FINAL REPORT
PART II

DIRECT ENERGY TRANSACTIONS MATRIX FOR 1971

by

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ABSTRACT

A matrix is produced showing the direct purchase of all energy (in British Thermal Units) by each of 90 consuming sectors covering the U.S. economy for the year 1971. Energy purchases are divided into five major types: Coal, Crude Oil, Refined Petroleum, Utility Gas and Electricity. This 5 x 90 matrix is produced from data in the National Energy Accounts and is essentially consistent with Input-Output Sector definitions from the Bureau of Economic Analysis, U.S. Department of Commerce.

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1.0 OVERVIEW AND OBJECTIVES

In this report we create a matrix showing direct sales of energy products from the five major energy-producing industries to a ninety-sector partition of the U.S. economy, including final demand and the energy sectors themselves. We call this 5 (row) X 90 (column) matrix Direct Energy Transactions (DET), and have already produced DET's for the years 1963, 1967, and 1971 [1, 2, 3]. Our present purpose is to create a DET identical in format to prior ones, but which contains data for the year 1971 and is based on recently available data from the National Energy Accounts (NEA) [4]. The desired DET can be produced almost entirely with NEA data, with modifications and caveats as set forth below.

1.1 GENERAL DESCRIPTION OF THE DET MATRIX

DET matrices show the physical amounts of energy sold from all energy producing industries. Because each of these industries sell a variety of energy products, a product and industry taxonomy is required to determine exactly what constitutes each of these energy sectors. Precise definitions are given by the Bureau of Economic Analysis (BEA) [5] based on the Standard Industrial Classification (SIC) system [6]. According to BEA, only five sectors of the economy sell significant quantities of energy in energy form:

BEA SECTOR NUMBER	NAME	SIC GROUPS CONTAINED [S]
7.0	Coal Mining	11, 12
8.0	Crude Oil and Petroleum	13
31.01	Refined Petroleum	2911, 2999
68.01	Electric Utilities	495
68.02	Gas Utilities	496

A complete list of the products of each of these Sectors is shown in Appendix A, Table A2.

It is important to realize that I have chosen to conform as closely as possible to B.E.A. sector definitions and conventions, i.e., which fuel type belongs in which sector. In this way our physical energy flows (Col. E of Appendix A Table A2) conform to B.E.A.'s dollar flows (Col. C). There is, however, one significant exception to this--B.E.A. puts refined aromatics in the chemical industry (27.00). Because most of these products are produced in refineries out of crude oil, I have put them in 31.01 contrary to B.E.A. dollar flows. A few other minor exceptions to this occur in sector 31.01.

Another consequence of the diversity of energy products is that some uniform measure of energy content must be employed. We use gross* heat or caloric value expressed in British Thermal Units (Btu). All energy values shown in the National Energy Accounts and this document are gross Btu's and are determined from physical measures using average fuel heat values. [Appendix A]. Note that these values are slightly different than those used to create previous DET's.

*Gross heating values express the total caloric value of the fuel including the heat used to vaporize the bound water in the fuel. Since this latent heat is not available for external work, gross energy values are a slight overestimate of the potential work available from a fuel.

The following section describes the National Energy Accounts, virtually the sole source of data for the present DET. Section 2 explains the modifications necessary to transform the 1971 accounts into the correct matrix format and explains all significant imperfections in the DET produced.

1.2 THE ORIGINAL DATA BASE: THE NATIONAL ENERGY ACCOUNTS

The National Energy Accounts [4] is a major new data base developed by Jack Faucett's Associates (JFA) for the Federal Energy Administration in November, 1975. This vast collection of numbers is organized into several sets of matrices showing Energy Sources, Domestic Production and Consumption, Energy Functional uses, Losses in Energy Conversion Processes, and several other aspects of energy use. Each of these tables was produced for benchmark years since 1947 in which the Census of Manufactures surveyed American industry. These figures were then interpolated to produce tables for every year between 1947 and 1972. Actual Bureau of Census fuel and energy data are available only for the benchmark years 1947, 1954, 1958, 1962, 1967, and 1971, which is one of our reasons for choosing the latter year as the year of our coefficient update. The major source for data in this report is Table I-1 of the Accounts. This table shows the sales of all domestic and imported energy (approximately 70 fuel types) to 126 industries (defined by Jack Faucett's) covering the entire U.S. economy. To produce DET from such a table, the 126 consuming sectors must be aggregated to conform to BEA 90-order sector definitions, and all fuel forms must be grouped into the five BEA energy sectors.

Table I-1 matrix 1 has a complex format composed as follows: Of the 126 consuming sectors (columns of I-1) which span the economy, 10 plus 15 electricity sectors are considered to produce energy in one form or another. Table I-1 is therefore organized according to these producing sectors; an entry in I-1 is of the form:

71	1	08003	11000	126 data entries	Row Total
----	---	-------	-------	------------------	-----------

Year	Matrix	Pro-	Product
	#	ducing	Code
		Sector	(Fuel
			Type)

The tape lists all of the 115 products actually produced by the first producing sector (typically a scattered list), then all those produced by the second producer, etc. The fifteen electricity sectors are aggregated row-wise even on the original NEA tape.

The hitch is that each of the 115 NEA fuel types is considered primary to only one of the 11 producing sectors. However, a product is often produced by several sectors. In this case the data for this entire row of entries are shown twice in Table I-1 Matrix 1, once in their actual produced sector row and also contained in the entry for this product in the primary producing sector. The primary sector entry for this product thus contains the sum of all this product no matter where it was produced.

2.0 PROGRAM TO CREATE THE DET FROM THE NATIONAL ENERGY ACCOUNTS

2.1 BASIC PROGRAM ALGORITHM

Our objective here is to perform two separate aggregations, one of the Table I-1 rows and one of the columns. The row aggregation is more difficult for several reasons: it must cumulatively combine the 115 types of fuel or power* shown in Appendix A Table A-2 into one of five BEA energy-producing sectors, taking care to avoid double-counting or unbalancing sector inputs and outputs. The column aggregation, performed second, simply creates 90 columns of (now five) entries out of the original 126 consuming sectors in the NEA. The 126 sectors are defined in a manner closely resembling the BEA sector definitions for the 90, so the aggregation is simple and straightforward. See Appendix A Table A-1 for details.

Figure 1 shows the basic algorithm for processing the 115 fuel rows into five aggregated rows. The program** begins with the computer tape of I-1 and a separate table of those products in I-1 which have been transferred from the nonproducing sector to the primary one. The first step in the algorithm is to select one row off the I-1 Table 1 tape and check the row to see if it is a transfer, i.e., contained in the primary sector entry. If it is not,

*A given year's data may not have entries for all fuel types; 1971 data showed nonzero entries for only 77 fuel types in Table I-1.

**I use the term "the program" loosely here, as in my instructions to programmermeister Milke. He interprets my instructions and writes a program which accomplishes what I've instructed, but does not follow the sequence of these instructions exactly and contains much more detail. For more literal information on the program, consult Milke's documentation.

Figure 1. DET Algorithms (Revised 7/7/78)

the row is cumulated into the correct BEA sector as shown in Appendix A Table A-2

A further check is also performed to see if the energy product in question is used within energy sectors as a material input or feedstock. If all or part is, this portion must be removed from the energy quantities our program allocates. Otherwise, this feedstock energy would be counted as consumed twice, once as self-use inside the energy sector and again as the energy product made from the feedstock and sold to a consuming sector. Table 1 shows NEA data for all feedstock usage in the energy industry, and forms the basis for calculating self-use adjustment factors shown in Appendix A Table A2 Column H.

Following this step, check is made to insure that the NEA data is of a form which will show correct energy sector balances for our aggregation. If it is not, a correction is made by adding or subtracting the total disposition of the product in the aggregated matrix. For example, if the balanced NEA matrix shows product Q primary to 08003, whereas we and Census consider it primary to 31.01 and add it to the row of the DET, industry 31.01 will appear to distribute more energy than it receives (since it produces none itself). This is remedied by adding the entire amount of Q produced in 1971 to the column entry (8.00, 31.01). The complete listing of NEA fuel products, our reclassification, and the matrix manipulations required for balance are shown as Appendix A Table A2. If a selected entry is a transfer, it is not added into one of the five new CAC rows, but is discarded. The result of this algorithm is a five-row, 154-column condensation of the 115-row, 154-column I-1 matrix.

Table 1.

Feedstock Inputs to CAC Energy Sectors.

CAC Energy Sector	Product	Feedstock 10^{12} Btu Input	Fuel Input	Our Way of Handling It	Fraction Used for Non-Feedstock Allocations
8.00 (08003)	12100	21466.883	-	Zeroed except for self-use. Entirely an intermediate product.	0.0
31.01 (31011)	11000	23709.292	-	Input to 31.01 column from 8.00 (i.e., produced primarily in 8.00).	1.0
	38100	742.341			1.0
	38200	177.776			1.0
	12310	96.908	934.443	Zero only that portion equalling feedstock input. Fuel input cumulated in the self-use term, i.e., (31.01, 31.01).	.90604
	23700	319.674	27.504		.07922
	53100	23.892	70.19024		.74605
	34000	25.249		Zeroed-entirely an intermediate product.	0.0
	67000	252.926			0.0

No Material inputs to 68.02 in 1971.

Source: NEA Table E Printouts, 1971.

A final note concerns the Btu conversion factors employed in the National Energy Accounts, which do not entirely agree with those of the Bureau of Mines. Because we are attempting to conform to B.O.M.'s aggregate figures for domestic energy consumption, we must occasionally weight NEA flows by a factor which brings the energy amounts into parity. This can be done by applying a single factor across the energy product row equal to the ratio of B.O.M.'s conversion factor to NEA's, and has no effect on the actual quantities of energy products consumed. Column I of Appendix A Table A2 shows the conversion factor adjustments employed.

2.2 ROW TOTAL VERIFICATION

When our aggregation program is complete, we have 5 rows each representing energy flows from the 5 BEA energy sectors to all consuming sectors. The sum of these rows is equal to apparent consumption of the output of the BEA sector. Since we often have independent tallies of apparent consumption for these sectors, we seek to compare totals for each of the 5 sectors as a check on the detailed data. Often the independent check data are figures on total production by the BEA sector. Total Production (called Total Disposition if it includes imports, as in NEA) differs from apparent consumption (also called The Row Total here) according to this identity:

$$\begin{array}{l} \text{apparent} \\ \text{consumption} \\ \text{(includes} \\ \text{imported} \\ \text{fuel)} \end{array} + \begin{array}{l} \text{additions to} \\ \text{inventory} \end{array} + \text{exports} - \begin{array}{l} \text{statistical} \\ \text{discrepancy} \\ \text{(s.d.)} \end{array} = \begin{array}{l} \text{Total Disposition} \\ \text{(includes imports)} \end{array}$$

Since our DET yields only figures on apparent consumption, if the check figure is total production we must also produce numbers on inventory change, exports, and statistical discrepancy consistent with NEA and BEA definitions. To do this we use a variety of independent data sources and the aggregation of NEA Table I-1 Matrix 5, which has entries for inventory additions, exports, storage and distribution losses, statistical discrepancies, and total disposition for each nonzero fuel type row entry in Matrix 1. Though the columns of matrix 5 do not need treatment, its rows must be aggregated into the five BEA sectors in a manner similar to the basic algorithm for Matrix 1. This is accomplished in a separate part of the program.

