x	x	x	x	x
1967	x	x	x	x	x	x
Survey Year						
1950				x	x	
1955		x		x	x	
1960		x		x	x	
1965		x		x	x	
1970		x		x	x	

standard deviations of less than 5%) fuel cost and electric energy data provided in the "Annual Survey of Manufactures" for every year excluding the Census Years. Annual surveys for the years 1950 (9), 1955 (10), 1960 (11), 1965 (13), and 1970 (14) were utilized. The census report for the year 1947 contained quantities of fuels consumed rather than energy values. For the year 1950 electric energy costs (rather than electric energy values) were available. The census reports subdivide the 2-digit industry data for 3 and 4-digit industries. However, the Annual Survey reports are limited in scope to the 2-digit industries (Table 1).

The approach utilized in manipulation of the existing data is summarized in Fig. 1. Industrial classifications were initially standardized to reflect industrial reclassification by comparing data for the census years of 1954 and 1958 with the revised data for these years tabulated in the 1967 census. Revisions were determined and the 1947 data were revised accordingly (see Appendix 6.3). In some cases this involved a simple matter of bookkeeping (e.g., transferring the Plastics Industry from the Miscellaneous and Ordnance Industries to the Rubber and Plastics Industry); in other cases it involved estimations (e.g., estimating the energy consumption of the Fluid Milk Industry and incorporating this into the Food and Kindred Products Industry for the year 1947).


APPROACH
Census Data
Standardize Industrial Classifications
Convert Fuels Into Energy Equivalents
Yes
? Year=1947
No
Correct Costs to 1958 $
Specific fuel cost (1958 $/kwh) = fuel cost (1958 $) / fuel energy (kwh)
Obtain specific fuel costs for annual survey years by interpolation
fuel energy (annual survey year) = corrected fuel cost /specific fuel cost
? Year=1950
Yes
Determine Electrical Energy from Cost Data
No
Total energy = fuel energy + electrical energy / efficiency of generation, transmission, and distribution
Annual Survey Data
Correct Costs to 1958 $
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY
LOGICAL FLOW DIAGRAM
FOR DATA MANIPULATION
DATE 3-26-73
DRAWN BY GG
FILE NO. CEPS-X-169
FIG. 1

For the year 1947 the fuel energy was calculated from the following relationship:

$$\text{fuel energy} = \Sigma c_i q_i \qquad (1)$$

where:

q_i = quantity of fuel i

c_i = conversion factor for fuel i, kwh/quantity (Appendix 7.1)

One particular complication concerned determining c_i for "Mixed Gases" which are a combination of natural and manufactured gases.

The total purchased energy for each industry was computed from the relationship:

$$\text{total purchased energy} = \text{fuel energy} + \frac{\text{electrical energy}}{\text{efficiency of generation, transmission, and distribution}} \qquad (2)$$

Specific fuel costs (1958 $/kwh fuel energy) were computed for each industry for the census years of 1947, 1954, 1958, 1962, and 1967 (Appendix 7.2). Values were also calculated for the sum of all manufacturing industries (classified as "All Manufacturing Industries"). This sum is listed as a separate classification in census data and computed parameters for "All Manufacturing Industries" will not necessarily reflect the actual sum of all the manufacturing industries due to independent rounding by the Bureau of the Census and due to the revisions necessitated by industrial reclassification.

Initial analysis of the cost and energy data for the Annual Survey Years involved data revision in accordance with industrial reclassification. Data were revised as follows. A correction factor (revised data value/ unrevised data value) was calculated for the census years for each industry that required revision; values of the correction factor were linearly interpolated for the industries requiring revision during the Annual Survey Years (interpolation was executed using the two census years between which the Annual Survey Year fell - in many cases the 1954 value of the correction factor was used for 1955 because of the negligible yearly change in the correction factor between 1947 and 1954). The revised data values were obtained from the relationship:

$$\text{revised value} = (\text{unrevised value})(\text{interpolated value of correction factor}) \qquad (3)$$

A detailed discussion of the revisions is located in Appendix 7.4.

Electrical energy data were calculated for each industry for the year 1950 (Appendix 7.5) by initially determining the specific cost of electric energy (1958 $/kwh) for the years 1947 and 1954; computing of a value of specific electrical energy cost for the year 1950 by linear interpolation of the 1947 and 1954 values; and calculating electrical energy for each industry by the following relationship:

$$\text{electrical energy 1950 } (10^6 \text{ kwh}) = \frac{\text{electrical energy cost } (1958\ \$ \times 10^6)}{\text{interpolated value of specific electrical energy cost for 1950 } (1958\ \$/\text{kwh})} \quad (4)$$

Specific fuel costs (1958 $/kwh) for the Annual Survey Years were computed by linear interpolation using the specific fuel costs for the two Census Years between which the Annual Survey Year fell. Values for 1970 were linearly extrapolated using 1962 and 1967 data; then fuel energy could be estimated as:

$$\text{fuel energy } (10^6 \text{ kwh}) = \frac{\text{revised fuel cost } (1958\ \$ \times 10^6)}{\text{interpolated value of specific fuel cost } (1958\ \$/\text{kwh})} \quad (5)$$

The total purchased energy for each industry was then calculated from the relationship given by Eq. (2).

$$\text{total purchased energy} = \text{fuel energy} + \frac{\text{electrical energy}}{\text{efficiency of generation, transmission, and distribution}} \quad (6)$$

Results obtained by the above method were compared to results obtained utilizing the value added (VA) method (3). The value added is the value of goods shipped minus the cost of raw materials and energy. This method (Appendix 7.7) consists of determining the value added per kilowatt hour of total energy (1958 $/kwh) for the Census Years, linearly interpolating to obtain the value added per kilowatt hour total energy for the Annual Survey Years (1958 $/kwh), obtaining value added data for the Annual Survey Years, correcting it to 1958 $, and calculating the total energy for the Annual Survey Years from the relationship:

$$\text{total energy} = \frac{\text{VA } (1958\ \$)}{\text{interpolated value of VA per kilowatt hour total energy } (1958\ \$/\text{kwh})} \quad (7)$$

3. RESULTS

3.1 General Trends

An examination of total purchased energy vs time for the "All Manufacturing Industries" classification (Fig. 2) indicates that a semilogarithmic plot of total purchased energy vs time yields a straight line for the period 1958-1970 indicative of exponential growth. Other studies in the energy field (5) have also presented energy data in the form of a semilogarithmic plot. Furthermore, since the data have limited accuracy due to the approximations inherent to a study of this nature, a semilogarithmic representation should be sufficient to indicate quantitative time history behavior.

In analyzing results it is important to note that electric energy is converted to an equivalent amount of fuel consumed at the power plant by dividing the electric energy by the efficiency of power generation, transmission, and distribution. Therefore the purchased energy pattern for an industry reflects progress made by the electric utilities in increasing efficiency of generation, transmission, and distribution, in addition to the industrial energy use patterns. This effect is pronounced for the period 1947-1958 when the overall efficiency of electric generation, transmission and distribution increased from 18.6% to 27.2% (see Appendix 7.6). Trends for industries 22, 23 (Fig. 5), 24 (Fig. 6), 27 (Fig. 8), 30 (Fig. 11), 31 (Fig. 12), 33 (Fig. 14), 35 and 36 (Fig. 16), 37 (Fig. 17), and 19 and 39 (Fig. 18) are similar: slow erratic growth during the 1950s followed by more rapid, exponential growth during the 1960s.

Energy consumption by industries 20 (Fig. 3) and 25 (Fig. 6) exhibited slow, erratic growth patterns for the 1950s followed by more rapid exponential growth for the period 1960-1967. Industry 21 (Fig. 4) exhibited an energy use pattern which was not exponential but which did increase more rapidly during the 1960s.

The classification "All Manufacturing Industries" (Fig. 2) and Industries 26 (Fig. 7), 32 (Fig. 13), 34 (Fig. 15), and 38 (Fig. 18) exhibited exponential growth at all times, the growth increasing at a more rapid rate during the later period of this study as indicated by a transition to a line of steeper slope in the semilogarithmic plot of total purchased energy vs time. Energy use patterns of industry 29 (Fig. 10) exhibited unsteady, rapid growth during the period 1954-1960 followed by a slight decline from 1960-1962 followed by slower exponential growth until 1970. The energy use pattern of Industry 28 (Fig. 9) exhibited rapid growth until 1955, followed by slower, exponential growth until 1970.

The validity of the linear extrapolation technique utilized to obtain specific fuel costs for the year 1970 is favorably reflected upon by the exponential growth exhibited by so many industries during the 1960s and 1970. In virtually every case [except Industries 25 (Fig. 6) and 30 (Fig. 11)] the total energy calculated for the year 1970 lies on the same straight line passing through total energy values for 1967 and 1965.

Major industrial energy consumers are determined to be: the Food and Kindred Products industry [Industry 20 (Fig. 3)] consuming 8% of the total purchased energy of the manufacturing industries in 1970 and exhibiting slow, erratic growth during the 1950s followed by more rapid, exponential growth for the period 1960-1967; the Petroleum and Coal Products industry [Industry 29 (Fig. 10)] accounting for 9% of the purchased energy consumption of the manufacturing industries during 1970 and exhibiting unsteady, rapid growth for the period 1954-1960, a slight decline between 1960 and 1962, and slower, exponential growth until 1970; the Stone, Clay, and Glass Products industry [Industry 32 (Fig. 13)] exhibiting slow growth until 1954, followed by rapid exponential growth for the period 1954-1970 consuming 9% of the energy purchased by all manufacturing industries during 1970; the Paper and Allied Products industry [Industry 26 (Fig. 7)] accounting for 9% of the purchased energy consumption of all manufacturing industries during 1970 and possessing an energy use pattern which is always exponential but which undergoes an increase in slope of the semilogarithmic plot during 1962; the Primary Metal Industries [Industry 33 (Fig. 14)] consuming a mammoth 21% of the energy purchased by all manufacturing industries during 1970 and exhibiting slow, unsteady energy consumption growth during the 1950s followed by exponential growth during the following decade; and the Chemical Industry likewise accounting for a huge 21% share of the energy purchased by the manufacturing industries during 1970 and exhibiting rapid growth until 1955 followed by slower, exponential growth through 1970 (see Table 3 for a complete tabulation).

3.2 The Chemical and Primary Metals Industries - A Closer View

The rapid growth in the energy consumption of the Chemical Industry during the early 1950s can be directly attributed to growth in purchased electricity by the Atomic Energy Commission (nuclear fuel production and processing is included in the Chemical Industry) (1):

Year	Purchased Electricity (kwh)	Purchased Electricity/(Efficiency of Generation, Transmission, and Distribution) (kwh)
1950	2.27×10^9	11.0×10^9
1955	47.1×10^9	158.6×10^9

Computed purchased energy values of the Annual Survey Years for the Chemical Industry (blackened circles on Fig. 9) were compared with values computed by the value added method (unshaded circles). Values differed by 14% for 1950 values, 5% for 1955 values, 1% for 1960 values, 4% for 1965 values, and 9% for 1970 values.

The relatively close agreement between energy values of the Chemical Industry determined by the value added method and the method generally used in this study substantiates the methodology used to obtain energy values

Table 3. Major Energy Consumers Among the Manufacturing Industries

Industry	$\left(\frac{\text{Purchased Energy Consumption of Industry}}{\text{Total Purchased Energy Consumptions of the Manufacturing Industries}}\right)_{1970}$ (%)	Purchased Energy Use Pattern
Food and Kindred Products	8	Slow, erratic growth during the 1950s; rapid, exponential growth during 1960-1970.
Petroleum and Coal Products	9	Unsteady, rapid growth during 1954-1960; slight decline between 1960-1962; slower, exponential growth until 1970.
Stone, Clay, and Glass Products	9	Slow, exponential growth until 1954; rapid, exponential growth for the period 1954-1970.
Paper and Allied Products	9	Slow, exponential growth until 1962; rapid, exponential growth until 1970.
Primary Metals	21	Slow, unsteady growth during the 1950s; exponential growth during the 1960s.
Chemical	21	Rapid growth until 1955; slower, exponential growth until 1970.

for the Annual Survey Years. In principle, the value added method is inferior to the method developed by the author since the value added method assumes energy use proportional to production figures while the author's technique deals with energy directly by considering fuel costs.

It should be noted that examination of data for the "All Manufacturing Industries" classification is dependent on revisions made in data for the Primary Metal industries for the Census Years of 1947 and 1954 (Appendix 7.3) and the Annual Survey Years of 1950 and 1955 (Appendix 7.4). In earlier years (before 1955) coke ovens and blast furnaces were not considered an integrated part of the Primary Metal industries, resulting in the incorporation of energy generated and consumed at the same establishment (e.g., coke from coke ovens) into the data. Sketchy information is available on exactly how much energy this represents but revisions were made based on the data available (Appendix 7.3).

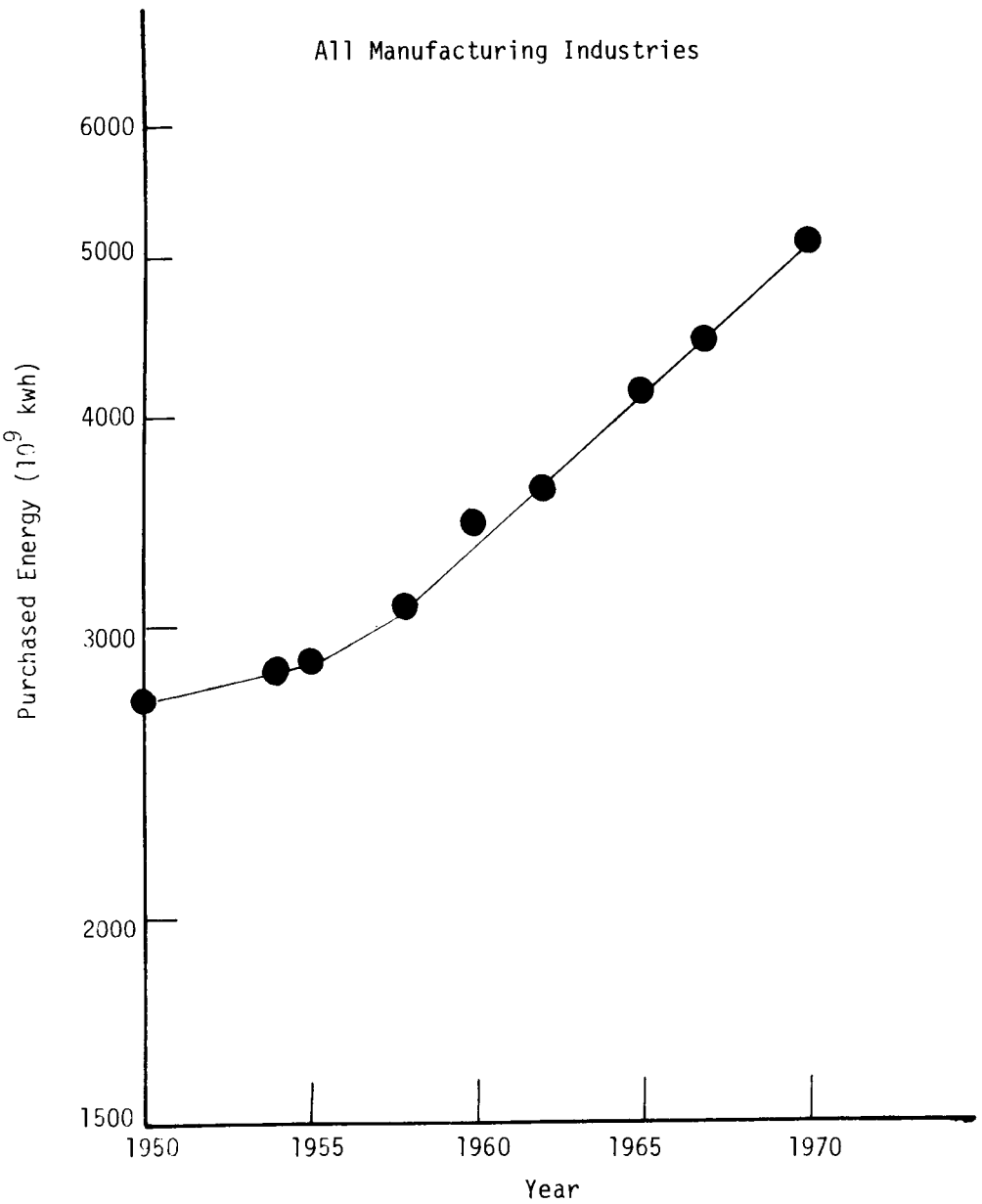
Examination of purchased energy consumption data for the Primary Metal Industries reveals a decline in purchased energy for the period 1950-1955; part of which can be attributed to the increased overall efficiency of electric energy generation, transmission, and distribution (20.7 - 27.2%) (Appendix 7.6). The sharp increase in efficiency would sharply affect corrected electrical energy values (purchased electric energy/efficiency) for the highly energy intensive aluminum industry.

Complete results in graphical and tabular form follow (refer to Figs. 2 through 18 and the computer output summarized in Table 4).

4. CONCLUSIONS

The analysis of incomplete data necessitated making a number of estimations and interpolations. Standardization of industrial classifications consisted of a simple bookkeeping method (e.g., transferring the Plastics Industry to the Rubber and Plastic Products Industry) in some cases and in a more complex situation making estimations of energy use for an industry for which no data were available (the Fluid Milk Industry in 1947). Purchased energy figures for the Annual Survey Years (1950, 1955, 1960, 1965, and 1970) were based on cost data available for those years and on interpolated specific fuel costs (1958 $/kwh) based on Census Years (1947, 1954, 1958, 1962, and 1967) figures. For the year 1970 specific cost data were estimated by linear extrapolation of the 1962 and 1967 census figures. Comparison of results obtained by the "specific cost" method developed by the author and the value added method (Appendix 7.7) indicated differences of 1-14% in total purchased energy values computed for the Chemical Industry for the Annual Survey Years.

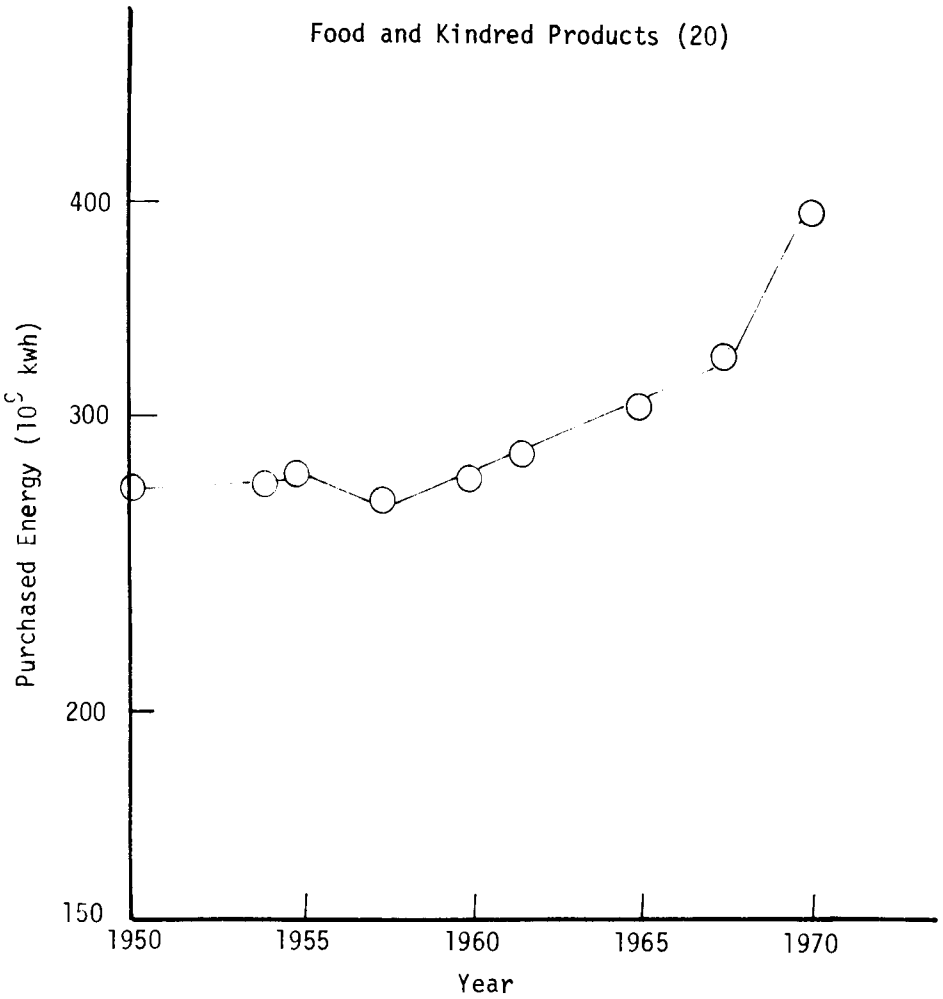
The classification "All Manufacturing Industries" exhibited exponential growth in energy consumption, the growth increasing at a more rapid rate for the period 1958-1970. Incomplete data were available for the Primary Metal Industries for the period before 1955, and estimation of energy use was based on the linear extrapolation of specific fuel costs for the years 1954 and 1947. The major industrial energy consumers and their use patterns are tabulated in Table 3.



