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ENERGY USE for FOOD in the UNITED STATES

Eric Hirst

OAK RIDGE NATIONAL LABORATORY
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ABSTRACT

The energy used in food-related activities in the United States — from agriculture to final consumption — is computed for the year 1963 using energy Input/Output tables developed at ORNL and economic Input/Output data from the Department of Commerce.

A total of 6,100 trillion Btu — 12% of total 1963 energy consumption — was required to grow, process, transport, wholesale, retail, refrigerate, and cook food. This includes 190 billion kWhr, 22% of total electricity use that year.

Farming accounted for less than one-fifth of the energy used for food. Farming and processing together used just over half the total. The remainder was used for transportation, trade, and household functions.

Between 1960 and 1970, food-related energy use grew at an estimated 3.3% a year. This growth rate was greater than that for population but less than that for total energy use.

On average, 6.4 Btu of primary energy were consumed in delivering one Btu of food energy to final demand. The comparable protein ratio was 840 Btu of primary energy per gram of food protein.

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ENERGY USE FOR FOOD IN THE UNITED STATES

Eric Hirst

INTRODUCTION

This report calculates, in detail, the quantities of energy required to grow, process, transport, wholesale, retail, refrigerate, and cook food in the United States for the year 1963, using data available from Input/Output (I/O) studies.* These data are then used to estimate annual energy consumption for food for the period 1960 to 1970. Energy requirements per unit of food energy and of food protein are computed for the major food groups.

Because food accounts for 20% of disposable personal income, it seems likely that the energy used in moving food through the economy is also a sizeable percentage of the total U.S. energy budget. The motivation for this work is the set of energy problems now facing the nation: fuel shortages, rapidly rising fuel prices, brownouts, adverse environmental impacts of fuel cycles, and continued growth in energy demand. This study analyzes the impacts of food on energy consumption, a necessary first step in evaluating methods to increase efficiency of energy use in delivering food to consumers. These results can also be used to assess the impacts of increased fuel prices on food prices.

Personal consumption expenditures (PCE)** for food totaled $132 billion in 1970.[1] Table 1 shows how food PCE[1-3] changed between 1960

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*1963 is the latest year for which such I/O data are available.

**PCE is basically the market value of goods and services purchased by individuals.

Table 1. Food expenditures in the United States

	Personal consumption expenditures for food (billion dollars)			Food expenditures, percent of disposable personal income
	Off-premise consumption	Purchased meals & beverages	Total[a]	
1960	62.0	16.2	80.5	23.0
1963	68.4	17.5	88.2	21.8
1965	76.4	20.1	98.8	20.9
1967	82.6	23.2	108.5	19.9
1970	100.1	29.2	132.1	19.2

[a]Total includes small amount spent for "food furnished government and commercial employees" and "food produced and consumed on farms."

Source: Refs. 1-3.

and 1970. The percentage of food dollars spent away from home (eating out) increased from 20% in 1960 to 22% in 1970. This, plus a shift to more expensive foods, accounted for the increase in food expenses. Although expenses rose during this decade, personal income grew more rapidly, so that food accounted for a smaller portion of the family budget in 1970 than in 1960.

Table 2 shows a number of per capita food indicators.[1-3] Consumption, energy content, and protein content remained quite stable during this decade. Per capita expenditures increased significantly, but much of this was due to inflation. Deflating the expenditure figures by the food price index[3] shows that the 25% increase in real (deflated) food expenditures was due in nearly equal measure to population growth and changes in consumption patterns. During the 1960's, per capita consumption of meat, poultry, fish, and processed fruits and vegetables increased, while consumption of fresh fruits and vegetables declined. Thus there was a slow

but steady shift towards: expensive foods (such as beef), processed foods, and consumption of food away from home. These factors increased expenditures without affecting per capita consumption.

Table 2. Per capita food trends in the United States

	Expenditures (dollars/year)	Consumption (lb/year)	Food energy (kcal/day)	Protein (gm/day)
1960	448	1440	3140	95
1963	468	1420	3150	96
1965	510	1420	3140	96
1967	549	1430	3210	98
1970	648	1450	3300	100

Source: Refs. 1-3.

Figure 1 shows how the 1963 food PCE originated among the major economic sectors associated with food.[4] About one-fourth of the total cost comes from agriculture, either directly or via processing. The value added by food processing is equal to two-fifths of the total. Transportation from processors to wholesalers (primarily truck and rail) accounts for only 2% of the total. Wholesale trade accounts for 9%, while retail trade — food stores, eating and drinking places — accounts for 25%. Thus the trade sectors account for a larger fraction of the PCE food dollar than does farming.

The following (second) section summarizes results developed in the third section to show the total energy impact of food in the U.S. for 1963. The 1963 data are appropriately scaled to estimate food energy requirements from 1960 to 1970. Energy use data from the third section and nutrient data from the Department of Agriculture[3] are used to estimate energy

requirements for each of the major food groups. Energy use per kcal of food energy and per gram of protein are calculated. These figures indicate the overall energy efficiency of food production in the U.S.

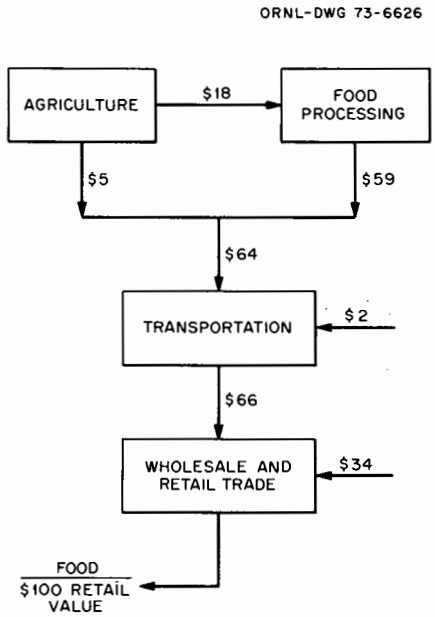

Fig. 1. Major components of a $100 retail food bill during 1963.

The third section analyzes the energy consumed within each of the economic sectors concerned with food: agriculture, processing, transportation, wholesale and retail trade, and homes. Results are given for both primary and electric energy.* For each sector, energy I/O tables for 1963 developed by Herendeen[5] are used to assign energy values to the dollar flows reported by the Bureau of Economic Analysis[4] (formerly the Office of Business Economics) for food PCE.

*Primary energy refers to the energy content of the basic fuels — coal, oil, natural gas, falling water, nuclear fuels. Electricity is a secdary energy form since it is derived from the basic fuels.

SUMMARY

Here we examine aggregate results concerning energy use for food in the U.S. using data developed for individual sectors in the following section.[4-20]

Energy Requirements for 1963

Table 3 summarizes total 1963 dollar, primary energy, and electricity costs for food PCE in the U.S. The dollar costs for all food-related activities was $94 billion, 23% of disposable personal income. A total of 6,100 trillion Btu, 12% of total U.S. energy use* for that year, was devoted, directly and indirectly,** to the production, processing, transportation, trade, and consumption of food. This includes 190 billion kWhr, 22% of total electricity use that year.* Thus food is a major component in the U.S. energy and electricity budgets.

Figure 2 shows the fractional contribution of each sector to food-related energy use for 1963. Agriculture and processing together account for just over half the food energy budget. The household sector accounts for a surprisingly large 30% for cooking, refrigeration, freezing, and food shopping by car. Trade accounts for another 16%. Thus services associated with food used almost as much energy as did farming and processing.