The following sections explain the exact balances found for each of the five BEA row totals, data sources, assumptions, calculations, etc. The basic technique used for verification uses the independent source to produce the correct total disposition, and then the correct apparent consumption using verified figures for exports and inventory additions. If this independent row total differs from the row total produced from NEA data, Btu's from the statistical discrepancy column of NEA are added or subtracted to make the NEA row total conform to the independent one. In this way the DET we produce entirely from NEA data agrees with independent measures of total energy use in the U.S. for 1971.

2.2.1 COAL

We can do this verification by working backwards because the structure of our row is so simple. The Bureau of Mines shows a total coal as listed in Table 2 below.

Table 2.

B.O.M. Gross Coal Use Data for 1971.	
(10 ¹² Btu)	
Anthracite	
Production	221.7
Exports	-35.3
Rest are zero	
	<hr/> 221.7 (don't subtr. exports because NEA doesn't)
Bit. Coal + Lignite	13,385.1
Exports	-1,533.5
Imports	2.7
& Inv.	-57.0 (to agree w/NEA signs)
Stat. Disc.	-54.4
	<hr/> 13,390.4 (Don't count exports)
GRAND TOTAL	13,612.10
Total Exports	1,568.80 (Incl. in grand total).

Source: 1972 Min. Yrbk., p. 29).

Note that aggregate coal conversion factors differ between B.O.M. (23, 891, 083 Btu/ST, 1972; MY p. 28) and NEA (23, 700, 000 Btu/ST, NEA Vol. 1, Pt. 2, p. 285) by about 1.17%. When B.O.M.'s figures for gross coal consumption and exports are adjusted to the NEA conversion factors, B.O.M. data shows a grand total of 13,447.315 E12 Btu's coal, only 1.0% difference from the hand-calculated row 7.00 total disposition shown in Table 3.

Because we have no reason to doubt the accuracy of the figures or applying them for this purpose, we below subtract our Matrix 5 to get what should be the Row 1 150-order or 90-order Row total.

So we want to allocate back into our DET as a residual 237.959 Btu of sector 7.00 products. This makes GDO for row 7.00:

13447.315E12 row total (incl. stat. disc. allocated)
-2.7E12 imports (1972 MY p. 29)
 13444.615E12 GDO row 7.00

Table 3.

7.00 Coal Sector Energy Balance From NEA Data .

	10 ¹² Btu's		Exp. (S & DL are zero)	Rev. Sign SDC	T.D.
	SUM DATA	Inv.			
13100	70.73895	- .101	17.043	133.985	221.665
13210	9498.04688	-41.055	1517.764	2028.124	13002.891
13220	75.28075	0.0	0.0	10.125	85.406
13900	1934.26904	0.0	0.0	-1934.275	0.0
Subtotal	11578.33562	-41.156	1534.807	237.959	13309.962
Minus (1,37011)	1422.237	-	-	-	-
+ 71900	1422.235	0.0	0.0	-1422.237	0.0
TOTAL	11578.33362	-41.156	1534.807	-1184.278	13309.962

Note that this agreement requires that we allocate all of the 238 trillion Btu of statistical discrepancy back into the DET as a residual. Note also that the reason our row 1 RT plus row 1 Matrix 5 entries do not sum can be seen in Table 3 to be that the product 71900 is added on normally, into

both the DET and Matrix 5, but that (1,37011) has 1422.237 subtracted out of it. The row above labeled subtotal does add all the way across, but below it we subtract out 1422.237 twice and add in only once. The effect is simply to add arbitrarily 1422.237 to the statistical discrepancy column for what appears to be no good reason.

2.2.2 CRUDE

Verification of the crude row in our DET is a two-stage process. First we take figures exclusively from the Bureau of Mines and try to produce a figure for apparent consumption of all energy products we consider in row 2 (8.00). This number should compare with the sum of our 150-order DET (including final demand and residual sectors) but not with matrix 5 entries, except possibly Storage and Distribution Loss and Statistical Discrepancy. If apparent consumption (from B.O.M.) is close to reported consumption (our 150-order DET row sum), we have a figure which is valid (provided it is properly composed of the right products to be consistent with the def. of 8.00).

Figure 2 following shows the derivation of apparent consumption of sector 8.00 products created entirely from B.O.M. data. Note that by BEA convention wet gas processing plants are entirely within sector 8.00. Outputs of 8.00 include only the natural gas liquids sold externally. We do, however, include the internal reported losses of wet gas called wet gas storage and distribution loss by NEA as a self-consumption of energy by 8.00. The 1971 NEA apparent consumption analogous to the total in Figure 2 is shown as the sum of the first column in the following (Table 4). Note that to create a definitionally valid figure for apparent consumption of sector 8.00 products the Row totals (10^{12} Btu sum data) in Table 4 had to be increased by the storage and distribution losses, which we consider to be consumption by sector 8.00 itself (in the case of 12100) or by sector 68.02 (for 12200). These added entries at the bottom of the first column in Table 4 are shown with asterisks in the table.

Figure 2. APPARENT CONSUMPTION OF SECTOR 8.00 OUTPUT FROM S.O.M. DATA ENTIRELY**

*This means the NEA cons. figure we compare to should not include Storage & Distribution Losses.

**Many of the ?'s here could be answered with NEA data.

SOURCES

^a1971 WTP. 765, p. 22.

^b1971 WTP. 23, p. 896.

^c1972 WTP. 31, Table 11

Table 4

NEA FIGURES FOR TOTAL DISPOSITION IN SECTOR B.OO.

CRUDE		10 ¹² BTU						
NEA PROD NUMBER, NAME	SOURCE	10 ¹² BTU SUPDATA	INV.	EXP.	\$ & O L	REVERSED SIGN SDC	TD	
11000 Crude	08001	23709.28516 ✓	-86.970	2.817	0.0	- 24.719	23590.516	
12200 Dry Gas	(2,68020)	15010.09766	0.0	82.688	1816.022	+7359.930	24268.770 ✓	
12310 Still Gas	(2,31011)	1031.35181	0.0	0.0	0.0	- 0.0	1031.352 ✓	
12320 C.O.G.	(2,68020)	426.85107	0.0	0.0	0.0	+ 47.078	473.930 ✓	
12390 Mfr. Gas	(2,68020)	0.0	0.0	0.0	0.0	- 0.0	0.0 ✓	
12400 Mixed Gas	(2,68020)	0.0	0.0	0.0	0.0	- 0.0	0.0 ✓	
12900 Gas MSK	(2,68020)	7588.30078	0.0	0.0	0.0	-7588.379	0.0 ✓	
54000 Isopentane	(2,31011)	25.24953	.109	0.0	0.0	+ .004	+ 25.354 ✓	
38100 N. Gasoline	08	742.34131 ✓	-4.384	0.0	0.0	+ .004	737.961	
38200 Plant Condensate	08	177.77643 ✓	.250	0.0	0.0	- 0.0	178.027	
23110 Propane (pr. to 8003)	(2,31011)	138.60950	71.850	3.172	0.0	+ 597.652	816.285 ✓	
23700 Liquid Gas MSK	(2,31011)	1032.08521	0.0	0.0	0.0	-1032.094	0.0 ✓	
12100 Wet Gas		Zeroed out - Transferred Inside B.OO	369.921	0.0	317.285 ✓	- 17.775	669.431	
TOTALS		48850.59665 +1816.022* 317.285*	340.776	93.787	2133.307	- 658.307	50760.274	
50983.906 - NEA APPARENT CONSUMPTION, 1971.							50831.023 (Our Row B.OO total sum of checked entries - see text)	

* Self-use addition to apparent consumption

Some comparison can be made between BOM and NEA figures for Wet Mat. Gas

BOM: Gross Prodn: 24,805.0 x 10¹² at unknown conv. factor (1971 NY p. 26)
 NEA: TD of 22,136 x 10¹² at unknown conv. factor (Mat. 5) of 1115.1 Btu/CF.
 (imports should be subtracted off of this to compare to BOM's figure)

These don't agree well, as Jack Faucett's admits on pp. 771 and 276 in the 1971 NEA, V. 1, pt. 2.

FOR COMPARISON TO BOM'S FIGURES ANALOGOUS TO T.D.: There is some question as to whether the matrix 5 entries for 12100 should be included since B.O.M. does not publish similar figures. So these rows show the above totals LESS THE MATRIX 5 ENTRIES FOR 12100. These should compare to the attached analog of TD prepared from BOM figures.

In order to compare the NEA and B.O.M. figures for apparent consumption slight adjustments are necessary. The NEA figure must be revised downward to exclude wet natural gas losses since B.O.M. figures do not reflect these. Similarly, the B.O.M. figures must be increased by the dry gas it reports as lost in transmission, shown in the middle right of Figure 2. Resulting apparent consumption figures are as follows:

1971 Adjusted Apparent Consumption (10^{12} Btu)

NEA	BOM
50,983.906 apparent consumption	49,973.44* apparent consumption
- 317.285 wet gas losses	+ 349.51 dry gas losses
50,666.621	50,322.950

The difference here is 343.67 trillion Btu or .7%.

Having shown that the basic data magnitudes and classifications are verified, we now produce a value to use as a check on the row 2 row total generated by our computer program. This program works by running down the list of product codes at the left of Table 4 and cumulating their 154-entry rows into our single row three. The source column shows whether the product is distributed (sold) by row 8.00 directly, in which case the 154-entry product row is cumulated into our row 8.00, or whether the product is entirely sold to another sector for distribution. In the latter

*Already adjusted for same conversion factors in Figure 2.

case the total disposition of the product is inserted as a transaction from row 8.00 to the distributing sector, reasoning being that exports, imports, and losses most generally occur in and should be charged to the distributing sector, not the producer. Our computer row total should therefore be the sum of all checked entries in Table 4, shown in the table as 50531.0269.

2.2.3 REFINED

The refined petroleum row of the DET is verified and balanced according to the following method: each entry in B.O.M.'s product balance for refined petroleum (1972 MY p. 32) is converted to its physical amount at the left of the attached table. This product entry def. is correlated to all products in the NEA which are consistent with it. The physical amounts (found using the NEA conversion factor) of these NEA products Btu's of sum data are summed and compared to the B.O.M. physical amount. The statistical discrepancy columns for these NEA products is also converted to a physical amount. The sum data and B.O.M. corrected physical amounts are compared.

- (1) If B.O.M. is greater than NEA then the correct physical amount of products from NEA statistical discrepancy is drawn into the row (via a residual allocation to be performed later). If there is not enough physical product in the statistical discrepancy, as much as possible is brought in. If all statistical discrepancy is the wrong sign to bring in, nothing is done.

- (ii) Vice versa from the above if NEA is greater than B.O.M.

The result as shown from Table 5 is that the physical amounts can be reconciled to within 4.1%, using the equivalent of 237.357E12 Btu's worth of statistical discrepancy. Due to different conversion factors, total Btu amounts (B.O.M. vs. NEA when physically "balanced") differ by 4.5%.

Note that several of the products in Table 5 are not considered outputs of 31.01 by BEA, making this one major instance where our energy allocations do not conform to BEA sector definitions.