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
ALL MANUFACTURING INDUSTRIES

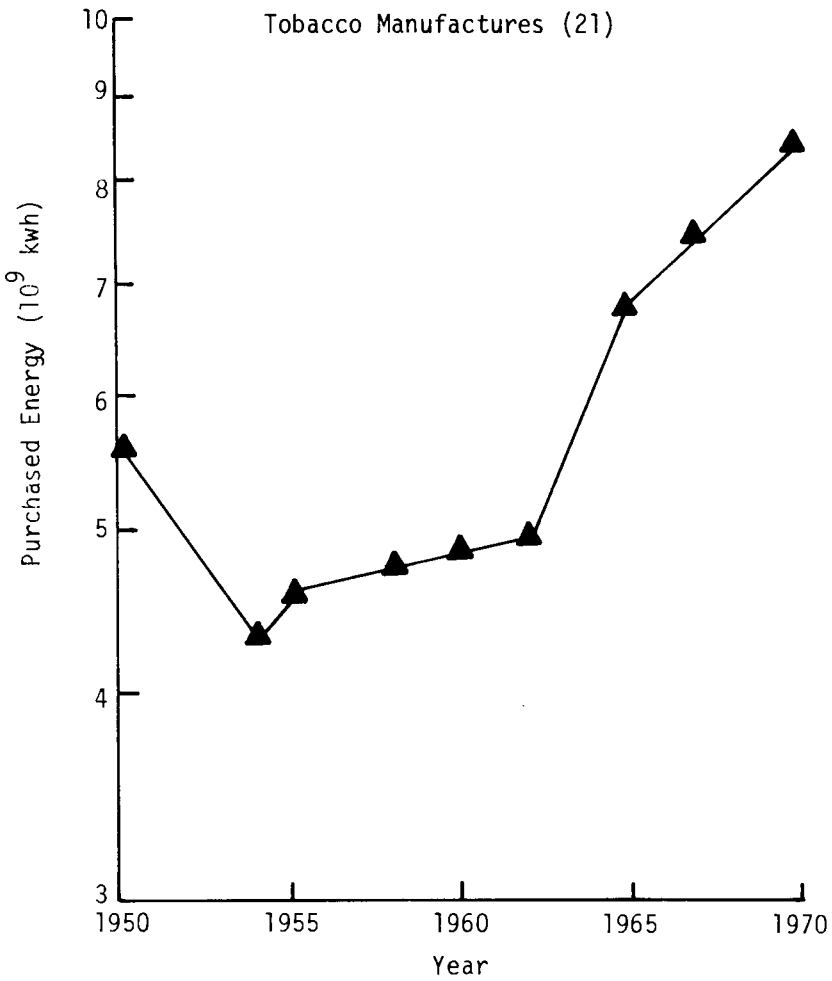
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	2



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
FOOD AND KINDRED PRODUCTS (20)

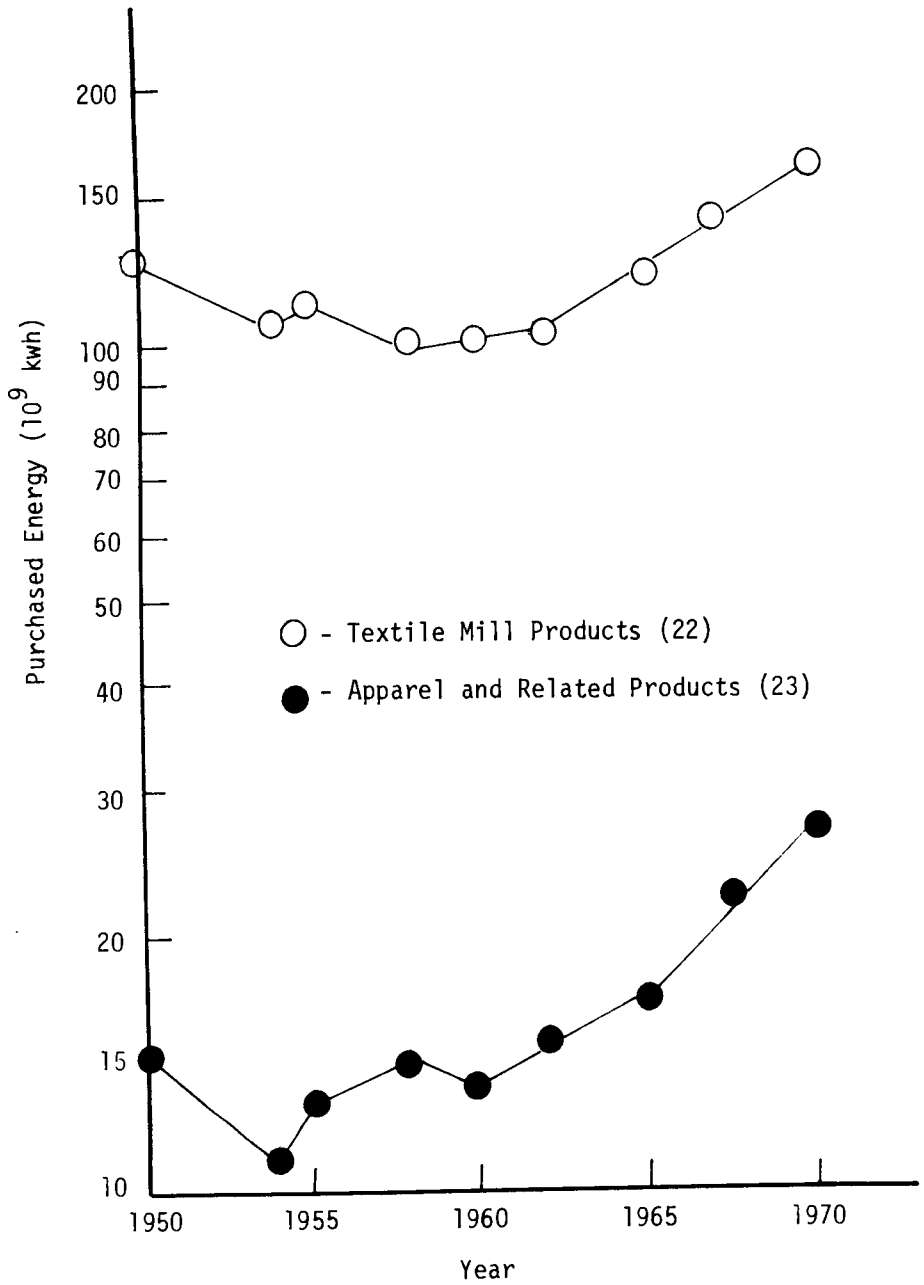
DATE	DRAWN BY	FILE NO.	F
3-26-73	GG	CEPS-X-169	3



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
TOBACCO MANUFACTURES (21)

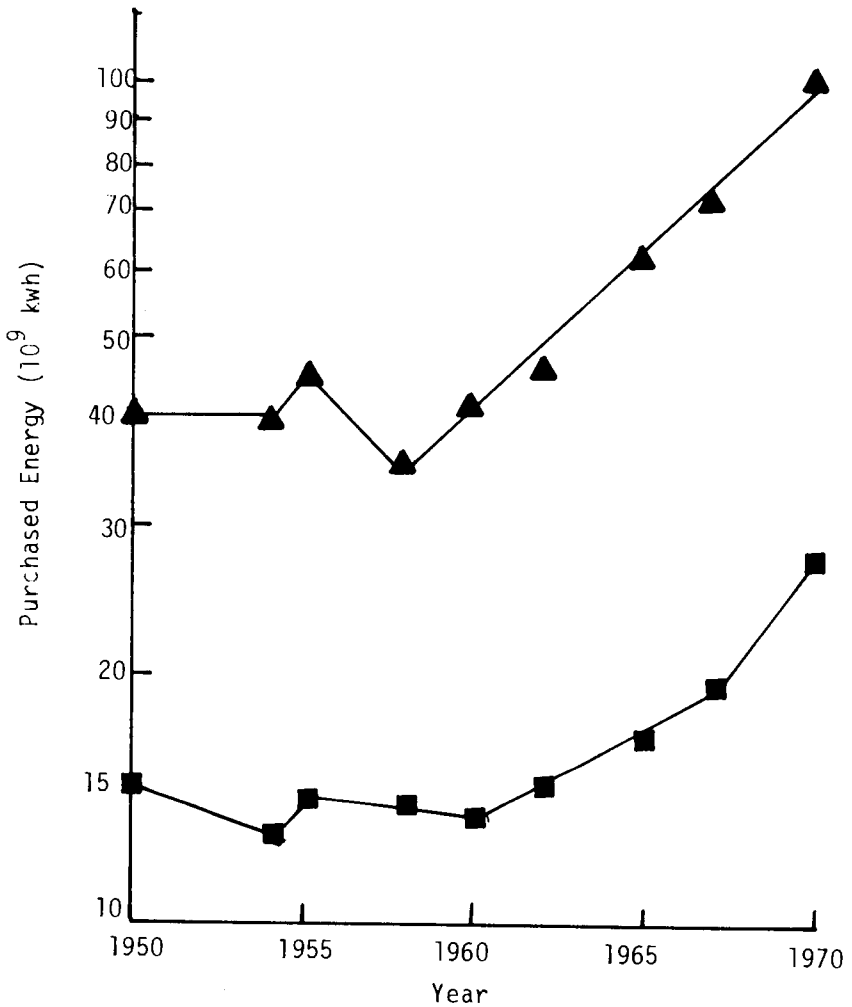
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	4



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
TEXTILE MILL PRODUCTS (22) AND
APPAREL AND RELATED PRODUCTS (23)

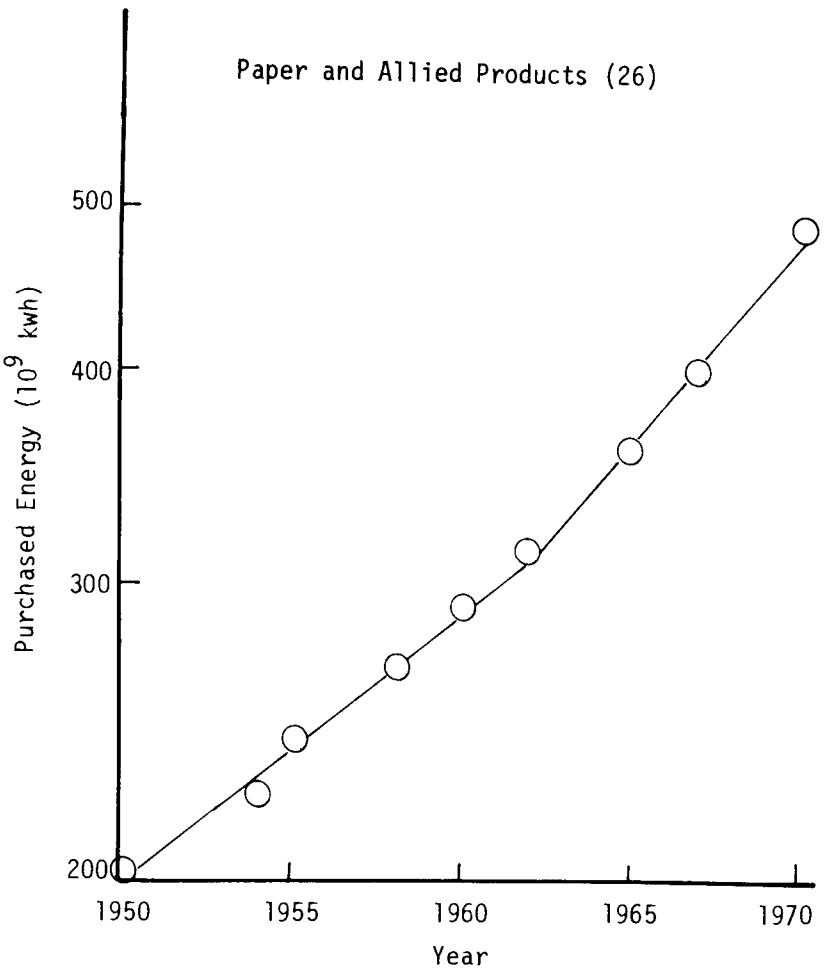
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	5



▲ - Lumber & Wood Products (24)

■ - Furniture & Fixtures (25)

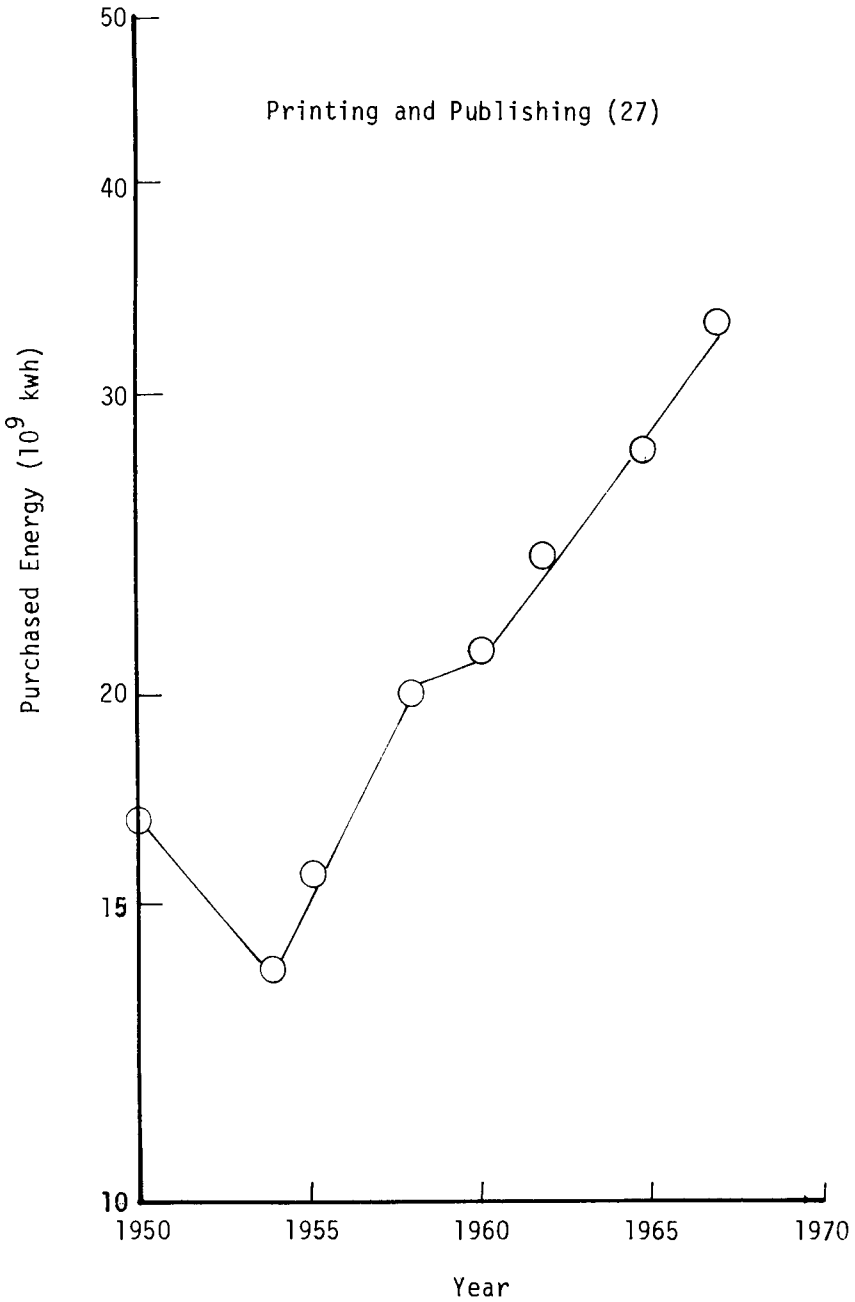
MASSACHUSETTS INSTITUTE OF TECHNOLOGY SCHOOL OF CHEMICAL ENGINEERING PRACTICE AT OAK RIDGE NATIONAL LABORATORY			
PURCHASED ENERGY - TIME HISTORY LUMBER & WOOD PRODUCTS (24) AND FURNITURE & FIXTURES (25)			
DATE 3-26-73	DRAWN BY GG	FILE NO. CEPS-X-169	FIG. 6



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
PAPER AND ALLIED PRODUCTS (26)

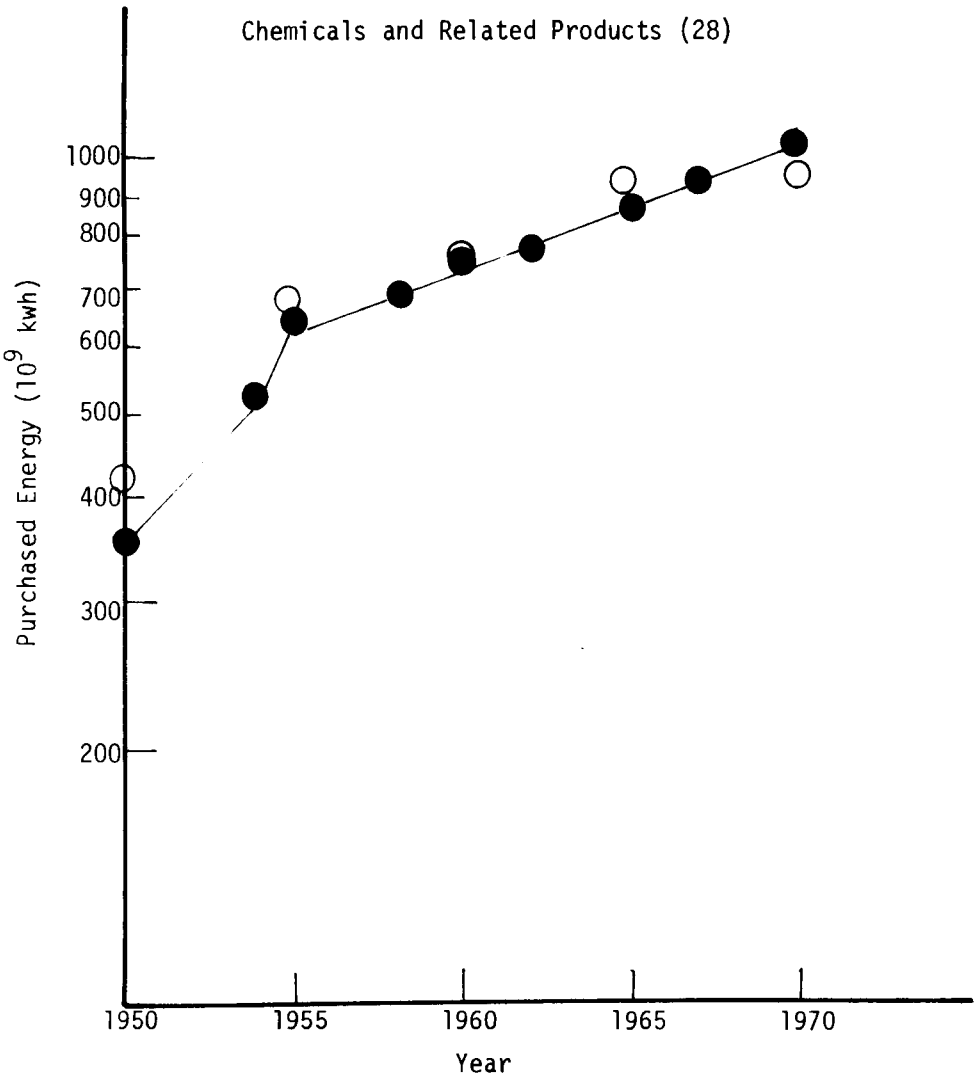
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	7



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
PRINTING AND PUBLISHING (27)

DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	8



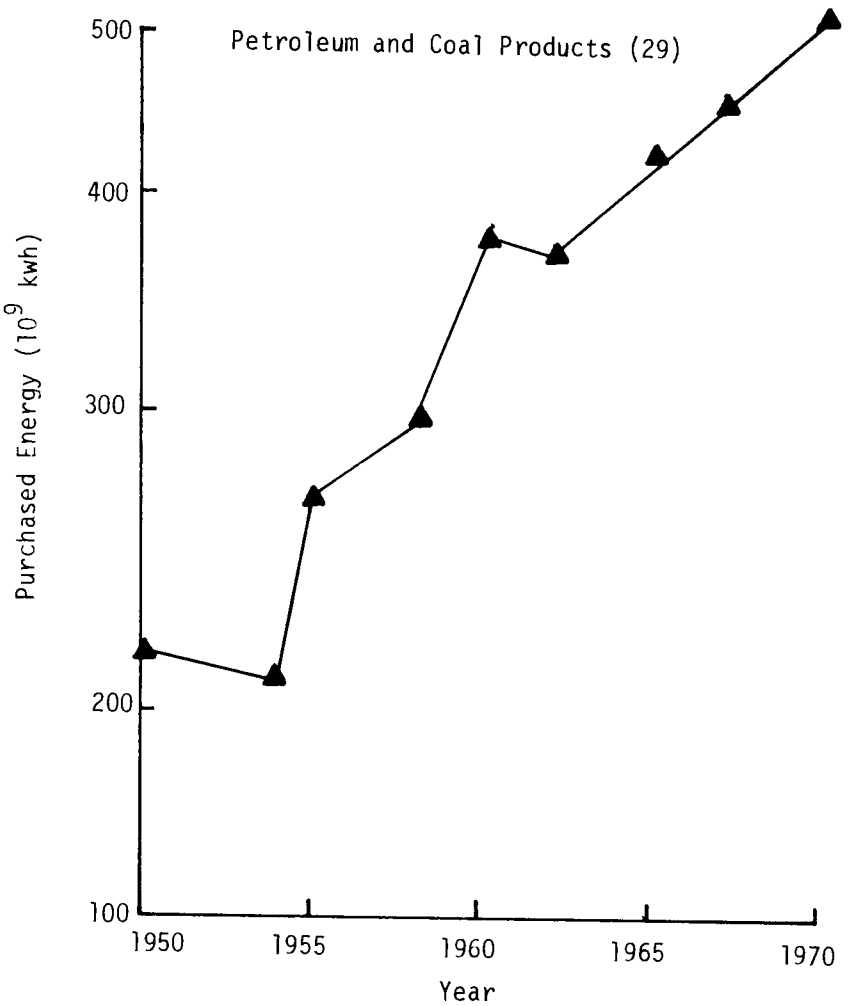
○ - Value added method

● - General method used

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
CHEMICALS AND RELATED PRODUCTS (28)