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*Total U.S. energy use in 1963 was 49,300 trillion Btu.[10] Total electricity use that year was 831 billion kWhr.[12]

**Total energy use is the sum of direct and indirect energy uses. Direct energy is that energy consumed within the sector considered; indirect energy is energy consumed in other producing sectors whose output is (in part) required to deliver output from the sector considered.

Table 3. Food in the United States, 1963

Sector	Cost (billion $)	Energy use (trillion Btu)	Electricity use (billion kWhr)
Agriculture			
to PCE	4.5	231	4.1
to processing[a]	(15.8)	(862)	(15.6)
Food processing[a]	51.5	2868	51.3
Transportation	2.0	170	1.0
Trade	29.9	982	26.0
Households	6.1	1868	104.4
Totals	94.0	6119	186.8

[a]Agricultural output delivered to processing (shown in parentheses) also appears in the figures for food processing.

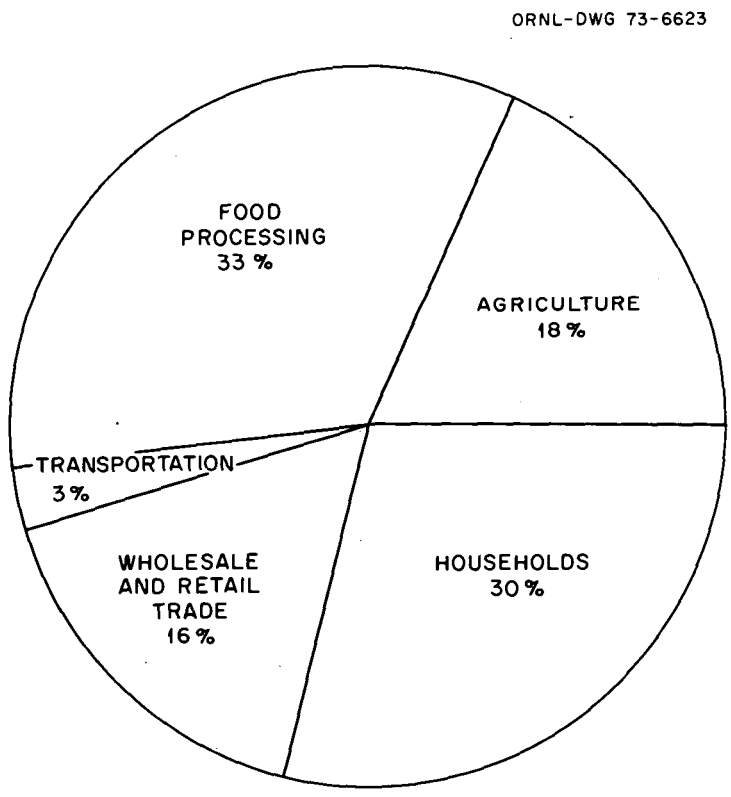

Fig. 2. Distribution of total energy requirements for personal consumption of food in the U.S., 1963. Total food-related energy use was 6,100 trillion Btu that year.

The electricity used for food (Table 3) was distributed in a quite different manner, with more than half the kWhr food budget devoted to residential use and only 30% used for farming and processing.

Figure 3 presents primary energy results for 1963 on a per capita basis to show how the 32 million Btu/person was built up in the various sectors. This figure also shows the flow of energy from farming through processing.

Temporal Changes

The bulk of this report deals with food-related energy use for the year 1963, because that is the most recent year for which complete data were available. To estimate changes in energy consumption patterns, one must know: (a) how food expenditures changed and (b) how energy coefficients changed. Answers to (a) are available in Department of Commerce[1] and Department of Agriculture[3] publications. Herendeen[5] suggests a simple, but approximate, method for scaling energy coefficients with time: the ratio of total national energy use to total GNP.

Table 4 and Figure 4 present food energy-use estimates* for 1960 to 1970. During this period, food-related energy use increased at an estimated annual rate of 3.3%, more than double the population growth rate. Increased per capita food energy use accounted for 60% of the decade's food energy growth, while population accounted for 40%. Growth in per

*These estimates may not adequately account for the energy impacts of the shift from trains to trucks for transport of agricultural inputs and food products and for changes in eating habits (particularly increased per capita meat and convenience-food consumption).

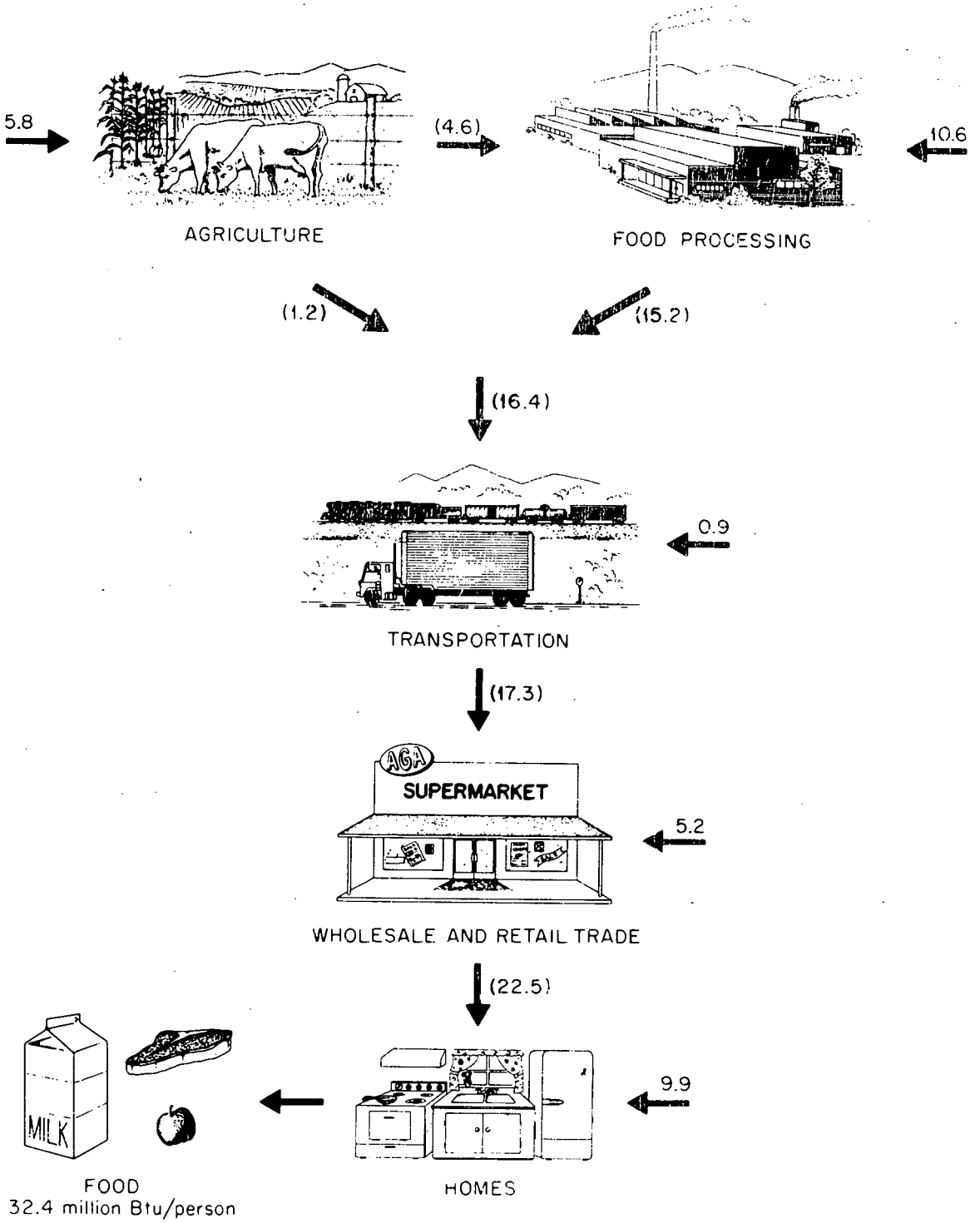

Fig. 3. Total annual per capita energy consumption for food in the U.S., 1963.

