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TECHNIQUES FOR THE ANALYSIS OF  
TOTAL ENERGY AND LABOR  
OF INDUSTRIAL PLANTS

by

Richard E. Klein  
Hasan Sehitoglu  
Bruce M. Hannon

May 1976

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University of Illinois  
at Urbana-Champaign



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## ABSTRACT

A method is developed for determination of the total energy (direct plus indirect) and the labor requirements to produce a unit of output from an industrial plant or facility. The total energy and labor requirements are determined by accounting for all energy and labor as the product or raw materials flow from the mine or other natural resource through all production and manufactures to a given production status. In this way, each manufacturing step is accounted for in its contribution to the total energy to produce a unit of product. The work requires an examination and evaluation of the input-output structure of the plant or facility in question, usually from the viewpoint of cost accounting data sources. To illustrate the method, several specific plants are studied.



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## INTRODUCTION

A complete energy balance of a plant or manufacturing facility involves both direct and indirect energy flows. For years, the importance of indirect energy has been largely neglected or avoided and attention has been focused on only direct energy balances and thus the measures that have been taken to conserve energy involved largely direct energy concepts. This led, for example, to turning down thermostats, better insulating, closing doors, and similar measures. Previous research done at the Center for Advanced Computation (CAC), University of Illinois at Urbana-Champaign [1,2] indicates that the percentage of indirect energy in the total energy required to produce a product is often considerably greater than that of direct energy for many industry types. Again, for many industries the portion of indirect energy is comparable to or greater than direct energy. The consideration of conserving total energy, of course, adds a new dimension to energy conservation concepts for several reasons.

A total energy balance for a given plant stems from the idea of "energy intensity". Specifically, it is now known [1,2] that the majority of industrial commodities produced in the United States and similar economic societies require typically from 50% up to 90% of the energy in the indirect form. Consequently, energy conservation efforts related to reducing indirect energy hold considerably greater potential for a larger net savings in energy per unit of final output made available to the public sector. A second and equally important reason to concentrate on reducing total energy per unit of final output is that minimization of direct energy by a single plant, for example, involved in only

one of the many steps required to produce a unit of final product does not necessarily lower the total energy to produce the unit of final output. In fact, the converse is often times true in that a direct energy minimization at a given step of manufacture can result in an increase in the total energy content in the final output.

This point may be illustrated by any of many examples, and all of them fall under the description of what is called exporting one's (direct) energy requirements. In the manufacture of automobiles, consider a manufacturer X who not only assembles the final components comprising the finished automobile, but also performs many preliminary manufacturing steps including the process of steel making. If one considers merely the energy intensity of X (direct energy) as the energy added during the final manufacturing step in X's factory per unit produced, then X can reduce his direct energy requirements merely by electing to purchase steel rather than manufacture it. Thus, X has made himself look better instantly, on paper at least, because X requires now fewer energy units per unit of final output. Of course, the deeper conservation question is unresolved but it suffices to state that X's decision, in the national interest with respect to conservation, should be predicated on the issue of minimizing the sum of energy inputs in the total of all manufacturing steps. This thus requires a method to evaluate total (direct plus indirect) energy required to produce a unit of final output. In the above we have defined indirect energy as the sum of all energy inputs due to prior manufactures, shippers, supplies and the like.

## Previous Studies

The determination of total energy in producing a unit of final output has long been a topic of discussion, but its determination has been elusive. First attempts have amounted to tampering with and making ad hoc adjustments on available direct energy figures. Specifically, a direct energy study in a plant is achieved by metering or counting all forms of direct energy purchased such as electricity (KWH), propane (gallons), natural gas (therms or CCF's), fuel oil (gallons), and possibly steam (BTU's). In order to reduce these to a common unit, BTU's are usually selected. Unfortunately, the conversion factor selected for electricity is often at the discretion of the user. The plant manager prefers to use 3414 BTU/KWH from the heat equivalent in physics, however the concerned environmentalist wishes to use 10,000 or 11,000 BTU/KWH which is the usual amount of fossil fuel heat value required by a previous manufacturer, in this case the electrical power utility. Obviously, the net difference is substantial and the adjustment is made so as to make the direct energy seem more realistic. Actually, this is where the attempt to include indirect energy usually stops.

Now, if a concerned plant manager, of, say, a pencil factory, wished to actually perform a total (direct plus indirect) energy analysis on his manufacturing facility or plant, he might contemplate doing the following. He would contact each previous supplier and determine the direct energy supplied per unit of say, wood, glue, pencil lead, paint, erasers, sheet metal. Now, each of these manufacturers would need to, in turn, calculate their direct energy and then, contact each of their previous suppliers.

The paint manufacturer would, for example, have to contact his suppliers of spirits, dyes, resins, and the like. This, of course, would be the case for the suppliers of glue, pencil lead, etc. It is not difficult to imagine that this procedure leads to a number of problems. In summary, the main difficulties are

1. The attempt to backtrack to each supplier and to their suppliers, ad nauseum leads one to an overwhelming book-keeping task with regard to the geometric progression of numbers until reaching the original mines, farms, and forests.
2. The geometric progression backward leads one outside of one's domain of authority in that many (or most) companies refuse to respond to inquiries regarding manufacturing process ingredients, quantities, and other proprietary data.
3. The backward search, involves some inquiries, possibly, back to the original pencil manufacturer in that his company supplied pencils to the paint manufacturer, the glue factory, and so forth. This phenomena constitutes implicit loops and thus it is difficult to resolve which came first, the pencil or the paint.

The above cited difficulties obviate all direct energy backtracking except in all but the simplest and vertically arranged industries.

Other techniques for total energy based on physics and theoretical values have been considered, however, in order to become workable, significant inaccuracies occur because of the estimation procedures required.



In what follows, a summary of the theory behind energy intensity is given. A more extensive description of the basics of the theory, as well as its limitations and assumptions, can be found in a series of CAC reports [1], [2].

### THEORY

By definition, the total output of an industry or a sector is the sum of its sales to other industries plus its sales for final consumption. Mathematically, this definition is described by the following equation.

$$X_j = \sum_{K=1}^N X_{JK} + Y_j \quad (1)$$

where

$X_j$  = Total output of  $j$ th sector in dollars.

$X_{JK}$  = Amount of product  $j$  sold to sector  $K$  in dollars.

$Y_j$  = Amount of product sold to final consumption in dollars.

$N$  = Total number of sectors. In this study 367 sectors have been used which conforms to previous works in this area [3], [4].

By retaining the same line of reasoning, the total energy embodied in a sector's output is equal to the sum of all indirect energy embodied in its purchased inputs from other sectors plus energy extracted from

earth by that sector. Thus

$$\sum_{P=1}^5 \sum_{i=1}^N \epsilon_{iP} X_{iJ} + \sum_{P=1}^5 E_{JP} = \sum_{P=1}^5 \epsilon_{JP} X_J \quad (2)$$

where

P = Energy types (i.e. which are defined as coal, crude petroleum, refined petroleum, natural gas and electricity, respectively).

$\epsilon_{iP}$  = P type energy intensity of sector i

$E_{JP}$  = P type energy extracted from earth by sector j.

Theoretically,  $\epsilon_{iP}$  represents the P<sup>th</sup> type of energy needed to produce one unit of product i if all inputs were obtained domestically. Treatment of the role of the imports and exports in total energy analysis is straightforward and is presented in the previously cited references. It has been shown in previous works, however, that the energy impact of noncompetitive imports is negligible. Thus, only competitive imports need be considered in a total energy analysis.

The approach described so far has a direct relationship to the well known input-output theory through the definition of a technological coefficient matrix A which, in this case, is equal to

$$A_{iJ} = \frac{X_{iJ}}{X_J} \quad (4)$$

Throughout this study, the matrix A is assumed to be independent of time and scale which is a commonly used assumption of static input-output theory. The errors associated with the assumption of static coefficients

and methods to minimize them are discussed briefly later and are, in addition, the subject of continued investigation.

The energy dependence of a given sector on the rest of sectors of the economic unit can be best understood by defining a set of energy input coefficients, as below,

$$G_{Pi\dot{j}} = \frac{\epsilon_{Pi} X_{i\dot{j}}}{\epsilon_{P\dot{j}} X_{\dot{j}}} \quad (5)$$

where,  $G_{Pi\dot{j}}$ , is defined to represent; the total amount of energy type P required to produce one unit of product  $\dot{j}$ , in that a percentage  $G_{Pi\dot{j}}$  entered through  $\dot{j}$ 's purchase of  $i$ .

Thus, with the introduction of the above definition, the equation (2) becomes

$$\sum_{P=1}^5 \sum_{i=1}^N G_{Pi\dot{j}} + \sum_{P=1}^5 \frac{E_{P\dot{j}}}{\epsilon_{P\dot{j}} X_{\dot{j}}} = 1 \quad (6)$$

The theory that is explained above is applicable to any economic unit, e.g., the U.S. economy, a state economy, a group of industries producing a similar item, a corporation, a single plant, etc. The Energy Research Group at CAC has applied this theory to the U.S. economy by using the data base collected by the Department of Commerce. The results for the years 1963 and 1967 are available in various CAC publications. The publication CAC Document 105, [3], for example, contains the detailed analyses of energy use in the 367 commercial and industrial sectors of the U.S. economy in 1963. Sectors are also ranked according to several energy use criteria like direct energy and energy intensity. Another related CAC publication is the document

140, [4], which presents a more recent improved method of calculating energy intensity. Reference [4] contains recalculated 1963 values and 1967 values for the first time. Because the historical data for two times is now available, researchers have focused considerable attention on the time varying behavior of the linear model coefficients and on the task of extrapolating the energy trends into the future for a particular sector.

#### DESCRIPTION OF GENERAL PROCEDURE

The input-output approach described above can be applied to a single plant's total energy and labor analysis. Due to the homogeneity of the U.S. industrial society, it is reasonable to assume that a single plant's inputs, energy wise, are approximately the same as the national energy and labor coefficients. Specific figures are available for the years 1963 and 1967. Each coefficient in the University of Illinois model represents the inherent energy (and labor) required by each sector to bring its product to final demand. The energy coefficient matrix is a 357 x 357 matrix and its units are BTU/\$ except for the five energy sectors which are dimensionless. Thus the data concerning the purchased inputs for a plant, except for its energy inputs, must be in terms of dollar figures. In order for a firm to obtain a total energy balance in a fixed time period all input purchases made by the plant are to be classified in one of the economic sectors found in Table 1. If difficulty arises in assigning a particular purchase to a sector, one may refer to the Standard Industrial Classification manual [5] which gives a much more general description of where products are assigned. The numbering code in the SIC can then be converted to particular sectors by utilizing the extreme

right hand column of Table 1.

Because the energy coefficients are based on producers' price data, all purchases must be converted to the producers' price and thus trade and transportation margins must be applied to the appropriate input sectors.

As mentioned above, the total energy coefficient matrix is available for the year 1967 at the latest. Thus, dollar input purchases of the plant must be deflated to this base year. The best price deflators appear in the "Survey of Current Business", [6]. This journal publishes the implicit price deflators for most of the sectors of U.S. economy in its July edition every year. The "Monthly Labor Review", [7], has also price deflators for a large number of sectors and they are presented under SIC format. Similarly, in the labor intensity analysis, the change in productivity between the year in question and the base year must be taken into account. Hence, direct and indirect labor inputs to the plant must be multiplied by the productivity index which can be found in the reference [7].

After preparing the data in the above manner what remains is to multiply the dollar figures of each input purchase by its corresponding energy and labor coefficient to get the energy and labor levels embedded in that particular purchase. In particular, application of the equation (6) yields the sectorwise percentage impact of the five energy sectors and labor on the plant's energy and labor flow.