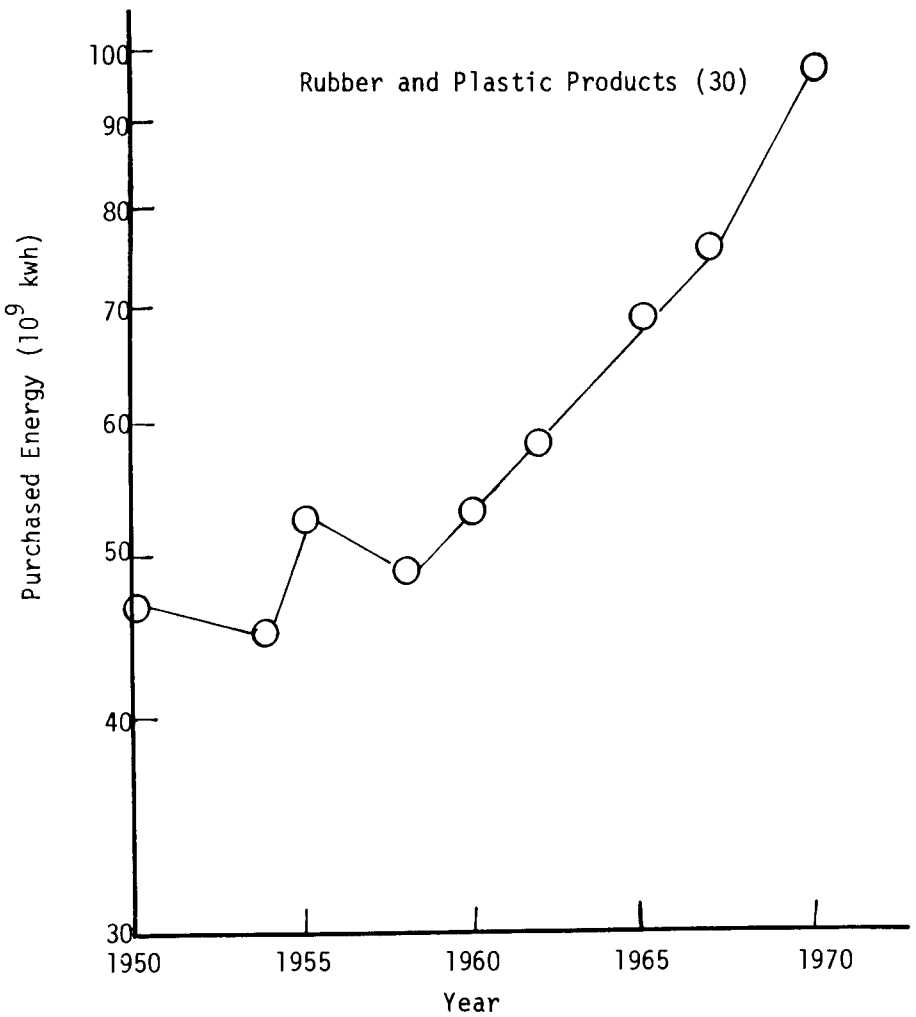
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	9



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
PETROLEUM AND COAL PRODUCTS (29)

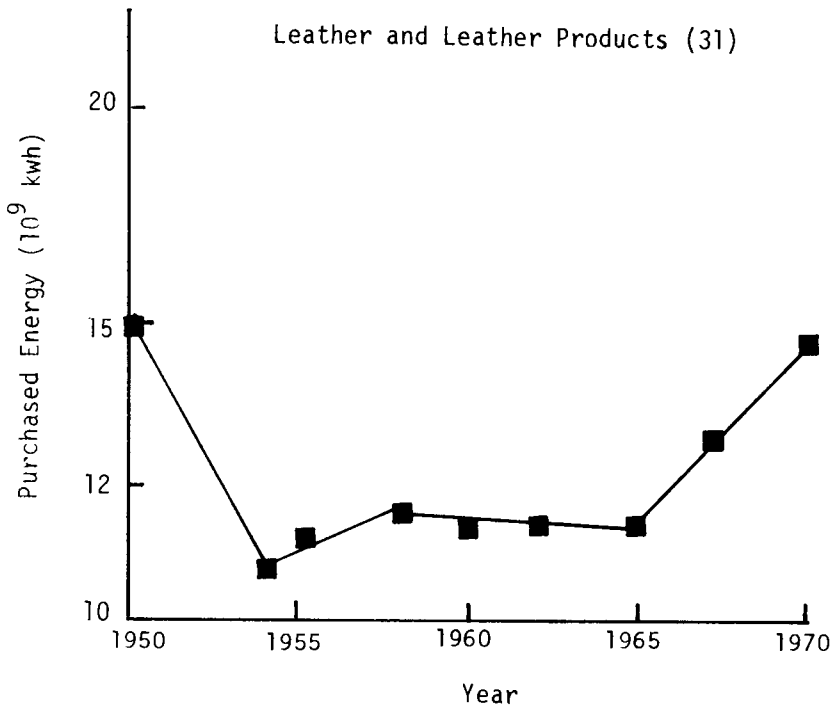
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	10



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
RUBBER AND PLASTIC PRODUCTS (30)

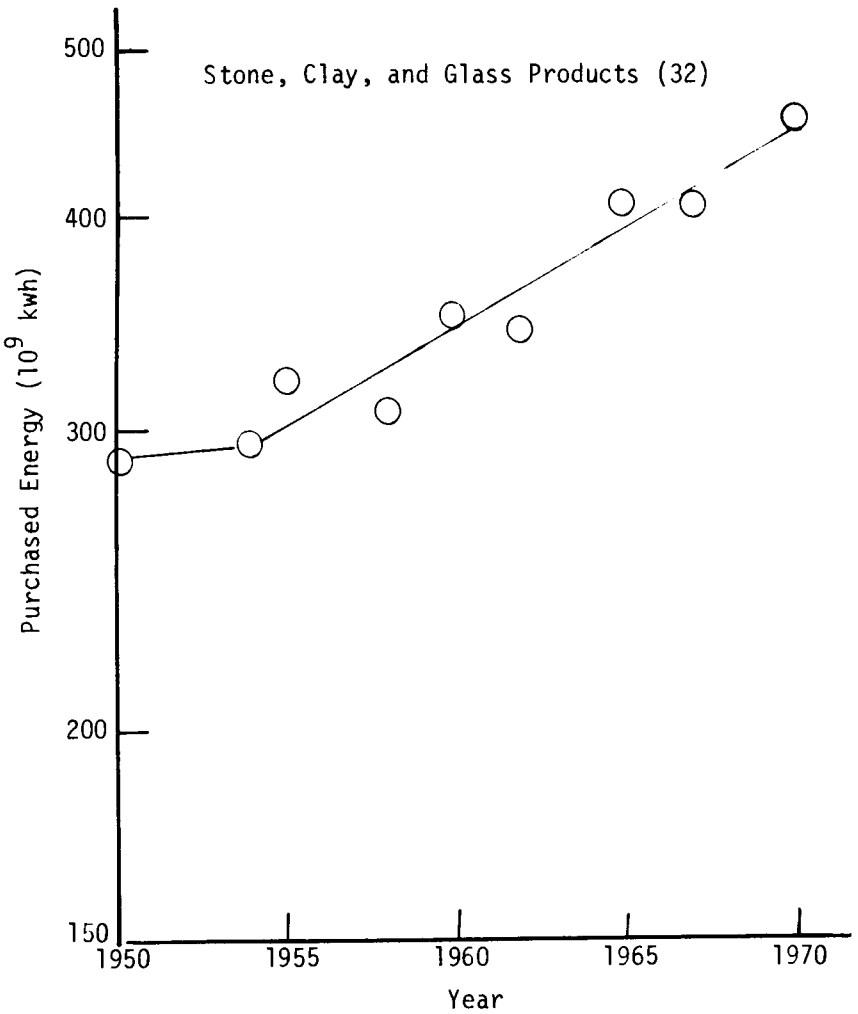
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	11



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
LEATHER AND LEATHER PRODUCTS (31)

DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	12

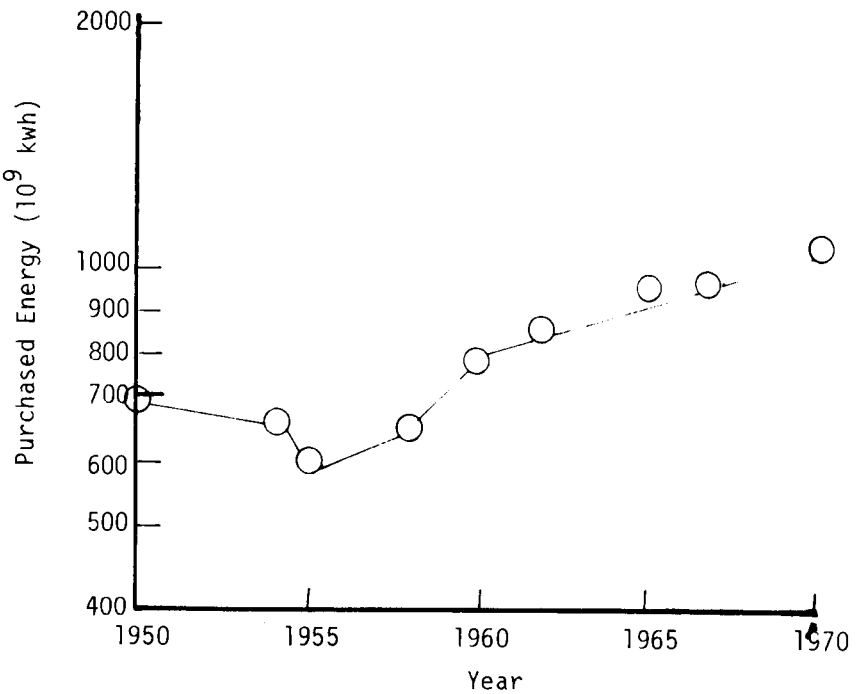


MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
STONE, CLAY, AND GLASS PRODUCTS (32)

DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	13

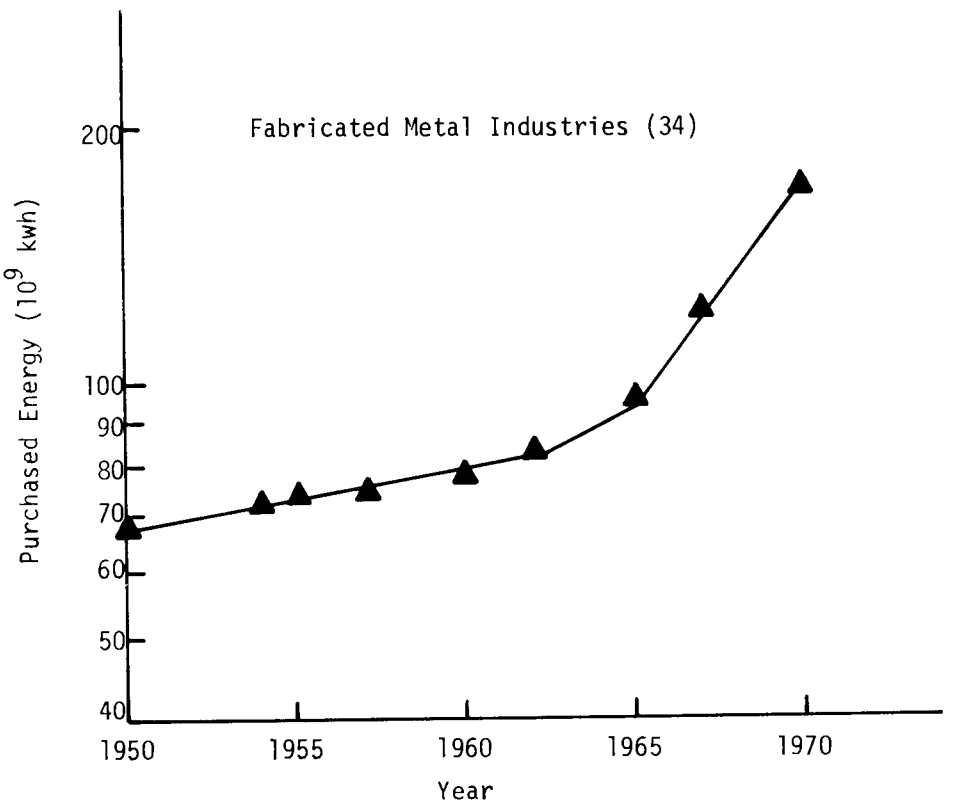
Primary Metal Industries (33)



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY TIME HISTORY
PRIMARY METAL INDUSTRIES (33)

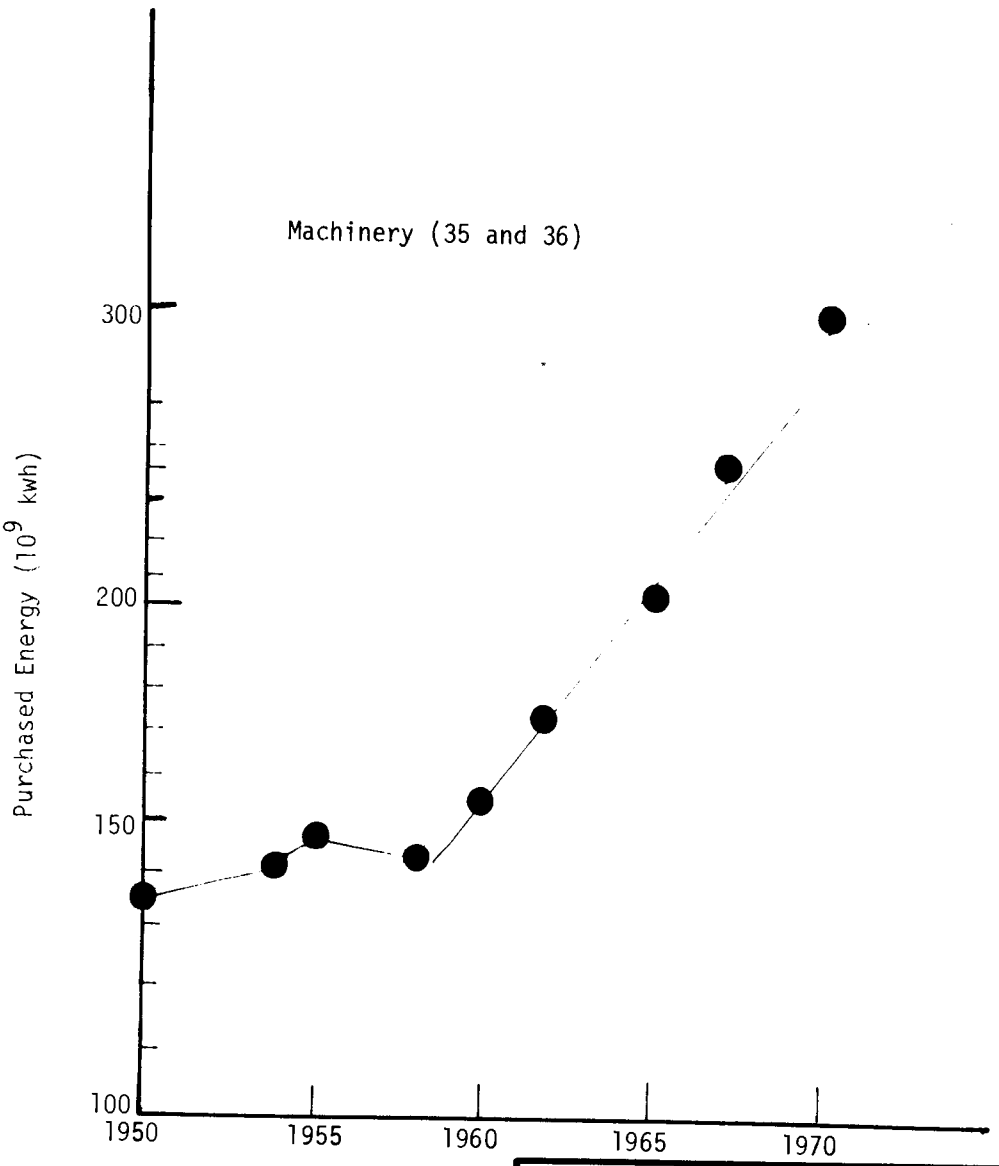
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	14



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
FABRICATED METAL INDUSTRIES (34)

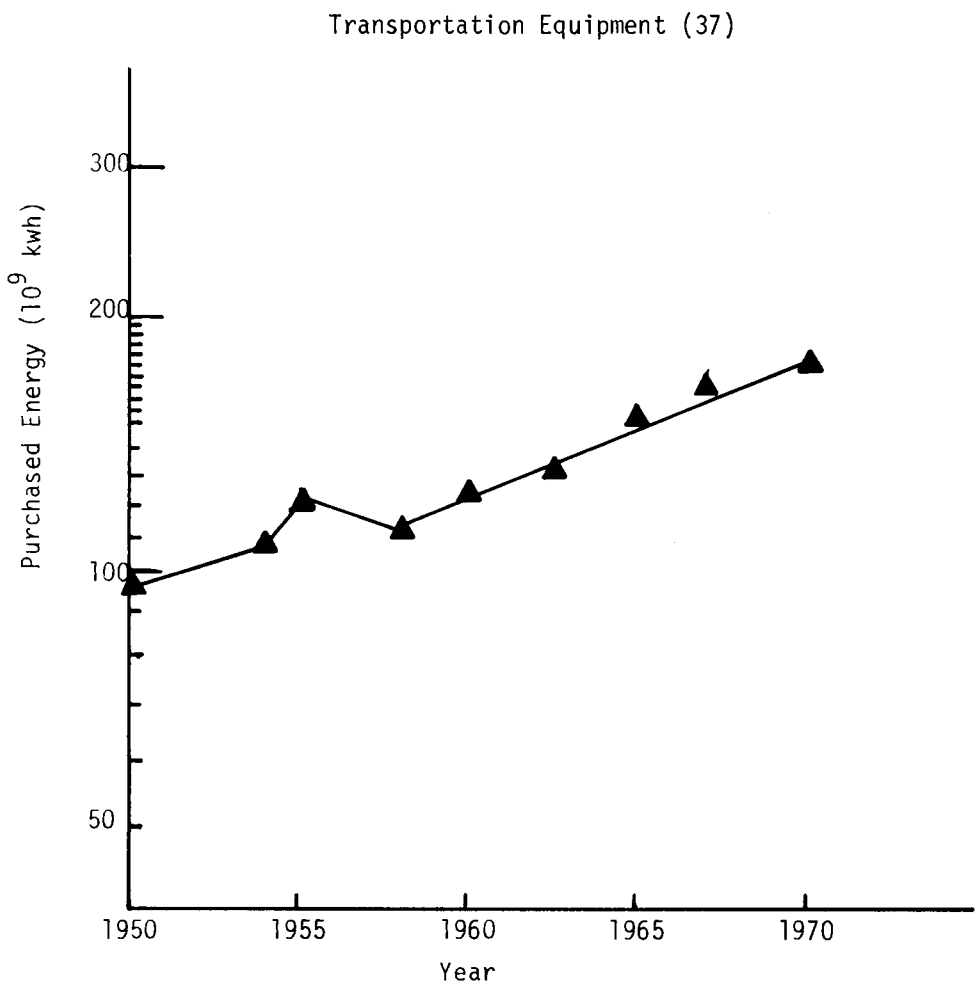
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	15



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
MACHINERY (35-36)

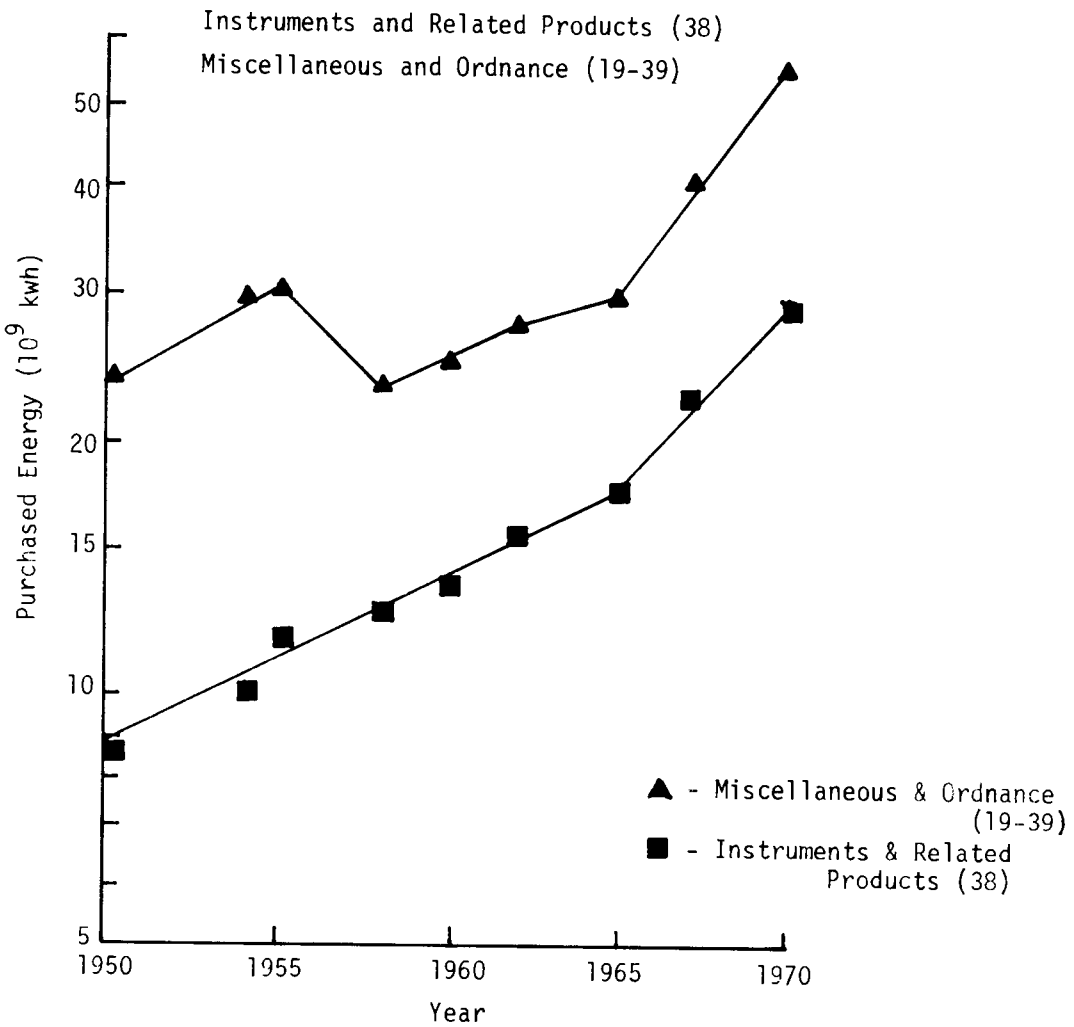
DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	16