Table 4. Food-related energy-consumption estimates

	Primary energy use (trillion Btu)				Total per capita (million Btu)	Total as a % of U.S. energy use
	Food eaten-		Household use	Total		
	At home[a]	On site[b]				
1960	3350	800	1660	5810	32.3	13.0
1963	3340	910	1870	6120	32.4	12.4
1965	3590	870	2090	6550	33.9	12.3
1967	3660	960	2280	6900	34.9	11.8
1970	4190	1090	2730	8010	39.3	11.9
Average annual growth rate	2.3%	3.1%	5.1%	3.3%	2.0%	

[a]Food eaten at home includes "food purchased for off-premise consumption" and "food produced and consumed on farms."

[b]Food eaten on-site includes "purchased meals and beverages" and "food furnished government and commercial employees."

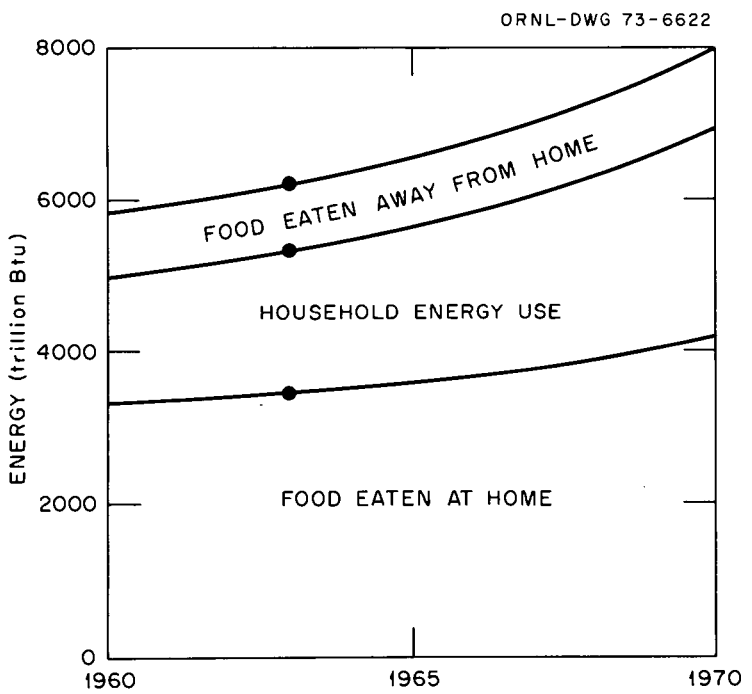

Fig. 4. Total energy requirements for farming, processing, transportation, delivery, and consumption of food in the U.S.

capita food energy use is due primarily to increased energy use for refrigerators, stoves, freezers, and automobiles. Changes in eating habits also contributed to energy growth.

Table 4 also shows that, while food energy use grew during the 1960's, the fraction of the total national energy budget devoted to food declined slightly from 13% to 12%.

Energy Costs of Major Food Groups

The energy required to produce and deliver various food types to PCE can be computed by matching energy flows through each Input/Output (I/O) sector (see the Appendix) with nutrient estimates* from the Department of Agriculture.[3] Figures 5 and 6 compare primary energy consumption for food with food energy content and food protein content.** The national averages for 1963 were 6.4 Btu of primary energy per Btu of food energy and 840 Btu of primary energy per gm of food protein. Thus the overall primary energy efficiency of the U.S. food system was 16%.

American agriculture required 0.011 Btu of human energy plus 1.14 Btu of primary energy per Btu of agricultural output. Primitive societies, which use no fuels, require about six times as much human energy per unit of farm output.[21] American farming achieves such a high labor productivity by substituting fuels for labor, at a rate of 21 units of primary energy per unit of human energy. (This comparison of farming methods ignores likely differences in diet and nutrition.)

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*This task is not trivial because I/O sectors and USDA food categories do not coincide exactly.

**Food energy and protein are not the only important nutrients; calcium, phosphorus, other minerals, carbohydrates, fats, and vitamins are also important.

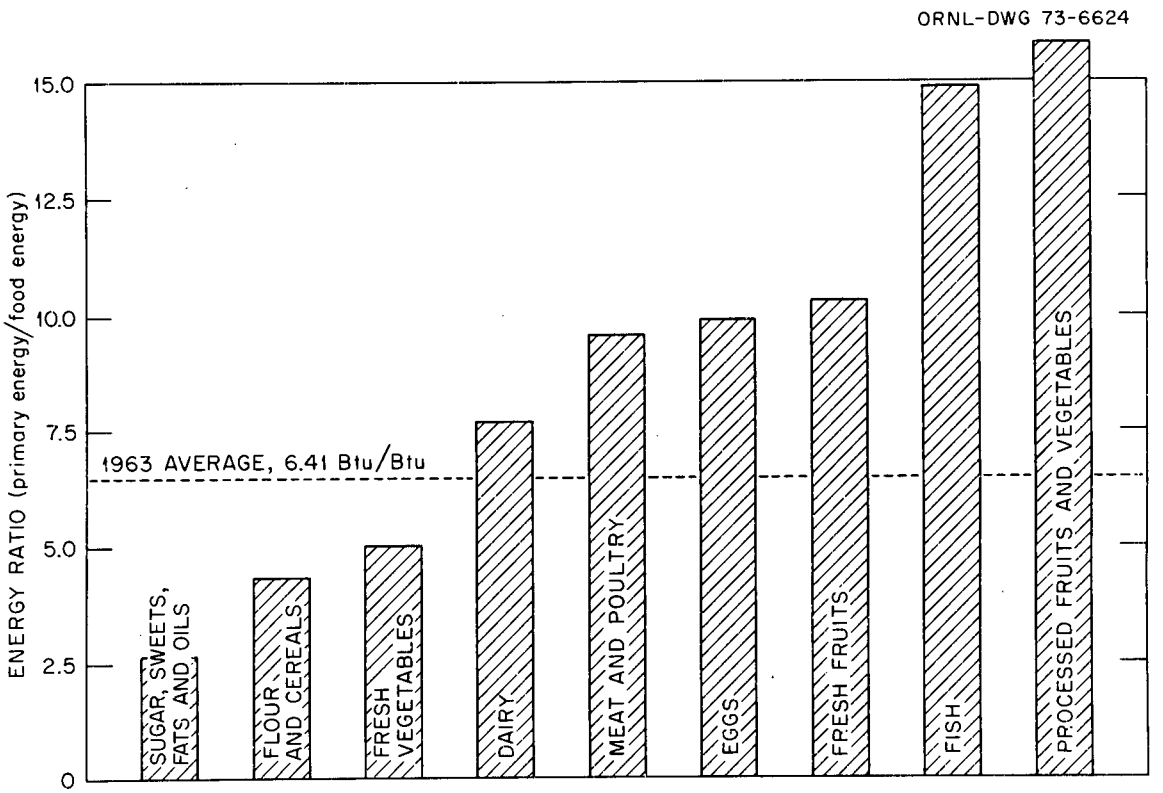

Fig. 5. Ratio of primary energy use to food energy content for major food groups, 1963.