## APPLICATIONS AND CONCLUSIONS

The theory has been applied to a number of selected industries. Three different selected industries are discussed below. In each case, as the analysis shows, the energy and labor content of the unit of output entered into plant mostly as indirect energy due to the purchase of supplies, materials and other inputs. Again, in each case, indirect energy and labor concentrated at certain of the sectors. This, of course, suggests that efforts to conserve energy most effectively should be directed at reducing these indirect inputs.

In the first case an iron foundry plant producing a variety of general purpose castings is investigated. In Fig. (1), 1967 national average energy flow of the iron foundry sector is given. The national average figures should be compared to the actual plant figures which are shown in Fig. (2). As it can be seen, the energy inputs are larger at certain spots with similar percentages. Most of the zero values appearing in the energy flow of the actual plant are due to lack of data, but were assumed a priori to negligible. According to the analysis this particular plant is doing better energy wise than an average foundry because its primary energy intensity (BTU/1967 \$) is less than the national average figure. In addition to energy figures, Fig. (2) gives labor analysis of the same plant. It indicates, for example, that in the case of a wage increase in the primary metal sector, this particular plant will be faced with the problem of increasing its dollar expenditure by a predictable amount for the associated input purchases. This, in turn, may force the plant manager to increase the price of the product manufactured by the plant under study.

INPUT SECTORS	CCAL	CRUDE	REF PET	ELEC	GAS	PRIM ENERGY
COAL MINING	25.00	0.09	0.19	0.05	0.05	11.17
CRUDE,GAS EXTRCT	0.00	0.00	0.00	0.00	0.00	0.00
REFINED PETROL	0.10	6.71	23.88	0.19	0.65	3.46
ELEC UTILITIES	19.04	10.10	10.47	58	10.00	16.50
GAS UTILITIES	0.21	34.14	0.61	0.38	46.30	17.44
AGRIC,FORESTRY	0.00	0.00	0.00	0.00	0.00	0.00
CTHER,MINING	0.35	0.81	1.25	0.55	0.61	0.58
NEW, MAINT CONST	0.20	0.62	1.56	0.22	0.28	0.41
CRDNANCE	0.03	0.03	0.04	0.03	0.02	0.03
FCOD,KINDRED PRD	0.03	0.01	0.02	0.00	0.01	0.02
TEXT, APPAREL	0.05	0.07	0.11	0.07	0.05	0.06
LUMBER,WOOD,PAPR	0.32	0.64	1.06	0.38	0.49	0.47
FURNITURE	0.00	0.00	0.00	0.00	0.00	0.00
CHEMICALS,PAINTS	0.94	2.55	2.72	1.27	1.82	1.75
LEATHER,FOOTWEAR	0.00	0.00	0.00	0.00	0.00	0.00
STONE,CLAY,GLASS	0.26	0.83	0.77	0.45	0.81	0.56
PRIMARY METALS	42.18	24.04	24.88	22.82	25.16	32.50
FABRIC METAL PRD	1.20	1.56	1.90	2.01	1.61	1.45
HEAVY MACHINERY	4.25	5.16	5.31	4.36	3.99	4.47
COMPUT MACH	0.01	0.02	0.02	0.01	0.01	0.01
ELECTRICAL EQPT	2.75	2.26	1.81	4.02	2.47	2.12
APPLIANCES	0.05	0.06	0.07	0.05	0.05	0.04
MOTOR VEHICALS	1.02	1.04	1.36	1.03	0.93	1.03
CTHER TRANSP EQP	0.01	0.01	0.01	0.01	0.01	0.01
INSTRUMENTS	0.01	0.02	0.04	0.02	0.01	0.02
MISC MANUF	0.03	0.06	0.10	0.04	0.04	0.04
RAIL TRANSP	0.20	1.40	4.70	0.20	0.32	0.84
LCCAL TRANSP	0.00	0.00	0.00	0.00	0.00	0.00
TRUCK, WAREHSE	0.08	0.70	2.25	0.10	0.15	0.41
WATER TRANSP	0.01	0.16	0.56	0.01	0.02	0.09
AIR TRANSP	0.00	0.04	0.13	0.00	0.00	0.00
PIPE TRANSP	0.00	0.00	0.00	0.00	0.00	0.00
TRANSP SERVICES	0.00	0.00	0.00	0.00	0.00	0.00
PRINTING,PUBL	0.01	0.02	0.03	0.01	0.01	0.01
WATER,SANIT SERV	0.06	0.17	0.16	0.10	0.18	0.12
W*SALE, RETAIL	0.45	1.77	4.90	0.75	0.71	1.74
FINANCE	0.09	0.28	0.62	0.12	0.19	0.13
AUTC REPAIR	0.03	0.10	0.23	0.04	0.04	0.06
AMUSEMENTS	0.00	0.00	0.00	0.00	0.00	0.00
MEDICAL,EDUC	0.00	0.00	0.00	0.00	0.00	0.00
GOVT.	0.00	0.07	0.21	0.02	0.04	0.05
MISC	0.12	0.82	2.47	0.21	0.24	0.48
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0
ENERGY INTENSITY	4.371	49863	12697	8146	35643	96256
(BTU/1967 \$)						

Fig. 1. SECTOR 3702 = IRON, STEEL FOUNDRIES  
1967 NATIONAL AVERAGE ENERGY FLOW

INPUT SECTORS	COAL	CRUDE	REF PET	ELEC	GAS	PRIM ENERGY	LABOR
COAL MINING	35.15	0.22	0.44	0.12	0.13	20.57	1.58
CRUDE,GAS EXTRCT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REFINED PETROL	0.08	10.09	31.64	0.25	1.02	3.82	0.68
ELEC UTILITIES	13.09	12.48	11.48	61.04	12.95	14.98	5.58
GAS UTILITIES	0.07	19.11	0.31	0.18	27.07	7.18	1.06
AGRIC,FCRESTRY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CTHER MINING	0.33	1.26	1.87	0.76	1.00	0.70	2.88
NEW, MAINT CONST	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRDNANCE	0.04	0.14	0.24	0.11	0.09	0.08	0.44
TEXT, APPAREL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LUMBER, WCOD, PPK	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FURNITURE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHEMICALS, PAINTS	0.36	1.59	1.34	0.83	1.47	0.84	1.45
LEATHER, FOOTWEAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STONE, CLAY, GLASS	1.36	6.56	7.79	3.62	6.02	3.40	13.29
PRIMARY METALS	49.50	48.48	44.65	33.06	50.18	48.39	72.91
FABRIC METAL PRD	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEAVY MACHINERY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COMPUT MACH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ELECTRICAL EQPT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
APPLIANCES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MOTOR VEHICALS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CTHER TRANSP EQP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTRUMENTS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC MANUF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAIL TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LOCAL TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRUCK, WAREHSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WATER TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIR TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRANSP SERVICES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRINTING, PUBL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WATER, SANIT SERV	0.01	0.07	0.05	0.03	0.07	0.03	0.13
W, SALE, RETAIL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FINANCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AUTC REPAIR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AMUSEMENTS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEDICAL, EDUC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GOVT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ENERGY INTENSITY							
(BTU/TON)	22704512	14533719	4168456	2790355	5556022	38958688	
(BTU/1967 \$)	37840	24222	6947	4650	16593	64931	
ENERGY USED DIRECTLY AND INDIRECTLY (% OF TOTAL BY FUEL TYPE)							
DIRECTLY	35.07	0.00	29.56	55.10	25.52	34.07	
INDIRECTLY	64.93	100.00	70.44	44.90	74.48	65.93	
LABOR INTENSITY							
(MAN-YEAR/TON)	0.932137E-02						
(MAN-YEAR/1967 \$)	0.155356E-04						

Fig. 2. ENERGY AND LABOR ANALYSIS OF AN IRON FOUNDRY



SECT. NO	SECTOR NAME	PURCHASE(\$)
700	COAL MINING	0.28535420E 13
3101	PETRO REFIN PROD	0.42310740E 12
6801	ELECTRIC UTIL	0.55699950E 12
6802	GAS UTILITIES	0.84903400E 12
900	STONE CLAY MIN	0.92286480E 06
1414	FLOUR,CEREALS	0.10560000E 06
1419	SUGAR	0.27840000E 04
2701	INORG-ORG CHEM	0.20172000E 06
2704	MISC CHEM PROD	0.14820000E 06
2801	PLASTICS	0.99867180E 05
3616	ABRASIVE PRODUCT	0.17748360E 07
3619	TREATED MINERALS	0.23169590E 07
3701	STEEL PROD	0.24968280E 08
3704	PRIMARY MET PROD	0.30225050E 05
3805	PRIM NONFER MET	0.74640000E 05
6803	WATER,SANIT SER	0.52998230E 05

Fig. 3. INPUT PURCHASES OF THE IRON FOUNDRY

INPUT SECTORS	COAL	CRUDE	REF PET	ELEC	GAS	PRIM ENERGY	LABOR
CCAL MINING	35.17	0.23	0.44	0.12	0.13	20.74	1.59
CRUDE,GAS EXTRCT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REFINED PETROL	0.08	10.30	31.95	0.25	1.05	3.85	0.69
ELEC UTILITIES	13.10	12.75	11.52	61.07	13.31	15.10	5.61
GAS UTILITIES	0.06	17.57	0.28	0.16	25.06	6.51	0.96
AGRIC,FORESTRY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CITHER MINING	0.33	1.28	1.86	0.75	1.02	0.70	2.87
NEW, MAINT CONST	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRDNANCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FCOD,KINDRED PRD	0.02	0.09	0.15	0.07	0.06	0.05	0.28
TEXT, APPAREL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LUMBER,WOOD,PAPR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FURNITURE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHEMICALS,PAINTS	0.35	1.50	1.13	0.84	1.52	0.80	1.22
LEATHER,FOOTWEAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STONE,CLAY,GLASS	1.36	6.70	7.82	3.62	6.19	3.43	13.36
PRIMARY METALS	49.52	49.52	44.80	33.08	51.58	48.78	73.30
FABRIC METAL PRD	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEAVY MACHINERY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCMPUT MACH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ELECTRICAL EQPT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
APPLIANCES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ACTOR VEHICALS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CITHER TRANSP EQP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTRUMENTS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC MANUF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAIL TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LOCAL TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRUCK, WAREHSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WATER TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIR TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRANSP SERVICES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRINTING,PUBL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WATER,SANIT SERV	0.01	0.07	0.05	0.03	0.08	0.04	0.13
W,SALE, RETAIL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FINANCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AUTC REPAIR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AMUSEMENTS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEDICAL,EDUC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCVT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ENERGY INTENSITY	22696944	14229951	4154074	2788727	5684512	36646336	
(BTU/TON)	37828	23716	6923	4647	16140	64410	
(BTU/1967 \$)							
ENERGY USED DIRECTLY AND INDIRECTLY (% OF TOTAL BY FUEL TYPE)							
DIRECTLY	35.08	0.00	29.66	55.13	23.62	33.69	
INDIRECTLY	64.92	100.00	70.34	44.87	76.38	66.31	
LABCR INTENSITY							
(MAN-YEAR/TON)	0.927270E-02						
(MAN-YEAR/1967 \$)	0.154545E-04						

Fig. 4. ENERGY AND LABOR ANALYSIS OF AN IRON FOUNDRY

SECT. NO	SECTOR NAME	PURCHASE (\$)
700	COAL MINING	0.28535420E 13
3101	PETRO REFIN PROD	0.42310740E 12
6801	ELECTRIC UTIL	0.55699950E 12
6802	GAS UTILITIES	0.94303400E 12
900	STONE CLAY MIN	0.93031480E 06
1414	FLOUR,CEREALS	0.16960000E 06
1419	SUGAR	0.27840000E 04
2701	INCRG-ORG CHEM	0.16812000E 06
2704	MISC CHEM PROD	0.26900000E 06
2801	PLASTICS	0.73627180E 05
3616	ABRASIVE PRODUCT	0.17748360E 07
3619	TREATED MINERALS	0.23169590E 07
3701	STFEL PROD	0.24968280E 08
3704	PRIMARY MET PROD	0.30225050E 05
3805	PRIM NONFER MET	0.74640000E 05
6803	WATER,SANIT SER	0.53014190E 05

Fig. 5. INPUT PURCHASES OF THE IRON FOUNDRY

Fig. (3) shows the annual sectorwise input purchases of this iron foundry in dollars. When this study was going on, the plant was planning to change one of the processes in the production line. Fig. (4) shows the energy map of the same plant if the planned process change is carried on. The analysis shows the plant will achieve a degree of energy savings in natural gas sector. Thus this kind of total energy analysis gives an idea to the decision maker, such as the plant manager, to decide on the possible energy savings through certain process changes. Fig. (5) shows the projected annual input purchases of the iron factory if the process change is implemented.