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
TRANSPORTATION EQUIPMENT (37)

DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	GG	CEPS-X-169	17



MASSACHUSETTS INSTITUTE OF TECHNOLOGY
SCHOOL OF CHEMICAL ENGINEERING PRACTICE
AT
OAK RIDGE NATIONAL LABORATORY

PURCHASED ENERGY - TIME HISTORY
MISCELLANEOUS & ORDNANCE (19-39)
AND INSTRUMENTS & RELATED PRODUCTS (38)

DATE	DRAWN BY	FILE NO.	FIG.
3-26-73	SVD	CEPS-X-169	18

Table 4. Tabulation of Results - Census and Annual Survey Years

a. TABULATION OF RESULTS -- CENSUS YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958 $/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
	ALL MANUFACTURING INDUSTRIES	1947.	0.001371	112822.	552806.	1762870.	2315676.
	ALL MANUFACTURING INDUSTRIES	1954.	0.001359	187148.	767000.	2033064.	2800064.
	ALL MANUFACTURING INDUSTRIES	1958.	0.001310	252909.	929813.	2164400.	3094212.
	ALL MANUFACTURING INDUSTRIES	1962.	0.001243	313961.	1071539.	2561330.	3632869.
	ALL MANUFACTURING INDUSTRIES	1967.	0.001114	427465.	1434446.	3033942.	4468388.
20	FOOD + KINDRED PRODUCTS	1947.	0.001391	9463.	50876.	189082.	239958.
20	FOOD + KINDRED PRODUCTS	1954.	0.001237	12005.	49201.	224015.	273216.
20	FOOD + KINDRED PRODUCTS	1958.	0.001408	15778.	58007.	208767.	266774.
20	FOOD + KINDRED PRODUCTS	1962.	0.001423	19055.	65034.	216145.	281179.
20	FOOD + KINDRED PRODUCTS	1967.	0.001228	24401.	81883.	239254.	321137.
21	TOBACCO MANUFACTURES	1947.	0.001283	155.	833.	3991.	4824.
21	TOBACCO MANUFACTURES	1954.	0.001425	241.	988.	3388.	4376.
21	TOBACCO MANUFACTURES	1958.	0.001374	327.	1202.	3551.	4753.
21	TOBACCO MANUFACTURES	1962.	0.001376	398.	1358.	3573.	4931.
21	TOBACCO MANUFACTURES	1967.	0.001223	737.	2473.	4935.	7408.
22	TEXTILE MILL PRODUCTS	1947.	0.001614	8166.	43903.	66378.	110281.
22	TEXTILE MILL PRODUCTS	1954.	0.001368	10959.	44914.	62804.	107718.
22	TEXTILE MILL PRODUCTS	1958.	0.001523	11925.	43642.	55298.	99140.
22	TEXTILE MILL PRODUCTS	1962.	0.001393	14143.	48270.	59110.	107380.
22	TEXTILE MILL PRODUCTS	1967.	0.001248	20264.	68000.	72164.	140164.
23	APPAREL + RELATED PROD.	1947.	0.001790	904.	4860.	8205.	13065.
23	APPAREL + RELATED PROD.	1954.	0.002141	940.	3852.	6930.	10782.
23	APPAREL + RELATED PROD.	1958.	0.002023	1751.	6438.	7808.	14246.
23	APPAREL + RELATED PROD.	1962.	0.002427	2218.	7570.	7519.	15089.
23	APPAREL + RELATED PROD.	1967.	0.002263	3595.	12064.	10259.	22323.

a. TABULATION OF RESULTS -- CENSUS YEARS

INDUSTRY NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
24	LUMBER + WOOD PRODUCTS	1947.	0.003277	1522.	8183.	26225.	34408.
24	LUMBER + WOOD PRODUCTS	1954.	0.002404	3218.	13189.	26572.	39761.
24	LUMBER + WOOD PRODUCTS	1958.	0.003051	3404.	12515.	23039.	35554.
24	LUMBER + WOOD PRODUCTS	1962.	0.002760	4486.	15311.	30003.	45314.
24	LUMBER + WOOD PRODUCTS	1967.	0.002052	7297.	24487.	47696.	72183.
25	FURNITURE + FIXTURES	1947.	0.001399	738.	3968.	9866.	13834.
25	FURNITURE + FIXTURES	1954.	0.001558	1131.	4635.	8382.	13017.
25	FURNITURE + FIXTURES	1958.	0.001724	1391.	5114.	8641.	13755.
25	FURNITURE + FIXTURES	1962.	0.001812	1692.	5775.	8976.	14751.
25	FURNITURE + FIXTURES	1967.	0.001613	2474.	8301.	11071.	19372.
26	PAPER + ALLIED PRODUCTS	1947.	0.001250	6175.	33199.	156794.	189993.
26	PAPER + ALLIED PRODUCTS	1954.	0.001359	10852.	44475.	179194.	223669.
26	PAPER + ALLIED PRODUCTS	1958.	0.001190	12538.	46096.	223806.	269902.
26	PAPER + ALLIED PRODUCTS	1962.	0.001122	17052.	58198.	255123.	313321.
26	PAPER + ALLIED PRODUCTS	1967.	0.000998	25858.	86771.	313038.	399809.
27	PRINTING + PUBLISHING	1947.	0.002253	1251.	6726.	6715.	13441.
27	PRINTING + PUBLISHING	1954.	0.002605	1680.	6835.	6843.	13728.
27	PRINTING + PUBLISHING	1958.	0.002426	3009.	11063.	8987.	20050.
27	PRINTING + PUBLISHING	1962.	0.002230	4014.	13700.	10471.	24171.
27	PRINTING + PUBLISHING	1967.	0.002013	5817.	19520.	13558.	33078.
28	CHEMICALS + RELATED PROD.	1947.	0.001165	11963.	64317.	241780.	306097.
28	CHEMICALS + RELATED PROD.	1954.	0.001113	46255.	189570.	327883.	517453.
28	CHEMICALS + RELATED PROD.	1958.	0.000981	85564.	314574.	366318.	680892.
28	CHEMICALS + RELATED PROD.	1962.	0.000929	90355.	308379.	459767.	768146.
28	CHEMICALS + RELATED PROD.	1967.	0.000823	95414.	320180.	625624.	945804.

a. TABULATION OF RESULTS -- CENSUS YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
29	PETROLEUM + COAL PROD.	1947.	0.000486	3147.	16919.	148159.	165078.
29	PETROLEUM + COAL PROD.	1954.	0.000623	5863.	24029.	183607.	207636.
29	PETROLEUM + COAL PROD.	1958.	0.000702	9496.	34912.	263545.	298457.
29	PETROLEUM + COAL PROD.	1962.	0.000770	12652.	43181.	322808.	365989.
29	PETROLEUM + COAL PROD.	1967.	0.000792	18186.	61027.	390297.	451324.
30	RUBBER + PLASTIC PROD.	1947.	0.001169	3040.	16344.	32598.	48942.
30	RUBBER + PLASTIC PROD.	1954.	0.001185	3961.	16234.	29060.	45294.
30	RUBBER + PLASTIC PROD.	1958.	0.001263	4819.	17717.	31111.	48828.
30	RUBBER + PLASTIC PROD.	1962.	0.001223	6691.	22836.	35182.	58018.
30	RUBBER + PLASTIC PROD.	1967.	0.001134	10184.	34174.	43384.	77558.
31	LEATHER + LEATHER PROD.	1947.	0.001438	475.	2554.	10889.	13443.
31	LEATHER + LEATHER PROD.	1954.	0.001706	645.	2643.	7918.	10561.
31	LEATHER + LEATHER PROD.	1958.	0.001611	776.	2853.	8627.	11480.
31	LEATHER + LEATHER PROD.	1962.	0.001649	891.	3041.	8369.	11410.
31	LEATHER + LEATHER PROD.	1967.	0.001354	1288.	4322.	8477.	12799.
32	STONE, CLAY, + GLASS PROD	1947.	0.001160	5865.	31532.	232074.	263606.
32	STONE, CLAY, + GLASS PROD	1954.	0.001187	9157.	37529.	256134.	293663.
32	STONE, CLAY, + GLASS PROD	1958.	0.001276	12091.	44452.	264874.	309326.
32	STONE, CLAY, + GLASS PROD	1962.	0.001249	15538.	53031.	293960.	346991.
32	STONE, CLAY, + GLASS PROD	1967.	0.001092	19570.	65671.	340563.	406234.
33	PRIMARY METAL INDUSTRIES	1947.	0.001856	31428.	168968.	409733.	578701.
33	PRIMARY METAL INDUSTRIES	1954.	0.001663	47429.	194381.	486042.	680423.
33	PRIMARY METAL INDUSTRIES	1958.	0.001589	56663.	186261.	467795.	654056.
33	PRIMARY METAL INDUSTRIES	1962.	0.001378	71251.	243177.	603583.	846760.
33	PRIMARY METAL INDUSTRIES	1967.	0.001334	109469.	367346.	600456.	967802.

a. TABULATION OF RESULTS -- CENSUS YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958 $/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
34	FABRICATED METAL PROD.	1947.	0.001941	3739.	20102.	39043.	59145.
34	FABRICATED METAL PROD.	1954.	0.001860	5950.	24385.	46729.	71114.
34	FABRICATED METAL PROD.	1958.	0.001895	7130.	26213.	48432.	74645.
34	FABRICATED METAL PROD.	1962.	0.001938	8831.	30311.	53610.	83921.
34	FABRICATED METAL PROD.	1967.	0.001701	14694.	49309.	72564.	121873.
35	MACHINERY, EXCEPT ELECT.	1947.	0.001710	5401.	29038.	58054.	87092.
35	MACHINERY, EXCEPT ELECT.	1954.	0.001870	7581.	31070.	64628.	95698.
35	MACHINERY, EXCEPT ELECT.	1958.	0.001765	7603.	27952.	54004.	81956.
35	MACHINERY, EXCEPT ELECT.	1962.	0.001722	10330.	35256.	58688.	93944.
35	MACHINERY, EXCEPT ELECT.	1967.	0.001582	16659.	55903.	74607.	130510.
36	ELECTRICAL MACHINERY	1947.	0.001610	3156.	16968.	24599.	41567.
36	ELECTRICAL MACHINERY	1954.	0.001676	5134.	21041.	25028.	46069.
36	ELECTRICAL MACHINERY	1958.	0.001747	7688.	28265.	33483.	61748.
36	ELECTRICAL MACHINERY	1962.	0.001698	11699.	39928.	39081.	79009.
36	ELECTRICAL MACHINERY	1967.	0.001524	19013.	63802.	49951.	113753.
35+36	MACHINERY (IND. 35 + 36)	1947.	0.0	8557.	46005.	82653.	128658.
35+36	MACHINERY (IND. 35 + 36)	1954.	0.0	12715.	52111.	89656.	141767.
35+36	MACHINERY (IND. 35 + 36)	1958.	0.0	15291.	56217.	87487.	143704.
35+36	MACHINERY (IND. 35 + 36)	1962.	0.0	22029.	75134.	97769.	172953.
35+36	MACHINERY (IND. 35 + 36)	1967.	0.0	35672.	119705.	124558.	244263.

a. TABULATION OF RESULTS -- CENSUS YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
37	TRANSPORTATION EQUIPMENT	1947.	0.001450	5552.	29849.	59860.	89709.
37	TRANSPORTATION EQUIPMENT	1954.	0.001671	11118.	45566.	62529.	108095.
37	TRANSPORTATION EQUIPMENT	1958.	0.001556	13375.	49173.	64384.	113557.
37	TRANSPORTATION EQUIPMENT	1962.	0.001538	17490.	59693.	69380.	129073.
37	TRANSPORTATION EQUIPMENT	1967.	0.001437	23468.	78752.	83598.	162350.
38	INSTRUMENTS +RELATED PROD	1947.	0.001718	456.	2452.	4403.	6855.
38	INSTRUMENTS +RELATED PROD	1954.	0.001586	723.	2984.	7261.	10245.
38	INSTRUMENTS +RELATED PROD	1958.	0.001738	1083.	3982.	8284.	12266.
38	INSTRUMENTS +RELATED PROD	1962.	0.001734	1744.	5952.	9704.	15656.
38	INSTRUMENTS +RELATED PROD	1967.	0.001431	2493.	8365.	12900.	21266.
39+19	MISCELLANEOUS + ORDNANCE	1947.	0.001590	1013.	5446.	13809.	19255.
39+19	MISCELLANEOUS + ORDNANCE	1954.	0.001646	2502.	10254.	19237.	29491.
39+19	MISCELLANEOUS + ORDNANCE	1958.	0.001787	2498.	9184.	13879.	23063.
39+19	MISCELLANEOUS + ORDNANCE	1962.	0.001795	3382.	11543.	16277.	27820.
39+19	MISCELLANEOUS + ORDNANCE	1967.	0.001482	6583.	22091.	19545.	41636.

b. TABULATION OF RESULTS -- ANNUAL SURVEY YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	TOTAL FUEL COST ($*10**6)	CORRECTED TOTAL FUEL COST ($*10**6) (1958 $)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
	ALL MANUFACTURING INDUSTRIES	1950.	0.001365	2277.0	2840.6	134380.	649179.	2079697.	2728875.
	ALL MANUFACTURING INDUSTRIES	1955.	0.001347	2379.1	2613.1	233702.	909346.	1944040.	2853386.
	ALL MANUFACTURING INDUSTRIES	1960.	0.001275	3192.9	3091.2	291949.	1017244.	2424499.	3441743.
	ALL MANUFACTURING INDUSTRIES	1965.	0.001164	3727.3	3362.2	373428.	1270163.	2887482.	4157645.
	ALL MANUFACTURING INDUSTRIES	1970.	0.001038	4629.1	3569.4	508142.	1722515.	3437445.	5159960.
20	FOOD + KINDRED PRODUCTS	1950.	0.001325	227.6	283.9	11728.	56657.	214288.	270945.
20	FOOD + KINDRED PRODUCTS	1955.	0.001280	260.5	235.7	13025.	50681.	223991.	274672.
20	FOOD + KINDRED PRODUCTS	1960.	0.001415	310.3	300.4	17865.	62247.	212232.	274479.
20	FOOD + KINDRED PRODUCTS	1965.	0.001306	324.6	292.8	22185.	75459.	224181.	299641.
20	FOOD + KINDRED PRODUCTS	1970.	0.001111	423.0	312.7	32484.	110114.	281424.	391538.
21	TOBACCO MANUFACTURES	1950.	0.001344	5.1	6.3	187.	993.	4710.	5614.
21	TOBACCO MANUFACTURES	1955.	0.001412	4.4	4.9	282.	1097.	3468.	4565.
21	TOBACCO MANUFACTURES	1960.	0.001375	5.1	4.8	367.	1279.	3571.	4849.
21	TOBACCO MANUFACTURES	1965.	0.001284	6.6	5.9	613.	2085.	4624.	6709.
21	TOBACCO MANUFACTURES	1970.	0.001131	8.5	6.3	841.	2851.	5554.	8405.
22	TEXTILE MILL PRODUCTS	1950.	0.001509	91.5	114.1	10290.	49710.	75641.	125351.
22	TEXTILE MILL PRODUCTS	1955.	0.001407	86.4	95.1	11620.	45214.	67589.	112803.
22	TEXTILE MILL PRODUCTS	1960.	0.001458	84.9	82.2	13291.	46310.	56359.	102669.
22	TEXTILE MILL PRODUCTS	1965.	0.001306	93.4	84.2	16998.	57816.	64488.	122305.
22	TEXTILE MILL PRODUCTS	1970.	0.001161	132.3	97.8	23581.	79934.	84229.	164163.
23	APPAREL + RELATED PROD.	1950.	0.001940	14.2	17.7	1110.	5362.	9103.	14466.
23	APPAREL + RELATED PROD.	1955.	0.002111	15.9	17.5	1168.	4545.	8271.	12816.
23	APPAREL + RELATED PROD.	1960.	0.002225	16.0	15.5	1829.	6373.	6958.	13330.
23	APPAREL + RELATED PROD.	1965.	0.002329	20.3	18.3	2861.	9731.	7865.	17597.
23	APPAREL + RELATED PROD.	1970.	0.002165	34.6	25.6	4729.	16029.	11815.	27844.

b. TABULATION OF RESULTS -- ANNUAL SURVEY YEARS

INDUSTRY NO.	NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	TOTAL FUEL COST ($*10**6)	CORRECTED TOTAL FUEL COST ($*10**6) (1958 $)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
24	LUMBER + WOOD PRODUCTS	1950.	0.002903	66.9	83.5	2457.	11870.	28755.	40625.
24	LUMBER + WOOD PRODUCTS	1955.	0.002566	71.8	79.0	3708.	14428.	30780.	45208.
24	LUMBER + WOOD PRODUCTS	1960.	0.002905	79.8	77.3	3987.	13892.	26605.	40497.
24	LUMBER + WOOD PRODUCTS	1965.	0.002335	112.0	101.0	5673.	19296.	43271.	62567.
24	LUMBER + WOOD PRODUCTS	1970.	0.001627	147.1	108.7	10740.	36406.	66820.	103226.
25	FURNITURE + FIXTURES	1950.	0.001467	11.6	14.5	1046.	5053.	9865.	14918.
25	FURNITURE + FIXTURES	1955.	0.001599	13.3	14.6	1264.	4918.	9124.	14043.
25	FURNITURE + FIXTURES	1960.	0.001768	14.7	14.3	1579.	5502.	8074.	13576.
25	FURNITURE + FIXTURES	1965.	0.001693	17.9	16.1	2141.	7282.	9535.	16817.
25	FURNITURE + FIXTURES	1970.	0.001494	27.2	20.1	4086.	13849.	13461.	27310.
26	PAPER + ALLIED PRODUCTS	1950.	0.001297	174.4	217.6	7485.	36159.	167807.	203966.
26	PAPER + ALLIED PRODUCTS	1955.	0.001317	243.0	267.4	11102.	43198.	203068.	246266.
26	PAPER + ALLIED PRODUCTS	1960.	0.001156	280.7	271.7	15068.	52502.	235049.	287550.
26	PAPER + ALLIED PRODUCTS	1965.	0.001047	334.3	301.6	21474.	73041.	287947.	360988.
26	PAPER + ALLIED PRODUCTS	1970.	0.000923	462.7	342.0	33781.	114512.	370554.	485066.
27	PRINTING + PUBLISHING	1950.	0.002404	19.1	23.9	1455.	7029.	9937.	16965.
27	PRINTING + PUBLISHING	1955.	0.002560	19.4	21.4	1894.	7370.	8358.	15728.
27	PRINTING + PUBLISHING	1960.	0.002328	21.4	20.7	3479.	12122.	8891.	21013.
27	PRINTING + PUBLISHING	1965.	0.002100	26.9	24.3	4781.	16262.	11574.	27836.
27	PRINTING + PUBLISHING	1970.	0.001883	46.6	34.4	8990.	30474.	18294.	48768.
28	CHEMICALS + RELATED PROD.	1950.	0.001143	253.3	316.0	17474.	84415.	276531.	360946.
28	CHEMICALS + RELATED PROD.	1955.	0.001080	353.8	389.4	73637.	286525.	360449.	646974.
28	CHEMICALS + RELATED PROD.	1960.	0.000955	415.7	402.4	89230.	310906.	421410.	732316.
28	CHEMICALS + RELATED PROD.	1965.	0.000865	541.6	488.5	92083.	313208.	564590.	877797.
28	CHEMICALS + RELATED PROD.	1970.	0.000760	772.2	570.8	88752.	300856.	751216.	1052071.

b. TABULATION OF RESULTS -- ANNUAL SURVEY YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	TOTAL FUEL COST ($*10**6)	CORRECTED TOTAL FUEL COST ($*10**6) (1958 $)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
29	PETROLEUM + COAL PROD.	1950.	0.000544	96.3	107.7	3966.	19159.	197946.	217105.
29	PETROLEUM + COAL PROD.	1955.	0.000641	138.5	152.5	6778.	26374.	237975.	264348.
29	PETROLEUM + COAL PROD.	1960.	0.000736	253.2	245.1	11133.	38791.	333065.	371855.
29	PETROLEUM + COAL PROD.	1965.	0.000730	301.0	271.6	15191.	51670.	372209.	423879.
29	PETROLEUM + COAL PROD.	1970.	0.000662	384.4	284.1	22198.	75248.	429278.	504526.
30	RUBBER + PLASTIC PROD.	1950.	0.001176	28.2	35.2	3479.	16807.	29950.	46757.
30	RUBBER + PLASTIC PROD.	1955.	0.001204	36.4	40.0	4716.	18350.	33247.	51597.
30	RUBBER + PLASTIC PROD.	1960.	0.001243	41.4	40.1	5718.	19923.	32259.	52182.
30	RUBBER + PLASTIC PROD.	1965.	0.001170	51.5	46.5	8695.	29575.	39730.	69304.
30	RUBBER + PLASTIC PROD.	1970.	0.001081	74.0	54.7	14038.	47565.	50618.	98202.
31	LEATHER + LEATHER PROD.	1950.	0.001553	15.3	19.1	538.	2599.	12292.	14891.
31	LEATHER + LEATHER PROD.	1955.	0.001682	12.9	14.2	701.	2728.	8459.	11187.
31	LEATHER + LEATHER PROD.	1960.	0.001630	14.3	13.8	799.	2784.	8492.	11276.
31	LEATHER + LEATHER PROD.	1965.	0.001472	13.3	12.0	1057.	3595.	8142.	11737.
31	LEATHER + LEATHER PROD.	1970.	0.001177	14.8	10.9	1577.	5344.	9294.	14638.
32	STONE, CLAY, + GLASS PROD	1950.	0.001172	236.5	295.0	7632.	36870.	251828.	288698.
32	STONE, CLAY, + GLASS PROD	1955.	0.001209	306.7	337.5	10331.	40198.	279104.	319303.
32	STONE, CLAY, + GLASS PROD	1960.	0.001262	392.9	380.4	14403.	50185.	301323.	351507.
32	STONE, CLAY, + GLASS PROD	1965.	0.001155	437.3	394.5	18671.	63507.	341623.	405130.
32	STONE, CLAY, + GLASS PROD	1970.	0.000998	511.9	378.4	24070.	81592.	379207.	460799.
33	PRIMARY METAL INDUSTRIES	1950.	0.001773	721.3	899.8	40722.	196725.	507434.	704158.
33	PRIMARY METAL INDUSTRIES	1955.	0.001644	565.8	622.6	55784.	217058.	378624.	595683.
33	PRIMARY METAL INDUSTRIES	1960.	0.001483	858.6	831.3	65679.	228847.	560358.	789205.
33	PRIMARY METAL INDUSTRIES	1965.	0.001352	968.5	873.7	93023.	316405.	646396.	962801.
33	PRIMARY METAL INDUSTRIES	1970.	0.001308	1103.9	816.0	127885.	433508.	624007.	1057514.