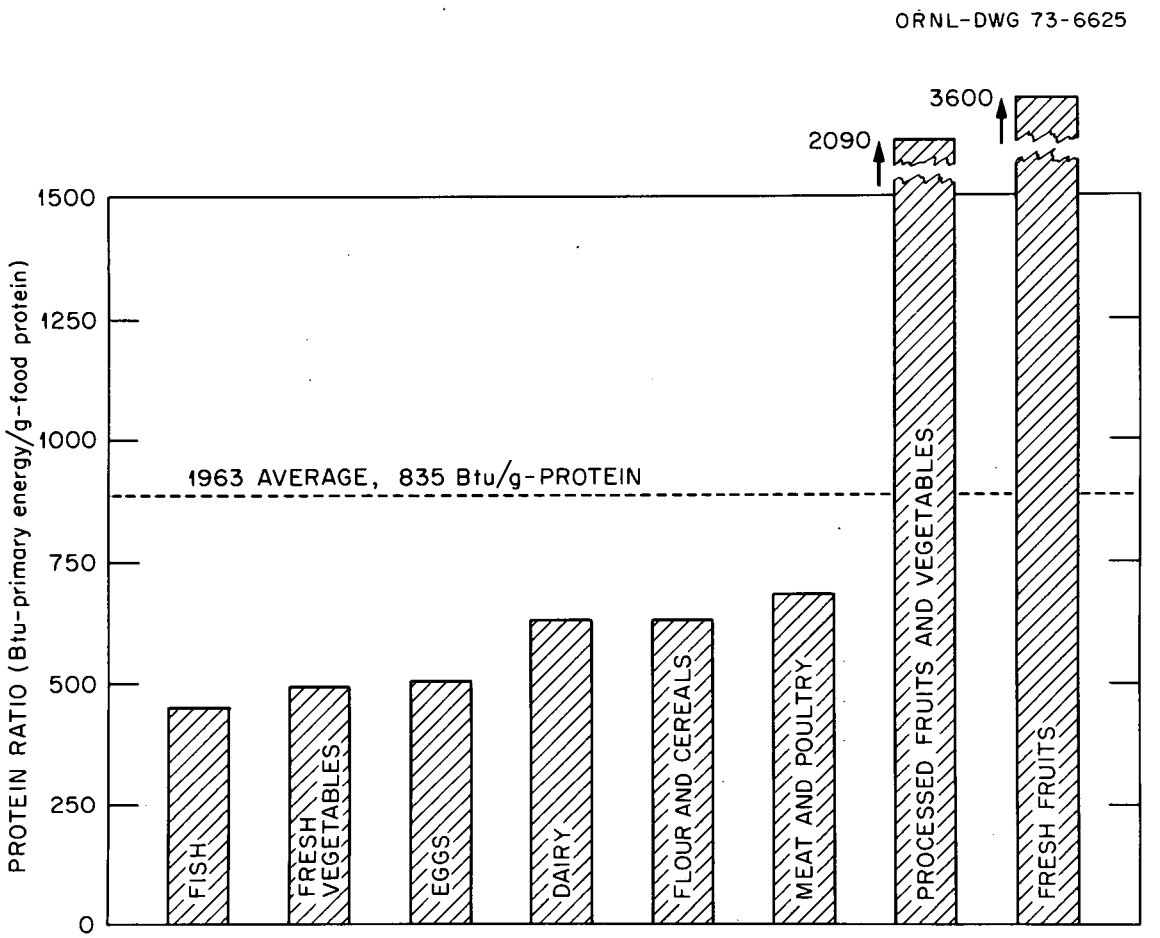

Fig. 6. Ratio of primary energy use to protein content for major food groups, 1963.

Figures 5 and 6 show the considerable variation in energy intensiveness among food groups. Processed fruits and vegetables are particularly energy-intensive with regard to both food energy and protein content. Flour and cereals, fresh vegetables, and dairy products, on the other hand, require relatively small energy inputs per unit of food nutrient. Also, fresh vegetables are a more energy-efficient source of protein than is meat.

Figure 7 shows how the total primary energy food budget for 1963 was distributed among the major food groups. The meat, poultry, and fish group is the largest energy consumer, followed by fruits and vegetables and dairy products.

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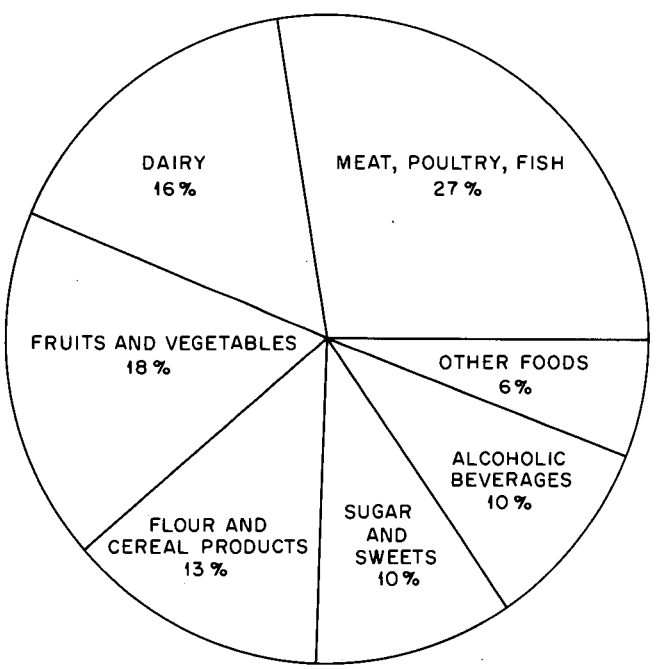

Fig. 7. Distribution of primary energy consumption for food by major food groups, 1963.

INDIVIDUAL ECONOMIC SECTORS

Agriculture

Agriculture is defined as "the production of crops or plants, vines and trees (excluding forestry operations); and the keeping, grazing, or feeding of livestock for the sale of animal products (including serums), for animal increase, or value increase."[6] The 1963 Input/Output tables[7,8] divide agriculture into two major divisions: Livestock and livestock products and Other agricultural products. There are ten agricultural sectors within these two divisions. (Appendix Table A.2 lists these I/O sectors and their energy coefficients.) Agricultural output includes food and non-food products such as feed grain, wool, cotton, tobacco, and seed.[9]

American farms are characterized by the use of large farm machines (tractors, combines, pickers) and use of fertilizers and other agricultural chemicals, with a resultant high labor productivity and high energy intensiveness.

Figure 8 shows the disposition of agricultural output[7] (both food and non-food) for 1963. Of the $54 billion gross output, 28% was consumed within the agricultural sectors themselves,* 42% was sold to food processors, 14% to other producers, and the remaining 16% to final demand. Final demand includes sales to consumers (PCE), exporters, and governments.

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*This includes consumption on farms, losses and waste, and sales from one subsector to another (e.g., corn sold to hog growers).