The second industry investigated in this study is a soap factory. The energy analysis of the factory yielded an energy map similar to the 1967 national average energy map of the cleaning preparations sector in which soap production falls. Fig. (6) and Fig. (7) show national average and actual plant energy flow, respectively. In Fig. (8) annual input purchases of the soap plant is given.

Finally, energy and labor analysis of a paint manufacturing plant is presented. A comparison between the national paint production energy flow shown in Fig. (9) and the actual plant energy flow shown in Fig. (10) results in the same conclusions as stated above. Fig. (11) gives the dollar input purchases of the paint plant.

This study has shown that the input-output energy and labor analysis, as given above, closes the gap between decision makers and the problems associated with energy and labor flows in an economic unit. An industry can lessen its dependence, for example, on critically short energy types by making practical substitutions from high energy intensive materials

INPUT SECTORS	COAL	CRUDE	REF PET	ELEC	GAS	PRIM ENERGY
COAL MINING	4.61	0.01	0.02	0.01	0.00	1.29
CRUDE,GAS EXTRCT	0.00	0.00	0.00	0.00	0.00	0.00
REFINED PETROL	0.14	0.60	15.45	0.20	0.46	3.16
ELEC UTILITIES	3.52	0.88	0.86	7.47	0.91	1.92
GAS UTILITIES	0.08	6.37	0.11	0.10	8.54	4.34
AGRIC,FORESTRY	0.06	0.14	0.37	0.08	0.05	0.12
OTHER MINING	0.41	0.74	0.40	0.63	0.89	0.64
NEW, MAINT CONST	0.10	0.15	0.36	0.08	0.07	0.14
CRDNANCE	0.00	0.00	0.00	0.00	0.00	0.00
FOOD,KINDRED PRD	4.89	3.84	6.19	2.73	2.95	4.08
TEXT, APPAREL	0.06	0.04	0.06	0.06	0.04	0.05
LUMBER,WOOD,PAPR	5.03	5.51	8.49	4.57	4.37	5.61
FURNITURE	0.00	0.00	0.00	0.00	0.00	0.00
CHEMICALS,PAINTS	62.44	63.09	42.41	70.30	70.65	63.24
LEATHER,FOOTWEAR	0.00	0.00	0.00	0.00	0.00	0.00
STONE,CLAY,GLASS	0.90	1.57	1.34	1.21	1.68	1.37
PRIMARY METALS	0.04	0.01	0.01	0.01	0.01	0.02
FABRIC METAL PRD	9.22	3.48	3.85	4.71	3.39	5.13
HEAVY MACHINERY	0.15	0.08	0.09	0.12	0.07	0.10
COMPUT MACH	0.03	0.02	0.02	0.02	0.01	0.02
ELECTRICAL EQPT	0.01	0.01	0.01	0.02	0.01	0.01
APPLIANCES	0.13	0.07	0.08	0.09	0.06	0.09
MOTOR VEHICALS	0.04	0.02	0.02	0.03	0.02	0.02
OTHER TRANSP EQP	0.00	0.00	0.00	0.00	0.00	0.00
INSTRUMENTS	0.01	0.01	0.02	0.01	0.01	0.01
MISC MANUF	0.16	0.12	0.16	0.15	0.11	0.13
RAIL TRANSP	0.28	0.92	2.60	0.19	0.21	0.71
LOCAL TRANSP	0.00	0.00	0.00	0.00	0.00	0.00
TRUCK, WAREHSE	0.11	0.45	1.38	0.10	0.10	0.34
WATER TRANSP	0.05	0.28	0.87	0.04	0.05	0.20
AIR TRANSP	0.00	0.01	0.02	0.00	0.00	0.00
PIPE TRANSP	0.00	0.00	0.00	0.00	0.00	0.00
TRANSP SERVICES	0.00	0.00	0.00	0.00	0.00	0.00
PRINTING,PUBL	0.13	0.10	0.14	0.12	0.09	0.11
WATER,SANIT SERV	0.03	0.04	0.04	0.03	0.05	0.04
W,SALE, RETAIL	0.60	1.14	2.81	0.80	0.51	0.97
FINANCE	0.49	0.76	1.38	0.62	0.53	0.67
AUTC REPAIR	0.02	0.03	0.07	0.02	0.01	0.03
AMUSEMENTS	0.00	0.00	0.00	0.00	0.00	0.00
MEDICAL, EDUC	0.00	0.00	0.00	0.00	0.00	0.00
GOVT	0.02	0.07	0.20	0.04	0.03	0.06
MISC	0.29	0.85	2.38	0.34	0.27	0.67
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0

Fig. 6. SECTOR 2902 = CLEANING PREPARATIONS  
1967 NATIONAL AVERAGE ENERGY FLOW

ENERGY INTENSITY (BTU/1967 \$) 27.21 67287 18126 7455 46531 95505

ENERGY AND LABOR ANALYSIS OF A SOAP PLANT

INPUT SECTORS	COAL	CRUDE	REF PET	ELEC	GAS	FRIM ENERGY	LABOR
COAL MINING	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRUDE, GAS EXTRACT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REFINED PETROL	0.20	5.45	13.05	0.25	0.72	0.00	0.19
ELEC UTILITIES	4.48	0.92	0.64	9.48	1.24	3.98	0.21
GAS UTILITIES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AGRIC, FORESTRY	0.06	0.15	0.25	0.10	0.05	0.12	0.77
OTHER MINING	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NEW, MAINT CONST	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRDNANCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FOOD, KINDRED PRD	21.43	26.35	29.57	18.86	26.75	24.88	31.26
TEXT, APPAREL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LUMBER, WOOD, PAPER	6.38	4.36	4.86	5.37	4.47	4.89	5.75
FURNITURE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHEMICALS, PAINTS	54.12	51.54	35.69	54.05	57.41	52.26	29.94
LEATHER, FOOTWEAR	0.12	0.09	0.10	0.13	0.09	0.10	0.42
STONE, CLAY, GLASS	0.33	0.51	0.21	0.46	0.50	0.47	0.44
PRIMARY METALS	0.48	0.18	0.12	0.33	0.25	0.26	0.33
FABRIC METAL PRD	2.80	0.93	0.78	1.59	1.15	1.40	1.27
HEAVY MACHINERY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCMPUT MACH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ELECTRICAL EQPT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
APPLIANCES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MOTOR VEHICLES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHER TRANSP EQP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTRUMENTS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC MANUF	2.06	1.16	1.18	1.75	1.26	1.40	5.02
RAIL TRANSP	0.51	1.39	3.00	0.36	0.42	1.17	1.78
LCCAL TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRUCK, WAREHOUSE	0.04	0.13	0.29	0.04	0.04	0.11	0.30
WATER TRANSP	0.08	0.39	0.89	0.07	0.05	0.31	0.19
AIR TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRANSP SERVICES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRINTING, PUBL	0.70	0.48	0.54	0.63	0.48	0.54	1.46
WATER, SANIT SERV	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W, SALE, RETAIL	1.64	2.66	4.87	2.03	1.42	2.39	9.41
FINANCE	0.07	0.07	0.08	0.10	0.07	0.07	0.31
AUTO REPAIR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AMUSEMENTS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEDICAL, EDUC	0.01	0.02	0.04	0.02	0.01	0.02	0.13
GOVT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ENERGY INTENSITY (BTU/1967 \$)	18466	54855	20711	4595	28858	76445	
ENERGY USED DIRECTLY AND INDIRECTLY (% OF TOTAL BY FULL TYPE)	0.00	0.00	12.15	8.56	0.00	3.85	
DIRECTLY	100.00	100.00	87.85	91.44	100.00	96.15	
INDIRECTLY							
LABOR INTENSITY (MAN-YEAR/1967 \$)							

0.054835F-04

Fig. 7. ENERGY AND LABOR ANALYSIS OF A SOAP PLANT

SECT. NO	SECTOR NAME	PURCHASE (\$)
700	COAL MINING	0.50587640E 08
3101	PETRO REFIN PROD	0.50731140E 12
6801	ELECTRIC UTIL	0.90934340E 11
6802	GAS UTILITIES	0.12100680E 09
203	TOBACCO	0.34444100E 06
1401	MEAT PRODUCTS	0.41022300E 06
1427	ANIMAL FATS	0.40865740E 08
2407	CONV PAPER PROD	0.72342140E 07
2601	NEWSPAPERS	0.43897400E 06
2602	PERIODICALS	0.41570600E 06
2603	BOOK PUBLISHING	0.45461800E 06
2604	MISC PUBLISHING	0.47500100E 06
2701	INCRG-ORG CHEM	0.91444130E 07
2704	MISC CHEM PROD	0.24254300E 08
2801	PLASTICS	0.45541600E 06
2804	ORGANIC FIBERS	0.40000000E 06
2901	DRUGS	0.97840400E 06
3000	PAINT PRODUCTS	0.13220000E 07
3203	MISC RUBBER PROD	0.64521500E 06
3402	FOOTWEAR EXC RLD	0.41961800E 06
3501	GLASS PRODUCTS	0.27607600E 06
3502	GLASS CONTAINERS	0.28423700E 06
3702	IR, STL FOUNDRIES	0.42314100E 06
3901	METAL CANS	0.79241500E 06
3902	METAL BARRELS	0.55700000E 06
4206	PIPE	0.43419900E 06
6412	MISC MFG	0.36227140E 07
6501	RAILROAD	0.25311700E 07
6503	MOTOR VGT TRANSP	0.41100000E 06
6504	WATER TRANSPORT	0.24418700E 06
6500	COMMUNICATIONS	0.25540500E 06
6501	WHOLESALE TRADE	0.10000000E 07
7001	BANKING	0.38216600E 06
7102	REAL ESTATE	0.22281400E 06
7302	ADVERTISING	0.13543000E 08
7701	DOCTORS, DENTISTS	0.25541600E 06