b. TABULATION OF RESULTS -- ANNUAL SURVEY YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	TOTAL FUEL COST ($*10**6)	CORRECTED TOTAL FUEL COST ($*10**6) (1958 $)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
34	FABRICATED METAL PROD.	1950.	0.001906	69.6	86.8	4717.	22787.	45555.	68342.
34	FABRICATED METAL PROD.	1955.	0.001869	80.3	88.4	6555.	25506.	47307.	72812.
34	FABRICATED METAL PROD.	1960.	0.001915	95.2	92.2	8167.	28456.	48113.	76569.
34	FABRICATED METAL PROD.	1965.	0.001796	114.1	102.9	11131.	37861.	57314.	95175.
34	FABRICATED METAL PROD.	1970.	0.001559	174.8	129.2	25969.	88029.	82887.	170916.
35	MACHINERY, EXCEPT ELECT.	1950.	0.001779	85.2	106.3	6016.	29063.	59774.	88837.
35	MACHINERY, EXCEPT ELECT.	1955.	0.001844	114.9	126.4	8531.	33195.	68576.	101771.
35	MACHINERY, EXCEPT ELECT.	1960.	0.001743	97.4	94.3	9182.	31993.	54059.	86052.
35	MACHINERY, EXCEPT ELECT.	1965.	0.001638	115.8	104.5	13362.	45449.	63779.	109228.
35	MACHINERY, EXCEPT ELECT.	1970.	0.001498	166.5	123.1	22823.	77366.	82156.	159522.
36	ELECTRICAL MACHINERY	1950.	0.001638	33.6	42.0	3874.	18715.	25617.	44332.
36	ELECTRICAL MACHINERY	1955.	0.001694	39.3	43.2	5527.	21506.	25507.	47013.
36	ELECTRICAL MACHINERY	1960.	0.001722	63.5	61.5	9767.	34031.	35681.	69713.
36	ELECTRICAL MACHINERY	1965.	0.001594	76.1	68.6	15042.	51163.	43054.	94217.
36	ELECTRICAL MACHINERY	1970.	0.001420	107.3	79.3	24397.	82702.	55869.	138571.
35+36	MACHINERY (IND. 35 + 36)	1950.	0.0	0.0	0.0	9890.	47778.	85391.	133168.
35+36	MACHINERY (IND. 35 + 36)	1955.	0.0	0.0	0.0	14058.	54700.	94083.	148784.
35+36	MACHINERY (IND. 35 + 36)	1960.	0.0	0.0	0.0	18949.	66024.	89740.	155765.
35+36	MACHINERY (IND. 35 + 36)	1965.	0.0	0.0	0.0	28434.	96612.	106833.	203445.
35+36	MACHINERY (IND. 35 + 36)	1970.	0.0	0.0	0.0	47220.	160068.	138024.	298093.

b. TABULATION OF RESULTS -- ANNUAL SURVEY YEARS

INDUSTRY NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	TOTAL FUEL COST ($*10**6)	CORRECTED TOTAL FUEL COST ($*10**6) (1958 $)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
37	TRANSPORTATION EQUIPMENT	1950.	0.001545	77.0	96.0	7206.	34812.	62155.	96967.
37	TRANSPORTATION EQUIPMENT	1955.	0.001642	101.0	111.2	13555.	52743.	67694.	120437.
37	TRANSPORTATION EQUIPMENT	1960.	0.001547	106.5	103.1	15979.	55676.	66652.	122328.
37	TRANSPORTATION EQUIPMENT	1965.	0.001477	127.6	115.1	22102.	75177.	77882.	153059.
37	TRANSPORTATION EQUIPMENT	1970.	0.001376	160.1	118.3	25747.	87278.	85977.	173255.
38	INSTRUMENTS +RELATED PROD	1950.	0.001661	8.0	10.0	556.	2686.	5989.	8675.
38	INSTRUMENTS +RELATED PROD	1955.	0.001624	11.6	12.8	820.	3191.	7860.	11051.
38	INSTRUMENTS +RELATED PROD	1960.	0.001736	14.9	14.4	1439.	5014.	8307.	13321.
38	INSTRUMENTS +RELATED PROD	1965.	0.001552	18.1	16.3	2030.	6905.	10502.	17406.
38	INSTRUMENTS +RELATED PROD	1970.	0.001249	23.3	20.9	3538.	11994.	16745.	28739.
39+19	MISCELLANEOUS + ORDNANCE	1950.	0.001614	21.2	26.5	1487.	7184.	16409.	23593.
39+19	MISCELLANEOUS + ORDNANCE	1955.	0.001681	29.2	32.1	2586.	10062.	19120.	29182.
39+19	MISCELLANEOUS + ORDNANCE	1960.	0.001791	26.5	25.6	2988.	10411.	14303.	24714.
39+19	MISCELLANEOUS + ORDNANCE	1965.	0.001607	26.3	23.8	4315.	14677.	14785.	29462.
39+19	MISCELLANEOUS + ORDNANCE	1970.	0.001294	48.9	36.1	7918.	26841.	27928.	54769.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS
(Tables 4a and 4b combined for comparison)

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
	ALL MANUFACTURING INDUSTRIES	1947.	0.001371	102322.	552876.	1762870.	2315676.
	ALL MANUFACTURING INDUSTRIES	1950.	0.001366	134380.	649179.	2079697.	2728875.
	ALL MANUFACTURING INDUSTRIES	1954.	0.001359	167148.	767000.	2033064.	2800064.
	ALL MANUFACTURING INDUSTRIES	1955.	0.001347	233702.	909346.	1944040.	2853386.
	ALL MANUFACTURING INDUSTRIES	1956.	0.001310	252909.	929813.	2164400.	3094212.
	ALL MANUFACTURING INDUSTRIES	1960.	0.001275	291949.	1017244.	2424499.	3441743.
	ALL MANUFACTURING INDUSTRIES	1962.	0.001240	313961.	1071539.	2561330.	3632869.
	ALL MANUFACTURING INDUSTRIES	1965.	0.001164	373428.	1270163.	2887482.	4157645.
	ALL MANUFACTURING INDUSTRIES	1967.	0.001114	427465.	1434446.	3033942.	4468388.
	ALL MANUFACTURING INDUSTRIES	1970.	0.001038	528142.	1722515.	3437445.	5159960.
20	FOOD + KINDRED PRODUCTS	1947.	0.001391	9463.	50876.	189082.	239958.
20	FOOD + KINDRED PRODUCTS	1950.	0.001325	11728.	56657.	214288.	270945.
20	FOOD + KINDRED PRODUCTS	1954.	0.001237	12005.	49201.	224015.	273216.
20	FOOD + KINDRED PRODUCTS	1955.	0.001280	13025.	50681.	223991.	274672.
20	FOOD + KINDRED PRODUCTS	1958.	0.001408	15778.	58007.	208767.	266774.
20	FOOD + KINDRED PRODUCTS	1960.	0.001415	17865.	62247.	212232.	274479.
20	FOOD + KINDRED PRODUCTS	1962.	0.001423	19055.	65034.	216145.	281179.
20	FOOD + KINDRED PRODUCTS	1965.	0.001306	22185.	75459.	224181.	299641.
20	FOOD + KINDRED PRODUCTS	1967.	0.001228	24431.	81833.	239254.	321137.
20	FOOD + KINDRED PRODUCTS	1970.	0.001111	32484.	110114.	281424.	391538.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
21	TOBACCO MANUFACTURES	1947.	0.001283	155.	833.	3991.	4824.
21	TOBACCO MANUFACTURES	1950.	0.001344	187.	903.	4710.	5614.
21	TOBACCO MANUFACTURES	1952.	0.001425	241.	983.	3388.	4376.
21	TOBACCO MANUFACTURES	1955.	0.001412	232.	1097.	3468.	4565.
21	TOBACCO MANUFACTURES	1958.	0.001374	327.	1202.	3551.	4753.
21	TOBACCO MANUFACTURES	1960.	0.001375	367.	1279.	3571.	4849.
21	TOBACCO MANUFACTURES	1962.	0.001376	398.	1358.	3573.	4931.
21	TOBACCO MANUFACTURES	1965.	0.001284	613.	2085.	4624.	6709.
21	TOBACCO MANUFACTURES	1967.	0.001223	737.	2473.	4935.	7408.
21	TOBACCO MANUFACTURES	1970.	0.001131	841.	2851.	5554.	8405.
22	TEXTILE MILL PRODUCTS	1947.	0.001614	8166.	43903.	66378.	110281.
22	TEXTILE MILL PRODUCTS	1950.	0.001509	10290.	49710.	75641.	125351.
22	TEXTILE MILL PRODUCTS	1954.	0.001368	10959.	44914.	62804.	107718.
22	TEXTILE MILL PRODUCTS	1955.	0.001407	11620.	45214.	67589.	112803.
22	TEXTILE MILL PRODUCTS	1958.	0.001523	11925.	43842.	55298.	99140.
22	TEXTILE MILL PRODUCTS	1960.	0.001458	13291.	46310.	56359.	102669.
22	TEXTILE MILL PRODUCTS	1962.	0.001393	14143.	48270.	59110.	107380.
22	TEXTILE MILL PRODUCTS	1965.	0.001306	16998.	57816.	64488.	122305.
22	TEXTILE MILL PRODUCTS	1967.	0.001243	20264.	68000.	72164.	140164.
22	TEXTILE MILL PRODUCTS	1970.	0.001161	23581.	79934.	84229.	164163.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

INDUSTRY NO.	NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
23	APPAREL + RELATED PROD.	1947.	0.001790	904.	4860.	8205.	13065.
23	APPAREL + RELATED PROD.	1950.	0.001940	1110.	5362.	9103.	14466.
23	APPAREL + RELATED PROD.	1954.	0.002141	940.	3852.	6930.	10782.
23	APPAREL + RELATED PROD.	1955.	0.002111	1168.	4545.	8271.	12816.
23	APPAREL + RELATED PROD.	1958.	0.002023	1751.	6438.	7808.	14246.
23	APPAREL + RELATED PROD.	1959.	0.002225	1829.	6373.	6958.	13330.
23	APPAREL + RELATED PROD.	1962.	0.002427	2218.	7570.	7519.	15089.
23	APPAREL + RELATED PROD.	1965.	0.002329	2861.	9731.	7865.	17597.
23	APPAREL + RELATED PROD.	1967.	0.002263	3595.	12064.	10259.	22323.
23	APPAREL + RELATED PROD.	1970.	0.002165	4729.	16029.	11815.	27844.
24	LUMBER + WOOD PRODUCTS	1947.	0.003277	1522.	8183.	26225.	34408.
24	LUMBER + WOOD PRODUCTS	1950.	0.002935	2457.	11870.	28755.	40625.
24	LUMBER + WOOD PRODUCTS	1954.	0.002404	3218.	13189.	26572.	39761.
24	LUMBER + WOOD PRODUCTS	1955.	0.002566	3708.	14428.	30780.	45208.
24	LUMBER + WOOD PRODUCTS	1958.	0.003051	3494.	12515.	23039.	35554.
24	LUMBER + WOOD PRODUCTS	1960.	0.002905	3987.	13892.	26605.	40497.
24	LUMBER + WOOD PRODUCTS	1962.	0.002760	4486.	15311.	30003.	45314.
24	LUMBER + WOOD PRODUCTS	1965.	0.002335	5573.	19236.	43271.	62567.
24	LUMBER + WOOD PRODUCTS	1967.	0.002052	7297.	24487.	47696.	72183.
24	LUMBER + WOOD PRODUCTS	1970.	0.001627	10740.	36406.	66820.	103226.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
25	FURNITURE + FIXTURES	1947.	0.001399	738.	3968.	9866.	13834.
25	FURNITURE + FIXTURES	1950.	0.001467	1046.	5053.	9865.	14918.
25	FURNITURE + FIXTURES	1954.	0.001558	1131.	4635.	8382.	13017.
25	FURNITURE + FIXTURES	1955.	0.001599	1264.	4918.	9124.	14043.
25	FURNITURE + FIXTURES	1958.	0.001724	1391.	5114.	8641.	13755.
25	FURNITURE + FIXTURES	1960.	0.001768	1579.	5502.	8074.	13576.
25	FURNITURE + FIXTURES	1962.	0.001812	1692.	5775.	8976.	14751.
25	FURNITURE + FIXTURES	1965.	0.001693	2141.	7282.	9535.	16817.
25	FURNITURE + FIXTURES	1967.	0.001613	2474.	8301.	11071.	19372.
25	FURNITURE + FIXTURES	1970.	0.001494	4086.	13849.	13461.	27310.
26	PAPER + ALLIED PRODUCTS	1947.	0.001251	6175.	33199.	156794.	189993.
26	PAPER + ALLIED PRODUCTS	1950.	0.001297	7485.	36159.	167807.	203966.
26	PAPER + ALLIED PRODUCTS	1954.	0.001359	10852.	44475.	179194.	223669.
26	PAPER + ALLIED PRODUCTS	1955.	0.001317	11192.	43198.	203068.	246266.
26	PAPER + ALLIED PRODUCTS	1958.	0.001190	12538.	46096.	223806.	269902.
26	PAPER + ALLIED PRODUCTS	1960.	0.001155	13068.	52502.	235049.	287550.
26	PAPER + ALLIED PRODUCTS	1962.	0.001122	17052.	58198.	255123.	313321.
26	PAPER + ALLIED PRODUCTS	1965.	0.001047	21474.	73041.	287947.	360988.
26	PAPER + ALLIED PRODUCTS	1967.	0.000998	25858.	86771.	313038.	399809.
26	PAPER + ALLIED PRODUCTS	1970.	0.000923	33781.	114512.	370554.	485066.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

INDUSTRY NO.	NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
27	PRINTING + PUBLISHING	1947.	0.002253	1251.	6726.	6715.	13441.
27	PRINTING + PUBLISHING	1950.	0.002404	1455.	7029.	9937.	16965.
27	PRINTING + PUBLISHING	1954.	0.002605	1680.	6885.	6843.	13728.
27	PRINTING + PUBLISHING	1955.	0.002560	1894.	7370.	8358.	15728.
27	PRINTING + PUBLISHING	1958.	0.002426	3009.	11063.	8987.	20050.
27	PRINTING + PUBLISHING	1960.	0.002328	3479.	12122.	8891.	21013.
27	PRINTING + PUBLISHING	1962.	0.002230	4014.	13700.	10471.	24171.
27	PRINTING + PUBLISHING	1965.	0.002100	4781.	16262.	11574.	27836.
27	PRINTING + PUBLISHING	1967.	0.002013	5817.	19520.	13558.	33078.
27	PRINTING + PUBLISHING	1970.	0.001883	6990.	30474.	18294.	48768.
28	CHEMICALS + RELATED PROD.	1947.	0.001165	11963.	64317.	241780.	306097.
28	CHEMICALS + RELATED PROD.	1950.	0.001143	17474.	84415.	276531.	360946.
28	CHEMICALS + RELATED PROD.	1954.	0.001113	46255.	189570.	327883.	517453.
28	CHEMICALS + RELATED PROD.	1955.	0.001080	73637.	286525.	360449.	646974.
28	CHEMICALS + RELATED PROD.	1958.	0.000981	85564.	314574.	366318.	680892.
28	CHEMICALS + RELATED PROD.	1960.	0.000955	89234.	310906.	421410.	732316.
28	CHEMICALS + RELATED PROD.	1962.	0.000929	90355.	308379.	459767.	768146.
28	CHEMICALS + RELATED PROD.	1965.	0.000865	92083.	313208.	564590.	877797.
28	CHEMICALS + RELATED PROD.	1967.	0.000823	95414.	320180.	625624.	945804.
28	CHEMICALS + RELATED PROD.	1970.	0.000760	88752.	300856.	751216.	1052071.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
29	PETROLEUM + COAL PROD.	1947.	0.000486	3147.	16919.	143159.	165078.
29	PETROLEUM + COAL PROD.	1950.	0.000544	3966.	19159.	197946.	217105.
29	PETROLEUM + COAL PROD.	1954.	0.000620	5863.	24029.	183607.	207636.
29	PETROLEUM + COAL PROD.	1955.	0.000641	6778.	26374.	237975.	264348.
29	PETROLEUM + COAL PROD.	1958.	0.000702	9496.	34912.	263545.	298457.
29	PETROLEUM + COAL PROD.	1960.	0.000736	11133.	38791.	333065.	371855.
29	PETROLEUM + COAL PROD.	1962.	0.000779	12652.	43181.	322808.	365989.
29	PETROLEUM + COAL PROD.	1965.	0.000730	15191.	51670.	372209.	423879.
29	PETROLEUM + COAL PROD.	1967.	0.000702	18186.	61027.	390297.	451324.
29	PETROLEUM + COAL PROD.	1970.	0.000662	22198.	75248.	429278.	504526.
30	RUBBER + PLASTIC PROD.	1947.	0.001169	3040.	16344.	32598.	48942.
30	RUBBER + PLASTIC PROD.	1950.	0.001176	3479.	16807.	29950.	46757.
30	RUBBER + PLASTIC PROD.	1954.	0.001185	3961.	16234.	29060.	45294.
30	RUBBER + PLASTIC PROD.	1955.	0.001204	4716.	18350.	33247.	51597.
30	RUBBER + PLASTIC PROD.	1958.	0.001263	4819.	17717.	31111.	48828.
30	RUBBER + PLASTIC PROD.	1960.	0.001243	5718.	19923.	32259.	52182.
30	RUBBER + PLASTIC PROD.	1962.	0.001223	6691.	22836.	35182.	58018.
30	RUBBER + PLASTIC PROD.	1965.	0.001170	8695.	29575.	39730.	69304.
30	RUBBER + PLASTIC PROD.	1967.	0.001134	10184.	34174.	43384.	77558.
30	RUBBER + PLASTIC PROD.	1970.	0.001081	14038.	47585.	50618.	98202.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
31	LEATHER + LEATHER PROD.	1947.	0.001438	475.	2554.	10889.	13443.
31	LEATHER + LEATHER PROD.	1950.	0.001553	538.	2599.	12292.	14891.
31	LEATHER + LEATHER PROD.	1954.	0.001706	645.	2643.	7918.	10561.
31	LEATHER + LEATHER PROD.	1955.	0.001682	701.	2728.	8459.	11187.
31	LEATHER + LEATHER PROD.	1958.	0.001611	776.	2853.	8627.	11480.
31	LEATHER + LEATHER PROD.	1960.	0.001630	799.	2784.	8492.	11276.
31	LEATHER + LEATHER PROD.	1962.	0.001649	891.	3041.	8369.	11410.
31	LEATHER + LEATHER PROD.	1965.	0.001472	1057.	3595.	8142.	11737.
31	LEATHER + LEATHER PROD.	1967.	0.001354	1288.	4322.	8477.	12799.
31	LEATHER + LEATHER PROD.	1970.	0.001177	1577.	5344.	9294.	14638.
32	STONE, CLAY, + GLASS PROD	1947.	0.001160	5865.	31532.	232074.	263606.
32	STONE, CLAY, + GLASS PROD	1950.	0.001172	7632.	36870.	251828.	288698.
32	STONE, CLAY, + GLASS PROD	1954.	0.001187	9157.	37529.	256134.	293663.
32	STONE, CLAY, + GLASS PROD	1955.	0.001209	10331.	40198.	279104.	319303.
32	STONE, CLAY, + GLASS PROD	1958.	0.001276	12091.	44452.	264874.	309326.
32	STONE, CLAY, + GLASS PROD	1960.	0.001262	14403.	50185.	301323.	351507.
32	STONE, CLAY, + GLASS PROD	1962.	0.001249	15538.	53031.	293960.	346991.
32	STONE, CLAY, + GLASS PROD	1965.	0.001155	18671.	63507.	341623.	405130.
32	STONE, CLAY, + GLASS PROD	1967.	0.001092	19570.	65671.	340563.	406234.
32	STONE, CLAY, + GLASS PROD	1970.	0.000998	24070.	81592.	379207.	460799.

C. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

NO.	INDUSTRY NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
33	PRIMARY METAL INDUSTRIES	1947.	0.001856	31428.	168968.	409733.	578701.
33	PRIMARY METAL INDUSTRIES	1950.	0.001773	40722.	196725.	507434.	704158.
33	PRIMARY METAL INDUSTRIES	1954.	0.001663	47429.	194381.	486042.	680423.
33	PRIMARY METAL INDUSTRIES	1955.	0.001644	55784.	217058.	378624.	595683.
33	PRIMARY METAL INDUSTRIES	1959.	0.001589	56653.	186261.	467795.	654056.
33	PRIMARY METAL INDUSTRIES	1960.	0.001483	65679.	228847.	560358.	789205.
33	PRIMARY METAL INDUSTRIES	1962.	0.001378	71251.	243177.	603583.	846760.
33	PRIMARY METAL INDUSTRIES	1965.	0.001352	93023.	316405.	646396.	962801.
33	PRIMARY METAL INDUSTRIES	1967.	0.001334	109469.	367346.	600456.	967802.
33	PRIMARY METAL INDUSTRIES	1970.	0.001305	127885.	433508.	624007.	1057514.
34	FABRICATED METAL PROD.	1947.	0.001941	3739.	20102.	39043.	59145.
34	FABRICATED METAL PROD.	1950.	0.001906	4717.	22787.	45555.	68342.
34	FABRICATED METAL PROD.	1954.	0.001860	5950.	24385.	46729.	71114.
34	FABRICATED METAL PROD.	1955.	0.001869	6555.	25536.	47307.	72812.
34	FABRICATED METAL PROD.	1958.	0.001895	7130.	26213.	48432.	74645.
34	FABRICATED METAL PROD.	1960.	0.001915	8167.	28456.	48113.	76569.
34	FABRICATED METAL PROD.	1962.	0.001938	8881.	30311.	53610.	83921.
34	FABRICATED METAL PROD.	1965.	0.001796	11131.	37861.	57314.	95175.
34	FABRICATED METAL PROD.	1967.	0.001701	14694.	49309.	72564.	121873.
34	FABRICATED METAL PROD.	1970.	0.001559	25969.	88029.	82887.	170916.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

INDUSTRY NO.	NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
35	MACHINERY, EXCEPT ELECT.	1947.	0.001710	5401.	29038.	58054.	87092.
35	MACHINERY, EXCEPT ELECT.	1950.	0.001779	6016.	29063.	59774.	88837.
35	MACHINERY, EXCEPT ELECT.	1954.	0.001870	7581.	31070.	64628.	95698.
35	MACHINERY, EXCEPT ELECT.	1955.	0.001844	8531.	33195.	68576.	101771.
35	MACHINERY, EXCEPT ELECT.	1958.	0.001765	7603.	27952.	54004.	81956.
35	MACHINERY, EXCEPT ELECT.	1960.	0.001743	9182.	31993.	54059.	86052.
35	MACHINERY, EXCEPT ELECT.	1962.	0.001722	10330.	35256.	58688.	93944.
35	MACHINERY, EXCEPT ELECT.	1965.	0.001638	13362.	45449.	63779.	109228.
35	MACHINERY, EXCEPT ELECT.	1967.	0.001582	16659.	55903.	74607.	130510.
35	MACHINERY, EXCEPT ELECT.	1970.	0.001498	22823.	77366.	82156.	159522.
36	ELECTRICAL MACHINERY	1947.	0.001610	3156.	16968.	24599.	41567.
36	ELECTRICAL MACHINERY	1950.	0.001638	3874.	18715.	25617.	44332.
36	ELECTRICAL MACHINERY	1954.	0.001675	5134.	21041.	25028.	46069.
36	ELECTRICAL MACHINERY	1955.	0.001694	5527.	21506.	25507.	47013.
36	ELECTRICAL MACHINERY	1958.	0.001747	7688.	28265.	33483.	61748.
36	ELECTRICAL MACHINERY	1960.	0.001722	9767.	34031.	35681.	69713.
36	ELECTRICAL MACHINERY	1962.	0.001698	11699.	39928.	39081.	79009.
36	ELECTRICAL MACHINERY	1965.	0.001594	15042.	51163.	43054.	94217.
36	ELECTRICAL MACHINERY	1967.	0.001524	19013.	63802.	49951.	113753.
36	ELECTRICAL MACHINERY	1970.	0.001420	24397.	82702.	55869.	138571.

C. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

INDUSTRY NO.	NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
35+36	MACHINERY (IND. 35 + 36)	1947.	0.0	8557.	46005.	82653.	128658.
35+36	MACHINERY (IND. 35 + 36)	1950.	0.0	9890.	47778.	85391.	133168.
35+36	MACHINERY (IND. 35 + 36)	1954.	0.0	12715.	52111.	89656.	141767.
35+36	MACHINERY (IND. 35 + 36)	1955.	0.0	14058.	54700.	94083.	148784.
35+36	MACHINERY (IND. 35 + 36)	1958.	0.0	15291.	56217.	87487.	143704.
35+36	MACHINERY (IND. 35 + 36)	1960.	0.0	18949.	66024.	89740.	155765.
35+36	MACHINERY (IND. 35 + 36)	1962.	0.0	22029.	75184.	97769.	172953.
35+36	MACHINERY (IND. 35 + 36)	1965.	0.0	28404.	96612.	106833.	203445.
35+36	MACHINERY (IND. 35 + 36)	1967.	0.0	35672.	119705.	124558.	244263.
35+36	MACHINERY (IND. 35 + 36)	1970.	0.0	47220.	160068.	138024.	298093.
37	TRANSPORTATION EQUIPMENT	1947.	0.001450	5552.	29849.	59860.	89709
37	TRANSPORTATION EQUIPMENT	1950.	0.001545	7206.	34812.	62155.	96967.
37	TRANSPORTATION EQUIPMENT	1954.	0.001671	11118.	45566.	62529.	108095.
37	TRANSPORTATION EQUIPMENT	1955.	0.001642	13555.	52743.	67694.	120437.
37	TRANSPORTATION EQUIPMENT	1958.	0.001556	13375.	49173.	64384.	113557.
37	TRANSPORTATION EQUIPMENT	1960.	0.001547	15979.	55676.	66652.	122328.
37	TRANSPORTATION EQUIPMENT	1962.	0.001538	17490.	59693.	69380.	129073.
37	TRANSPORTATION EQUIPMENT	1965.	0.001477	22102.	75177.	77882.	153059.
37	TRANSPORTATION EQUIPMENT	1967.	0.001437	23468.	78752.	83598.	162350.
37	TRANSPORTATION EQUIPMENT	1970.	0.001376	25747.	87278.	85977.	173255.

c. TABULATION OF RESULTS -- CENSUS AND ANNUAL SURVEY YEARS

INDUSTRY NO.	NAME	YEAR	SPECIFIC FUEL COST (1958$/KWH)	ELECTRICAL ENERGY (KWH*10**6)	CORRECTED ELECTRICAL ENERGY (KWH*10**6)	FUEL ENERGY (KWH*10**6)	TOTAL ENERGY (KWH*10**6)
38	INSTRUMENTS +RELATED PROD	1947.	0.001718	456.	2452.	4403.	6855.
38	INSTRUMENTS +RELATED PROD	1950.	0.001661	556.	2686.	5989.	8675.
38	INSTRUMENTS +RELATED PROD	1954.	0.001586	728.	2984.	7261.	10245.
38	INSTRUMENTS +RELATED PROD	1955.	0.001624	820.	3191.	7860.	11051.
38	INSTRUMENTS +RELATED PROD	1956.	0.001738	1083.	3982.	8284.	12266.
38	INSTRUMENTS +RELATED PROD	1959.	0.001736	1439.	5014.	8307.	13321.
38	INSTRUMENTS +RELATED PROD	1962.	0.001734	1744.	5952.	9704.	15656.
38	INSTRUMENTS +RELATED PROD	1965.	0.001552	2030.	6905.	10502.	17406.
38	INSTRUMENTS +RELATED PROD	1967.	0.001431	2493.	8366.	12900.	21266.
38	INSTRUMENTS +RELATED PROD	1970.	0.001249	3538.	11994.	16745.	28739.
39+19	MISCELLANEOUS + ORDNANCE	1947.	0.001590	1013.	5446.	13809.	19255.
39+19	MISCELLANEOUS + ORDNANCE	1950.	0.001614	1487.	7184.	16409.	23593.
39+19	MISCELLANEOUS + ORDNANCE	1954.	0.001646	2502.	10254.	19237.	29491.
39+19	MISCELLANEOUS + ORDNANCE	1955.	0.001681	2586.	10062.	19120.	29182.
39+19	MISCELLANEOUS + ORDNANCE	1958.	0.001787	2498.	9184.	13879.	23063.
39+19	MISCELLANEOUS + ORDNANCE	1960.	0.001791	2983.	10411.	14303.	24714.
39+19	MISCELLANEOUS + ORDNANCE	1962.	0.001795	3382.	11543.	16277.	27820.
39+19	MISCELLANEOUS + ORDNANCE	1965.	0.001607	4315.	14677.	14785.	29462.
39+19	MISCELLANEOUS + ORDNANCE	1967.	0.001482	6583.	22091.	19545.	41636.
39+19	MISCELLANEOUS + ORDNANCE	1970.	0.001294	7918.	26841.	27928.	54769.

IHC0021 STOP 69

5. RECOMMENDATIONS

1. Correlate other industries with economic data (e.g., value added data) to determine the effect of economic conditions on energy use.

2. Perform a literature search and attempt to attain more precise criteria for revising the Primary Metal industries.

3. Correlate total energy consumption for each industry in the following manner:

   a. Determine the amount of energy generated and consumed at the same establishment and add this to the amount purchased.

   b. Data are available from the 1967 census for the total of all manufacturing industries.

      year = 1967

      amount generated and consumed = 1069.8×10^9 kwh

      amount purchased = 3461.4×10^9 kwh

      The effect of considering energy generated and consumed will be pronounced in the Petroleum and Coal Products Industry and in the Primary Metal Industries but will be negligible in many other industries (Tobacco, Leather, Apparel, etc.).

4. Computerize as many operations as possible.

6. ACKNOWLEDGEMENTS

The author wishes to thank E.A. Hirst for his consultation and quick wit. Special thanks are due to L.T. Bauer and H.R. Greenberg for their instruction and assistance in computer programming and to S.V. Demetriou and K.N. Petigara for their assistance with the graphical representation of data.

7. APPENDIX

7.1 Calculation of Fuel Energy for 1947

For the year 1947 values of fuel energy for each industry must be calculated. Values have been revised to reflect industrial reclassifications. Results are given in Table 5.

7.2 Calculation of Specific Fuel Costs for Census Years

The following scheme was employed to calculate specific fuel costs:

1. Convert fuel energy cost to 1958 $.

2. Specific fuel cost $= \dfrac{\text{fuel energy cost (1958 \$ x } 10^6)}{\text{fuel energy } (10^6 \text{ kwh})}$

Results are presented in Table 6 for all manufacturing industries considered.

7.3 Revisions for Census Years

7.3.1 Food and Kindred Products (Industry 20) (15, 16)

Problem: The Food and Kindred Products Industry does not include data for the Fluid Milk Industry for the year 1947. (No data are available for the Fluid Milk Industry in 1947).

Solution: Assume

$$\frac{(XFM)_{1947}}{(XRD)_{1947}} = \frac{(XFM)_{1954}}{(XRD)_{1954}}$$

where:

XFM = cost or energy data for the fluid milk industry

XRD = cost or energy data for the rest of the dairy industry

Then,

$$XFK_{1947} = XFM_{1947} + XUFK_{1947}$$

where:

Table 5. Calculation of Fuel Energy for 1947 (15)

Industry	Coal: Bituminous (M tons)	Coal: Bituminous (10^6 kwh)	Coal: Anthracite (M tons)	Coal: Anthracite (10^6 kwh)	Coke (M tons)	Coke (10^6 kwh)	Fuel Oil (M bbl)	Fuel Oil (10^6 kwh)	Gas: Natural (10^6 ft^3)	Gas: Natural (10^6 kwh)	Gas: Manufactured (10^6 ft^3)	Gas: Manufactured (10^6 kwh)	Gas: Mixed (10^6 ft^3)	Gas: Mixed (10^6 kwh)	Gas: Other (10^3 $)	Gas: Other (10^6 kwh)	Total Fuel Energy (10^6 kwh)	Fuel Cost (10^6 $)	Uncorrected Electrical Energy (10^6 kwh)
All Manufacturing Industries**																	1,762,870	1821.6	102,822
20. Food & Kindred Products*																	189,082	198.2	9,463
21. Tobacco Manufactures	463	3,555	26	193.3	0	0	121	207	44	13.5	25	4.0	7	1.1	73	17.4	3,991	3.86	155
22. Textile Mill Products	5,803	44,550	558	4,148	18	137	10,791	18,420	4,877	1,501	1,185	187	54	9	646	154	66,378	80.7	8,166
23. Apparel & Related Products	562	4,314	146	1,085	5	38	1,035	1,767	2,150	662	1,065	168	283	45	526	126	8,205	11.06	904
24. Lumber & Wood Products*																	26,225	64.75	1,522
25. Furniture & Fixtures*																	9,866	10.4	738
26. Paper & Allied Products	13,501	103,647	1,374	10,213			11,908	20,327	68,940	21,207	512	80.9	1,290	207	4,273	1,021	156,794	147.7	6,175
27. Printing & Publishing	288	2,211	83	616.9			745	1,272	4,581	1,410	2,364	374	1,146	184	2,579	616	6,715	11.41	1,251
28. Chemicals & Allied Products	17,709	135,952	1,279	9,507			16,673	28,461	154,824	47,639	12,817	2,028	6,441	1,034	4,443	1,062	241,780	212.3	11,963
29. Petroleum & Coal Products*																	148,159	54.31	3,147
30. Rubber & Plastic Products	3,031	23,269	251	1,866			2,821	4,815	7,957	2,448	570	90	279	45	175	42	32,598	28.69	3,040
31. Leather & Leather Products	1,154	8,859	66	490.6			753	1,285	448	138	264	41.8	20	3.2	200	47.8	10,889	11.83	475
32. Stone, Clay, & Glass Products	16,601	127,446	384	2,854			14,679	25,057	222,334	68,412	16,078	2,544	11,373	1,825	4,672	1,117	232,074	202.9	5,865
33. Primary Metal Industries*																	409,733	572.9	31,428
34. Fabricated Metal Products	2,175	16,697	132	981.2			5,230	8,928	20,690	6,366	10,418	1,648	5,408	868	1,961	469	39,043	57.05	3,739
35. Machinery, Except Electrical	3,990	30,631	205	1,524			6,260	10,686	25,637	7,889	5,938	939	5,252	843	2,467	590	58,054	75.0	5,401
36. Electrical Machinery	1,914	14,694	187	1,390			2,268	3,871	6,587	2,027	3,911	619	2,387	383	764	183	24,599	29.84	3,156
37. Transportation Equipment	4,446	34,132	86	639			5,258	8,975	20,011	6,157	5,101	807	33,173	5,324	4,977	1,190	59,860	65.45	5,552
38. Instruments & Related Products	360	2,764	25	186			567	968	503	155	1,583	250	265	42.6	94	22.4	4,403	5.70	456
39 & 19. Miscellaneous & Ordnance*																	13,809	16.58	1,013

*Total values available only.

**Note that the total for "All Manufacturing Industries" does not agree exactly with the sum calculated from the individual industries. This is due to "independent rounding" error as described in the 1947 Census.

$ = dollars (actual unless other wise designated)

M = millions

bbl = barrels

kwh = kilowatt hours

Table 6. Calculation of Specific Fuel Costs: Census Years (15, 18)

Industry	Year	Fuel Energy (10^6 kwh)	Cost of Fuel Energy (10^6 \$)	Corrected Cost of Fuel Energy (1958 \$ x 10^6)	Specific Cost of Fuel Energy (1958 \$ x 10^{-3}/kwh)
All Manufacturing*	1947	1,762,870	1821.6	2417.5	1.371
	1954	2,033,064	2496.1	2763.1	1.359
	1958	2,164,400	2836.2	2836.2	1.310
	1962	2,561,330	3360.7	3177.1	1.240
	1967	3,033,942	3974.9	3380.3	1.114
20. Food & Kindred Products	1947	189,082	198.2	263.1	1.391
	1954	224,015	250.4	277.2	1.237
	1958	208,767	293.9	293.9	1.408
	1962	216,145	325.3	307.5	1.423
	1967	239,254	345.4	293.7	1.228
21. Tobacco Manufactures	1947	3,991	3.9	5.1	1.283
	1954	3,388	4.4	4.8	1.425
	1958	3,551	4.9	4.9	1.374
	1962	3,573	5.2	4.9	1.376
	1967	4,935	7.1	6.0	1.223
22. Textile Mill Products	1947	66,378	80.7	107.1	1.614
	1954	62,804	77.6	85.9	1.368
	1958	55,298	84.2	84.2	1.523
	1962	59,110	87.1	82.3	1.393
	1967	72,164	105.9	90.1	1.248
23. Apparel & Related Products	1947	8,205	11.1	14.7	1.792
	1954	6,930	13.4	14.8	2.141
	1958	7,808	15.8	15.8	2.023
	1962	7,519	19.3	18.2	2.427
	1967	10,259	27.3	23.2	2.263
24. Lumber & Wood Products	1947	26,225	64.8	85.9	3.277
	1954	26,572	57.7	63.9	2.404
	1958	23,039	70.3	70.3	3.051
	1962	30,003	87.6	82.8	2.760
	1967	47,696	115.1	97.9	2.052
25. Furniture & Fixtures	1947	9,866	10.4	13.8	1.399
	1954	8,382	11.8	13.1	1.558
	1958	8,641	14.9	14.9	1.724
	1962	8,976	17.2	16.3	1.812
	1967	11,071	21.0	17.9	1.613
26. Paper & Allied Products	1947	156,794	147.7	196.0	1.250
	1954	179,194	220.0	243.6	1.359
	1958	223,806	266.4	266.4	1.190
	1962	255,123	302.9	286.3	1.122
	1967	313,038	367.2	312.3	0.9976
27. Printing & Publishing	1947	6,715	11.4	15.1	2.253
	1954	6,843	16.1	17.8	2.605
	1958	8,987	21.8	21.8	2.426
	1962	10,471	24.7	23.4	2.230
	1967	13,558	32.1	27.3	2.013
28. Chemicals & Allied Products	1947	241,780	212.3	281.8	1.165
	1954	327,883	335.3	371.2	1.113
	1958	366,318	359.5	359.5	0.9814
	1962	459,767	451.6	426.9	0.9286
	1967	625,624	605.5	514.9	0.8213

*Note that the total for "All Manufacturing" does not agree exactly with the sum calculated from the individual industries. This is due to "independent rounding" error as described in the 1947 Census.

Table 6. (continued)

	Year	Fuel Energy (10^6 kwh)	Cost of Fuel Energy (10^6 \$)	Corrected Cost of Fuel Energy (1958 \$ x 10^6)	Specific Cost of Fuel Energy (1958 \$ x 10^{-3}/kwh)
29. Petroleum & Coal Products	1947	148,159	54.3	72.1	0.4865
	1954	183,607	102.9	113.9	0.6204
	1958	263,545	184.9	184.9	0.7016
	1962	322,808	263.0	248.6	0.7702
	1967	390,297	322.4	274.2	0.7025
30. Rubber & Plastic Products	1947	32,598	28.7	38.1	1.169
	1954	29,060	31.1	34.4	1.185
	1958	31,111	39.3	39.3	1.263
	1962	35,182	45.5	43.0	1.223
	1967	43,384	57.8	49.2	1.134
31. Leather & Leather Products	1947	10,889	11.8	15.7	1.438
	1954	7,918	12.2	13.5	1.706
	1958	8,627	13.9	13.9	1.611
	1962	8,369	14.6	13.8	1.649
	1967	8,477	13.5	11.5	1.354
32. Stone, Clay & Glass Products	1947	232,074	202.9	269.3	1.160
	1954	256,134	274.7	304.1	1.187
	1958	264,874	338.1	338.1	1.276
	1962	293,960	388.4	367.2	1.249
	1967	340,563	437.5	372.1	1.092
33. Primary Metal Industries	1947	409,742	572.9	760.4	1.856
	1954	486,042	730.3	808.4	1.663
	1958	467,795	743.5	743.5	1.589
	1962	603,583	879.8	831.7	1.378
	1967	600,456	942.2	801.3	1.334
34. Fabricated Metal Products	1947	39,043	57.1	75.8	1.941
	1954	46,729	78.5	86.9	1.860
	1958	48,432	91.8	91.8	1.895
	1962	53,610	109.9	103.9	1.938
	1967	72,564	145.2	123.5	1.701
35 Machinery, Except Electrical	1947	58,054	75.0	99.5	1.714
	1954	64,628	109.0	120.7	1.868
	1958	54,004	95.3	95.3	1.765
	1962	58,688	106.9	101.1	1.722
	1967	74.607	138.8	118.0	1.582
36. Electrical Machinery	1947	24,599	29.8	39.6	1.610
	1954	25,028	37.9	42.0	1.676
	1958	33,483	58.5	58.5	1.747
	1962	39,081	70.2	66.4	1.698
	1967	49,951	89.5	76.1	1.524
37. Transportation Equipment	1947	59,860	65.5	86.9	1.452
	1954	62.529	94.4	104.5	1.671
	1958	64,384	100.2	100.2	1.556
	1962	69,380	112.9	106.7	1.538
	1967	83,598	141.3	120.2	1.437
38. Instruments & Related Products	1947	4,403	5.7	7.6	1.718
	1954	7,261	10.4	11.5	1.586
	1958	8,284	14.4	14.4	1.738
	1962	9,704	17.8	16.8	1.734
	1967	12,900	21.7	18.5	1.431
39 & 19. Misc and Ordnance	1947	13,809	16.6	22.0	1.593
	1954	19,237	28.6	31.7	1.646
	1958	13,879	24.8	24.8	1.787
	1962	16,277	30.9	29.2	1.795
	1967	19,545	38.5	32.7	1.482

XFK = revised cost or energy data for the Food and Kindred Products Industry (revised to include the Fluid Milk Industry)

XUFK = unrevised cost or energy data for the Food and Kindred Products Industry (excluding the Fluid Milk Industry)

7.3.2 Textile Mill Products (Industry 22) and Apparel and Related Products (Industry 23) (15, 16, 18)

Problem: For the years 1947 and 1954, the Hard Surface Floor Covering Industry and the Hats and Caps Industry were incorrectly included in Industry 22. The Hats and Caps Industry was incorrectly excluded from Industry 23. In addition, data for Industry 23 were underestimated by 3-6% due to the Census procedure followed in 1947. This procedure did not tabulate data for small manufacturing establishments submitting abbreviated data forms.