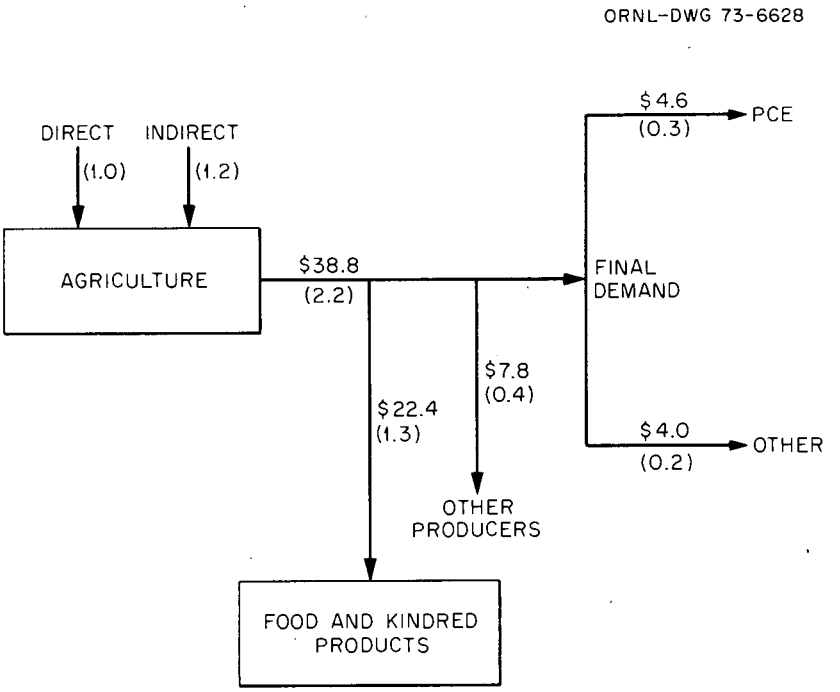

Fig. 8. Dollar and energy flows from agriculture in the U.S. for 1963. Dollar values in billions; energy values (in parentheses) in quadrillion Btu.

Figure 8 also shows, in parentheses, the primary energy flows corresponding to the dollar sales from agriculture. These energy flows are obtained by multiplying the dollar figures[7] by the appropriate energy coefficients.[5] The total energy consumed in producing this agricultural output was 2,190 trillion Btu, equal to 4.4% of the 1963 U.S. energy budget. Of the total agricultural energy, 44% was consumed directly on farms for operation of tractors, trucks, and other farm machinery and for irrigation, heating, ventilating, and crop conditioning. This value for direct energy use — 960 trillion Btu in 1963 — agrees well with the 1140 trillion Btu figure for 1966 estimated by the Farm Electrification Council.[11] The remaining 56% (indirect energy use) was consumed in other sectors to produce fertilizers and other agricultural chemicals, petroleum products, and other farm supplies.

The total electricity consumed in producing agricultural output was 36.3 billion kWhr, equal to 4.4% of total 1963 electricity use. Of this total agricultural use, 13.6 billion kWhr (37%) was consumed directly on farms for production purposes. This figure also agrees well with the 13.8 billion kWhr estimate for 1966 from ref. 11.

Table 5 shows how the total energy consumed in delivering agricultural output to final demand (FD) is built up from the energy consumed within the various producing sectors whose output is used, directly and indirectly, by agriculture. The percentage figures represent the ratios of: (a) direct energy use within each sector to produce that portion of the sector's output used by agriculture to (b) the total energy required to deliver agricultural output to FD.*

Table 5. Distribution of total energy consumption for delivery of agricultural output to final demand, 1963

I/O	Industry name	Percentage of total energy used directly by sector
1,2	Agriculture	50
14	Food processing	2
24	Paper	2
27	Chemicals	21
31	Petroleum refining	10
65	Transportation	6
69	Trade	2
	Other producers	7
	Total energy coefficient (Btu/$-final demand)	56,600

*For example, the chemicals industry produced $0.067 (54% of which was used directly by agriculture) for every $ of agricultural output delivered to FD. Multiplying the dollar flow by the direct energy coefficient — 178,000 Btu/$ — yields the total energy consumed directly by the chemical industry — 12,010 Btu — per $ of agricultural output to FD. Dividing by total agricultural energy use — 56,570 Btu/$-FD, yields the 21% figure in Table 5.

Direct energy use accounts for the largest fraction of agriculture's total energy use.* The chemicals industry is the largest indirect energy user, and petroleum refining is the second largest.

Table 6 presents the dollar,[4] primary energy, and electricity flows associated with that portion of agricultural output (including fish) delivered to PCE, either directly or indirectly via food processing.

About half the output is delivered to PCE. A total of 1,090 trillion Btu was consumed in 1963, directly and indirectly, by agriculture in providing food to PCE; this includes 19.7 billion kWhr. Considerably more energy (and electricity) was associated with meat than with plant products, although personal consumption of plant products is greater than consumption of meat on a weight basis.

About three-fourths of the appropriate totals (money, energy, electricity) flow through processing rather than directly to PCE, which suggests that most food receives some processing before delivery to final demand.

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*The fraction of total energy used directly in agriculture is higher in Table 5 (50%) than in Fig. 8 (44%). Table 5 refers only to sales to final demand, whereas Fig. 8 deals with sales both to other producers and to final demand. To deliver output to final demand, the producing sector must make enough output to satisfy: its own internal needs (self-use), the needs of other industries which provide input to the producing sector, and final demand. The second factor — output consumed by other industries to produce goods and services consumed by the sector in question — is not included in Fig. 8 but is included in Table 5. For example, to deliver $1 from agriculture to final demand requires a total agricultural production of $1.327. Of this, $0.282 is for self-use, $0.045 is for other producing sectors, and $1 is delivered to final demand.

Table 6. Flow of agricultural output for delivery of food to PCE, 1963

I/O	Industry name	Sales[a] (billion $)		Energy use[b] (trillion Btu)		Electricity use[b] (billion kWhr)	
		to processing	to PCE	to processing	to PCE	to processing	to PCE
101	Dairy-farm products	3.60	0.19	204	11	4.16	0.22
102	Poultry & eggs	1.50	1.46	112	110	1.79	1.75
103	Meat, animals & misc. products	8.31		428		7.75	
202	Food feed grains & grass seeds	0.78		54		0.71	
204	Fruits & tree nuts	0.63	0.92	25	35	0.52	0.75
205	Vegetables, sugar & misc. crops	0.64	1.55	26	63	0.49	1.18
206	Oil bearing crops	0.10	0.01	6	1	0.08	
300	Forestry & fishery products	0.25	0.37	7	11	0.13	0.20
	Totals	15.81	4.50	862	231	15.63	4.10

[a]Source: Ref. 4.

[b]Energy coefficients obtained from Ref. 5; see Appendix Table A.5 for details.

Food Processing

The Food and kindred products sector "manufactur[es] foods and beverages for human consumption, and certain related products, such as manufactured ice, chewing gum, vegetable and animal fats and oils, and prepared feeds for animals and fowls."[6] The I/O classification scheme subdivides this sector into 32 components;[8] see Appendix Table A.2 for a listing of these subsectors and their energy coefficients.

As indicated in Fig. 8 and Table 6, more than 75% of the food grown on farms is processed before shipment to final demand. The extent to which food is processed is related to the concentration of population in urban areas (and the concomitant remoteness from farms), family income (which is sufficient to allow the purchase of processed foods), and the value of convenience (the time saved by serving prepared foods).