Table 5. COMPARISON OF PETROLEUM DISPOSITION, 1971.

 

D. Deviation did these numbers of projects exactly added from 81.84 (deviating +0.15-0.20) has been very serious and sometimes dangerous.

2.2.4 ELECTRIC UTILITIES

From EEI Yearbook, 1973, p. 14, Table 8S

Total Electricity Disposition, 1971

	<u>10⁶ kWh</u>	<u>10¹² Btu @ 3412.193* Btu/kWh</u>
Total sales to Ult. customers	1,466,441	5003.7797
Energy used by producer	2,854	9.73840
Company used and free service	3,894	13.28708
Industrials	<u>96,841p</u>	<u>330.44018</u>
Subtotal		5357.24536
Exports	3,514	11.99044
Lost, Unaccounted for	<u>151,020p</u>	<u>515.30939</u>
	1,724,564p	5572.9979

Our row total should be the above less exports, plus or minus statistical discrepancy (say plus, since we'll use stat. disc. to allocate residually to sectors with zero elec. use). This is 5508.19, a difference of .2% - OK.

Note that exports agree exactly with our matrix 5 entry. NEA's storage and dist. loss is slightly less than EEI's (by -31 E12 Btu's), which mainly accounts for the differences in total disposition .76%, still not bad.

Note that our entire row 4 adds across the RT and Matrix 5.

$$5520.184 + 0.0 + 11.990 - .180 = 5531.094$$

(In this equation, the sign of the statistical discrepancy is reversed.)

Note we do not count the S & DL figure in Matrix 5 because it has already been brought inside the DET in the diagonal term for electricity.

*NEA's conv. factor.

2.2.5 GAS UTILITIES

Table 6 shows the complete disposition of products allocated to sector 68.02. Below the table are several manipulations required to make the total disposition number comparable to B.O.M.'s figure for gross consumption of dry natural gas in 1971, 22,818.6 trillion Btu @ 1031 Btu/CF.

Several items are worth pointing out in this table. First, apparent domestic consumption (the row sum column of Table 6) totals significantly larger than B.O.M.'s gross consumption. This number can be revised downward because the NEA product Gas, NSK (12900) has a larger conversion factor even though JFA states (NEA, Vol. 1, Pt. 2, p. 272) that gas, NSK is "largely composed of natural gas, with possibly small amounts of mixed [992 Btu/CF] and manufactured gas [540 Btu/CF]." It is hard to see how such a mixture could have a higher heat content than pure natural gas. The adjustment is done in parentheses.

To compare to B.O.M.'s apparent consumption, storage and distribution losses should also be taken into account. Also consumption of coke oven gas must be subtracted out since it is not a natural gas product as B.O.M. defines things. These two steps are performed at the bottom of the page and reveal a NEA apparent consumption 1.18 Quads greater than B.O.M.'s, a difference of +5.17%.

Table 6.

1971 NEA Disposition for Sector 68.02.
(10¹² Btu)

Prod. Code	Row Sum (10 ¹² Btu Sum Data)	Addition to Inv.	Exports	S. and D. L.	Rev. Sign. Stat. Disc.	Total Disp.	Conv. Factor
12200	15010.09766		82.698	1816.022	7359.933	24268.772	1031 Btu/CF
12320	426.85017				47.078	473.930	952 Btu/CF
12900	7588.30078				-7588.301	0.0	1090.89 Btu/CF
(12900)	(7171.70210)				(7171.70210)	0.0	
TOTAL	23025.24861		82.698	1816.022	- 181.371	24742.702	-

(TOTAL WITH
ADJUSTED 12900) (22608.6499) (82.698) (1816.022) (235.3089) (24742.702)

- 426.85017 (coke oven gas not considered in B.O.M.'s figures)

+ 1816.022 (losses included in def. of apparent cons.)

23997.82173 (Total domestic apparent consumption)

Compare to: 22818.6 (B.O.M. total domestic apparent consumption--at same conversion factor).

2.2.6 COMPARISON OF OVERALL U.S. GROSS
ENERGY CONSUMPTION FIGURES

Table 7 shows a summary of comparable B.O.M. and NEA values for total U.S. energy consumption in 1971.

Table 7.

N.E.A. and B.O.M. Gross U.S. Energy Consumption by Sector, 1971.

(10¹² Btu's)

	NEA-Derived CAC Row Total and Adjustments**	Verification Source	Verification Value and Adjustment	Difference (%)	Comment
7.00	11578.33 237.959 (stat. disc. to be allocated) 11816.29	Anthracite Bit. Coal + Lignite Table 7, p. 26*	186 11857 12043	- 226 (1.88%)	
8.00	50985.906 (Table 4) - 340.776 (8.00 inv. addns.)* - 93.776 (8.00 exports)* + 4974.2 (31.01 imports)* - 466.1 (31.01 exports)* - 201.9 (31.01 inv. addn.)* - 206.5 (losses)* 54649.054	Dry Natural Gas* Petroleum* Nat. Gas Liquids*	22819 28045 2525 53389	+1,260 (2.4%)	Difference due to: (a) conversion factor for crude, etc. (b) other data differences, esp. for natural gas.
31.01	28947	Petroleum products including natural gas liquids	30570	-1,620 (-5.3%)	Difference due to: (a) conversion factor (b) other glitches.
68.01	5520.18	Electricity from EEF yearbook	5572.9979 -11.99044 exports 5561.007	40 (.7%)	
68.02	23997.82173 (Table 6)	Dry natural gas	22819	1179 (+5.17%)	

TOTAL GROSS U.S. CONSUMPTION:

70,499 Quads

69,492 Quads

+1.0 Q (+1.44%)

*1972 Man. Yrbk.

**Fearrow 8/78.

2.3 ALLOCATION OF RESIDUAL STATISTICAL DISCREPANCIES

2.3.1 INTRODUCTION

As a result of our independent verification, we have a 5 x 1 vector of statistical discrepancies (10^{12} Btu) which must be allocated among the 90 columns of the DET in order that they sum to the correct apparent consumption agreeing with B.O.M. This vector is derived in the memo of 5/25/78 as

(10^{12} Btu)

1.	375.318
2.	0.0
3.	273.356
4.	-.180
5.	-181.375

This memo describes the technique we will use to allocate these amounts across the columns into their respective rows.

To review the residuals which must be allocated consider Figure 3.

Figure 3. Residuals in the 1971 DET

Our residual allocation scheme occurs in three parts. Part One consists of taking the two negative entries below (rows 4 and 5) and adding them to the most general positive residual sector entries inside the matrix, thereby reducing the size of the latter. Step 2 consists of allocating the specialized residual sectors back to the columns to which they apply based on dollar flows. Step 3 does the same across the entry row for the general residual sectors 999-- and the positive statistical discrepancies.

2.3.2 STEP 1: ELIMINATING NEGATIVE STATISTICAL DISCREPANCY RESIDUALS

We have negative S.D.'s in rows 4 and 5. These same rows have residual sector entries as shown in Table 8. Although the row 4 S.D. could come out of either 129xx or 779xx, we have little choice with row 5. Arbitrarily, both are removed from column 779xx (No. 144). Its slightly better to take the row 4 S.D. out of 779xx since it will be "noticed" less there, a smaller percentage change. See Table 9.

Table 8.
Rows 4 and 5 Before Residual Allocation (10^{12} Btu)

ROW	NEA SECTORS									Stat. Disc. to be allocated
	049xx	109xx	129xx	649xx	65000	779xx	99081	999xx	99999	
4	0.0	0.0	18.2689	0.0	0.0	997.2368	0.0	0.0	0.0	-.180
5	0.0	0.0	0.0	0.0	0.0	1103.2947	0.0	0.0	0.0	-181.375

Table 9.
Rows 4 and 5 After Residual Allocation (10^{12} Btu)

	049xx	109xx	129xx	649xx	65xxx	779xx	99081	999xx	99999	S.D.
4	0.0	18.2689	0.0	0.0	0.0	997.0568	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	921.9197	0.0	0.0	0.0	0.0

2.3.3 STEP 2: ALLOCATION OF SPECIALIZED RESIDUALS

Note first that even though the residual sectors are found only on the 154-order printout, the columns into which they're inserted are 90-order ones so TT can be used.

2.3.3.1 Construction Resid. 129xx

The first residual to be done is 129xx. Refer to Appendix A, Table A1 and Table 10.

Table 10

129xx Data Before Allocation { Energy (10^{12} Btu, 1971).
Dollars (10^6 \$1967 or 1971) }

	11.00 (14)	12.00 (15)	129xx (24)
1	0.0	0.0	0.0
	0.0	0.0	--
2	0.0	0.0	0.0
	0.0	0.0	--
3	328.9	81.23	696.4004
	1,997.0*	877.0*	--
4	.184	0.00	18.2689
	39.7**	6.0**	--
5	19.50806	0.0	0.0
	N/A	N/A	--

N/A = Not Applicable

* total transactions (\$1971) for 31.01, 31.02, and 31.03 from BEA-SP-77-028.

** total transactions (\$1967) from: I/O Structure of the U.S. Economy, 1967.

Consider the row 3 allocation first. These are petroleum products sold to construction industries - probably gasoline and diesel fuel. In 1971 gasoline retailed for 25.2¢/gal. (no taxes) (see data appendix). The existing (3,11.00) cell has data which implies a price now of 164,697.05 Btu/\$1971 or 75.8¢/gal. (producers price which means its too high).

Assume that the average price of petroleum products to these two sectors is equal. This allows for a 2-equation 2-variable solution which allocates the 696.4E12 Btu to the 2 sectors in such a way as to imply the same price paid. The result is shown below and implies a price of 32.5¢/gal. which is a little high since most construction companies are quite large (see Appendix) and may purchase fuels wholesale.

A similar scheme is used for the electricity allocation. Assume most construction companies use less than 500×10^6 kWh/yr, the approximate cut-off for the industrial classification. The average 1971 commercial electricity price was 2.12¢/kWh, which compares to a ridiculous existing implied price of 4,635 Btu/\$ (\$.74/kWh) for (4,11.00). Using an equal price allocation as above, results come out as shown in Table 11 and imply a price to both sectors of 1.0¢/kWh at 1967 price levels. The 1973 EEI yearbook shows an inflator of 113.2\$1971/\$1967 which yields an implied 1971 price of 1.121¢/kWh 1971, somewhat low.

Table 11.
129xx Data After Allocation $\left\{ \begin{matrix} 10^{12} \text{ Btu} \\ 10^6 \$ 67 \end{matrix} \right\}$

	11.00 (14)	12.00 (15)	129xx (24)
1	0.0	0.0	0.0
	0.0	0.0	--
2	0.0	0.0	0.0
	0.0	0.0	--
3	768.88	337.65	0.0
	1,997.0*	877.0*	--
4	16.3847	2.0682	0.0
	39.7**	6.0**	--
5	20.7181	0.0	0.0
	N/A	N/A	--

N/A = Not Applicable

* total transactions for 31.00 from BEA-SP-77-028 (\$1971)

** total transactions (\$1967) from I/O Structure of the U.S. Economy 1967.

2.3.3.2 Trade Residuals

Table 12 below shows the original data. The refined petroleum row is difficult to allocate because it is likely to be a mixture of gasoline, diesel oil, and home heating fuel -- probably even some LPG. Since any sort of weighted price of these products is not available, we allocate the 502E12 Btu back based on prior use, i.e., according to the formula for trade sector i:

$$(3, i)' = (3, i) [1 + .6926]$$

Residuals of gas and electricity are allocated based on dollar flows from the 1971 BEA table and 1967 percentages. In 1967, flows from 68.00 into the trade sectors had the following value breakdown:

PERCENTAGES OF SECTOR 68.00 GDO FROM 68.01 and 68.02, 1967

BEA SECTOR	69	70	71	72	73	75	76	77
68.01	.722	.632	.426	.665	.391	.855	.712	.672
68.02	.165	.135	.156	.179	.451	.073	.146	.151

Source: I/O Struc. Econ., 1967

These percentages are applied to the 78.00 row of 1971 TT flows (10^6 \$1971).