Fig. 8. INPUT PURCHASES OF THE SOAP PLANT

INPUT SECTORS	COAL	CRUDE	REF PET	LLC	GAS	PRIM ENERGY
COAL MINING	1.13	0.00	0.00	0.00	0.00	0.29
REFINED PETROL	0.00	0.00	0.00	0.00	0.00	0.00
ELEC UTILITIES	4.51	13.17	34.96	0.61	1.46	5.37
GAS UTILITIES	0.07	4.56	0.77	9.09	1.14	2.26
AGRIC, FORESTRY	0.40	1.03	0.06	0.08	6.77	3.08
OTHER MINING	0.56	0.50	2.24	0.46	0.38	0.85
NEW MAINT CONST	0.16	0.20	0.62	0.56	0.43	0.52
CRDNANCE	0.00	0.00	0.38	0.12	0.11	0.19
FOOD, KINDRED PRD	1.18	0.00	0.00	0.00	0.00	0.00
TEXT, APPAREL	0.06	1.58	2.37	1.13	1.15	1.46
LUMBER, WOOD, PPK	1.12	0.04	0.05	0.06	0.04	0.05
FURNITURE	0.00	0.87	1.06	0.76	0.77	0.93
CHEMICALS, PAINTS	69.93	0.00	0.00	0.00	0.00	0.00
LEATHER, FOOTWEAR	0.00	63.67	38.08	73.97	77.24	65.73
STONE, CLAY, GLASS	0.00	0.00	0.00	0.00	0.00	0.00
PRIMARY METALS	1.90	0.40	0.37	0.32	0.42	0.37
FABRIC METAL PRD	14.12	1.32	0.81	1.95	1.61	1.49
HEAVY MACHINERY	0.13	4.71	4.10	6.59	5.08	7.19
COMPUT MACH	0.00	0.06	0.06	0.10	0.06	0.08
ELECTRICAL EQPT	0.01	0.00	0.00	0.00	0.00	0.00
APPLIANCES	0.00	0.00	0.00	0.01	0.01	0.01
MOTOR VEHICLES	0.04	0.02	0.02	0.00	0.00	0.00
OTHER TRANSP EGP	0.00	0.00	0.00	0.03	0.02	0.02
INSTRUMENTS	0.01	0.00	0.00	0.00	0.00	0.00
MISC MANUF	0.05	0.01	0.01	0.01	0.01	0.01
RAIL TRANSP	0.35	0.03	0.03	0.04	0.03	0.03
LOCAL TRANSP	0.00	1.04	2.49	0.23	0.26	0.83
TRUCK, WAREHSE	0.17	0.00	0.00	0.00	0.00	0.00
WATER TRANSP	0.10	0.58	1.39	0.14	0.15	0.46
AIR TRANSP	0.01	0.52	1.30	0.09	0.10	0.39
PIPE TRANSP	0.00	0.07	0.19	0.01	0.01	0.05
TRANSP SERVICES	0.00	0.00	0.00	0.00	0.00	0.00
PRINTING, PUBL	0.02	0.01	0.02	0.00	0.00	0.00
WATER, SANIT SERV	0.05	0.06	0.04	0.02	0.01	0.02
W, SALE, RETAIL	0.68	1.13	2.18	0.07	0.07	0.05
FINANCE	0.39	0.53	0.76	0.87	0.57	1.00
AUTC REPAIR	0.05	0.06	0.11	0.45	0.41	0.49
AMUSEMENTS	0.00	0.00	0.11	0.05	0.03	0.06
MEDICAL, EDUC	0.00	0.00	0.00	0.00	0.00	0.00
GOVT	0.03	0.07	0.13	0.04	0.03	0.05
MISC	0.63	1.56	3.43	0.69	0.57	1.29
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0
ENERGY INTENSITY	31247	86028	29346	8891	52749	122757
(ETU/1967 \$)						

Fig. 9. SECTOR 3000 = PAINT PRODUCTS  
1967 NATIONAL AVERAGE ENERGY FLOW



INPUT SECTORS	CCAL	CRUDE	REF PET	ELLC	GAS	FRIM ENERGY	LABOR
CCAL MINING	7.35	0.01	0.01	0.01	0.01	1.94	0.05
CRUDE,GAS EXTRCT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REFINED PETROL	0.81	24.89	49.12	1.14	3.40	17.49	1.10
ELEC UTILITIES	8.97	2.08	1.20	18.66	2.91	4.63	0.60
GAS UTILITIES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AGRIC,FOHLSTRY	0.20	0.53	0.85	0.24	0.00	0.00	0.00
CITHR, MINTNG	3.54	3.16	2.03	4.41	4.20	3.32	1.38
NEW, MAINT CONST	0.00	0.00	0.00	0.00	0.00	0.00	4.00
CRDNANCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FOOD,KINDRED,PKL	4.89	7.23	7.82	5.30	6.77	6.53	15.35
TEXT, APPAREL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LUMFR,WOOD,PAPK	1.49	1.15	1.06	1.23	1.23	1.25	1.95
FURNITURE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHEMICALS,PAINTS	46.54	43.56	22.20	50.72	62.55	45.05	29.18
LEATHER,FOOTWEAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STONE,CLAY,GLASS	0.25	0.17	0.13	0.31	0.20	0.20	0.45
PRIMARY METALS	9.72	5.52	2.62	7.23	8.21	6.70	6.51
FABRIC METAL PRD	9.51	3.46	2.36	4.60	4.50	5.11	5.96
HEAVY MACHINERY	0.24	0.12	0.08	0.20	0.15	0.15	0.53
COMPUT MACH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ELECTRICAL EGPT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
APPLIANCES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MOTCH VEHICALS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CTHER TRANSP EGP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTRUMENTS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC MANUF	3.08	1.55	1.64	2.57	2.21	2.28	10.90
RAIL TRANSP	0.51	1.55	2.78	0.35	0.49	1.23	2.57
LCCAL TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRUCK, WAREHSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WATER TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIR TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE TRANSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRANSP SERVICES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRINTING,PUBL	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WATER, SANIT SERV	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W,SALE, RETAIL	2.07	3.20	5.72	2.53	2.11	3.29	17.26
FINANCE	0.10	0.12	0.12	0.14	0.12	0.12	0.61
AUTC REPAIR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AMUSEMENTS	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEDICAL, EDUC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GOVT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ENERGY INTENSITY	21716	57137	26209	5978	28971	82540	
(BTU/1967 \$)							
ENERGY USED DIRECTLY AND INDIRECTLY (% CF TOTAL BY FULL TYPE)							
DIRECTLY	7.33	0.00	45.60	16.84	0.00	17.63	
INDIRECTLY	92.67	100.00	54.40	83.16	100.00	82.37	
LABOR INTENSITY							
(MAN-YEAR/1967 \$)							
	0.563237E-04						

Fig. 10. ENERGY AND LABOR ANALYSIS OF A PAINT PLANT

SECT. NO	SECTOR NAME	PURCHASE (\$)	
700	COAL MINING	0.35525510E	12
3101	PETRO REFIN PROD	0.25564110E	13
6201	ELECTRIC UTIL	0.22726650E	12
206	OIL BEARING CROP	0.17112550E	07
500	IRON ORE MINING	0.91522200E	06
602	NONFERR MINING	0.18652320E	07
900	STONE CLAY MIN	0.24456310E	07
1420	CONFECTIONERY	0.87666800E	06
1426	VEG OIL MILLS	0.20877400E	08
2407	CONV PAPER PROD	0.21256780E	07
2701	INORG-ORG CHEM	0.14756400E	08
2704	MISC CHEM PROD	0.24227000E	07
2801	PLASTICS	0.10473770E	08
2902	CLEANING PREP	0.71211500E	06
3203	MISC RUBLER PROD	0.53370000E	06
3204	MISC PLASTICS	0.45674800E	06
3616	ABRASIVE PRODUCT	0.48842100E	06
3701	STEEL PROD	0.60700500E	06
3802	PRIMARY LEAD	0.67680120E	07
3803	PRIMARY ZINC	0.11463240E	07
3901	METAL CANS	0.38110000E	07
3902	METAL BARRELS	0.20725070E	07
4208	PIPE	0.13702040E	07
5000	MACH SHCP PROD	0.46220300E	06
6412	MISC MFG	0.67577780E	07
6501	RAILROAD	0.31476000E	07
6501	WHOLESALE TRADE	0.15779000E	07
7001	BANKING	0.52000500E	06
7102	REAL ESTATE	0.57862200E	06
7302	ADVERTISING	0.13220040E	07

Fig. 11. INPUT PURCHASES OF THE PAINT PLANT

and services purchased by the plant to low energy intensive ones. Hence, the industry will ideally be able to reduce the energy intensity of its outputs in spite of fluctuations and other changes in the energy supply situation.

Appendix A contains a brief user's handbook which summarizes the steps involved in the method developed for analyzing total energy. Appendix B consists of a sample listing of the Fortran program used in the total energy analysis.

## REFERENCES

1. C. W. Bullard and R. A. Herendeen, 'Energy impact of consumption decisions'. Document No: 135, Center for Advanced Computation, University of Illinois, Urbana, Illinois 61801
2. Herendeen, R. A., "An energy input-output matrix for the United States 1963 User's Guide'. Document No. 69, Center for Advanced Computation, University of Illinois, Urbana, Illinois 61801.
3. Bullard, C. W. and Herendeen, R. A., "Energy use in the commercial and industrial sectors of the U.S. economy 1963'. Document 105, Center for Advanced Computation, University of Illinois, Urbana, Illinois 61801.
4. Herendeen, R. A. and Bullard, C. W., 'Energy cost of goods and services, 1963 and 1967'. Document 140, Center for Advanced Computation, University of Illinois, Urbana, Illinois 61801.
5. Standart Industrial Classification Manual, Bureau of the Budget, Executive Office of the President, 1957.
6. Survey of Current Business.
7. Monthly Labor Review.

TABLE 1.  
367-LEVEL SECTOR NAMES

Industry Classification of the 1963 Input-Output Tables

The underlined titles represent the groupings of industries used for the summary version of the 1963 tables and were also used in the 1958 and 1961 input-output tables prepared by the Office of Business Economics.

Industry number and title	Related SIC codes (1957 edition)
<u>AGRICULTURAL, FORESTRY &amp; FISHERIES</u>	
<u>1 Livestock &amp; livestock products</u>	
1.01 Dairy farm products-----	0132, pt. 014, pt. 02
1.02 Poultry & eggs-----	0133, pt. 014, pt. 02
1.03 Meat, animals & miscellaneous livestock products----	0139, pt. 014, 0193, pt. .0729, pt. 02
<u>2 Other agricultural products</u>	
2.01 Cotton-----	0112, pt. 014, pt. 02
2.02 Food feed grains & grass seeds-----	0113, pt. 0119, pt. 014, pt. 02
2.03 Tobacco-----	pt. 0119, pt. 014, pt. 02
2.04 Fruits & tree nuts-----	0122, pt. 014, pt. 02
2.05 Vegetables, sugar & miscellaneous crops-----	0123, pt. 0119, pt. 014, pt. 02
2.06 Oil bearing crops-----	pt. 0119, pt. 014, pt. 02
2.07 Forest, greenhouse & nursery products-----	0192, pt. 014, pt. 02
<u>3 Forestry &amp; fishery products</u>	
3.00 Forestry & fishery products-----	074, 081, 082, 084, 086, 091
<u>4 Agricultural, forestry &amp; fishery services</u>	
4.00 Agricultural, forestry & fishery services-----	071, 0723, 073, pt. 0729, 085, 098
<u>MINING</u>	
<u>5 Iron &amp; ferroalloy ores mining</u>	
5.00 Iron & ferroalloy ores mining-----	1011, 106
<u>6 Nonferrous metal ores mining</u>	
6.01 Copper ore mining-----	102
6.02 Nonferrous metal ores mining, except copper-----	103, 104, 105, 108, 109
<u>7 Coal mining</u>	
7.00 Coal mining-----	11, 12
<u>8 Crude petroleum &amp; natural gas</u>	
8.00 Crude petroleum & natural gas-----	1311, 1321
<u>9 Stone &amp; clay mining &amp; quarrying</u>	
9.00 Stone & clay mining & quarrying-----	141, 142, 144, 145, 148, 149
<u>10 Chemicals &amp; fertilizer mineral mining</u>	
10.00 Chemical & fertilizer mineral mining-----	147