Fig. 9 shows the disposition of food processing output for 1963.[7] Of the $74.3 billion gross output, 17% was consumed within the processing industry itself; 11% was sold to other producers, and the remaining 72% was delivered to final demand. Thus most of the processing output goes directly to consumers, rather than to other producers.

Figure 9 also shows, in parentheses, the primary energy flows corresponding to the dollar sales. The total energy consumed in producing processed food was 3,540 trillion Btu, equal to 7.2% of the 1963 U.S. energy budget. Of this total, 28% was consumed directly by food processors. About half of the indirect energy use flowed through the agricultural sectors as they delivered part of their output to processers (see Fig. 8).

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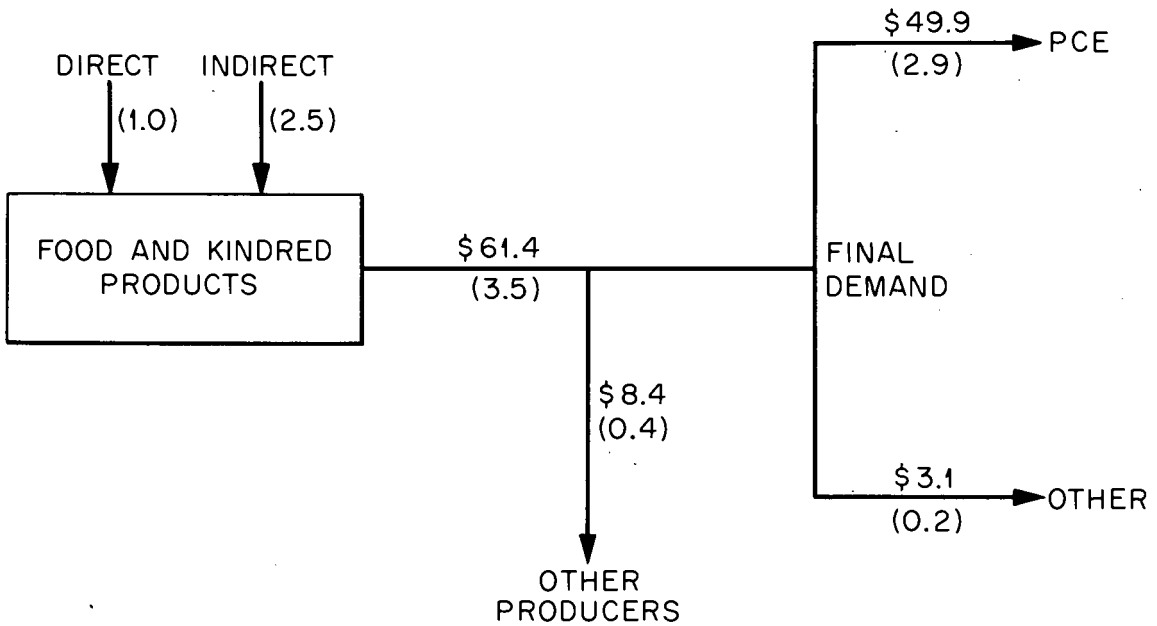

Fig. 9. Dollar and energy flows from food processing in the U.S. for 1963. Dollar values in billions; energy values (in parentheses) in quadrillion Btu.

The total electricity used to process food was 63.4 billion kWhr, equal to 7.6% of total 1963 electricity use, of which the processing sector directly consumed 18.1 billion kWhr (28%). Again, about half the indirect electricity use flowed through agriculture.

Table 7 shows how the total energy coefficient for food processing is built up from the energy used by various producers. The processing sector itself consumes 30% of the total energy associated with delivery

Table 7. Distribution of total energy consumption for delivery of food processing output to final demand, 1963

I/O	Industry name	Percent of total energy used directly by sector
1,2	Agriculture	16
14	Food processing	30
24	Paper	6
27	Chemicals	10
31	Petroleum refining	5
37	Iron & steel	6
65	Transportation	12
69	Trade	3
	Other producers	12
Total energy coefficient (Btu/$-final demand)		57,700

of processed food to final demand.* Agriculture directly consumes an additional 16% in producing that portion of its output which contributes to food processing,** transportation uses 12% and the chemicals industry 10%.

Table 8 presents the dollar,[4] primary energy, and electricity flows associated with that portion of processing production delivered to PCE. (about two-thirds of the gross output). A total of 2,870 trillion Btu

*The fraction of total energy used directly in processing is higher in Table 7 (30%) than in Fig. 9 (28%). See the footnote on page 17 for the explanation of this apparent discrepancy.

**Figures 8 and 9 suggest that 36% of the total energy consumed in processing is due to agriculture, while Table 7 states that only 16% is due to agriculture. The 16% value refers to the direct energy consumed within agriculture to produce that part of its output required, directly and indirectly, by processing. The 36% figure includes both the direct and indirect energy use on farms to produce the farm output which flows directly to processing. Once again, there is no discrepancy — only a matter of definition.

Table 8. Flow of food processing output to PCE, 1963

I/O	Industry name	Sales[a] (billion $)	Energy use[b] (trillion Btu)	Electricity use[b] (billion kWhr)
1401	Meat products	13.7	780	14.2
1402	Creamery butter	0.7	51	0.9
1403	Cheese, natural & processed	0.7	45	0.9
1404	Condensed & evaporated milk	0.4	36	0.6
1405	Ice cream & frozen desserts	1.2	69	1.7
1406	Fluid milk	5.2	313	6.5
1407	Canned & cured sea foods	0.3	14	0.3
1408	Canned specialties	0.9	66	1.0
1409	Canned fruits & vegetables	2.3	169	2.6
1410	Dehydrated food products	0.2	12	0.2
1411	Pickles, sauces & salad dressings	0.6	40	0.7
1412	Fresh or frozen packaged fish	0.3	14	0.3
1413	Frozen fruits & vegetables	1.4	94	2.3
1414	Flour & cereal preparations	1.2	79	1.5
1415	Prepared feeds for animals & fowls	0.5	37	0.7
1416	Rice milling	0.1	8	0.1
1417	Wet corn milling	0.02	2	0.01
1418	Bakery products	5.6	279	4.8
1419	Sugar	0.9	68	0.4
1420	Confectionery & related products	1.8	99	1.8
1421	Alcoholic beverages	5.5	238	3.7
1422	Bottled & canned soft drinks	2.0	112	1.9
1423	Flavoring extracts & sirups	0.2	12	0.2
1428	Roasted coffee	1.5	36	0.6
1429	Shortening & cooking oils	0.7	63	1.1
1431	Macaroni & spaghetti	0.2	11	0.2
1432	Other miscellaneous foods	1.7	102	1.7
Totals[c]		51.5	2,868	51.3

[a]Source: Ref. 4.

[b]Energy coefficients obtained from Ref. 5; see Appendix Tables A.3 and A.4 for details.

[c]Totals include small amounts of food from I/O sectors 1000, 2704, 6503, 6902, 7804, and 8001.

was consumed in 1963, directly and indirectly, by processors in providing food to PCE; this includes 51.3 billion kWhr. The major energy consumers were meat products, fluid milk, bakery products, and beverages.

Transportation

Food is transported from farms and processing plants to wholesalers by railroad, truck, waterway, and airplane. (Transportation of agricultural produce and other materials to processors and farms and from retail stores to homes is considered in Tables 5, 7, and 12 but not in this section.)