TOTAL TRANSACTIONS, 1971, MILLIONS OF CURRENT DOLLARS

BEA SECTOR	69	70	71	72	73	75	76	77
68.00	3239	548	668	455	282	119	109	2295

Source: BEA SP-77

to yield the figures shown in the table below. Total rows 4 and 5 value of flows to service sectors are 5104 and 1283 (10^6 \$1971) respectively. These imply average prices of roughly 718,565 Btu/\$ for gas (row 5) and 195,348 Btu/\$ for elec (1.747¢/kWh) row 4). These compare to respective average 1971 quoted prices of 1,176,470 Btu/\$ for gas and 2.12¢/kWh. The electricity imputed price thus lies below commercial but above industrial, implying that some service sectors have customers paying industrial rates. Examining the data appendix, we see that most service sectors establishments have an average of 2 to 10 employees and \$76-200,000 per year in sales. The distribution of sizes in all these sectors (except retail trade perhaps) is one with a small percentage (less than 10%) of firms possessing most (50-90%) of the employees and

revenues. The remaining 90% of the establishments have only a small number of employees and low sales volumes, since the dollar magnitudes indicate a mixture of commercial and industrial prices, it is likely that within each sector we have the large companies paying the lower industrial price and the small ones paying commercial rates. It also appears from the derived prices that those sectors which use gas buy it at a rate even higher than residential - probably an error in JFA data or my constant-percentage assumption. Final results are shown in Table 13.

Table 12.

779xx Data Before Allocation $\left\{ \begin{array}{l} 10^{12} \text{ Btu 1971} \\ 10^6 \$1971 \end{array} \right\}$

(CAC Col. Number)

	69 (79)	70 (80)	71 (81)	72 (82)	73 (83)	75 (84)	76 (85)	77 (86)	779xx
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	122.7	142.1412	52.1920	143.9924	121.99230	30.7400	19.2484	215.8795	502.9617
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	997.0568*
	2339	346	285	303	110	102	77	1542	--
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	921.9197*
	534	74	104	81	127	9	16	347	--

* Adjusted values from Step 1.

Table 13.
779xx Data After Allocation (10^{12} Btu/1971)

	69	70	71	72	73	75	76	77	779xx
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	195.3993	226.35934	83.11557	229.30736	194.27229	48.95334	30.65301	343.78731	0.0
4	456.9190	67.5904	55.6742	59.1904	21.4883	19.9255	15.0418	301.2266	0.0
5	381.0410	52.8034	74.2102	57.79836	90.6221	6.4220	11.4170	247.6056	0.0

2.3.4 STEP 3: ALLOCATION OF OVERALL RESIDUAL CATEGORIES

In this step we allocate residual sectors which apply to all sectors in the DET, namely 999xx, 99999, and statistical discrepancy. Of these only the latter is nonzero in 1971, and previous allocations leave only the amounts of 375.318 and 273.356 E12 Btu, from sectors 1 and 3 respectively, to be allocated.

Consider the following points:

- (i) We do not have a consistent set of prices of either coal or refined petroleum for each of the 90 sectors.
- (ii) There do not seem to be any sectors normally consuming these products which have zero entries before allocation.

Based on these points, I have elected to use a residual allocation scheme which distributes the above residual amounts back to all sectors now listed as consuming these products proportional to their fraction of total consumption. Practically, this means applying the following correction to all coal and ref. pct. row entries:

$$(1, i)' = (1, i) \left[1 + (375.318E12) \left(\frac{1}{\sum_{j=1}^{90} (1, j)} \right) \right]$$

$$(3, i)' = (3, i) \left[1 + 273.356E12 \left(\frac{1}{\sum_{j=1}^{90} (3, j)} \right) \right]$$

2.3.5 RESULTS OF RESIDUAL ALLOCATION

The table following (Table 14) shows the final values of the 5 x 90 DET matrix entries. Next to each entry is the percentage of that entry which has been residually allocated; the remainder is the result of the direct allocation of NEA data via our program. Total residuals are allocated from the 1971 NEA accounts, amount to 3966 E12 Btu out of a DET total of about 72,000 E12 Btu or 5.5%. Table 14 shows the complete 1971 D.E.T. and the portion of each entry allocated as a residual. See section 3.2 for further discussion of the effects of the residual allocation.

Table 14. DIRECT CASH TRANSACTIONS, 1971
(in \$M)

[illegible]

*Proportionally allocated amount as a percent of pre-residual entry. If pre-residual entry was zero, this figure is 100%.

Table 14. GUEST ENERGY TRANSACTIONS, 1971
(in \$ mil)

GUESTS AND ELECTRICITY		GUESTS PETROLEUM (MIL \$ MIL)			ELECTRIC UTILITIES (MIL \$ MIL)			
CONSUMING SECTOR								
SEC	NAI	Before 1971	After 1971	% Ratio	Before 1971	After 1971	% Ratio	
1	700	COAL MINING	4,917.20	3,051.35	1.71	3,073.53	3,073.53	0.00
2	800	CRUDE PETRO. RES.	10,044.70	10,044.70	1.71	0,000.00	0,000.00	0.00
3	3101	PETRO. REFIN. PROD.	15,260.20	15,260.20	1.71	7,728.00	7,728.00	0.00
4	3401	ELECTRIC UTIL.	1,207,000.00	1,207,000.00	1.71	1,000,000.00	1,000,000.00	0.00
5	3402	WATER UTILITIES	935.12	935.12	1.71	0.00	0.00	0.00
6	100	AGRICULTURE	60,117.00	60,117.00	1.71	3,117.00	3,117.00	0.00
7	200	FOREST & WOODS	7,000.00	7,000.00	1.71	3,000.00	3,000.00	0.00
8	300	MINING & QUARRYING	6,500.00	6,500.00	1.71	0.00	0.00	0.00
9	400	MANUFACTURING	2,225.17	2,225.17	1.71	0.00	0.00	0.00
10	500	TRANSPORTATION	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
11	600	COMMERCE	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
12	700	GOVERNMENT	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
13	800	RESIDENTIAL	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
14	900	NON-RESIDENTIAL	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
15	1000	OTHER	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
16	1100	GOVERNMENT	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
17	1200	GOVERNMENT	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
18	1300	GOVERNMENT	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
19	1400	GOVERNMENT	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
20	1500	GOVERNMENT	1,111.00	1,111.00	1.71	1,111.00	1,111.00	0.00
 

*Originally allocated amount as a percent of pre-residual entry. If pre-residual entry was zero, table figure is 100%.

Table 14. ENERGY ENERGY TRANSACTIONS, 1971
(in \$ mil)

GAS AND TOTAL PRIMEVAL		GAS UTILITIES (MCA 65-67)		TOTAL PRIMEVAL		
SEC. 1	SEC. 2	Before Audit	After Audit	Before Audit	After Audit	
1	700	CORL MORGAN	1557.00	1557.00	0.00	1557.00
2	700	CHURCH PAYSON, GAS	341247.00	341247.00	0.00	341247.00
3	7101	PAID GAS/IN PRAG	110500.00	110500.00	0.00	110500.00
4	7001	ELECTRIC UTIL	411007.00	411007.00	0.00	411007.00
5	7002	GAS UTILITIES	407001.00	407001.00	0.00	407001.00
6	7004	LIVESTOCK	4075.00	4075.00	0.00	4075.00
7	7004	WISC AS PRODUCED	154040.00	154040.00	0.00	154040.00
8	7004	FORGET FIRM FLOD	0.00	0.00	0.00	0.00
9	7004	LC FIRM, FIRM 112	0.00	0.00	0.00	0.00
10	7004	FORGET FIRM FLOD	407001.00	407001.00	0.00	407001.00
11	7004	FORGET FIRM FLOD	21201.00	21201.00	0.00	21201.00
12	7004	FORGET FIRM FLOD	30701.00	30701.00	0.00	30701.00
13	7004	FORGET FIRM FLOD	10701.00	10701.00	0.00	10701.00
14	7100	NEW CONSTRUCTION	19500.00	19500.00	0.00	19500.00
15	7200	HAIRY, REP COMST	0.00	0.00	0.00	0.00
16	7300	FORNANCE	7200.00	7200.00	0.00	7200.00
17	7400	FORNANCE	50000.00	50000.00	0.00	50000.00
18	7500	FORNANCE	0.00	0.00	0.00	0.00
19	7600	FORNANCE	7000.00	7000.00	0.00	7000.00
20	7700	FORNANCE	2000.00	2000.00	0.00	2000.00
 
68	7500	FORNANCE	0.00	0.00	0.00	0.00
69	7600	FORNANCE	0.00	0.00	0.00	0.00
70	7700	FORNANCE	0.00	0.00	0.00	0.00
71	7800	FORNANCE	0.00	0.00	0.00	0.00
72	7900	FORNANCE	0.00	0.00	0.00	0.00
73	7000	FORNANCE	0.00	0.00	0.00	0.00
74	7100	FORNANCE	0.00	0.00	0.00	0.00
75	7200	FORNANCE	0.00	0.00	0.00	0.00
76	7300	FORNANCE	0.00	0.00	0.00	0.00
77	7400	FORNANCE	0.00	0.00	0.00	0.00
78	7500	FORNANCE	0.00	0.00	0.00	0.00
79	7600	FORNANCE	0.00	0.00	0.00	0.00
80	7700	FORNANCE	0.00	0.00	0.00	0.00
81	7800	FORNANCE	0.00	0.00	0.00	0.00
82	7900	FORNANCE	0.00	0.00	0.00	0.00
83	7000	FORNANCE	0.00	0.00	0.00	0.00
84	7100	FORNANCE	0.00	0.00	0.00	0.00
85	7200	FORNANCE	0.00	0.00	0.00	0.00
86	7300	FORNANCE	0.00	0.00	0.00	0.00
87	7400	FORNANCE	0.00	0.00	0.00	0.00
88	7500	FORNANCE	0.00	0.00	0.00	0.00
89	7600	FORNANCE	0.00	0.00	0.00	0.00
90	7700	FORNANCE	0.00	0.00	0.00	0.00

* Total primeval is the non-redundant sum of primary fossil-energy expenditure, i.e., the sum of coal, crude oil and gas, and non-fossil-generated electricity

* Annually allocated amount as a percent of pre-residual entry. If pre-residual entry was zero, this figure is 100%.