Industry number and title	Related SIC codes (1957 edition)
<b>CONSTRUCTION</b>	
<u>11 New construction</u>	
11.01	New construction, residential buildings (nonfarm)--- pt. 15, pt. 16, pt. 17, pt. 6561
11.02	New construction, nonresidential buildings----- pt. 15, pt. 17
11.03	New construction, public utilities----- pt. 15, pt. 16, pt. 17
11.04	New construction, highways----- pt. 16, pt. 17
11.05	New construction, all other----- pt. 15, pt. 16, pt. 17, 138
<u>12 Maintenance &amp; repair construction</u>	
12.01	Maintenance & repair construction, residential buildings (nonfarm)----- pt. 15, pt. 17
12.02	Maintenance & repair construction, all other----- pt. 15, pt. 16, pt. 17
<b>MANUFACTURING</b>	
<u>13 Ordnance &amp; accessories</u>	
13.01	Complete guided missiles----- 1925
13.02	Ammunition, except for small arms, n.e.c.----- 1929
13.03	Tanks & tank components----- 1931
13.04	Sighting & fire control equipment----- 1941
13.05	Small arms----- 1951
13.06	Small arms ammunition----- 1961
13.07	Other ordnance & accessories----- 1911, 1999
<u>14 Food &amp; kindred products</u>	
14.01	Meat products----- 201
14.02	Creamery butter----- 2021
14.03	Cheese, natural & processed----- 2022
14.04	Condensed & evaporated milk----- 2023
14.05	Ice cream & frozen desserts----- 2024
14.06	Fluid milk----- 2026
14.07	Canned & cured sea foods----- 2031
14.08	Canned specialties----- 2032
14.09	Canned fruits & vegetables----- 2033
14.10	Dehydrated food products----- 2034
14.11	Pickles, sauces & salad dressings----- 2035
14.12	Fresh or frozen packaged fish----- 2036
14.13	Frozen fruits & vegetables----- 2037
14.14	Flour & cereal preparations----- 2041, 2043, 2045
14.15	Prepared feeds for animals & fowls----- 2042
14.16	Rice milling----- 2044
14.17	Wet corn milling----- 2046
14.18	Bakery products----- 205
14.19	Sugar----- 206
14.20	Confectionery & related products----- 207
14.21	Alcoholic beverages----- 2082-5
14.22	Bottled & canned soft drinks----- 2086
14.23	Flavoring extracts & sirups, n.e.c.----- 2087
14.24	Cottonseed oil mills----- 2091
14.25	Soybean oil mills----- 2092
14.26	Vegetable oil mills, n.e.c.----- 2093
14.27	Animal & marine fats & oils----- 2094
14.28	Roasted coffee----- 2095
14.29	Shortening & cooking oils----- 2096
14.30	Manufactured ice----- 2097
14.31	Macaroni & spaghetti----- 2098
14.32	Food preparations, n.e.c.----- 2099

Industry number and title	Related SIC codes (1957 edition)
<u>15 Tobacco manufactures</u>	
15.01 Cigarettes, cigars, etc.-----	2111, 2121, 2131
15.02 Tobacco stemming & redrying-----	2141
<u>16 Broad &amp; narrow fabrics, yarn &amp; thread mills</u>	
16.01 Broadwoven fabric mills & fabric finishing plants---	2211, 2221, 2231, 2261, 2262
16.02 Narrow fabric mills-----	2241
16.03 Yarn mills & finishing of textiles, n.e.c.-----	2269, 2281-3
16.04 Thread mills-----	2284
<u>17 Miscellaneous textile goods &amp; floor coverings</u>	
17.01 Floor coverings-----	227
17.02 Felt goods, n.e.c.-----	2291
17.03 Lace goods-----	2292
17.04 Paddings & upholstery fillings-----	2293
17.05 Processed textile waste-----	2294
17.06 Coated fabrics, not rubberized-----	2295
17.07 Tire cord & fabric-----	2296
17.08 Scouring & combing plants-----	2297
17.09 Cordage & twine-----	2298
17.10 Textile goods, n.e.c.-----	2299
<u>18 Apparel</u>	
18.01 Hosiery-----	2251, 2252
18.02 Knit apparel mills-----	2253, 2254, 2259
18.03 Knit fabric mills-----	2256
18.04 Apparel made from purchased materials-----	23 (exc. 239), 3992
<u>19 Miscellaneous fabricated textile products</u>	
19.01 Curtains & draperies-----	2391
19.02 Housefurnishings, n.e.c.-----	2392
19.03 Fabricated textile products, n.e.c.-----	2393-9
<u>20 Lumber &amp; wood products, except containers</u>	
20.01 Logging camps & logging contractors-----	2411
20.02 Sawmills & planing mills, general-----	2421
20.03 Hardwood dimension & flooring-----	2426
20.04 Special product sawmills, n.e.c.-----	2429
20.05 Millwork-----	2431
20.06 Veneer & plywood-----	2432
20.07 Prefabricated wood structures-----	2433
20.08 Wood preserving-----	2491
20.09 Wood products, n.e.c.-----	2499
<u>21 Wooden containers</u>	
21.00 Wooden containers-----	244
<u>22 Household furniture</u>	
22.01 Wood household furniture-----	2511, 2519
22.02 Upholstered household furniture-----	2512
22.03 Metal household furniture-----	2514
22.04 Mattresses & bedsprings-----	2515
<u>23 Other furniture &amp; fixtures</u>	
23.01 Wood office furniture-----	2521
23.02 Metal office furniture-----	2522
23.03 Public building furniture-----	2531
23.04 Wood partitions & fixtures-----	2541
23.05 Metal partitions & fixtures-----	2542
23.06 Venetian blinds & shades-----	2591
23.07 Furniture & fixtures, n.e.c.-----	2599

Industry number and title		Related SIC codes (1957 edition)
<u>24 Paper &amp; allied products except containers &amp; boxes</u>		
24.01	Pulp mills-----	2611
24.02	Paper mills, except building paper-----	2621
24.03	Paperboard mills-----	2631
24.04	Envelopes-----	2642
24.05	Sanitary paper products-----	2647
24.06	Wallpaper & building paper & board mills-----	2644, 2661
24.07	Converted paper, products n.e.c. except containers & boxes-----	2641, 2643, 2645, 2646, 2649
<u>25 Paperboard containers &amp; boxes</u>		
25.00	Paperboard containers & boxes-----	265
<u>26 Printing &amp; publishing</u>		
26.01	Newspapers-----	2711
26.02	Periodicals-----	2721
26.03	Book printing & publishing-----	273
26.04	Miscellaneous publishing-----	2741
26.05	Commercial printing-----	2751, 2752
26.06	Manifold business forms, blankbooks & binders-----	2761, 2782
26.07	Greeting card publishing-----	2771
26.08	Miscellaneous printing services-----	2753, 2789, 279
<u>27 Chemicals &amp; selected chemical products</u>		
27.01	Industrial inorganic & organic chemicals-----	281 except 28195
27.02	Fertilizers-----	2871, 2872
27.03	Agricultural chemicals, n.e.c.-----	2879
27.04	Miscellaneous chemical products-----	2861, 289
<u>28 Plastics &amp; synthetic materials</u>		
28.01	Plastics materials & resins-----	2821
28.02	Synthetic rubber-----	2822
28.03	Cellulosic man-made fibers-----	2823
28.04	Organic fibers, noncellulosic-----	2824
<u>29 Drugs, cleaning &amp; toilet preparations</u>		
29.01	Drugs-----	283
29.02	Cleaning preparations-----	284 except 2844
29.03	Toilet preparations-----	2844
<u>30 Paints &amp; allied products</u>		
30.00	Paints & allied products-----	2851
<u>31 Petroleum refining &amp; related industries</u>		
31.01	Petroleum refining & related products-----	2911, 299
31.02	Paving mixtures & blocks-----	2951
31.03	Asphalt felts & coatings-----	2952
<u>32 Rubber &amp; miscellaneous plastics products</u>		
32.01	Tires & inner tubes-----	3011
32.02	Rubber footwear-----	3021
32.03	Reclaimed rubber & miscellaneous rubber products, n.e.c.-----	3031, 3069
32.04	Miscellaneous plastics products-----	3079
<u>33 Leather tanning &amp; industrial leather products</u>		
33.00	Leather tanning & industrial leather products-----	3111, 3121



Industry number and title		Related SIC codes (1957 edition)
<u>34 Footwear &amp; other leather products</u>		
34.01	Footwear cut stock-----	3131
34.02	Footwear except rubber-----	314
34.03	Other leather products-----	3151, 3161, 317, 3199
<u>35 Glass &amp; glass products</u>		
35.01	Glass & glass products except containers-----	3211, 3229, 3231
35.02	Glass containers-----	3221
<u>36 Stone &amp; clay products</u>		
36.01	Cement, hydraulic-----	3241
36.02	Brick & structural clay tile-----	3251
36.03	Ceramic wall & floor tile-----	3253
36.04	Clay refractories-----	3255
36.05	Structural clay products, n.e.c.-----	3259
36.06	Vitreous plumbing fixtures-----	3261
36.07	Food utensils, pottery-----	3262, 3263
36.08	Porcelain electrical supplies-----	3264
36.09	Pottery products, n.e.c.-----	3269
36.10	Concrete block & brick-----	3271
36.11	Concrete products, n.e.c.-----	3272
36.12	Ready-mixed concrete-----	3273
36.13	Lime-----	3274
36.14	Gypsum products-----	3275
36.15	Cut stone & stone products-----	3281
36.16	Abrasive products-----	3291
36.17	Asbestos products-----	3292
36.18	Gaskets & insulations-----	3293
36.19	Minerals, ground or treated-----	3295
36.20	Mineral wool-----	3296
36.21	Nonclay refractories-----	3297
36.22	Nonmetallic mineral products, n.e.c.-----	3299
<u>37 Primary iron &amp; steel manufacturing</u>		
37.01	Blast furnace & basic steel products-----	331
37.02	Iron & steel foundries-----	332
37.03	Iron & steel forgings-----	3391
37.04	Primary metal products n.e.c.-----	3399
<u>38 Primary nonferrous metals manufacturing</u>		
38.01	Primary copper-----	3331
38.02	Primary lead-----	3332
38.03	Primary zinc-----	3333
38.04	Primary aluminum-----	3334, 28195
38.05	Primary nonferrous metals, n.e.c.-----	3339
38.06	Secondary nonferrous metals-----	3341
38.07	Copper rolling & drawing-----	3351
38.08	Aluminum rolling & drawing-----	3352
38.09	Nonferrous rolling & drawing, n.e.c.-----	3356
38.10	Nonferrous wire drawing & insulating-----	3357
38.11	Aluminum castings-----	3361
38.12	Brass, bronze & copper castings-----	3362
38.13	Nonferrous castings, n.e.c.-----	3369
38.14	Nonferrous forgings-----	3392
<u>39 Metal containers</u>		
39.01	Metal cans-----	3411
39.02	Metal barrels, drums & pails-----	3491

## Industry number and title

Related SIC codes  
(1957 edition)