Solution: Let

XHS = cost or energy data for the Hard Surface Floor Covering Industry

XHC = cost or energy data for the Hats and Caps Industry

XUTM = unrevised cost or energy data for the Textile Mill Products Industry

XTM = revised cost or energy data for the Textile Mill Industry

XUA = unrevised cost or energy data for the Apparel and Related Products Industry

XA = revised cost or energy data for the Apparel and Related Products Industry

Assume the Apparel Industry was underestimated by 4.5%. Then,

$$(XA)_{1947} = \frac{(XUA)_{1947}}{0.955} + (XHC)_{1947}$$

$$(XTM)_{1947} = (XUTM)_{1947} - (XHC)_{1947} - (XHS)_{1947}$$

For the year 1954 the problem is solved by referring to the revised 1954 data presented in the 1967 census.

7.3.3 Lumber and Wood Products (Industry 24) (15)

Problem: Data for Logging Camps and Contractors are incorrectly excluded from Industry 24 for the year 1947. (No data are available for Logging Camps and Contractors in 1947).

Solution: Let

XLC = cost or energy data for Logging Camps and Contractors

XULW = unrevised cost or energy data for Industry 24 (excluding Logging Camps and Contractors)

XRLW = revised cost or energy data for Industry 24 (including Logging Camps and Contractors)

Assume,

$$(XLC)_{1947} = (XLC)_{1954} \frac{(XULW)_{1947}}{(XULW)_{1954}}$$

Then,

$$(XRLW)_{1947} = (XULW)_{1947} + (XLC)_{1947}$$

A tabulation of revisions for Industries 20, 22, 23, and 24 are given in Table 7.

7.3.4 Furniture and Fixtures (Industry 25) (15)

Problem: Data for the year 1947 are underestimated by 3-6% due to the Census procedure of not tabulating data for small manufacturing establishments submitting abbreviated data forms in the year 1947.

Solution: Let

XUFF = unrevised cost or energy data for the Furniture and Fixtures Industry

XRFF = revised cost or energy data for the Furniture and Fixtures Industry

Assume all data were underestimated by 4.5%. Then,

$$(XRFF)_{1947} = \frac{(XUFF)_{1947}}{0.955}$$

Table 7. Calculation of Revised Fuel Energy, Fuel Costs, Electrical Energy, and Electrical Energy Costs for Industries 20, 22, 23, and 24 for the Years 1947 and 1954 (15, 16, 18)

Industry	Year	Coal: Bituminous (M tons)	Coal: Bituminous Heat Value (10^6 kwh)	Coal: Anthracite (M tons)	Coal: Anthracite Heat Value (10^6 kwh)	Coke (M tons)	Coke (10^6 kwh)	Fuel Oil (M bbl)	Fuel Oil (10^6 kwh)	Gas: Natural ($10^6 ft^3$)	Gas: Natural (10^6 kwh)	Gas: Manufactured ($10^6 ft^3$)	Gas: Manufactured (10^6 kwh)	Gas: Mixed ($10^6 ft^3$)	Gas: Mixed (10^6 kwh)	Other (10^3 \$)	Other (10^6 kwh)	Total Fuel Energy (10^6 kwh)	Fuel Cost (10^6 \$)	Electrical Energy (10^6 kwh)	Electrical Energy Cost (10^6 \$)
Fluid Milk	1954	1,411	10,832	included in Bituminous		3	23	2,604	4,445	56,719	17,452	all gas assumed to be natural				5,127	1225	23,122	37.395	1,445	22.704
Dairy (Excluding Fluid Milk)	1947	1,741	13,366	0	0	5	38	1,724	2,943	6,525	2,009	169	27	272	44	911	218	18,644	20.615	716	11.549
Dairy (Excluding Fluid Milk)	1954	1,449	11,124	included in Bituminous		1	7	2,810	4,796	13,878	4,270	all gas assumed to be natural				1,506	360	20,557	27.574	998	16.141
Fluid Milk (Calculated)	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,970	27.957	1036	16.245
Unrevised Food & Kind. Prod.	1947	12,495	95,924	774	5753	195	1486	15,314	26,142	108,785	33,473	11,992	1897	4935	792	11,067	2645	168,112	170.252	8427	108.531
Revised Food & Kind. Prod.	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	189,082	198.209	9463	124.776
Unrevised Food & Kind. Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	213.035	10,560	145.941
Revised Food & Kind. Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	224,015	250.430	12,005	168.645
Hats and Caps	1947	57	438	12	89	0	0	269	459	56	17	39	6	6	1	23	5	1,016	1.465	28	0.623
Hard Surface Floor Coverings	1947	78	598	104	773	0	0	260	444	502	155	6	1	0	0	5	1	1,972	1.874	94	0.802
Uncorrected Textile Mill Prod	1947	5,938	45,586	674	5010	18	137	11,320	19,323	5,435	1,673	1,230	194	60	10	674	160	72,093	84.036	8288	82.456
Corrected Textile Mill Prod.	1947	5,803	44,550	558	4148	18	137	10,791	18,420	4,877	1,501	1,185	187	54	9	646	154	69,105	80.697	8166	81.031
Uncorrected Apparel & Rel.P.	1947	483	3,702	128	951	5	38	732	1,249	2,000	616	980	155	265	42	480	116	-	9.161	837	20.567
Corrected Apparel & Rel.Prod.	1947	562	4,314	146	1085	5	38	1,035	1,767	2,150	662	1,065	168	283	45	526	126	8,205	11.058	904	22.338
Unrevised Textile Mill Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80.718	11,105	114.748
Revised Textile Mill Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62,804	77.6	10,959	112.8
Unrevised Apparel	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.534	915	23.538
Revised Apparel	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,930	13.4	940	24.051
Logging Camps & Contractors	1954	104	798	included in Bituminous		1	7.6	946	1,700	3,554	1,094	all gas assumed to be natural				9185	2195	5,795	15.084	41	0.577
Unrevised Lmbr & Wood Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,777	42.643	3,177	40.928
Unrevised Lmbr & Wood Prod.	1947	855	6,563	21	156	0	0	3,251	5,549	3,185	980	42	7	39	6	30,310	7244	20,506	47.834	1,503	19.964
Logging Camps and Contract.	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,719	16.920	19	0.281
Revised Lmbr & Wood Prod.	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26,225	64.754	1,522	20.245

7.3.5 Petroleum and Coal Products (Industry 29) (15, 16, 18)

Problem: The Beehive and Byproduct Coke Oven Industries are incorrectly included in Industry 29 for the years 1947 and 1954.

Solution: Let

XBB = cost or energy data for the Beehive and Byproduct Coke Oven Industries

XUPC = unrevised cost or energy data for the Petroleum and Coal Products Industry

XRPC = revised cost or energy data for the Petroleum and Coal Products Industry

Then,

$$XRPC = XUPC - XBB$$

For the year 1954 revised data are available in the 1967 Census.

7.3.6 Rubber and Plastic Products (Industry 30) (15, 16, 18)

Problem: The Plastic Products Industry was incorrectly excluded from Industry 30 in 1947 and 1954. For the year 1947 data for the Plastic Products Industry data are underestimated by 3-6% because of the Census procedure of not correlating data for small establishments submitting abbreviated data forms.

Solution: Let

XUP = unrevised cost or energy data for the Plastic Products Industry

XRP = revised cost or energy data for the Plastic Products Industry

XURP = unrevised cost or energy data for the Rubber and Plastic Products Industry

XRRP = revised cost or energy data for the Rubber and Plastic Products Industry

Assume:

$$(XRP)_{1947} = \frac{(XUP)_{1947}}{0.955}$$

(i.e., the Plastic Product Industry was underestimated by 4.5%). Then,

$$(XRRP)_{1947} = (XURP)_{1947} + (XRP)_{1947} = (XURP)_{1947} + \frac{(XUP)_{1947}}{0.955}$$

For the year 1954 revised data are obtained from the 1967 Census. Revisions of Industries 25, 29, and 30 for the years 1947, 1954, and 1958 are tabulated in Table 8.

7.3.7 Miscellaneous and Ordnance (Industries 39 and 19) (15, 16, 18)

Problem: For the year 1947 the Plastic Products Industry is incorrectly included in Industries 39 and 19. The Hard Surface Floor Covering Industry is incorrectly excluded from Industries 39 and 19. The Ordnance Industry (except for Small Arms and Small Arms Ammunition) was incorrectly excluded from Industries 39 and 19. (No data are available for the Ordnance Industry for 1947.) The Miscellaneous and Ordnance Industry and the Plastic Products Industry are underestimated by 3-6% due to Census accounting procedures in 1947.

Solution: Let

XUP = unrevised cost or energy data for the Plastics Products Industry

XRP = revised cost or energy data for the Plastic Products Industry

XHS = cost or energy data for the Hard Surface Floor Covering Industry

XSA = cost or energy data for the Small Arms and Small Arms Ammunition Industry

XUMO = unrevised cost or energy data for the Miscellaneous and Ordnance Industry

XRMO = revised cost or energy data for the Miscellaneous and Ordnance Industry

XO = cost or energy data for the Ordnance Industry

Assume the Plastic Industry and the Miscellaneous and Ordnance Industry were both underestimated by 4.5%:

$$(XO)_{1947} = (XO)_{1954} \frac{(XSA)_{1947}}{(XSA)_{1954}}$$

Table 8. Revisions for Industries 25, 29, and 30 for 1947, 1954, and 1958 (15, 16, 17, 18)

Industry	Year	Coal: Bituminous (M tons)	Coal: Bituminous (10^6 kwh)	Coal: Anthracite (M tons)	Coal: Anthracite (10^6 kwh)	Coke (M tons)	Coke (10^6 kwh)	Fuel Oil (M bbl)	Fuel Oil (10^6 kwh)	Gas: Natural (10^6 ft^3)	Gas: Natural (10^6 kwh)	Gas: Manufactured (10^6 ft^3)	Gas: Manufactured (10^6 kwh)	Gas: Mixed (10^6 ft^3)	Gas: Mixed (10^6 kwh)	Other (10^3 $)	Other (10^6 kwh)	Total Fuel Energy (10^6 kwh)	Fuel Cost (10^6 $)	Electrical Energy (10^6 kwh)	Electrical Energy Cost (10^6 $)
Unrevised Furniture & Fixtures	1947	967	7,424	50	371.7	6	45.7	436	744	2,002	616	593	93.8	429	68.9	322	77	9,422	9.90	705	11.670
Revised Furniture & Fixtures	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,866	10.4	738	12.219
Unrevised Petrol. & Coal Prod.	1947	2442	18,747	130	966	41	312	3360	6196	414,169	127,532	255,447	40,412	26,956	4326	2534	606	199,097	68.398	3753	28.293
Behive & Byproduct Coke Oven	1947	416	3,193	89	661	41	312	601	1025	2,378	732	254,794	40,309	26,863	4311	1653	395	50,938	14.087	606	4.996
Revised Petrol.& Coal Prod.	1947	2026	15,554	41	305	0	0	3029	5171	412,091	126,800	653	103	93	15	881	211	148,159	54.31	3147	23.297
Unrevised Petrol. & Coal Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	128.66	6702	56.05
Revised Petrol. & Coal Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	183,607	102.9	5863	47.7
Unrevised Plastic Prod.	1947	156	1,198	59	439	0	0	665	1181	147	45	176	28	104	18	32	8	2,917	3.645	372	4.715
Unrevised Rubber & Plastic Prod.	1947	2868	22,071	189	1427	3	23	2125	3634	7803	2,403	386	62	170	27	141	34	29,681	24.872	2650	24.685
Revised Rubber & Plastic Prod.	1947	3031	23,269	251	1866	3	23	2821	4815	7957	2448	570	90	279	45	175	42	32,598	28.688	3040	29.517
Unrevised Rubber & Plastic Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.005	3087	-
Revised Rubber & Plastic Prod.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29,060	31.2	3961	-
Unrevised Rubber & Plastic Prod.	1958	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	29.831	4819	-
Revised Rubber & Plastic Prod.	1958	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31,111	39.331	3484	-

Then,

$$(XRP)_{1947} = \frac{(XUP)_{1947}}{0.955}$$

For the year 1947,

$$XRMO = \frac{XUMO}{0.955} - \frac{XUP}{0.955} + XHS + XO - XSA$$

Problem: For the year 1954 the Plastic Industry is incorrectly included in the Miscellaneous and Ordnance Industry, and the Hard Surface Floor Covering Industry is incorrectly excluded from the Miscellaneous and Ordnance Industry.

Solution: Revised data are obtained from the 1967 Census. The proportions of gas for the Ordnance Industry and the Small Arms and Ammunition Industry are estimated by the relationship:

$$\left[\frac{ft^3 \text{ manufactured gas for Small Arms and Ordnance Industries}}{ft^3 \text{ natural gas}}\right]_{1954} = \left[\frac{ft^3 \text{ of manufactured gas for Small Arms Industry}}{ft^3 \text{ of natural gas for Small Arms Industry}}\right]_{1947}$$

NOTE: Individual quantities of natural and manufactured gas are not presented in the 1954 or 1967 Census (rather a total quantity of all gases is presented).

7.3.8 Machinery Except Electrical (Industry 35) and Electrical Machinery (Industry 36) (16, 18)

Problem: The 1967 tabulation of 1954 data combines Industries 35 and 36. Data values for the revised combination are less than for the combination of unrevised values (obtained from the 1954 Census). The source of this revision remains undetermined and data for other years are not revised.

NOTE: In calculating the fuel energy for the unrevised Machinery Industries, all gas was assumed to be natural.

Revisions for Industries 39, 35, and 36 are tabulated in Table 9.

7.3.9 Primary Metal Industries (Industry 33) (15, 16, 18)

Problem: For the years 1947 and 1954 integrated coke overns, blast furnaces, and steel works were considered as separate establishments.

Table 9. Revised Values for Industries 39, 19, and 36 for the Years 1947 and 1954 (15, 16, 18)

Industry	Year	Coal: Bituminous (M tons)	Coal: Bituminous (10^6 kwh)	Coal: Anthracite (M tons)	Coal: Anthracite (10^6 kwh)	Coke (M tons)	Coke (10^6 kwh)	Fuel Oil (M bbl)	Fuel Oil (10^6 kwh)	Gas: Natural (10^6 ft^3)	Gas: Natural (10^6 kwh)	Gas: Manufactured (10^6 ft^3)	Gas: Manufactured (10^6 kwh)	Gas: Mixed (10^6 ft^3)	Gas: Mixed (10^6 kwh)	Other (10^3 $)	Other (10^6 kwh)	Total Fuel Energy (10^6 kwh)	Fuel Cost (10^6 $)	Electrical Energy (10^6 kwh)	Electrical Energy Cost (10^6 $)
Small Arms & Small Arms Ammun.	1947	55	422	16	119	0	0	51	87	61	19	187	30	0	0	-	-	677	0.944	40	0.546
Small Arms & Small Arms Ammun.	1954	92	706	included in bituminous		1	7	622	1062	1054	324	2143	339	0	0	260	62	2500	3.527	260	3.384
Ordnance	1954	283	2172	included in bituminous		4	30.5	1812	3093	3967	1221	8069	1277	-	-	1522	364	8157	12.775	1411	17.351
Ordnance	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2209	3.42	217	2.80
Unrevised Plastic Products	1947	156	1197	59	439	0	0	665	1134	147	46	176	28	104	-	32	-	2844	3.645	372	4.615
Hard Surface Floor Coverings	1947	78	599	104	774	0	0	260	444	502	156	6	1	0	0	5	-	1974	1.874	94	0.802
Unrevised Misc. & Ordnance	1947	812	6231	141	1047	13	95	1970	3361	1793	558	1945	312	603	-	437	-	11.604	15.742	1043	17.528
Revised Misc. & Ordnance	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13,809	17.018	1013	16.578
Unrevised Misc. & Ordnance	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.214	3255	26.781
Revised Misc. & Ordnance	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19,237	28.6	2502	36.0
Unrevised Mach. except Elec.	1954	3249	24,943	included in bituminous		327	2491	7546	12,881	6117.7	18,824	-	-	-	-	22,969	5490	64,628	109.9	7581	-
Unrevised Electrical Mach.	1954	1448	11,116	included in bituminous		20	152	3433	5,860	22,024	6,777	-	-	-	-	4696	1122	25,028	37.9	5134	-
Unrevised Machinery	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	89,656	147.8	12,615	-
Revised Machinery	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86,599	141.5	12,400	166.4

Consequently 1947 and 1954 data contain data for fuels produced and consumed in the same industry (coke and coke oven gas) as well as data for fuels purchased by a given industry. No separate data are presented for those fuels which were produced and consumed.

Solution: The 1967 Census presents semi-revised data for 1954. Examination of the specific cost data indicates that the data were revised for fuel energy but not for fuel cost. Assume: (1) a linear relationship between specific fuel cost and time, (2) determine the revised specific fuel cost (1958 \$/kwh) for 1954 and 1947, (3) revised fuel cost for 1954 (1958 \$ x 10^6) = (specific fuel cost of 1954) x (fuel energy for 1954 [10^6 kwh]), (4) revised fuel cost for 1947 (1958 \$/kwh) = unrevised fuel cost for 1947 times revised fuel cost for 1954 divided by unrevised fuel cost for 1954, and (5) revised fuel energy for 1947 = revised fuel cost for 1947 divided by revised specific fuel cost for 1947.

A linear least squares method was used to calculate the 1947 and 1954 revised specific cost. The following is a sample calculation for 1947. Let

x = year - 1947 (e.g., for 1954 let $x = 7$)

y = specific fuel cost (1958 \$/kwh)

n = number of points = 3

x	y	xy	x^2	y^2
11	0.001589	0.01749	121	2.5249×10^{-6}
15	0.001378	0.02067	225	1.8989×10^{-6}
20	0.001334	0.02668	400	1.7796×10^{-6}

$$y = mx + b$$

$$m = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{n\Sigma x^2 - (\Sigma x)^2} = -2.7533 \times 10^{-5}$$

$$b = \frac{\Sigma y}{n} - m\frac{\Sigma x}{n} = 1.8558 \times 10^{-3}$$

Therefore,

x	Year	Specific Cost
0	1947	0.001856
7	1954	0.001663

Results are presented in Table 10.

Table 10. Revisions for Primary Metals (Industry 33)

Industry	Year	Specific Fuel Cost (1958 $/kwh)	Corrected Fuel Cost (1958 $x10^6)	Fuel Energy (10^6 kwh)
Semirevised Primary Metal Industries	1954	0.003276	1592.3	486,042
Revised Primary Metal Industries	1954	0.001663	808.4	486,042
Unrevised Primary Metal Industries	1947		1497.7	
Revised Primary Metal Industries	1947	0.0018558	760.4	409,742

NOTE: For unrevised Primary Metals (1947)

$$\text{fuel cost (1958 \$)} = \frac{\text{fuel cost (\$)}}{0.7534} = \frac{1128.4}{0.7534}$$

7.3.10 All Manufacturing Industries (15, 16, 18)

Problem: Because fuels generated and consumed are included in the Primary Metal Industries, a sizeable error is introduced into the total of All Manufacturing Industries for the years 1947 and 1954.

Solution: Let

RAM^{FC} = revised fuel cost for All Manufacturing Industries

UAM^{FC} = unrevised fuel cost for All Manufacturing Industries

RPM^{FC} = revised fuel cost for Primary Metal Industries

UPM^{FC} = unrevised fuel cost for Primary Metal Industries

RSF = revised specific fuel cost for All Manufacturing Industries

RPM^{FE} = revised fuel energy for Primary Metal Industries

UPM^{FE} = unrevised fuel energy for Primary Metal Industries

UAM^{FE} = unrevised fuel energy for All Manufacturing Industries

RAM^{FE} = revised fuel energy for All Manufacturing Industries

Therefore,

$$RAM^{FC} = UAM^{FC} - UPM^{FC} + RPM^{FC}$$

$$RSF = \frac{RAM^{FC}}{RAM^{FE}}$$

where:

$$RAM^{FE} = UAM^{FE} - UPM^{FE} + RPM^{FE}$$

A tabulation of revisions for Industry 33 and All Manufacturing Industries for the years 1947 and 1954 is shown in Table 11.

7.4 Revisions for Annual Survey Years

Annual Survey Year revisions are obtained as follows:

1. Calculate correction factors $\left(\frac{\text{revised cost or energy value}}{\text{unrevised cost or energy value}}\right)$ for the census years.

2. A correction factor for an Annual Survey Year is obtained by linear interpolation.

3. $(\text{revised cost or energy value})_{\text{Annual Survey Year}}$ = (interpolated correction factor) x $(\text{unrevised cost or energy value})_{\text{Annual Survey Year}}$

For the year 1955 correction factors of 1954 are utilized for all industries except Industry 30. This is a reasonable assumption because the correction factors vary negligibly with time. Tabulations of the problems to be revised and the revisions are given in Tables 12 and 13.

7.5 Calculation of Purchased Electrical Energy for 1950

Problem: For the year 1950 cost data (rather than actual energy values) are presented for electrical energy.

Solution:

1. Given: cost data and energy data for 1947 and 1954. Compute specific electrical energy costs (1958 $/kwh) for 1947 and 1954.