3.0 IMPERFECTIONS IN THE DET

The manipulation of the computer tape containing the 1971 National Energy Accounts to produce a DET matrix is a complex process. One can imagine the many problems which arise when both the rows and columns of an energy transactions matrix must be reaggregated. The following explains the main imperfections in the DET, due to the nature of NEA data, we have located. We stress that, in our opinion, none of these flaws seriously affect the usefulness of the DET or results based on it. Error in the original NEA data itself is another matter entirely, and is discussed in Chapter 1 of the Accounts. Because we use only data from census benchmark years, NEA values are listed as having the highest reliability possible, a probable error of $\pm 10\%$. It is not known if the changes applied to our data source (Table 1) in order to balance it substantially affect this error, but according to the Accounts "the inter-relationships between energy producing and consuming industries remain valid in Table 1."

[9]

3.1 SECTOR DEFINITIONS AND REAGGREGATION

Some difficulty was encountered in trying to reconcile NEA and BEA sector definitions. For example, some minor energy products in NEA are not specifically SIC-classified and so had to be classified arbitrarily. Many of the problems of classifying energy products have to do with feed-stocks, which are discussed in Section 2.3. All problems of this sort are outlined in the notes to Appendix A, which also contains the correspondence between BEA and NEA sector definitions for both producing and consuming industries.

One NEA Sector (31990) represents the aggregation of two 90-order BEA sectors (31.02, 31.03). This sector's rows and columns had to be disaggregated based on the gross domestic output of sectors 31.02 and 31.03. Other NEA sectors having directly corresponding BEA sectors had no energy data collected. These sectors are:

<u>BEA</u>	<u>NEA</u>	<u>NAME</u>	<u>1971 GROSS DOMESTIC OUTPUT*</u>
76.00	76000	Amusements	12,609
77.00	none	Medical, Educational Services	76,720
81.00	81000	Business Travel, Entertainment	15,358
82.00	82000	Office Supplies	3,393

Of these sectors, only the first two can consume non-negligible amounts of energy. Notice that NEA defines no sector comparable to BEA 77.00.

BEA Sector 74.00, "Research and Development," was eliminated in I/O studies in 1963 and its consumption allocated to the industries actually doing the R & D. However, Jack Faucett's Associates did collect data on this sector separately, consumption amounting to about .03% of total domestic energy use. We ignore this small amount rather than attempting to allocate it across all sectors doing research.

3.2 RESIDUAL ALLOCATION

The National Energy Accounts contain several residual sectors which contain energy required by an undetermined combination of several related sectors. For example, NEA Sector 049XX, "Agriculture N.S.C.", contains energy belonging somewhere in Agriculture Sectors 01000, 02000, 03000, and 04000. Because we have no information on the exact distribution of residuals to each sector, we use a number of techniques to allocate

*99.03 (Total Output) from BEA SP-77-028. In millions of 1971 Dollars, producer's prices.

these amounts (see previous section). In the data base we use, Table I-1, the residual sectors and their total energy contents are:

			<u>% of Total 1971 U.S. Energy Use</u>
049XX	Agriculture N.S.S.	163 Trillion Btu	.2%
129XX	Construction N.S.S.	714 Trillion Btu	1.1%
779XX	Commercial Industries N.S.S.	2658 Trillion Btu	4.0%

Note that these residuals are of the same order of magnitude as the sectors they cover, and so could introduce much larger errors in coefficients for these sectors, as shown in Table 15.

3.3 FEEDSTOCK ADJUSTMENT

Feedstocks, also called "Material inputs to non-energy activities," are quantities of energy consumed for reasons other than their ability to produce heat and power.* A number of energy forms known as "aromatics" separately reported in the National Energy Accounts are routinely classified as feedstocks only by the Bureau of Economic Analysis. However, several varieties of liquid refining gases can be classified as either feedstocks or energy according to their actual use by the consuming industry. Because the interindustry energy flows in Tables I-1 and I-2 contain all consumption of each type of energy, the feedstock portion of these flows is automatically included in a Sector's direct energy use.

*From our standpoint as energy analysts, we would prefer to consider all burnable energy forms as primary outputs of the energy sectors, but we conform to BEA definitions nevertheless.

Table 15.

Absolute Error Bounds Due to Residual Allocation as
a Percentage of Uncorrected Sector Value*

SECTOR	TOTAL UNCORRECTED FUEL USE [†] (10 ¹² Btu)	RESIDUAL SECTOR	ERROR BOUND* (As a Fraction of Uncorrected Value)
1.00	526.86	049XX	.31
2.00	741.517		.22
3.00	85.698		1.92
4.00	23.624		6.92
11.0	351.499	129XX	2.14
12.00	85.698		9.27
69.00	1227.341	779XX	3.86
70.00	142.141		33.37
71.00	52.192		90.87
72.00	143.991		32.94
73.00	119.344		39.74
75.00	30.739		154.29
76.00	19.248		246.00
77.00	215.879		21.97

} residual of fuel i (Btu)
i

* Computed using the formula:

Total uncorrected sector fuel use (Btu)

Applies only to residual allocation error, and only to total primary figures.

[†] All fuel use is computed with electricity costed at 10,536 Btu fossil per Btu electric, the 1971 average electric utility heat rate [9]. Fuel use data from Table I-2 [4].

3.4 PRODUCTION AND CONSUMPTION WITHIN MANUFACTURING SECTORS

Energy which is produced and then consumed by energy sectors, such as petroleum refineries, is properly reported in NEA data. However, due to the Census of Manufactures' data collection format, energy which is produced and consumed within a single manufacturing sector is not reported. This has the effect of understating the energy content of the product of the sectors in which this occurs, and also causes incorrect row totals or totals of all energy produced of a given type.

3.5 TRANSMISSION AND DISTRIBUTION LOSSES

In the National Energy Accounts, several sectors exist which are outside the interindustry portion of the U.S. economy. These sectors, contained in matrices I-5 and I-6, are inventory additions, exports, storage and distribution losses, and statistical discrepancy. With the exception of storage and distribution losses, all of these sectors are considered components of final demand, and are used only in the computation of total sector output (gross output). Input-Output accounting conventions dictate that storage and distribution losses be considered a self-use of the original producing sector. Entries in this column are therefore added to the column of the sector which produced them.

3.6 TRANSFERS OF SECONDARY PRODUCTS

BEA makes a number of transfers in and out of the five major energy sectors. These transfers are of three basic types: feedstock adjustments (described in Section 2.3), BEA redefinitions, and secondary products. BEA redefinitions are transfers due to the fact that BEA sectors do not conform to the SIC format used by the Bureau of the Census in collecting data.

One example of this is the transfer of much of SIC 1321 (normally part of SIC 13, BEA 8.00) into BEA 31.01. The final type of transfer is necessary when an energy sector produces a secondary output considered primary to some other industry (usually a non-energy one) and vice versa.

The latter two types of transfers can introduce errors in energy cost results because the input required to produce the transferred good is not assigned to the sector receiving the transfer. For example, certain aromatic chemicals produced by natural gas utilities are transferred to Sector 27.00 which normally produces aromatics. However, the energy required by the utilities to produce the chemicals is not transferred. Therefore, the Chemical Sector appears to consume less energy than it does to produce its entire chemical output, while the natural gas utilities appear to consume more. A satisfactory resolution or even error analysis of this situation is impossible because many secondary products are produced jointly and do not have a straightforward energy cost. (See [1] for the original discussion of this problem). We have attempted to minimize this sort of error (as well as keep our procedure conceptually clean) by ignoring BEA transfers of energy products out of the five energy sectors in which they are made. This is conceptually and physically correct, but it leads to another problem: some energy products are produced (by conversion of purchased energy forms or occasionally even production) as secondary products in non-energy sectors. To be consistent, we must transfer the Btu value of these products out of the non-energy sectors and into the proper primary energy sector. For example, the coke produced in the steel industry from coal and sold externally must be considered a product of the coal industry without altering the actual energy consumption figure for the steel industry.

Here is the methodology we use for handling these secondary energy products produced by non-primary energy sectors: The Btu value of the products made inside and consumed outside the sectors is subtracted from that sector's use of the primary energy form used in the conversion process. In the above example, the Btu output of coke from the steel industry would be subtracted from the steel industry's use of coal. This leaves the correct total net energy use within the Steel Sector. However, some conversion losses were occurred in producing the coke within the Steel Sector. All of these show up as energy consumption by the Steel Sector. Therefore our procedure contains the implicit assumption that all energy lost in producing secondary energy products within a non-energy sector are entirely a cost of producing the primary output of the sector.

REFERENCES

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- [2] D. Simpson and D. Smith "Direct Energy Use in the U.S. Economy, 1967," CAC Tech. Memo 39, Center for Advanced Computation, University of Illinois, Urbana, IL 61801, December 1974.
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- [4] Jack Faucett Associates, Inc., National Energy Accounts: Energy Flows in the U.S., 1947-1972. Five volumes. Federal Energy Administration, Washington, D.C. 20450, November 1975.
- [5] Input-Output Structure of the U.S. Economy: 1967, Vol. 1-3. Bureau of Economic Analysis, U.S. Department of Commerce, 1974.
- [6] Standard Industrial Classification Manual, 1972. Office of Management and Budget, Executive Office of the President, Washington, D.C.
- [7] See Vol. 1, Part 1, Chapter 5 of the National Energy Accounts, op cit.
- [8] Hilary Kaufman, "Notes to Table I - Interindustry Flows of Energy." Unpublished memo, Jack Faucett Associates, Inc., 5454 Wisconsin Avenue, Chevy Chase, Md. 20015. November 1975.
- [9] Statistical Yearbook of the Electric Utility Industry, Edison Electric Inst., 90 Park Avenue, N.Y., N.Y. 10016, Report #72-25, October 1972.

APPENDIX A
NOTES TO TABLE A1

- (1) 049XX is "Agriculture, Forestry and Fishery, N.S.S.", an aggregate Sector containing all the unaccounted-for residues in Section 6, 7, 8, 9. The contents of 049XX must be allocated to Sectors 6-9. This is accomplished by assigning portions of 049XX based on Sector GDO.
- (2) 129XX is "Construction, N.S.S.", a residue Sector for all construction. It is allocated to Sectors 14 and 15 based on Sector GDO.
- (3) 779XX is "Commercial Industries." This is allocated to Wholesale and Retail trade (79 or 69.00), Finance and Insurance (80 or 70.00).
- (4) This JFA sector is an aggregation of two CAC 90-order sectors. Using it in this form would require an aggregation of established rows and columns of all CAC data base matrices, a complicated process. Instead we disaggregate the JFA sector using gross domestic outputs as weighting factors. Gross domestic outputs for 31.02, 31.03 are determined by taking the percentage of 1972 GDO of 31.00 attributed to these two sectors from the 1972 Census of Manufactures. These figures are shown as allocation fractions and are applied to all rows and columns of 31990.

Prepared by Peter S. Penner 6/10/77.

Reviewed by Hilary Kaufman, JFA, and Nancy Simon, BEA. Thanks go to them for their patient assistance and cooperation.