Table 9 lists dollar and energy statistics associated with the transportation of food to PCE. In 1963, transportation of food cost $2.0 billion, about 5% of the gross output from the transportation sector. The concomitant energy and electricity use figures were 170 trillion Btu* and 0.97 billion kWhr.

Table 9 also shows the propulsion energy intensiveness for these freight modes.[13] Trains and ships are relatively energy-efficient although slow, while trucks and airplanes are energy-intensive and fast.

Food processors shipped a total of 205 million tons[14] in 1963 (Table 10). Trucks accounted for just over half the weight shipped, while railroads accounted for slightly less than half. On a ton-mile basis, trains

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*Including the energy consumed in transporting materials to the agricultural and processing sectors and in transporting food from stores to homes by car would more than triple transportation energy use associated with delivery of food to PCE. This additional transportation energy is included in the energy figures for agriculture, processing, and households.

Table 9. Transportation of food to PCE, 1963

I/O	Industry name	Cost[a] (billion $)	Energy use[b] (trillion Btu)	Electricity use[b] (billion kWhr)	EI[c] (Btu/ton-mile)
6501	Railroads	0.75	59.9	0.400	750
6503	Motor freight	1.03	86.8	0.493	2,460
6504	Water	0.15	20.8	0.065	490
6505	Air	0.02	2.9	0.009	42,700
Totals		1.95	170.4	0.967	

[a]Source: Ref. 4.

[b]Energy coefficients obtained from Ref. 5; see Appendix Tables A.3 and A.4 for details.

[c]EI = energy intensiveness (propulsion only), from Ref. 13.

Table 10. Propulsion energy requirements for food transport, 1963

Mode	Tons shipped[a] (10^6)	Ton-miles shipped[a] (10^9)	Average haul length[a] (miles)	Propulsion energy use[b] (10^{12} Btu)
Railroads	93.7	50.6	540	38.0
Trucks	108.2	24.6	230	60.5
Boats	2.7	1.4	520	0.7
Totals	204.6	76.6	370	99.2

[a]Source: Ref. 14.

[b]Energy use for propulsion calculated using EI values from Table 9.

carried two-thirds of the total, while trucks carried one-third. The average shipping distance for food products was 370 miles, with trucks used primarily for short-haul transport, and trains used for long-distance traffic.

Table 10 also gives the energy consumed for propulsion of trucks, trains, and boats in food transportation. The propulsion requirement is almost 60% of the total transportation energy consumption.

Wholesale and Retail Trade

Wholesale trade involves "selling goods to trading establishments, or to industrial, commercial, institutional, and professional users."[6] Two of the nine wholesale sectors deal specifically with food: Groceries and related products and Farm products — raw materials. The wholesale trade portion of food delivery to PCE cost $7.5 billion in 1963,[4] 15% of the gross wholesale trade margin.[8]

Retail trade establishments primarily "sell merchandise to the general public for personal or household consumption."[6] Two of the eight retail sectors deal specifically with food: Food stores and Eating and drinking places. The retail trade margin associated with delivery of food to PCE[4] in 1963 was $22.4 billion, 31% of the gross retail trade margin.[8] Almost 80% of food sales was for off-premise consumption, the remaining 20% having been eaten in restaurants, cafeterias, etc.[3,15]

Table 11 presents the dollar,[4] primary energy, and electricity flows through the trade sectors associated with delivery of food to PCE in 1963. A total of 982 trillion Btu was consumed in selling food to PCE, 2% of the total energy budget. This includes 26 billion kWhr, 3% of total electricity

Table 11. Trade transactions in delivering food to PCE

I/O	Industry name	Cost[a] (billion $)	Energy use[b] (trillion Btu)	Electricity use[b] (billion kWhr)
6901	Wholesale trade	7.5	249	4.8
6902	Retail trade	22.4	733	21.2
	Totals	29.9	982	26.0

[a]Source: Ref. 4.

[b]Energy coefficients obtained from Ref. 5; see Appendix Tables A.3 and A.4 for details.

use that year. A comparison of Tables 6 and 11 yields the surprising result that food trade consumed almost as much energy as (and more electricity than) agriculture did in producing that food.

Households

The residential sector consumes energy in storing food (refrigerators and freezers), in preparing food (stoves), and in transporting food from stores to homes (autos). In addition, energy is consumed by producers in delivering fuels to homes and in manufacturing and selling household kitchen equipment.

In 1963, 390 trillion Btu of gas[16,17] plus 22 billion kWhr[16,18] were consumed in homes for cooking. Operation of refrigerators and freezers used 64 billion kWhr.[16,18] The overall energy efficiency[5] with which natural gas was delivered to final demand was 85.5%; the comparable efficiency for electricity was 25.8%. Thus total energy use associated with household cooking, refrigeration, and freezing was 1,600 trillion Btu in 1963; this includes 101 billion kWhr (Table 12).[5,12,16-19]

Table 12. Residential food-related functions, 1963

Function	Cost[a] (billion $)	Energy use[b] (trillion Btu)	Electricity use[b] (billion kWhr)
Cooking	0.97	752	26.3
Refrigeration, freezing	1.61	845	74.5
Manufacture and sale of kitchen appliances	2.00	128	3.6
Auto travel for food shopping	1.53	143	
Totals	6.11	1,868	104.4

[a]Source: fuel prices from Refs. 12 and 19; PCE expenditures for kitchen appliances from Ref. 4; auto costs from Ref. 13.

[b]Direct energy use for cooking, refrigeration, and freezing from Refs. 16-18; indirect energy use computed using coefficients in Ref. 5; automobile energy costs from Refs. 13 and 20.

In 1963, $2.0 billion of household stoves, refrigerators, and freezers were sold to PCE.[4] The total energy used to manufacture, transport, and sell these appliances[5] was 130 trillion Btu, including 3.6 billion kWhr of electricity.

About 2% of automobile mileage is devoted to food shopping.[15,20] Combining this information with data on urban auto fuel economy and total auto travel[13] yields an estimated 143 trillion Btu for food shopping by car in 1963.

Altogether, preparation and storage of food in homes and transportation of food to homes cost $6.1 billion and consumed 1,870 trillion Btu (including 104 billion kWhr) in 1963 (Table 12).* This energy figure is 50% greater than energy used in growing food on farms.

*Energy used in the manufacture and operation of other kitchen equipment (e.g., mixers, dishwashers, can openers, a fraction of water heaters) is ignored. Similarly, the energy associated with construction and space conditioning of kitchens and dining rooms is ignored.

CONCLUSIONS

This study used dollar and energy Input/Output data to determine the quantities of primary and electric energy consumed in the agricultural, processing, transportation, wholesale and retail trade, and household sectors for personal consumption of food.

Before drawing conclusions from these results, it is important to note the assumptions and approximations used in this analysis. First, the economic I/O data published by the Department of Commerce[4,7,8] is subject to a number of inaccuracies including lack of complete coverage for an industry, restriction of data for proprietary reasons, and use of different time periods for different data.

Second, aggregation can combine within the same sector industries whose energy intensities differ widely. For example, eating and drinking places probably consume more energy per dollar of sales (because of refrigerators, stoves, and freezers) than do department stores. However, both types of establishment are included in retail trade. Thus energy use for food-related retail trade may be underestimated because of aggregation.

Third, the energy coefficients are also subject to error. In particular, the coefficients for the agricultural and trade sectors are especially vulnerable because energy use within these sectors is not well documented.