Table 11. Revisions for Industry 33 and All Manufacturing Industries for the Years 1947 and 1954 (15, 16, 18)

Industry	Year	Coal: Bituminous (M tons)	Coal: Bituminous (10^6 kwh)	Coal: Anthracite (M tons)	Coal: Anthracite (10^6 kwh)	Coke (M tons)	Coke (10^6 kwh)	Fuel Oil (M bbl)	Fuel Oil (10^6 kwh)	Gas: Natural (10^6 ft^3)	Gas: Natural (10^6 kwh)	Gas: Manufactured (10^6 ft^3)	Gas: Manufactured (10^6 kwh)	Gas: Mixed (10^6 ft^3)	Gas: Mixed (10^6 kwh)	Other (10^3 $)	Other (10^6 kwh)	Total Fuel Energy (10^6 kwh)	Fuel Cost (10^6 $)	Corrected Fuel Cost (1958 x10^6$)	Specific Fuel Cost (1958 $/kwh)
Unrevised Primary Metals	1947	14,483	111,186	1186	8816	61,797	470,770	64,372	109,883	168,387	51,813	1,016,313	160,781	1,318,764	211,662	24,021	5,471	1,130,382	1128.4	1497.7	0.001325
Unrevised Primary Metals	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	486,042	1438.3	1592.3	0.003276
Unrevised All Manufact.	1947	103,788	796,780	7081	52,633	66,171	504,091	166,947	284,979	1,238,311	381,028	1,347,763	213,216	1,418,879	227,730	96,457	23,053	2,483,510	2376.8	3154.8	0.00127
Unrevised All Manufact.	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,033,064	3203.9	3547.0	0.00174
Revised Primary Metals	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	409,742	572.9	760.4	0.001856
Revised Primary Metals	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	486,042	730.2	808.4	0.001663
Revised All Manufacturing	1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,762,870	1821.6	2417.5	0.001371
Revised All Manufacturing	1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,033,064	2495.9	2763.1	0.001359

Table 12. Necessary Revisions for Annual Survey Years

Industry	Year	Problems to be Revised
All Manufacturing Industries	1950 1955	Energy generated and consumed at the same establishment are incorrectly included in the data.
Food and Kindred Products	1950	The Fluid Milk Industry is incorrectly excluded.
Textile Mill Products	1950 1955	The Hats and Caps Industry and the Hard Surface Flood Covering Industry were incorrectly included.
Apparel and Related Products	1950 1955	The Hats and Caps Industry was incorrectly excluded.
Petroleum and Coal Products	1950	The Beehive and Byproduct Coke Oven Industries were incorrectly included.
Rubber and Plastic Products	1950 1955	The Plastic Industry was incorrectly excluded.
Primary Metal Industries	1950 1955	Energy generated and consumed at the same establishment are incorrectly included in the data.
Miscellaneous and Ordnance	1950	Ordnance and Hard Surface Floor Coverings were incorrectly excluded. Plastic Products incorrectly included.
	1955	Plastic Products incorrectly included. Hard Surface Floor Coverings incorrectly excluded.

Table 13A. Annual Survey Year Revisions for Calculation of Census Year Correction Factors (15, 16, 17, 18)

Industry	Year	Revised Fuel Cost (10^6 \$)	Unrevised Fuel Cost (10^6 \$)	Fuel Cost Correction Factor	Revised Electrical Energy (10^6 kwh)	Unrevised Electrical Energy (10^6 kwh)	Fuel Cost Correction Factor	Revised Cost of Electrical Energy (10^6 \$)	Unrevised Cost of Electrical Energy (10^6 \$)	Electrical Energy Correction Factor
All Manufacturing Industries	1947	2417.5[a]	3154.8[a]	0.7663	-	-	-	-	-	-
	1954	2763.1[a]	3547.0	0.7790	-	-	-	-	-	-
Food & Kindred Products	1947	198.209	170.252	1.16	9,463	8,427	1.123	124.776	108.531	1.1497
	1954	250.430	213.035	1.18	12,005	10,560	1.137	168.645	145.941	1.1555
Textile Mill Products	1947	80.697	84.036	0.960	8,166	8,288	0.985	81.031	82.456	0.983
	1954	77.600	80.718	0.961	10,959	11,105	0.987	112.8	114.758	0.983
Apparel and Related Products	1947	11.058	9.593	1.15	904	876	1.03	22.338	21.536	1.037
	1954	13.400	12.534	1.07	940	915	1.03	24.051	23.538	1.021
Petroleum & Coal Products	1947	54.31	68.398	0.794	-	-	-	23.297	28.293	0.823
	1954	102.90	128.66	0.800	-	-	-	47.7	56.05	0.851
Rubber & Plastic Products	1947	28.688	24.685	1.16	-	-	-	29.517	24.685	1.20
	1954	31.200	24.005	1.30	3,961	3,087	1.28	45.60	32.745	1.39
	1958	39.331	29.831	1.32	4,819	3,484	1.38	-	-	-
Primary Metal Industries	1947	-	-	0.5077	-	-	-	-	-	-
	1954	808.4[a]	1592.3[a]	0.5077	-	-	-	-	-	-
Miscellaneous & Ordnance	1947	17.018	16.570[b]	1.02	-	-	-	16.578	18.354	0.90
	1954	28.600	24.214	1.18	2,502	3,255	0.77	36.0	33.549	1.07

[a]Denotes 1958 \$.

[b]Represents $\frac{\text{uncorrected value}}{0.955}$ (to account for small establishments).

Table 13B. Annual Survey Revisions (9, 10)

Industry	Year	Interpolated Value of Fuel Cost Correction Factor	Unrevised Fuel Cost (10^6 \$)	Revised Fuel Cost (10^6 \$)	Interpolated Value of Electrical Energy Correction Factor	Unrevised Electrical Energy (10^6 kwh)	Revised Electrical Energy (10^6 kwh)	Interpolated Value of Electrical Energy Cost Correction Factor	Unrevised Cost of Electrical Energy (10^6 \$)	Revised Cost of Electrical Energy (10^6 \$)
All Manufacturing Industries	1950	0.7772	2929.8	2277.0	--------- not calculated		--------	---------- not calculated		-------
	1955	0.78	3065.0	2379.1	--------- not calculated		--------	---------- not calculated		-------
Food & Kindred Products	1950	1.17	194.519	227.6	--------- not calculated		--------	1.153	136.2	157.0
Textile Mill Products	1950	0.960	95.281	91.47	--------- not calculated		--------	0.983	104.2	102.3
	1955	0.961	87.27	86.40	0.99	12,104	11,620	---------- not calculated		-------
Apparel and Related Products	1950	1.12	12.641	14.16	--------- not calculated		--------	1.029	26.7	27.5
	1955	1.02	15.403	15.87	1.03	1,145	1,168	---------- not calculated		-------
Petroleum & Coal Products	1950	0.797	108.285	86.30	--------- not calculated		--------	0.835	36.1	30.1
Rubber & Plastic Products	1950	1.22	23.138	28.23	--------- not calculated		--------	1.28	27.9	35.7
	1955	1.31	27.781	36.39	1.31	3,600	4,716	---------- not calculated		-------
Primary Metal Industries	1950	0.5077	1420.7	721.3	--------- not calculated		--------	---------- not calculated		-------
	1955	0.508	1113.8	565.8	--------- not calculated		--------	---------- not calculated		-------
Miscellaneous & Ordnance	1950	1.09	19.481	21.23	--------- not calculated		--------	0.97	23.6	22.9
	1955	0.85	34.367	29.21	0.77	3,359	2,586	---------- not calculated		-------

2. Obtain specific electrical energy costs for 1950 (1958 $/kwh) by a linear interpolation of the 1947 and 1954 values.

3. Correct 1950 cost data to 1958 $.

4. Obtain electrical energy for 1950 by the relationship:

$$\text{electrical energy for 1950 } (10^6 \text{ kwh}) = \frac{\text{corrected cost of electrical energy for 1950 } (1958 \times 10^6)}{\text{interpolated value of specific elec. energy cost for 1950 (1958 \$/kwh)}}$$

Calculation of the electrical energy for the year 1950 is shown in Table 14 using values specified in Tables 15 and 16.

7.6 Energy Conversions, Efficiencies, and Cost Considerations

Overall thermal efficiency of the U.S. electric power system, implicit GNP price deflator, and fuel conversion factors are given in Tables 17, 18, and 19, respectively.

Table 14. Calculation of Electrical Energy for 1950 (9)

Industry	Cost of Electrical Energy (10^6 \$)	Corrected Cost of Electrical Energy (1958 \$ x 10^6)	Interpolated Value of Specific Electrical Energy Cost (1958 \$/kwh)	Electrical Energy (10^6 kwh)
All Manufacturing Industries	1228.0	1532.0	0.0114	134,380
20. Food & Kindred Products	157.0	196.0	0.0167	11,728
21. Tobacco Manufactures	2.6	3.3	0.0175	187
22. Textile Mill Products	102.3	127.6	0.0124	10,290
23. Apparel & Related Prod.	27.5	34.3	0.0309	1,110
24. Lumber & Wood Products	31.9	39.8	0.0162	2,457
25. Furniture & Fixtures	17.1	21.3	0.0204	1,046
26. Paper & Allied Products	61.2	76.3	0.0102	7,485
27. Printing & Publishing	28.8	35.9	0.0247	1,455
28. Chemicals & Related Prod.	117.1	146.1	0.0084	17,474
29. Petroleum & Coal Prod.	30.1	37.6	0.0095	3,966
30. Rubber & Plastic Prod.	35.7	44.5	0.0128	3,479
31. Leather & Leather Prod.	9.9	12.3	0.0229	538
32. Stone, Clay, & Glass Prod.	72.8	90.8	0.0119	7,632
33. Primary Metal Industries	252.0	314.4	0.0077	40,722
34. Fabricated Metal Products	69.2	86.3	0.0183	4,717
35. Machinery, Except Elec.	81.5	101.7	0.0169	6,016
36. Electrical Machinery	44.1	55.0	0.0142	3,874
37. Transportation Equipment	77.4	96.6	0.0134	7,206
38. Instruments & Rel. Prod.	8.3	10.4	0.0187	556
39 & 10. Miscellaneous and Ordnance	22.9	28.6	0.0192	1,487

Table 15. Calculation of Electrical Energy for 1950 Via Determination of Specific Electrical Energy Costs for 1947

Industry	Electrical Energy (10^6 kwh)	Cost of Electrical Energy (10^6 \$)	Corrected Cost of Electrical Energy (1958 \$ x 10^6)	Specific Electrical Energy Cost (1958 \$/kwh)
All Manufacturing Industries	102,822	954.7	1267.2	0.0123
20. Food & Kindred Products	9,463	124.8	165.6	0.0175
21. Tobacco Manufactures	155	2.2	2.9	0.0186
22. Textile Mill Products	8,166	81.0	107.6	0.0132
23. Apparel & Related Products	904	22.3	29.7	0.0328
24. Lumber & Wood Products	1,522	20.2	26.8	0.0176
25. Furniture & Fixtures	738	12.2	16.2	0.0219
26. Paper and Allied Products	6,175	50.6	67.2	0.0109
27. Printing and Publishing	1,251	23.8	31.6	0.0253
28. Chemicals & Related Products	11,963	85.5	113.5	0.0095
29. Petroleum & Coal Products	3,147	23.3	30.9	0.0098
30. Rubber & Plastic Products	3,040	29.5	39.2	0.0129
31. Leather & Leather Products	475	8.9	11.8	0.0248
32. Stone, Clay, & Glass Prod.	5,865	54.9	71.7	0.0122
33. Primary Metal Industries	31,428	188.8	250.6	0.0080
34. Fabricated Metal Products	3,739	54.0	71.7	0.0197
35. Machinery, Except Electrical	5,401	72.0	95.6	0.0177
36. Electrical Machinery	3,156	34.6	45.9	0.0146
37. Transportation Equipment	5,552	59.2	78.6	0.0142
38. Instruments & Related Prod.	456	6.8	9.0	0.0197
39 & 19. Miscellaneous & Ordnance	1,013	16.6	22.0	0.0217

Table 16. Calculation of Electrical Energy for 1950 Via Determination of Specific Electrical Energy Costs for 1954

Industry	Electrical Energy (10^6 kwh)	Cost of Electrical Energy (10^6 \$)	Corrected Cost of Electrical Energy (1958 \$ x 10^6)	Specific Electrical Energy (1958 \$/kwh)
All Manufacturing Industries	187,146	1728.0	1913.0	0.0102
20. Food & Kindred Products	12,005	168.6	186.6	0.0156
21. Tobacco Manufactures	241	3.5	3.9	0.0161
22. Textile Mill Products	10,959	112.8	124.9	0.0114
23. Apparel & Related Products	940	24.1	26.7	0.0284
24. Lumber & Wood Products	3,218	41.5	45.9	0.0143
25. Furniture & Fixtures	1,131	18.8	20.8	0.0184
26. Paper & Allied Products	10,852	91.5	101.3	0.0093
27. Printing & Publishing	1,680	36.2	40.1	0.0239
28. Chemicals & Related Products	46,255	286.0	316.6	0.0069
29. Petroleum & Coal Products	5,863	47.7	52.8	0.0090
30. Rubber & Plastic Products	3,961	45.6	50.5	0.0127
31. Leather & Leather Products	645	11.9	13.2	0.0204
32. Stone, Clay, & Glass Prod.	9,157	95.1	105.3	0.0115
33. Primary Metal Industries	47,429	316.0	349.8	0.0074
34. Fabricated Metal Products	5,947	88.7	98.2	0.0165
35. Machinery, Except Electrical	7,581	107.9	119.5	0.0158
36. Electrical Machinery	5,134	63.3	70.1	0.0136
37. Transportation Equipment	11,118	123.5	136.7	0.0123
38. Instruments & Related Products	728	11.4	12.6	0.0173
39 & 19. Miscellaneous & Ordnance	2,502	36.0	39.9	0.0159

Table 17. Overall Thermal Efficiency of the U.S. Electric Power System (4, 8)

	Heat Rate[a] (Btu/kwh)	Efficiency[a] of Generation (3412/hr)	Efficiency[b] of T & D (Sales/ Generation)	Overall Efficiency (Sales/ Primary Energy In)
1947	15,600	21.9%	0.851	18.6%
1950	14,030	24.3	0.853	20.7
1954	12,180	28.0	0.871	24.4
1955	11,699	29.2	0.879	25.7
1958	11,085	30.8	0.882	27.2
1960	10.760	31.7	0.905	28.7
1961	10,650	32.0	0.908	29.1
1962	10.558	32.3	0.908	29.3
1963	10,482	32.6	0.906	29.5
1964	10,462	32.6	0.904	29.5
1965	10,453	32.6	0.903	29.4
1966	10,415	32.8	0.908	29.8
1967	10,432	32.7	0.912	29.8
1968	10,398	32.8	0.904	29.7
1969	10,447	32.7	0.907	29.7
1970	10,494	32.5	0.909	29.5
1971	10,494	32.5	0.909	29.5

[a]Data from U.S. Bureau of Mines Press Release, March 31, 1972, "U.S. Energy Use at New High in 1971" (8).

[b]Data from EEI Statistics, 1970 (4), T&D - transmission and distribution.

Table 18. Implicit GNP Price Deflator (20, 21, 22)

Year	Current $/100 1958 $
1947	75.34
1950	80.16
1954	90.33
1955	90.87
1958	100
1960	103.29
1962	105.78
1965	110.86
1967	117.59
1970	135.29

Table 19. Conversion Factors (12, 15)

Fuel	Conversion Factor
bituminous and lignite	7.677×10^6 kwh/1000 tons
anthracite	7.433×10^6 kwh/1000 tons
coke	7.618×10^6 kwh/1000 tons
fuel oil	1.707×10^6 kwh/1000 bbl
natural gas	0.3077×10^6 kwh/10^6 ft^3
manufactured gas	0.1582×10^6 kwh/10^6 ft^3
other fuels	0.239×10^6 kwh/10^3 \$
mixed gas*	0.1605×10^6 kwh/10^6 ft^3

*NOTE: mixed gas conversion factor calculation:

mixed gas = natural + manufactured gas

Assume: Linear interpolation of heat value based on \$/10^6 ft^3 values for natural and manufactured gas. For the year 1947,

$$\text{cost}/10^6 ft^3 \text{ natural gas} = \frac{210,637}{1,238,311} = \$0.1701$$

$$\text{cost}/10^6 ft^3 \text{ manufactured gas} = \frac{82,921}{1,347,763} = \$0.0615$$

$$\$/10^6 ft^3 \text{ mixed gas} = \frac{89,611}{1,418,879} = 0.0632$$

Let,

M = conversion factor for mixed gas

Then by linear interpolation

$$M = \frac{0.3077 - 0.1582}{0.1701 - 0.0615}(0.0632 - 0.0615) + 0.1582$$

$$= 0.1605 \times 10^6 \text{ kwh}/10^6 ft^3$$

7.7 Value Added (VA) Method (3)

The following scheme was used for the value added method.

1. Determine total purchased energy for each census year.
2. Obtain value added by manufacturer.
3. Correct to 1958 $.
4. Determine VA/kwh (1958 $/kwh).
5. Interpolate to get values of VA/kwh for the annual survey years.
6. Obtain VA data for the annual survey years and correct to 1958 $.
7. Compute total energy for annual survey years from:

$$\text{total energy} = \frac{\text{VA in 1958 \$}}{\text{interpolated VA/kwh}}$$

Results are tabulated in Table 20.

Table 20. Value Added Method for Chemicals and Related Products

1) Calculation of Value Added per kwh for Census Years (15, 16, 19)

Year	Value Added (10^6 $)	Value Added (1958 $ x 10^6)	Total Purchased Energy (10^6 kwh)	VA/kwh (1958 $/kwh)
1947	5,317	7,057	306,097	0.02306
1954	9,611	10,640	517,453	0.02056
1958	12,308	12,308	680,892	0.01808
1962	16,009	15,134	768,146	0.01970
1967	23,770	20,214	945,804	0.02137

Table 20 (Continued)

2) Calculation of Total Energy for Annual Survey Years (9, 10, 19)

Year	Interpolated Value of VA/kwh (1958 $/kwh)	Value Added (10^6 $)	Value Added (1958 $ x 10^6)	Total Energy from VA Method (10^6 kwh)	Total Energy from Method Used in Study (10^6 kwh)
1950	0.02199	7,237	9,028	410,559	360,946
1955	0.01994	11,172	12,294	616,574	646,974
1960	0.01889	14,415	13,956	738,796	732,316
1965	0.02070	20,956	18,903	913,194	877,797
1970	0.02237	29,050	21,472	959,875	1,052,071

7.8 Literature References

1. Adgate, K., personal communication, data from Federal Power Commission, March 26, 1973.

2. Bravard, J.C., and Charles Portal, "Energy Expenditures Associated with the Production and Recycle of Metals," ORNL-MIT-132 (May 1971).

3. Commoner, B., "Power Consumption and Human Welfare," Presented at the Annual Meeting of the AAAS, Philadelphia (December 1971).

4. Edison Electric Institute, "Statistical Yearbook of the Electric Utility Industry for 1970," New York (1971).

5. Hottel, H.C., and J.B. Howard, "New Energy Technology - Some Facts and Assessments," M.I.T. Press, Cambridge (1971).

6. ORNL-NSF Environmental Program, "Energy Conservation and the Environment," Research Proposal Submitted to the NSF (1973).

7. Stanford Research Institute, "Patterns of Energy Consumption in the United States," Prepared for Office of Science and Technology, U.S. Govt. Printing Office, Washington (1972).

8. U.S. Bureau of Mines, "U.S. Energy Use at New High in 1971," Press Release (March 31, 1971).

9. U.S. Dept. of Commerce (Bureau of the Census), "Annual Survey of Manufactures - 1950," U.S. Govt. Printing Office, Washington (1952).

10. U.S. Dept. of Commerce (Bureau of the Census), "Annual Survey of Manufactures - 1955," U.S. Govt. Printing Office, Washington (1957).

11. U.S. Dept. of Commerce (Bureau of the Census), "Annual Survey of Manufactures - 1960," U.S. Govt. Printing Office, Washington (1962).

12. U.S. Dept. of Commerce (Bureau of the Census), "Annual Survey of Manufactures - 1963," U.S. Govt. Printing Office, Washington (1966).

13. U.S. Dept. of Commerce (Bureau of the Census), "Annual Survey of Manufactures - 1965," U.S. Govt. Printing Office, Washington (1967).

14. U.S. Dept. of Commerce (Bureau of the Census), "Annual Survey of Manufactures - 1970," U.S. Govt. Printing Office, Washington (1972).

15. U.S. Dept. of Commerce (Bureau of the Census), "1947 Census of Manufactures," U.S. Govt. Printing Office, Washington (1950).

16. U.S. Dept. of Commerce (Bureau of the Census), "1954 Census of Manufactures," U.S. Govt. Printing Office, Washington (1957).

17. U.S. Dept. of Commerce (Bureau of the Census), "1958 Census of Manufactures," U.S. Govt. Printing Office, Washington (1961).

18. U.S. Dept. of Commerce (Bureau of the Census), "1967 Census of Manufactures," U.S. Govt. Printing Office, Washington (1971).

19. U.S. Dept. of Commerce (Bureau of the Census), "Industry Profiles 1958-1968," U.S. Govt. Printing Office, Washington (1970).

20. U.S. Dept. of Commerce (Bureau of the Census), "1971 Statistical Abstract of the United States," 92nd ed., U.S. Govt. Printing Office, Washington (1972).

21. U.S. Dept. of Commerce (Bureau of the Census), "1957 Statistical Abstract of the U.S.,"78th ed., U.S. Govt. Printing Office, Washington (1959).

22. U.S. Dept. of Commerce (Bureau of the Census), "1960 Statistical Abstract of the U.S.," 81st ed., U.S. Govt. Printing Office, Washington (1961).

INTERNAL DISTRIBUTION

1. S.E. Beall
2. L.L. Bennett
3. C.C. Burwell
4. R.S. Carlsmith
5. D.F. Cope
6. F.L. Culler
7. W. Fulkerson
8. J.H. Gibbons
9. H.E. Goeller
10. M.P. Guthrie
11-30. E.A. Hirst
31. J.W. Michel
32. Lewis Nelson
33. C.H. Peterson
34. Herman Postma
35. S. Siegel
36. E.G. Struxness
37-38. Central Research Library
39. Document Reference Section
40-42. Laboratory Records
43. Laboratory Records, ORNL R.C.
44. ORNL Patent Office
45-65. M.I.T. Practice School

EXTERNAL DISTRIBUTION

66. L.A. Clomburg, MIT
67. S.M. Fleming, MIT
68. J.E. Vivian, MIT