**APPENDIX A - TABLE A1 CORRESPONDENCE OF 90 ORDER CAC AND BEA SECTORS TO SIC
AND NATIONAL ENERGY ACCOUNT SECTORS**

CAC	90-Order Sector BEA	Includes These BEA 357-Order Sectors	Description	SIC Codes	Is Equivalent to the Sum of these Jack Faucett I-O Codes
1.	7.00		Coal Mining	11, 12	07000, 07010 07020, part 109xx ⁶
2.	8.00		Crude Petroleum and Natural Gas	1311, 1321	08000, 08001 08002, 08003 08008, 109xx
3.	31.01		Petroleum Refining and Related Products	2911, 299	31011, 31012
4.	68.01		Electric Utilities	491, pt. 493 pt. 9149, 9249 9349* 68922, 68923, 68930, 68931, 68932 68933, 68941, 68942, 68943, 689xx	68900, 68901, 68903 68910, 68911, 68912 68913, 68920, 68921 68922, 68923, 68930, 68931, 68932 68933, 68941, 68942, 68943, 689xx
5.	68.02		Gas Utilities	492, pt. 493	68020, 68021, 68022
6.	1.00	1.01, 1.02, 1.03	Livestock and Livestock Products	0132, 0133, 0139, pts. 014, 02, 0193, -820	01000, part 049xx**
7.	2.00	2.01, 2.02, 2.03, 2.04, 2.05, 2.06, 2.07	Other Agricultural Products	0112, 0113, 0119, pt. 014, 0122, 0123, 02	02000, part 049xx**
8.	3.00		Forestry and Fishery Products	074, 081, 082, 084, 086, 091	03000, part 049xx**
9.	4.00		Agricultural, forestry, and fishery services	071, 0723, 073, pt. 0729, 085, 098	04000, part 049xx**
10.	5.00		Iron and ferroalloy Ores Mining	1011, 106	05000, part 109xx ⁶
11.	6.00	6.01, 6.02	Nonferrous metal ores mining	102, 103, 104, 105, 108, pt. *109	06001, 06002 part 109xx ⁶
12.	9.00		Stone and Clay Mining and quarrying	141, 142, 144, 145, 148, 149	09000, part 109xx ⁶
13.	10.00		Chemicals and Fertilizer	147	10000, part 109xx ⁶
14.	11.00	11.01, 11.02, 11.03, 11.04 11.05	New Construction	pt. 13, pt. 15 pt. 16, pt. 17 pt. 6561	11000, 11001, 11002, part 129xx ⁶

*1967 Codes Only

**See Note 1

#See Note 2

§See note 3

CAC	90-Order Sector BEA	Includes These BEA 357-Order Sectors	Description	SIC Codes	Is Equivalent to the Sum of these Jack Faucett I-D Codes
15.	12.00	12.01, 12.02	Maintenance and Repair Construction	PH 5, pt. 16, pt. 17	12000 Part 129xx**
16.	13.00	13.01, 13.02 13.03, 13.04 13.05, 13.06 13.07	Ordinance and Accessories		13000
17.	14.00	14.01, 14.32, Consec.	Food and Kindred Products	20	14000
18.	15.00	15.01, 15.02	Tobacco Manufactures	21	15000
19.	16.00	16.01, 16.02, 16.03, 16.04	Broad and Narrow Fabrics, Yarn & Thread Mills	2211, 2221, 2231, 2261, 2262, 2281, 2269, 2281,	16000
20.	17.00	17.01, 17.10 Consec.	Misc. Textile Goods and Floor Coverings	227, 229	17000
21.	18.00	18.01, 18.02 18.03, 18.04	Apparel	229, 23 exc. 329, 3992	18000
22.	19.00	19.01, 19.02, 19.03	Misc. Fabricated Textile	230	19000
23.	20.00	20.01, 20.09 Consec.	Lumber and Wood Products Except Containers	24 exc. 244	20000
24.	21.00		Wooden Containers	244	21000
25.	22.0	22.01, 22.02, 22.03, 22.04	Household Furniture	2511, 2512, 2514, 2515, 2519	22000
26.	23.0	23.01, 23.07, Consec.	Other Furniture and Fixtures	252, 253, 254, 259	23000
27.	24.00	24.01, 24.07	Paper and Allied Products Except Containers and Boxes	26 exc. 265	24020, 24990
28.	25.00		Paperboard Containers and Boxes	265	25000
29.	26.00	26.01, 26.08 Consec.	Printing and Publishing	27	26000

** See Note 2

CAC	90-Order Sector BEA	Include: These BEA 357-Order Sectors	Description	SIC Codes	Is Equivalent to the Sum of these Jack Faucett I-O Codes
30.	27.00	27.01, 27.02 27.03, 27.04	Chemicals and Selected Chemical Products	281 exc. 28195, 2871, 2872, 2879, 289	27010, 27011, 27012 27020, 27030, 27040
31.	28.00	28.01, 28.02, 28.03, 28.04	Plastics and Synthetic Materials	282	28010, 28020, 28990
32.	29.00	29.01, 29.02, 29.03	Drugs, Cleaning & Toilet Preparations	283, 284	29000
33.	30.00		Paints and Allied Products	2851	30000
34.	31.02		Paving Mixtures & Blocks	2951	Allocation 31990 ⁸⁸ <u>Prastion</u> 128
35.	31.03		Asphalt Felts & Coatings	2952	.502
36.	32.00	32.01, 32.02, 32.03	Rubber and Misc. Plastic Products	30	32000
37.	33.00		Leather Tanning and Indus- trial Leather Products	3111, 3121	33000
38.	34.00	34.01, 34.02, 34.03	Footwear and Other Leather Products	31 exc. 3111, 3121	34000
39.	35.00	35.01, 35.02	Glass and Glass Products	321, 322	35000
40.	36.00	36.01, 36.22	Stone and Clay Products	32 except. 321, 322	36010, 36900
41.	37.00	37.01, 37.02, 37.03, 37.04	Primary Iron and Steel Manufacturing	331, 332, 3391, 3399	37000, 37011, 37012, 37990
42.	38.00	38.01, 38.14 Consec.	Primary Nonferrous Metals Manufacturing	333, 334, 335, 336, 3392, 28195	38000, 38040 38990

⁸⁸ See Note 4.

CAC	90-Order Sector BEA	Includes These BEA 357-Order Sectors	Description	SIC Codes	Is Equivalent to the sum of these Jack Faucett 1-0 Codes
43.	39.00	39.01, 39.02	Metal Containers	341, 3491	39000
44.	40.00	41.01, 40.09 Consec.	Heating, Plumbing, and Fabricated Structural Metal Products	343, 344	40000
45.	41.00	41.01, 41.02	Screw Machine Products	341, 3461	41000
46.	42.00	42.01-42.11 Consec.	Other Fabricated Metal Products	342, 347, 349 exc. 3491	42000
47.	43.00	43.01, 43.02	Engines and Turbines	351	43000
48.	44.00		Farm Machinery	3522	44000
49.	45.00	45.01, 45.02, 45.03	Construction, Mining, Oil Field Machinery and Equipment	3531, 3532, 3533	45000
50.	46.00	46.01, 46.02, 46.03, 46.04	Materials Handling Machine- ry and Equipment	3534, 3535, 3536, 3537	46000
51.	49.00	47.01, 47.02, 47.03, 47.04	Metal Working Machinery and Equipment	354	47000
52.	48.00	48.01-48.06 Consec.	Special Industry Machinery and Equipment	355	48000
53.	49.00		General Industrial Machinery and Equipment	356	49000
54.	50.00		Machine Shop Products	359	50000
55.	51.00		Office, Computing and Accounting Machines	357	51000

90-Order Sector		Includes These BEA 357-Order Sectors	Description	SIC Codes	Is Equivalent to the <u>Sum</u> of these Jack Faucett I-O Codes
CAC	BEA				
56.	52.00		Service Industry Machines	358	52000
57.	53.00		Electric Transmission and Distribution Equipment and Electrical Industrial Apparatus	361, 362	53000
58.	54.00		Household Appliances	363	54000
59.	55.00		Electric Light and Wiring Equipment	364	55000
60.	56.00		Radio, Television, and Communication Equipment	365, 366	56000
61.	57.00		Electronic Components and Accessories	367	57000
62.	58.00		Misc. Electrical Machinery, Equipment and Supplies	369	58000
63.	59.00		Motor Vehicles and Equipment	371	59000
64.	60.00		Aircraft and Parts	372	60000
65.	61.00		Other Transportation Equipment	373, 374, 375, 379	61000
66.	62.00		Professional, Scientific, and Controlling Instruments and supplies	381, 382, 384, 387	62000
67.	63.00		Optical, Ophthalmic and Photographic Equipment and Supplies	3831, 3851, 3861	63000

CAC	90-Order Sector BEA	Includes These BEA 357-Order Sectors	Description	SIC Codes	Is Equivalent to the sum of these Jack Faucett I-O Codes
68.	64.00		Misc. Manufacturing	39	64000
69.	65.01		Railroads and Related Services	40, 474	65010 part 65000 [#]
70.	65.02		Local, Suburban, and Inter- urban Highway Passenger Transportation	41	65020 part 65000 [#]
71.	65.03		Motor Freight Transporta- tion, and Warehousing	42, 473	65030 part 65000 [#]
72.	65.04		Water Transportation	44	65040 part 65000 [#]
73.	65.05		Air Transportation	45	65050 part 65000 [#]
74.	65.06		Pipeline Transportation	46	65060 part 65000 [#]
75.	65.07		Transportation Services	47 except 473, 474	65070 part 65000 [#]
76.	66.00		Communications except Radio and Television Broadcasting	48 except 483	66000
77.	67.00		Radio and Television Broadcasting	483	67000
78.	68.03		Water and Sanitary Services	494, 495, 496, 497, pt. 493	68030
79.	69.00		Wholesale and Retail Trade	50, 52, 53, 54, 55, 56, 57, 58, 59, 73, 517	69000, 69010 69012, 69020 69021, 69024 part 779XX [#]

[#] See Note (4)

[#] See Note (3)

90-Order Sector CAC	BEA	Includes These BEA 357-Order Sectors	Description	SIC Codes	Is Equivalent to the Sum of these Jack Faucett I-O Codes
80.	70.00		Finance and Insurance	60, 61, 62, 63, 64, 67	70000, part 779xx
81.	71.00		Real Estate and Rental	65 except pt. 6561, 66	71000 part 779xx [#]
82.	72.00		Hotels and Lodging Places, Personal and Repair Services except Automobile Repair	70, 72 (except 723, 724), 76, (except 7694, 7692, pt. 7699) 723, 724	72000 part 779xx [#]
83.	73.00		Business Services	73 (except 731, 7396), 7694, 7692, pt. 7699, 731, 81, 89 (except 8921)	73000 part 779xx [#]
84.	75.00		Automobile Repair and Services	75	75000 part 779xx [#]
85.	76.00		Amusements	78, 79	76000 part 779xx [#]
86.	77.00		Medical, Educational Services and Non-Profit Organization	80, 82, 8921, 0722, 84, 86 (excl. pt. 8099)	None part 779xx [#]
87.	78.00		Federal Government Enterprises	- -	78009, 78030
88.	79.00		State and Local Government Enterprises	- -	79009
89.	81.00		Business Travel, Enter- tainment and Gifts	- -	81000
90.	82.00		Office Supplies	- -	82000

[#] See Note (b)

APPENDIX A--TABLE A2

CROSS REFERENCE OF ENERGY PRODUCTS BY SIC,
NATIONAL ENERGY ACCOUNTS, AND BEA SECTOR
CLASSIFICATION

Adapted from Appendix 1 of the National
Energy Accounts.