<u>40 Heating, plumbing &amp; fabricated structural metal products</u>		
40.01	Metal sanitary ware-----	3431
40.02	Plumbing fittings & brass goods-----	3432
40.03	Heating equipment except electric-----	3433
40.04	Fabricated structural steel-----	3441
40.05	Metal doors, sash & trim-----	3442
40.06	Fabricated plate work (boiler shops)-----	3443
40.07	Sheet metal work-----	3444
40.08	Architectural metal work-----	3446
40.09	Miscellaneous metal work-----	3449
<u>41 Screw machine products, bolts, nuts, etc. &amp; metal stampings</u>		
41.01	Screw machine products & bolts, nuts, rivets & washers-----	345
41.02	Metal stampings-----	3461
<u>42 Other fabricated metal products</u>		
42.01	Cutlery-----	3421
42.02	Hand & edge tools including saws-----	3423, 3425
42.03	Hardware, n.e.c.-----	3429
42.04	Coating, engraving & allied services-----	3471, 3479
42.05	Miscellaneous fabricated wire products-----	3481
42.06	Safes & vaults-----	3492
42.07	Steel springs-----	3493
42.08	Pipe, valves & pipe fittings-----	3494, 3498
42.09	Collapsible tubes-----	3496
42.10	Metal foil & leaf-----	3497
42.11	Fabricated metal products, n.e.c.-----	3499
<u>43 Engines &amp; turbines</u>		
43.01	Steam engines & turbines-----	3511
43.02	Internal combustion engines, n.e.c.-----	3519
<u>44 Farm machinery</u>		
44.00	Farm machinery-----	3522
<u>45 Construction, mining, oil field machinery, equipment</u>		
45.01	Construction machinery-----	3531
45.02	Mining machinery-----	3532
45.03	Oil field machinery-----	3533
<u>46 Materials handling machinery &amp; equipment</u>		
46.01	Elevators & moving stairways-----	3534
46.02	Conveyors & conveying equipment-----	3535
46.03	Hoists, cranes & monorails-----	3536
46.04	Industrial trucks & tractors-----	3537
<u>47 Metalworking machinery &amp; equipment</u>		
47.01	Machine tools, metal cutting types-----	3541
47.02	Machine tools, metal forming types-----	3542
47.03	Special dies & tools & machine tool accessories-----	3544, 3545
47.04	Metalworking machinery, n.e.c.-----	3548
<u>48 Special industry machinery &amp; equipment</u>		
48.01	Food products machinery-----	3551
48.02	Textile machinery-----	3552
48.03	Woodworking machinery-----	3553
48.04	Paper industries machinery-----	3554
48.05	Printing trades machinery-----	3555
48.06	Special industry machinery, n.e.c.-----	3559

Industry number and title	Related SIC codes (1957 edition)
<u>49 General industrial machinery &amp; equipment</u>	
49.01 Pumps & compressors-----	3561
49.02 Ball & roller bearings-----	3562
49.03 Blowers & fans-----	3564
49.04 Industrial patterns-----	3565
49.05 Power transmission equipment-----	3566
49.06 Industrial furnaces & ovens-----	3567
49.07 General industrial machinery, n.e.c.-----	3569
<u>50 Machine shop products</u>	
50.00 Machine shop products-----	359
<u>51 Office, computing &amp; accounting machines</u>	
51.01 Computing & related machines-----	3571
51.02 Typewriters-----	3572
51.03 Scales & balances-----	3576
51.04 Office machines, n.e.c.-----	3579
<u>52 Service industry machines</u>	
52.01 Automatic merchandising machines-----	3581
52.02 Commercial laundry equipment-----	3582
52.03 Refrigeration machinery-----	3585
52.04 Measuring & dispensing pumps-----	3586
52.05 Service industry machines, n.e.c.-----	3589
<u>53 Electric transmission &amp; distribution equipment &amp; electrical industrial apparatus</u>	
53.01 Electric measuring instruments-----	3611
53.02 Transformers-----	3612
53.03 Switchgear & switchboard apparatus-----	3613
53.04 Motors & generators-----	3621
53.05 Industrial controls-----	3622
53.06 Welding apparatus-----	3623
53.07 Carbon & graphite products-----	3624
53.08 Electrical industrial apparatus, n.e.c.-----	3629
<u>54 Household appliances</u>	
54.01 Household cooking equipment-----	3631
54.02 Household refrigerators & freezers-----	3632
54.03 Household laundry equipment-----	3633
54.04 Electric housewares & fans-----	3634
54.05 Household vacuum cleaners-----	3635
54.06 Sewing machines-----	3636
54.07 Household appliances, n.e.c.-----	3639
<u>55 Electric lighting &amp; wiring equipment</u>	
55.01 Electric lamps-----	3641
55.02 Lighting fixtures-----	3642
55.03 Wiring devices-----	3643, 3644
<u>56 Radio, television &amp; communication equipment</u>	
56.01 Radio & TV receiving sets-----	3651
56.02 Phonograph records-----	3652
56.03 Telephone & telegraph apparatus-----	3661
56.04 Radio & TV communication equipment-----	3662
<u>57 Electronic components &amp; accessories</u>	
57.01 Electron tubes-----	3671, 3672, 3673
57.02 Semiconductors-----	3674
57.03 Electronic components, n.e.c.-----	3679

Industry number and title		Related SIC codes (1957 edition)
<u>58 Miscellaneous electrical machinery, equipment &amp; supplies</u>		
58.01	Storage batteries-----	3691
58.02	Primary batteries, wet & dry-----	3692
58.03	X-ray apparatus & tubes-----	3693
58.04	Engine electrical equipment-----	3694
58.05	Electrical equipment, n.e.c.-----	3699
<u>59 Motor vehicles &amp; equipment</u>		
59.01	Truck & bus bodies-----	3713
59.02	Truck trailers-----	3715
59.03	Motor vehicles & parts-----	3717
<u>60 Aircraft &amp; parts</u>		
60.01	Aircraft-----	3721
60.02	Aircraft engines & parts-----	3722
60.03	Aircraft propellers & parts-----	3723
60.04	Aircraft equipment, n.e.c.-----	3729
<u>61 Other transportation equipment</u>		
61.01	Shipbuilding & repairing-----	3731
61.02	Boatbuilding & repairing-----	3732
61.03	Locomotives & parts-----	3741
61.04	Railroad & street cars-----	3742
61.05	Motorcycles, bicycles & parts-----	3751
61.06	Trailer coaches-----	3791
61.07	Transportation equipment, n.e.c.-----	3799
<u>62 Professional, scientific &amp; controlling instruments &amp; supplies</u>		
62.01	Engineering & scientific instruments-----	3811
62.02	Mechanical measuring devices-----	3821
62.03	Automatic temperature controls-----	3822
62.04	Surgical & medical instruments-----	3841
62.05	Surgical appliances & supplies-----	3842
62.06	Dental equipment & supplies-----	3843
62.07	Watches, clocks & parts-----	387
<u>63 Optical, ophthalmic, &amp; photographic equipment &amp; supplies</u>		
63.01	Optical instruments & lenses-----	3831
63.02	Ophthalmic goods-----	3851
63.03	Photographic equipment & supplies-----	3861
<u>64 Miscellaneous manufacturing</u>		
64.01	Jewelry, including costume & silverware-----	391, 3961
64.02	Musical instruments & parts-----	3931
64.03	Games, toys, etc.-----	3941
64.04	Sporting & athletic goods, n.e.c.-----	3949
64.05	Pens, pencils, etc.-----	395
64.06	Artificial flowers-----	3962
64.07	Buttons, needles, pins & fasteners-----	3963, 3964
64.08	Brooms & brushes-----	3981
64.09	Hard surface floor covering-----	3982
64.10	Barbers' goods-----	3988
64.11	Signs & advertising displays-----	3993
64.12	Miscellaneous manufactures, n.e.c.-----	3983, 3984, 3987, 3995, 3999

## Industry number and title

Related SIC codes  
(1957 edition)

## TRANSPORTATION, COMMUNICATION, ELECTRIC, GAS, &amp; SANITARY SERVICES

<u>65 Transportation &amp; warehousing</u>		
65.01	Railroads & related services-----	40, 474
65.02	Local, suburban & interurban highway passenger transportation-----	41
65.03	Motor freight transportation & warehousing-----	42, 473
65.04	Water transportation-----	44
65.05	Air transportation-----	45
65.06	Pipe line transportation-----	46
65.07	Transportation services-----	47, except 473, 474
<u>66 Communications, except radio &amp; television broadcasting</u>		
66.00	Communications, except radio & television-----	48, except 483
<u>67 Radio &amp; TV broadcasting</u>		
67.00	Radio & television broadcasting-----	483
<u>68 Electric, gas, water &amp; sanitary services</u>		
68.01	Electric utilities-----	491, pt. 493
68.02	Gas utilities-----	492, pt. 493
68.03	Water & sanitary services-----	494, 495, 496, 497, pt. 493

## WHOLESALE &amp; RETAIL TRADE

<u>69 Wholesale &amp; retail trade</u>		
69.01	Wholesale trade-----	50 (except manufacturers' sales offices)
69.02	Retail trade-----	52, 53, 54, 55, 56, 57, 58, 59, 7396

## FINANCE, INSURANCE &amp; REAL ESTATE

<u>70 Finance &amp; insurance</u>		
70.01	Banking-----	60
70.02	Credit agencies-----	61, 67
70.03	Security & commodity brokers-----	62
70.04	Insurance carriers-----	63
70.05	Insurance agents & brokers-----	64
<u>71 Real estate &amp; rental</u>		
71.01	Owner-occupied dwellings-----	NA
71.02	Real estate-----	65 (except pt. 6561), 66

## SERVICES

<u>72 Hotels &amp; lodging places; personal &amp; repair services, except automobile repair</u>		
72.01	Hotels & lodging places-----	70
72.02	Personal & repair services, except auto repair, barber, & beauty shops-----	72 (except 723, 724), 76 (except 7694 & pt. 7699)
72.03	Barber & beauty shops-----	723, 724
<u>73 Business Services</u>		
73.01	Miscellaneous business services-----	73 (except 731, 7396), 7694, pt. 7699
73.02	Advertising-----	731
73.03	Miscellaneous professional services-----	81, 89 (except 8921)

Industry number and title	Related SIC codes (1957 edition)
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74 Research & development  
74.00 Eliminated as a separate industry in the 1963 study. Research & development performed for sale is distributed to the purchaser by each of the industries performing the research & development.

75 Automobile repair & services  
75.00 Automobile repair & services----- 75

76 Amusements  
76.01 Motion pictures----- 78  
76.02 Amusement & recreation services----- 79

77 Medical, educational services & nonprofit organizations  
77.01 Doctors & dentists----- 801, 802, 803, 804  
77.02 Hospitals----- 8061  
77.03 Other medical & health services----- 0722, 807, 809  
77.04 Educational services----- 82  
77.05 Nonprofit organizations----- 84, 86, 8921

GOVERNMENT ENTERPRISES

78 Federal Government enterprises  
78.01 Post Office-----  
78.02 Federal electric utilities-----  
78.03 Commodity Credit Corporation-----  
78.04 Other Federal Government enterprises-----

79 State & local government enterprises  
79.01 Local government passenger transit-----  
79.02 State & local electric utilities-----  
79.03 Other state & local government enterprises-----

IMPORTS

80 Gross imports of goods & services  
80.01 Directly allocated imports-----  
80.02 Transferred imports-----

DUMMY INDUSTRIES

81 Business travel, entertainment & gifts  
81.00 Business travel, entertainment & gifts-----

82 Office supplies  
82.00 Office supplies-----

83 Scrap, used & secondhand goods  
83.00 Scrap, used & secondhand goods-----

SPECIAL INDUSTRIES

84 Government industry  
84.00 Government industry-----

85 Rest of the world industry  
85.00 Rest of the world industry-----

86 Household industry  
86.00 Household industry-----

Industry number and title	Related SIC codes (1957 edition)
87.00 <u>87 Inventory valuation adjustment</u> Inventory valuation adjustment-----	
88.00 Total intermediate output-----	
96.60 <u>Personal consumption expenditures</u> Personal consumption expenditures-----	
96.70 <u>Gross private fixed capital formation</u> Gross private fixed capital formation-----	
96.80 <u>Net inventory change</u> Net inventory change-----	
96.90 <u>Net exports</u> Net exports-----	
97.10 <u>Federal Government purchases</u> Federal Government purchases, defense----- 97.20 Federal Government purchases, other-----	
98.60 <u>State and local government purchases</u> State and local government purchases, education--- 98.70 State and local government purchases, health, welfare and sanitation----- 98.80 State and local government purchases, safety----- 98.90 State and local government purchases, other-----	
99.02 Total final demand-----	
99.03 Total output-----	
99.04 Transfers-----	
I Total intermediate inputs-----	
V.A. Value added-----	
T Total inputs-----	
TR Transfers-----	

TABLE 2.

SECTOR AGGREGATION SCHEME (368 to 42 sectors)

42-LEVEL TITLE	368-LEVEL SECTORS CONTAINED*
1. COAL MINING	7.00
2. CRUDE, GAS EXTRACT	8.00
3. REFINED PETROL.	31.01
4. ELEC. UTIL.	68.01
5. GAS UTIL.	68.02
6. AGRIC., FORESTRY	1-4
7. OTHER MINING	5,6,9,10
8. NEW, MAINT. CONSTRUCT.	11,12
9. ORDNANCE	13
10. FOOD, KINDRED PROD.	14,15
11. TEST, APPAREL	16-19
12. LUMBER, WOOD, PAPER	20,21,24,25
13. FURNITURE	22,23
14. CHEMICALS, PAINTS	27-30,31.02,31.03,32
15. LEATHER, FOOTWEAR	33-34
16. STONE, CLAY, GLASS	35,36
17. PRIMARY METALS	37,38
18. FABR. METAL PROD.	39-42
19. HEAVY MACH.	43-50,52
20. COMPUT. MACH.	51
21. ELECT. EQUIPT.	53,55,58
22. APPLIANCES	54,56,57
23. MOTOR VEHICLES	59
24. OTHER TRANSP. EQPT.	60,61
25. INSTRUMENTS	62,63
26. MISC. MANUF.	64
27. RAIL TRANSP.	65.01
28. LOCAL TRANSP.	65.02
29. TRUCK WAREHSE.	65.03
30. WATER TRANSP.	65.04
31. AIR TRANSP.	65.05
32. PIPELINE TRANSP.	65.06
33. TRANSP. SERVICES	65.07
34. PRINT, PUBLISHING	26,66,67
35. WATER, SANIT. SERVICES	68.03
36. W'SALE, RETAIL	69
37. FINANCE	70-73
38. AUTO REPAIR	75
39. AMUSEMENTS	76
40. MEDICAL, EDUC.	77
41. GOV'T.	78,79
42. MISC.	80-87

\*When sectors are denoted by an integer, all sectors with that integer to left of decimal point are included. Thus ordnance, 13, contains 13.01-13.07.



APPENDIX-A

CALCULATIONS FOR A SAMPLE PLANT

The method described earlier in this study will be applied to a plant which is assumed to purchase all its inputs needed to operate the plant from seven different sectors of the 367 level economy. It is again assumed that 100 units of output were produced by this plant in 1974. Let the same plant purchase the following amount of inputs in 1974.

Sector Name	Sector No.	Amount
COAL	1	150000 BTU
ELECTRICITY	4	110000 BTU
GLASS	151	10.5 \$
STEEL	175	31.5 \$
ELECTRIC MOTORS	257	14.5 \$

An analysis in the accounting department of the plant has shown that the plant paid the following amount, for railroad transportation and wholesale trading in purchasing its inputs.

	RAIL (\$)	WHOLESALE (\$)
COAL	1.5	2.0
ELECTRICITY	0.0	0.0
GLASS	0.0	0.5
STEEL	1.0	1.5
EL. MOTORS	0.5	1.0
TOTAL	<u>3.0</u>	<u>5.0</u>

Hence, the plant has an input purchase matrix,  $x$ , as shown below;

$$x = \begin{bmatrix} 150 & 000 & \text{BTU} \\ 110 & 000 & \text{BTU} \\ & 10 & \$ \\ & 29 & \$ \\ & 13 & \$ \\ & 3 & \$ \\ & 5 & \$ \end{bmatrix}$$

where the last two rows are now the railroad transportation sector and the wholesale trade sector with sector numbers 320 and 330 respectively. The total energy coefficients of the seven input sectors can be selected from the national data prepared by CAC for the year 1967. Therefore, the total energy coefficient matrix for this plant is;

$$\epsilon = \begin{bmatrix} 1.0025 & 0.0040 & 0.0023 & 0.0004 & 0.0016 & 1.0068 \\ 1.9336 & 1.1797 & 0.3112 & 1.1078 & 0.8384 & 3.7963 \\ 19704.0 & 78960.0 & 10886.0 & 7032.9 & 65866.0 & 103000.0 \\ 159600.0 & 99796.0 & 26383.0 & 13030.0 & 70729.0 & 267430.0 \\ 26248.0 & 32912.0 & 11020.0 & 5781.1 & 20977.0 & 62725.0 \\ 8374.0 & 68235.0 & 55674.0 & 1593.8 & 10783.0 & 77592.0 \\ 5912.4 & 28515.0 & 19702.0 & 1985.2 & 8021.0 & 35651.0 \end{bmatrix}$$

Similarly, the total labor coefficient matrix is;

$$L = \begin{bmatrix} 0.14278 \cdot 10^{-10} \\ 0.26115 \cdot 10^{-9} \\ 0.10453 \cdot 10^{-3} \\ 0.83780 \cdot 10^{-4} \\ 0.90575 \cdot 10^{-4} \\ 0.85412 \cdot 10^{-4} \\ 0.98654 \cdot 10^{-4} \end{bmatrix}$$

and the implicit price deflators (IPD) of the seven input sectors, based on the year 1958 (IPD = 100) for the years 1967 and 1974 are;

SECTOR NO	1967 IPD	1974 IPD	RATIO ( $\frac{1967}{1974}$ )
1	112.7	139.2	0.80963
4	103.0	128.6	0.80093
151	109.7	129.7	0.84580
175	107.4	131.4	0.81735
257	102.5	113.4	0.90388
320	102.3	136.0	0.75221
330	98.5	111.3	0.88500

Now, all the input purchases will be deflated back to 1967 using the ratio between 1967 IPD'S and 1974 IPD'S. Hence, the deflated input purchases become

$x_{\text{DEFLATED}}$	=	121443.90	BTU
		88102.60	BTU
		8.45	\$
		23.70	\$
		11.75	\$
		2.25	\$
		4.42	\$

Then, total energy consumed in BTU by the plant by energy type will equal to

$$x_{\text{DEF}}^T \cdot \epsilon = \begin{bmatrix} \text{COAL} & \text{CRUDE OIL} & \text{REF. PET.} & \text{ELEC.} & \text{GAS} & \text{PRIM.ENERGY} \\ 0.459 \cdot 10^7 & 0.380 \cdot 10^7 & 0.108 \cdot 10^7 & 0.546 \cdot 10^6 & 0.261 \cdot 10^7 & 0.873 \cdot 10^7 \end{bmatrix} \text{BTU}$$

Energy intensity of the product by energy type can be obtained by dividing the total energy consumed by the total output of the plant. Hence, energy intensity matrix, in BTU/unit output, is

$$\begin{bmatrix} \text{COAL} & \text{CRUDE OIL} & \text{REF. PET.} & \text{ELEC.} & \text{GAS} & \text{PRIM.ENERGY} \\ 0.459 \cdot 10^5 & 0.380 \cdot 10^5 & 0.108 \cdot 10^5 & 0.546 \cdot 10^4 & 0.261 \cdot 10^5 & 0.873 \cdot 10^5 \end{bmatrix}$$

Energy input coefficients, given by the EQ.(5) are calculated as

	COAL	CRUDE OIL	REF.PET.	ELEC.	GAS	PRIM.ENERGY
COAL	2.65	0.01	0.03	0.01	0.01	1.40
ELEC.	3.71	2.73	2.52	17.87	2.83	3.83
GLASS	3.63	17.55	8.47	10.89	21.30	9.97
STEEL	82.32	62.17	57.50	56.54	64.14	72.55
EL. MOTORS	6.71	10.16	11.91	12.43	9.43	8.44
RAIL	0.41	4.05	11.55	0.66	0.93	2.00
WHOLESALE	0.57	3.32	8.02	1.61	1.36	1.81
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00

It is know that 121443.9 BTU equivalent of coal and 88102.62 BTU equivalent of electricity entered directly into the plant. Then, percentage of the coal energy entered directly becomes;

$$\% \text{ Direct coal} = \frac{121443.9}{4590000.0} \times 100.0 = 2.64$$

and similarly for electricity;

$$\% \text{ Direct electricity} = \frac{88102.62}{3800000.0} \times 100.0 = 16.13$$

Direct primary energy input is:

$$\% \text{ Direct primary energy} = \frac{(121443.9+88102.62)}{8730000.0} \times 100.0=2.40$$

Hence, the plant has the following direct and indirect energy inputs.

	COAL	CRUDE	REF.PET.	ELEC.	GAS	PRIM.EN.
DIRECT	2.64	0.0	0.0	16.13	0.0	2.40
INDIRECT	97.36	100.0	100.0	83.87	100.0	97.60

Similar calculations can be easily done for total labor analysis of the same plant. From reference [7], it is found that output per man-hour in manufacturing sector has increased to 129.2 in 1974 from 100.0 in 1967. Hence, the productivity index is equal to 1.292. The total labor put into the production in 1974, then, becomes

$$1.292 \cdot (x^T_{\text{DEFLATED}} \cdot L) = 0.005928 \text{ man-year}$$

Labor intensity is equal to the total labor divided by the total output. Thus,

$$\text{Labor intensity} = 0.5928 \cdot 10^{-4} \text{ man-year/unit output}$$

The calculated labor input coefficients are;