This appendix lists all products considered to be primary forms of energy in the United States in 1971. The first column (column A) shows the 1972 SIC classification of the energy product. Column B shows the sector designation used in the National Energy Accounts, an entirely independent numbering system shown here for identification purposes only. The third column (C) shows the correct 90-order BEA sector the product ends up in after BEA has performed all relevant transfers and adjustments. This would be the sector classification we'd use if we wanted to adhere strictly to BEA allocation conventions.

We employ the convention of assigning an energy product to the primary energy form* from which the product was originally produced. For example, coal coke is assigned to the coal sector and petroleum coke is assigned to 31.01 refined petroleum. In contrast, BEA classifies coal coke as an output of 37.01. Column D lists the BEA sectors which actually produced the product in 1971 (according to Table D, Volume V of the Accounts). Column E shows the final classification we use in our 1971 DET matrix.

*The five primary energy sectors are BEA 7.00, 8.00, 31.01, 68.01, and 68.02.

NOTES TO THIS APPENDIX:

- ¹ All products classified in 8.00 (Crude Petroleum and Natural Gas) are sold either to 31.01, 68.02, or 28.00. Sector 68.02 then sells what was originally the output of 8.00 to all other sectors. Thus 68.02 is not listed as the primary producer of any energy form. Note that in this case sector 68.02's self-use of natural gas is equal to its purchases of energy from 8.00 less its total output (since it consumes no crude oil).
- ² Not one of five energy sectors considered as primary energy sources in this report (BEA 7.00, 8.00, 31.01, 68.01, 68.02). Steam is transferred out of 68.02.
- ³ The amount of these products used as feedstocks can be determined in several ways. First, certain energy forms are useful only as feedstocks, i.e., Toluene. Secondly, NEA use classification 3000 (and subclassifications) are specifically feedstock uses of energy. Note this does not include energy converted to other useful energy forms (e.g., coke conversion). Feedstock use of energy can be read from the conversion account (Table E) or by juggling the totals in Tables G and H.
- ⁴ All contents of SIC 1321 (Natural Gas Liquids) except natural gasoline and plant condensate are transferred to BEA 31.01 rather than staying in BEA 8.00. (BEA, 6/6/77.) This convention is followed here.
- ⁵ Contains a product not specifically classified into an SIC sector. Product has been assigned to this sector because the sector contains similar products.
- ⁶ These products are in 31.01 only if they are produced in petroleum refineries. This is assumed for all purposes in this table.
- ⁷ These products are in categories shown only if they are NOT produced in petroleum refineries, which is assumed throughout.

National Energy Account Notes
(from the original source)

^a Ethylene, propylene, and butylene are listed for separate reporting in the olefins category (55000), under unsaturated light hydrocarbons. However, production of these products is presently reported in conjunction with ethane, propane, and butane, and categories are therefore provided for these olefins under light hydrocarbon gases (20000). These duplicate categories are to be dropped as separate data on ethylene, propylene, and butylene become available.

^b Formerly called liquified gases (liquified refinery gases, when produced in petroleum refineries; liquified petroleum gases, when produced in natural gas processing plants).

^c Most coal tar and light oil derivatives are reported in the principal hydrocarbon series, especially in the aromatics categories (51000, 53000).

APPENDIX A - TABLE A2

NATIONAL ENERGY ACCOUNTS APPENDIX 1 - ENERGY PRODUCTS TAXONOMY

	A.	B.	C.	D.	E.	F.	G.	H.	I.
	1972 EST. QUANTITY	SEA FIRM. COST	90-GRAND SEA QUANTITY	ACTUAL PRODUCE- MENT QUANTITY - 1972	FINAL USE SEA QUANTITY	SEA "PER CENT. QUANTITY"	TYPE QUANTITY(S) PROD. FOR USE, COST @	INDUSTRIAL INPUT ADJUSTMENT YEAR**	CONVERSION Factor (1/1000000)
PRIMARY ENERGY Products									
Crude oil (including losses and waste)	13 ¹	13000	8.00 ²	8.00	8.00	08001	-		
Natural gas and similar products		12000							
Natural gas -- wet	13 ¹	12200	8.00 ²	8.00	8.00	08002		0.0	
Natural gas -- dry	13 ¹	12200	8.00 ²	8.00	68.02	08003	TP to (2,00000)		
Manufactured gases		12300							
Still gas	0901	12300	31.01	31.01	31.01		TP to (2,00000)	0.0000	
Other gases	0902	12300	48.02	48.01	48.02		TP to (2,00000)		
Other manufactured gases	0903	12300	48.02	48.02	48.02		TP to (2,00000)		
Manufactured gases, n.e.c.	0905	12300	48.02	48.02	48.02		TP to (2,00000)		
Wet Gas	0905	12400	48.02	48.02	48.02		TP to (2,00000)		
Natural or similar gas, n.e.c.	13 ¹	12900	8.00 ²	8.00	68.02		TP to (2,00000)		.04518
Coal	11, 12	13000	7.00	7.00	7.00				
Anthracite		13100							
Bituminous coal and lignite		13200							
Bituminous coal		13200							
Lignite		13200							
Bituminous and lignite, n.e.c.		13200							
Coal, n.e.c.		13300							
Nuclear energy	0.0.2	14000	0.0.2	0.0.2	0.0.2				
Uranium ore		14100							
Thorium ore		14200							
Other nuclear ore, n.e.c.		14300							
Water power		15000							
Geothermal power		16000							
Solar power		17000							
Wind, for fuel		18000							
Other primary energy products, n.e.c.		19000							

For more details 2/16/79. See entry 08 in ERY documentation files.

** - See Table.

*** See entries noted.

APPENDIX A TABLE A2

INTERNAL ENERGY ACCOUNTS APPENDIX I - ENERGY PRODUCTS THROUGH (CONTINUED)

	A. 1972 SEC. 500000	B. NEA PROD. CODE	C. 90-00000 NEA PRODUCT	D. ACTUAL PRODUCTION THRU SEPTEMBER, 1972	E. FINAL CAC SEC. 500000	F. NEA "FRI" PROD. ADJUST*	G. EXPS. ELEMENT(S) PROD. ADJ. FRI, CODE**	H. MATERIAL INPUT ADJUSTMENT TEMP*	I. CONVERSION FACTOR ADJUSTMENT**
CONVERTED HYDROCARBONS									
Light hydrocarbon gases (olefins): ^a		20000							
Ethane and ethylene	1321 ^{3,4}	21000	21.01 ^{3,4}		21.01	00003	BT to (2,32022)		
Ethane	1321 ^{3,4}	21100	21.01 ^{3,4}	0.00	21.01				
Ethane and ethylene, n.s.s.	1321 ^{3,4,5}	21000	21.01 ^{3,4,5}	21.01	21.01				
Propane and butanes ^b	1321 ³	23000	21.01 ^{3,4}						
Propane and propylene		23100							
Propane		23110		0.00	21.01	00003	BT to (2,31011)		
Propane and propylene, n.s.s.		23100		21.01	21.01	00003			
Butanes and butylene		23200							
Normal butane		23210		0.00	21.01				
Isobutane		23220		0.00	21.01				
Other butanes, n.s.s.		23230		0.00	21.01				
Butanes and butylene, n.s.s.		23200							
Butane, n.s.s.		23290		0.00	21.01				
Propane-butane mixtures		23300		0.00	21.01				
Other liquefied gas mixtures		23400		none	21.01				
Liquefied gases, not including propylene and butylene, n.s.s.		23700		none	21.01				
Liquefied gases, including propylene and butylene, n.s.s.		23600		none	21.01				
Gasoline and naphthalene	2911 ⁵	30000	21.01 ⁵						
Gasoline		31000							
Motor gasoline		31100		0.00	21.01	33011			
Aviation gasoline		31200		0.00	21.01				
Gasoline, n.s.s.		31300		21.01	21.01				
Special naphthalene ^c		33000							
Special naphthalene, except naphthalene 400		33100		0.00	21.01				
Naphthalene 400		33200		21.01	21.01				
Special naphthalene, n.s.s.		33300		21.01	21.01				

*BT = Net Total

**See tables noted.

APPENDIX A TABLE A2

NATIONAL ENERGY ACCOUNTS APPENDIX 1 - ENERGY PRODUCTS TAXATION (CONTINUED)

	A.	B.	C.	D.	E.	F.	G.	H.	I.
	1972 BSC BASTON	SEA PROD. 1988	90-0000 BSC BASTON	ACTUAL PRODUCE (BSC BASTON, 1971)	FINAL CAC BSC BASTON	SEA "TOL" FOR BASTON	OVER SLIDING(S) FOR BSC BASTON	MINERAL INPUT ADJUSTMENT	CONVERSION FACTOR ADJUSTMENT***
Incipient ¹		14000	11.01	11.01	11.01	08003	12 to (2,31011)	0.0	
Gasoline-type jet fuel		35000	11.01	11.01	11.01	11011			
Other gasoline and products in the gasoline range, n.e.c.	1301 ^b	10000	11.01 ^b						
Natural gasoline		10000	11.01 ^b	11.01	11.01	08003			
Plant condensate		10000	11.01 ^b	11.01	11.01	08003			
Other natural gas liquids, n.e.c.		10000	11.01 ^b	11.01	11.01	08003	12 to (2,31011)		
Pool oil	2911	10000	11.01	11.01	11.01				
Distillate fuel oil		11000				11011			
Kerosene and no. 1 fuel oil		11000							
Kerosene used for jet fuel		11000							
Aberration oil	2911 ⁵	11000	11.01 ⁵	11.01	11.01				
Kerosene for other uses	2911	11000	11.01	11.01	11.01				
Kerosene, n.e.c.		11000		11.01	11.01				
No. 1 fuel oil, n.e.c.		11000							
No. 2 fuel oil		11000							
No. 3 fuel oil		11000							
No. 4 fuel oil		11000							
Distillate fuel oil, n.e.c.		11000							
Distillate used for heating		11000							
Distillate used for diesel fuel		11000							
Distillate for unspecified use		11000							
Distillate fuel oil, n.e.c.		11000							
Residual fuel oil		11000							
No. 5 fuel oil		11000							
No. 6 fuel oil		11000							
Other residual fuel oil, n.e.c.		11000							
Pool oil, n.e.c.		11000							

*12 = Sea Total.