COAL	0.04
ELECTRICITY	0.50
GLASS	19.27
STEEL	43.28
ELEC. MOTORS	23.20
RAIL	4.20
WHOLESALE	<u>9.51</u>
TOTAL	100.00

APPENDIX B

A SAMPLE PROGRAM

```

$JCB
1 DIMENSION NCM(50),KLN(7)
2 REAL*8 SN(74,5,2),RSN1(42),RSN2(42),SN1,SN2
3 REAL*8 SN3(3),SN4(3)
4 INTEGER SEC(357),SIG(357),NRGINT(6),INTLES(6)
5 REAL*4 DEN(6),IND(6)
6 REAL*4 TINT(7),C(357),IPD67(357),IPD74(357),CEEC(357,6),
  1DEF(357),P(357),PLRC(357,7),RSYST(42,7),CLC(357)
7 NN=1
8 DO 301 I=1,42
9 READ(5,300) RSN1(I),RSN2(I)
10 300 FORMAT(2A6)
11 301 CONTINUE
12 READ(5,660) (IPD67(I),I=1,357)
13 READ(5,660) (IPD74(I),I=1,357)
14 660 FORMAT(36(10(F8.2)/))
15 DO 67 I=1,357
16 READ(5,10) SEC(I),SIG(I),(CEEC(I,J),J=1,6)
17 10 FORMAT(13,1X,14,6E12.5)
18 67 CONTINUE
19 DO 68 I=1,74
20 READ(5,20) ((SN(I,J,K),K=1,2),J=1,5)
21 20 FORMAT(10A6)
22 68 CONTINUE
23 READ(5,35) (CLC(I),I=1,357)
24 35 FORMAT(60(6(E12.7,1X)/))
25 READ(5,19) SN3(1),SN4(1),SN3(2),SN4(2),SN3(3),SN4(3)
26 19 FORMAT(6A6)
27 LL=0
28 77 LL=LL+1
29 READ(5,333) NCMSEC,SN1,SN2,(NRGINT(J),J=1,6),OUTPUT
30 333 FORMAT(15,2A8,6I7,F17.1)
31 DO 44 M=1,42
32 READ(5,41) (RSYST(M,I),I=1,6)
33 41 FORMAT(6F5.2)
34 44 CONTINUE
35 PRINT 545,NCMSEC,SN1,SN2
36 545 FORMAT('1',37X,' SECTOR',15,' '='',2A8,/)
37 IF(NCMSEC.1) PRINT 546
38 546 FORMAT(35X,' 1967 NATIONAL AVERAGE ENERGY FLOW ',/)
39 PRINT 110
40 110 FORMAT(' ',11X,13H INPUT SECTORS,8X,5H CCAL,7X,5H CRUDE,5X,7H REF PET
  1,5X,4H ELEC,7X,4H GAS,3X,11H PRIM ENERGY,/)
41 DO 202 I=1,42
42 PRINT 109,RSN1(I),RSN2(I),(RSYST(I,K),K=1,6)
43 109 FORMAT(' ',10X,2A8,6(6X,F5.2))
44 202 CONTINUE
45 PRINT 400
46 400 FORMAT(' ',27X,6(5X,6H-----))
47 PRINT 401
48 401 FORMAT(' ',10X,6HTOTALS,10X,6(6X,5H100.0))
49 PRINT 302
50 302 FORMAT(10X,59(1H*))
51 PRINT 303
52 303 FORMAT(' ',10X,16H ENERGY INTENSITY)
53 PRINT 304,(NRGINT(J),J=1,6)
54 304 FORMAT(' ',12X,12H(BTU/1967 $),2X,6(4X,I7),/)
55 4 CONTINUE
56 DO 49 I=1,7
57 TINT(I)=0.0

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58      DO 49 M=1,42
59      RSYST(M,I)=0.0
60      49 CONTINUE
61      TP=0.0
62      DO 644 K=1,357
63      P(K)=0.0
64      DO 644 I=1,7
65      PERC(K,I)=0.0
66      644 CONTINUE
67      NSEC=0
68      179 NSEC=NSEC+1
69      READ(5,8) NUM(NSEC),C(NSEC)
70      8 FORMAT(13,EX,E16.2)
71      IF(NUM(NSEC).EQ.0) GO TO 180
72      GO TO 179
73      180 NSEC=NSEC-1
74      DO 658 K=1,NSEC
75      L=NUM(K)
76      P(L)=IPD67(L)/IPD74(L)*C(K)
77      TP=TP+P(L)*CLBC(L)*1.295
78      658 CONTINUE
79      SINT=TP/OUTPUT
80      DO 81 J=1,6
81      DO 82 K=1,NSEC
82      L=NUM(K)
83      TINT(J)=TINT(J)+P(L)*CEBC(L,J)
84      82 CONTINUE
85      NRGINT(J)=TINT(J)/OUTPUT
86      81 CONTINUE
87      DO 83 J=1,7
88      DO 83 I=1,NSEC
89      K=NUM(I)
90      IF(J.EQ.7) GO TO 7
91      PERC(K,J)=P(K)*CEBC(K,J)/TINT(J)*100.0
92      IF(J.NE.7) GO TO 17
93      7 PERC(K,J)=P(K)*CLBC(K)*1.295/TP*100.0
94      17 CONTINUE
95      IF(K.EQ.1) RSYST(1,J)=PERC(K,J)+RSYST(1,J)
96      IF(K.EQ.2) RSYST(2,J)=PERC(K,J)+RSYST(2,J)
97      IF(K.EQ.3) RSYST(3,J)=PERC(K,J)+RSYST(3,J)
98      IF(K.EQ.4) RSYST(4,J)=PERC(K,J)+RSYST(4,J)
99      IF(K.EQ.5) RSYST(5,J)=PERC(K,J)+RSYST(5,J)
100     IF(K.GE.6.AND.K.LE.17) RSYST(6,J)=PERC(K,J)+RSYST(6,J)
101     IF(K.GE.18.AND.K.LE.22) RSYST(7,J)=PERC(K,J)+RSYST(7,J)
102     IF(K.GE.23.AND.K.LE.29) RSYST(8,J)=PERC(K,J)+RSYST(8,J)
103     IF(K.GE.30.AND.K.LE.36) RSYST(9,J)=PERC(K,J)+RSYST(9,J)
104     IF(K.GE.37.AND.K.LE.70) RSYST(10,J)=PERC(K,J)+RSYST(10,J)
105     IF(K.GE.71.AND.K.LE.91) RSYST(11,J)=PERC(K,J)+RSYST(11,J)
106     IF(K.GE.92.AND.K.LE.101) RSYST(12,J)=PERC(K,J)+RSYST(12,J)
107     IF(K.GE.113.AND.K.LE.120) RSYST(12,J)=PERC(K,J)+RSYST(12,J)
108     IF(K.GE.102.AND.K.LE.112) RSYST(13,J)=PERC(K,J)+RSYST(13,J)
109     IF(K.GE.129.AND.K.LE.146) RSYST(14,J)=PERC(K,J)+RSYST(14,J)
110     IF(K.GE.147.AND.K.LE.150) RSYST(15,J)=PERC(K,J)+RSYST(15,J)
111     IF(K.GE.151.AND.K.LE.174) RSYST(16,J)=PERC(K,J)+RSYST(16,J)
112     IF(K.GE.175.AND.K.LE.183) RSYST(17,J)=PERC(K,J)+RSYST(17,J)
113     IF(K.GE.184.AND.K.LE.216) RSYST(18,J)=PERC(K,J)+RSYST(18,J)
114     IF(K.GE.217.AND.K.LE.244) RSYST(19,J)=PERC(K,J)+RSYST(19,J)
115     IF(K.GE.245.AND.K.LE.253) RSYST(20,J)=PERC(K,J)+RSYST(20,J)
116     IF(K.GE.254.AND.K.LE.261) RSYST(21,J)=PERC(K,J)+RSYST(21,J)
117     IF(K.GE.269.AND.K.LE.283) RSYST(21,J)=PERC(K,J)+RSYST(21,J)
118     IF(K.GE.282.AND.K.LE.283) RSYST(22,J)=PERC(K,J)+RSYST(22,J)
119     IF(K.GE.284.AND.K.LE.290) RSYST(23,J)=PERC(K,J)+RSYST(23,J)
120     IF(K.GE.291.AND.K.LE.297) RSYST(24,J)=PERC(K,J)+RSYST(24,J)
121     IF(K.GE.298.AND.K.LE.306) RSYST(25,J)=PERC(K,J)+RSYST(25,J)
122     IF(K.GE.307.AND.K.LE.319) RSYST(26,J)=PERC(K,J)+RSYST(26,J)
123     IF(K.EQ.320) RSYST(27,J)=PERC(K,J)+RSYST(27,J)
124     IF(K.EQ.321) RSYST(28,J)=PERC(K,J)+RSYST(28,J)
125     IF(K.EQ.322) RSYST(29,J)=PERC(K,J)+RSYST(29,J)
126     IF(K.EQ.323) RSYST(30,J)=PERC(K,J)+RSYST(30,J)
127     IF(K.EQ.324) RSYST(31,J)=PERC(K,J)+RSYST(31,J)

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128      IF(K.EQ.325) RSYST(32,J)=PERC(K,J)+RSYST(32,J)
129      IF(K.EQ.326) RSYST(33,J)=PERC(K,J)+RSYST(33,J)
130      IF(K.GE.121.AND.K.LE.128) RSYST(34,J)=PERC(K,J)+RSYST(34,J)
131      IF(K.EQ.329) RSYST(35,J)=PERC(K,J)+RSYST(35,J)
132      IF(K.GE.330.AND.K.LE.331) RSYST(36,J)=PERC(K,J)+RSYST(36,J)
133      IF(K.GE.332.AND.K.LE.339) RSYST(37,J)=PERC(K,J)+RSYST(37,J)
134      IF(K.EQ.345) RSYST(38,J)=PERC(K,J)+RSYST(38,J)
135      IF(K.EQ.347) RSYST(39,J)=PERC(K,J)+RSYST(39,J)
136      IF(K.GE.348.AND.K.LE.351) RSYST(40,J)=PERC(K,J)+RSYST(40,J)
137      IF(K.GE.353.AND.K.LE.355) RSYST(41,J)=PERC(K,J)+RSYST(41,J)
138      IF(K.GE.356) RSYST(42,J)=PERC(K,J)+RSYST(42,J)
139      83 CONTINUE
140      DO 50 I=1,5
141      DEN(I)=P(1)/TINT(1)*100.0
142      IND(I)=100.0-DEN(I)
143      90 CONTINUE
144      DEN(6)=(P(1)+P(2)+P(3)+P(4)+P(5))/TINT(6)*100.0
145      IND(6)=100.0-DEN(6)
146      40 CONTINUE
147      PRINT 555,SN3(LL),SN4(LL)
148      555 FORMAT('1',30X,' ENERGY AND LABOR ANALYSIS OF A ',2A8,/)
149      PRINT 120
150      120 FORMAT(' ',11X,13HINPUT SECTORS,6X,5H COAL,7X,5HCRUDE,5X,7HREF PET
1,6X,4HFLLC,7X,4HGAS ,3X,11HPRIM ENERGY,6X,5HLAEUR,/)
151      DO 222 I=1,42
152      PRINT 129, RSN1(I),RSN2(I),(RSYST(I,K),K=1,7)
153      129 FORMAT(' ',10X,2A8,6(6X,F5.2),7X,F5.2)
154      222 CONTINUE
155      PRINT 420
156      420 FORMAT(' ',27X,6(5X,6H-----),6X,6H-----)
157      PRINT 421
158      421 FORMAT(' ',10X,6HTOTALS,10X,6(6X,5F100.0),7X,5F100.0)
159      PRINT 302
160      PRINT 303
161      PRINT 304,(NEGINT(J),J=1,6)
162      PRINT 500
163      500 FORMAT(11X,6HENERGY USED DIRECTLY AND INDIRECTLY( % OF TOTAL BY F
1UEL TYPE))
164      PRINT 502,(DEN(I),I=1,6)
165      502 FORMAT(' ',10X,8HDIRECTLY,8X,6(6X,F5.2)),
166      PRINT 503,(IND(I),I=1,6)
167      503 FORMAT(' ',10X,10HINDIRECTLY,6X,6(5X,F6.2),/)
168      PRINT 700
169      700 FORMAT(' ',10X,15HLABOR INTENSITY)
170      PRINT 701,SINT$
171      701 FORMAT(' ',10X,'(MAN-YEAR/1967 $)',4X,E12.6)
172      PRINT 54,SN3(LL),SN4(LL)
173      54 FORMAT('1',10X,' INPUT PURCHASES OF THE ',2A8,/)
174      PRINT 554
175      554 FORMAT(8X,'SECT. NO',4X,'SECTOR NAME',15X,'PURCHASE($)',/)

176      NJ=1
177      N=1
178      DO 51 I=1,72
179      DO 51 J=1,5
180      IF(N.GT.357) GO TO 51
181      IF(N.NE.NUM(NJ)) GO TO 53
182      PRINT 52,SIC(N),(SN(1,J,K),K=1,2),C(NJ)
183      52 FORMAT(' ',10X,14,5X,2A8,8X,E16.8)
184      NJ=NJ+1
185      53 N=N+1
186      51 CONTINUE
187      IF(LL.NE.2) GO TO 77
188      PRINT 58
189      58 FORMAT('1')
190      CONTINUE
191      STOP
192      END

```

ENTRY











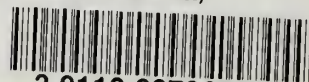


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