**12 = Sea Total.

APPENDIX A TABLE A2

NATIONAL ENERGY ACCOUNTS APPENDIX 1 - ENERGY PRODUCTS TAKENOWN (CONTINUED)

	A. 1912 SEC. SECTOR	B. MIA PROD. CODE	C. 90-ORDER MIA SECTOR	D. ACTUAL PRODUCE- MIA SECTOR, 1912	E. FINAL OAC MIA SECTOR	F. MIA "FUEL" PROD. SECTOR	G. SPIN RECOVERY(S) PROD. FOR SEC. CODE*	H. MATERIALS INPUT ADJUSTMENT TERM**	I. CONVERSION FACTOR ADJUSTMENT**
Unrefined light hydrocarbons		50000			None	37011	None		
Unrefined aromatics	2865	51000	27.00						
Crude light oil (from coal)		51100		37.00					
Intermediate light oil (from coal)		51200		37.00					
Other unrefined aromatics, n.e.c.		51700		37.01					
Refined aromatics	28	53000	27.00						
Benzene		53100		31.36 31.01	31.00	31011			
Toluene		53200		6.78 31.01	31.00	31011			.74605
Xylene		53300		58.58 31.01	31.00	31011			
Naphthalene		53400		1.51 31.01	31.00	31011			
Softens phenolates or carbolates		53500		39.38 31.01	31.00	31011			
Other refined aromatics, n.e.c.		53600		53 31.01	31.00	31011			
Other refined aromatics, n.e.c.		53700		1.15 31.01	31.00	31011			
Other refined aromatics, n.e.c.		53800		58.58 31.01	31.00	31011			
Other refined aromatics, n.e.c.		53900		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54000		36.95 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54100		3.15 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54200		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54300		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54400		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54500		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54600		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54700		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54800		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		54900		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55000		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55100		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55200		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55300		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55400		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55500		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55600		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55700		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55800		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		55900		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56000		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56100		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56200		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56300		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56400		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56500		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56600		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56700		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56800		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		56900		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57000		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57100		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57200		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57300		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57400		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57500		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57600		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57700		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57800		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		57900		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58000		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58100		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58200		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58300		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58400		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58500		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58600		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58700		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58800		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		58900		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59000		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59100		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59200		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59300		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59400		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59500		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59600		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59700		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59800		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		59900		37.00 31.01	31.00	31011			
Other refined aromatics, n.e.c.		60000		37.00 31.01	31.00	31011			

*Supposedly glitch: half of this is actually from coal but we report it.

**WT = low limit.

***One unless noted.

APPENDIX A TABLE A2
NATIONAL ENERGY ACCOUNTS APPENDIX 1 - ENERGY PRODUCTS TARIFFS (CONTINUED)

	A	B	C	D	E	F	G	H	I
	1972 BIC SECTION	SEA PROD. CODE	90-DIGIT SEA SECTION	ACTUAL PRODUCE TIC SECTION, 1971	FINAL CAC DET-SECTION	SEA "TIC" PROD. SECTION	SEA ELEMENT (B) PROD. FOR SEA, CODE, 0	MATERIAL INPUT CONVERSION TERM	CONVERSION FACTOR AND UNIT
Gasoline oil	2911 ¹	62000	31.01	31.01	31.01	7	-	-	-
Petroleum	2913	63000	31.01	31.01	31.01	7	-	-	-
Motor	2913 ²	64000	31.01 ⁶	↓	↓	31002	-	-	-
Asphalt and road oil	2913 ³	65000	31.02, 03 ²	↓	↓	31002	-	-	-
Asphalt and road tar	↓	65100	↓	↓	↓	31002	-	-	-
Asphalt	↓	65110	↓	31.02	31.01 ⁶	31002	-	-	-
Road tar	↓	65120	↓	31.02	31.01 ⁶	31002	-	-	-
Road oil	↓	65200	↓	31.01	31.01 ⁶	31002	-	-	-
Carbon black	2913 ²	66000	31.02 ²	-	-	-	-	-	-
Refined oil	2913 ^{2,5}	67000	31.02, 2,5	-	31.01	31002	-	-	0.0
Petroleum products, n.e.c. used for									
jet fuel	2913 ⁵	68000	31.01 ⁵	none	31.01	31002	-	-	-
Other finished petroleum products, n.e.c.	2913 ⁵	69000	31.01 ⁵	none	31.01	31002	-	-	-
Coal derivatives, n.e.c.		70000							
Coal and breeze		71000							
Coal		71100							
Coal coke	2912 ²	71110	31.01 ²	31.01	31.01	31002	-	-	-
Petroleum coke	2912	71120	31.01	31.01	31.01	31002	-	-	-
Breeze	2912	71200	31.01	31.01	31.01	31001	-	-	-
Coal and breeze, n.e.c.	2912	71300	31.01	none	31.01	31001	-	-	-
Coal tar	2913 ²	72000	31.01 ²	31.01	31.01	31001	-	-	-
Pitch (from coal tar)	↓	72000	↓	31.01	31.01	31001	-	-	-
Coal tar derivatives, n.e.c.	↓	73000	↓	31.01	31.01	31001	-	-	-
Coal light oil derivatives, n.e.c.	↓	74000	↓	31.01	31.01	31001	-	-	-
Ammonia products	2913, 2914, 2915 ²	75000	31.01 ²	31.01	31.01	31001	-	-	-
Paraffin	2915	76000	31.01	31.01	31.01	31001	-	-	-

*ET = Sea Total.
*The unless noted.

APPENDIX A TABLE A2

NATIONAL ENERGY ACCOUNTS APPENDIX I - ENERGY PRODUCTS TARIFFS (CONTINUED)

	A. 1972 SEC. SECTOR	B. REA PROD. CODE	C. 94-GRND REA SECTOR	D. ACTUAL PRODC- TIC SECTOR, 1971	E. FINAL CAC SEC. SECTOR	F. REA "PRO TIC" SECTOR	G. TYPE ELEMENT(S) CODE, FOR SEC. CODE	H. MATERIAL INPUT ASSIGNMENT TERM*	I. CONVERSION FACTOR, QUANTITY**
NUCLEAR ENERGY PRODUCTS	N.A. ²		N.A. ²						
Enriched uranium		81000							
Uranium hexafluoride		82000							
Enriched uranium		83000							
Plutonium		84000							
Fabricated nuclear energy products		85000							
Fabricated uranium		85100							
Fabricated plutonium		85200							
Fabricated thorium		85300							
Spent nuclear energy products		86000							
Nuclear wastes		88000							
ELECTRICITY									
Electricity	491	91000	65.01	various	65.01	various			
Steam	N.A. ²	92000	N.A. ²						
COMBUSTIBLE FUELS									
Hydrogen and other hydrocarbons, n.e.c.		93000							
Gasified fuel		95000							

*See Table A1.

**See Table A1.

APPENDIX B

DATA APPENDIX

This appendix contains two sections. The first quotes census data on the size (receipts and employees) of construction and service establishments. This helps give an idea what sort of electricity and gas rates these sectors are subject to.

The second section quotes available detailed data on energy prices to sectors by energy type.

CENSUS OF CONSTRUCTION, 1967 Vol. 1.

BEA 11.00 = pt. SIC 15, 16, 17, 6561

BEA 12.00 = pt. SIC 15, 17, 183, 16

TABLE B1 - SIZE OF ESTABLISHMENTS

SIC	No. Estab.	All Employees	Total Recpts. (10 ³ /)	Calculated
				Empl./Estab.
1511	156,400	871,705	35,457,912	5.57
16	42,839	884,357	24,648,649	20.64
17	563,028	1,585,390	34,803,297	2.82
6561*	13,237	72,305	4,769,190	5.46

↓
weighted average by
total receipts ~5 or less

* w/payroll only

By eyeballing Table A2 it appears that most establishments are

SIC 1511 - a couple of \$10⁶ business that take in 80% of receipts.

SIC 16 - same.

SIC 17 - more spread out - avg. is about a \$250K/yr co.

SIC 6561 - same as 17 but slightly bigger.

CENSUS OF SELECTED SERVICES, 1972

TABLE B2: RECEIPTS SIZE OF ESTABLISHMENTS- U.S. BY
KIND OF BUSINESS, 1972.

SIC	ESTAB. (10 ³)	RECEIPTS	Paid Employees as of 3/12/72 (10 ³)	Calculated		TABLE 1b. EYEBALL COMMENTS
				10 ³ \$/Estab.	Empl/Estab.	
701, 3	76	10,638	727	139	9.5	A few thousand establish. employ > 20 employees and account for 90% of all employees.
72	503	14,049	977	28	~2	Must have 2-3 employees even gaussian
73	326	37,801	1,759	116	~5.8	60% of employees from the upper 10,000 firms. (Over 20 per firm). A hump at 8-9 employees too.
75	169	12,081	392	72	~2	Even gaussian at avg. of 3 employees.
78, 79	146	13,445	653	92	~4	Half come from a scattering of firms of 20 empl., but evenly below that at avg. of 6.
81	144	10,938	268	76	~2.2	Avg. of 10 empl. evenly done.
891	64	7,588	293	118	4.55	Same as 78, 79.

1972 CENSUS OF WHOLESALE TRADE

BEA 69.01 = SFC 50 excl. mfr. sales offices

Table 1: U.S. Summary Stats by Type of Operation and Kind of Business, 1972
All types of operations and kinds of businesses (SIC 50, 51)

369,791 establishments

\$694,223,644,000.00 sales

4,026,118 employees

Eyeballing Table 1a, Sales Size of Establishments Avg. size about $\$2 \times 10^6$
 Virtually all $< \$500K$
Table 1c, Employment Size of Establishments { Most have 10 or less people
 - there's a hump at
 20-50 people

(Both of these tables exclude mfr. sales offices per BEA convention)

1972 CENSUS OF RETAIL TRADE

BEA 69.01 = 52, 53, 54, 55, 56, 57, 58, 59, 7396, pt 8099

Table 1: U.S., by Kind of Business, 1972

"Retail Trade, Total" 1,912,871 establishments \$459,040,436,000 sales
 \$239,974/estab.

With payroll: 1,264,922 establishments
 11,210,998 employees
 8.86 empl/estab.

Table 6a: 415,000 establishments 3×10^6 ft floorspace

ENERGY PRICES 1971REFINED PETROLEUM

Basic Petroleum Data Book, API

Table 4, Section 6, April '77

Retail Price of Reg. Gasoline (¢/gal.)

1971: 25.20 + 11.23 tax = 36.43

1967: 22.55 + 10.61 = 33.16

Table 5, sec. 6, april '77

U.S. Annl Avg. of #2 Home Oil

1967: 16.91 ¢/gal

1971: 19.63 ¢/gal → 16.18¢/gal
1967 pricesELECTRICITY EEI Stat. Yearbook of the Elec. Util. Industry for 1973

Class	Resid	Comm. & Incl.		Street Hwy	Other Public	Railroad	Interdep.	SOURCE
		Small Lite Power	Large Lite Power					
No. of cust.	65,650,046	8,002,572	355,967	96,252	155,414	48	4,772	Table 275
Total Sales (10 ⁶ kWh)	479,080	333,752	592,700	11,673	39,819	4,537	4,880	Table 245
Calculated: Sales/cust. Avg.	7297.5	41,706	1,665,042					Calculated
Total Revenues (10 ³ /\$)	10,483,526	7,071,971	6,133,964					Table 335
Avg (\$/kWh)	.0210	.0212	.0104					Calculated

GAS

6/13/78 3:15P

Arlington

AGA

(703) 524-2000

Karen Forcey, Mgr. of Statistics

1971 Gas Prices U.S. Average $\$/10^6$ Btu

Resid.	\$1.12	Commercial 85¢	Industrial 41¢	Other 38¢
Total Sold (10^9 Btu)	5,040.1	2,155.5	8,645.5	844.7
No. of Cust. (10^3)	38,788.7	3,199.0	204.7	49.5

Lydia Kate - Rate Structures

Try Gas Rate Fundamentals by AGA

*U.S. GOVERNMENT PRINTING OFFICE: 1979-640-092 1036