Finally, the scaling factor used to estimate food-related energy use for the 1960's is approximate, in that it neglects the possibility that these energy coefficients changed differently with time. These limitations are described more fully in Ref. 5.

This analysis shows that the U.S. food cycle consumes considerable energy, about 12% of the total national energy budget. The residential sector, which accounts for 30% of the total, is the most energy-intensive in terms of energy consumed per dollar of food-related expenditure. This is because food-related expenditures in homes are primarily for fuel to operate kitchen appliances and automobiles. Transportation is the second most energy-intensive food-related sector, again because much of the cost is for fuel.

The electricity consumed in these activities is 22% of total kWhr consumption. More than half the electricity is used in homes, and more than two-thirds in the trade and household sectors. Thus agriculture and processing consume little electricity relative to the total.

From past trends, it appears that food-related energy use will continue to grow at a rate faster than population, principally because of growing affluence (i.e., use of processed foods, purchase of meals away from home, use of energy-intensive kitchen appliances).

Food energy efficiency could be increased in a number of ways. Use of more efficient kitchen appliances, such as smaller, better-insulated refrigerators, offers one possibility. Closer attention to energy use in retail trade (e.g., lighting, open freezers) would save energy. Increased use of unprocessed foods (e.g., fresh potatoes rather than frozen french fries) would save energy because it takes three times as much energy to deliver a physical unit of food from processing than from agriculture. However, because much processing is done for health reasons related to preservation, there are limits to such a shift. Finally, substituting vegetable protein for some animal protein would also save energy.

Thus there are a number of ways in which food-related energy growth could be slowed. Recent concerns with both high food prices and energy problems might serve to increase efficiency of food-related energy use.

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REFERENCES

1. Bureau of Economic Analysis, *Survey of Current Business*, July 1966, 1968, 1971, and 1972 issues, U.S. Dept. of Commerce.

2. U.S. Bureau of the Census, *Statistical Abstract of the United States: 1972*, 93rd edition, 1972.

3. Economic Research Service, *Food: Consumption, Prices, Expenditures*, AER Report 138, U.S. Dept. of Agriculture, 1968; also, Supplement to AER Report 138 for 1971, 1972.

4. Bureau of Economic Analysis, "Industrial Composition of Personal Consumption Expenditures, by PCE Category, in Producers' and Purchasers' Prices, 1963," U.S. Dept. of Commerce, 1971.

5. R. A. Herendeen, *The Energy Cost of Goods and Services*, Oak Ridge National Laboratory report in preparation; also, *An Energy Input-Output Matrix for the United States, 1963; User's Guide*, CAC No. 69, University of Illinois, March 4, 1973.

6. U.S. Bureau of the Budget, *Standard Industrial Classification Manual*, 1967.

7. U.S. Dept. of Commerce, "Input-Output Structure of the U.S. Economy: 1963," *Survey of Current Business* 49(11), November 1969.

8. Bureau of Economic Analysis, *Input-Output Structure of the U.S. Economy: 1963*, Vol 1, Transactions Data for Detailed Industries; Vol 2, Direct Requirements for Detailed Industries; Vol 3, Total Requirements for Detailed Industries, U.S. Dept. of Commerce, 1969.

9. Bureau of Economic Analysis, *Definitions and Conventions of the 1963 Input-Output Study*, U.S. Dept. of Commerce, April 1972.

10. W. Dupree, Jr. and J. West, *United States Energy Through the Year 2000*, U.S. Dept. of the Interior, December 1972.

11. Farm Electrification Council, *Energy Consumption on Farms in the United States*, 1966.

12. Edison Electric Institute, *Statistical Yearbook of the Electric Utility Industry for 1970*, No. 71-25, September 1971.

13. E. Hirst, *Energy Intensiveness of Passenger and Freight Transport Modes: 1950-1970*, Oak Ridge National Laboratory Report ORNL-NSF-EP-44, April 1973.

14. U.S. Bureau of the Census, *1963 Census of Transportation*, Vol. III, Commodity Transportation Survey, 1966.

15. U.S. Bureau of the Census, *Census of Business, 1967*, Vol. II, Retail Trade, 1970.

16. U.S. Bureau of the Census, *1970 Census of Housing*, Report HC(1)-B1, 1972. Also, *1960 Census of Housing*.

17. Stanford Research Institute, *Patterns of Energy Consumption in the United States*, prepared for the Office of Science and Technology, January 1972.

18. J. Tansil, *Residential Consumption of Electricity: 1950-1970*, Oak Ridge National Laboratory Report ORNL-NSF-EP-51, July 1973.

19. American Gas Association, *1971 Gas Facts*, 1971; also, American Petroleum Institute, *Petroleum Facts & Figures*, 1971.

20. Federal Highway Administration, *Nationwide Personal Transportation Study*, Report 7, U.S. Department of Transportation, December 1972.

21. R. A. Rappaport, "The Flow of Energy in an Agricultural Society," *Scientific American*, 225(3), September 1971.

APPENDIX

Detailed Tables

This Appendix presents tables which form the basis for results presented earlier. Table A.1, taken directly from Ref. 4, tabulates industrial composition of personal consumption expenditures (PCE) associated with food, by originating I/O sector. The first column lists I/O sectors from which food originates (generally an agricultural or a processing sector). The second column gives the value of output from that sector in producers' prices. The next four columns (third through sixth) give the transportation dollar margins associated with shipment of food from producers to the trade sectors. The seventh and eighth columns give the wholesale and retail trade margins. The last (ninth) column is the sum of the preceding seven columns, and equals the value of food delivered to PCE in purchasers' prices.

The numbers in the bottom line of each table give vertical sums within each table. Table A.1(e) is the sum of the preceding four tables; thus the numbers in the bottom line of Table A.1(e) give the overall dollar totals for food PCE in 1963.

Table A.2 presents primary and electric energy coefficients, obtained from Ref. 5. The direct coefficient is the energy (or electricity) consumed directly within each sector per dollar of output from that sector. The total coefficient is the energy (or electricity) consumed — directly and indirectly — in delivering a dollar's worth of output from that sector to final demand.

The numbers in Table A.3 are obtained by multiplying each dollar figure in the corresponding Table A.1 by the appropriate total energy coefficient in Table A.2. Thus Table A.3 gives the industrial composition of primary energy consumption associated with food PCE. The last column is the sum of the preceding seven columns and equals the total energy consumed in delivering food from the originating sector to PCE. The numbers in the bottom line of each table give vertical sums for each table. Table A.3(e) is the sum of the preceding four tables; thus the numbers in the bottom line of Table A.3(e) give overall energy totals associated with food PCE in 1963.

Table A.4 is the electricity consumption analog to Table A.3.

Table A.5 shows the flows of energy and electricity associated with output from agriculture. Values are given for total energy consumption within each sector for delivery of food to PCE (directly and via processing sectors), and for direct delivery to PCE. The total energy figures are defined as:

$$TE_i = \underbrace{T_i PCE_i}_{\text{(direct)}} + \underbrace{\sum_{j=1401}^{1432} A_{ij} [I - A]^{-1}_{jj} PCE_j T_i}_{\text{(through I/O 14)}}$$

where:

T_i = total energy (or electricity) coefficient for sector i, from Ref. 5.

PCE_i = \$ sales from sector i to PCE, from Ref. 4.

A_{ij} = \$ sales from i to j/total \$ output from j, from vol. II, Ref. 8.

$[I - A]^{-1}_{jj}$ = \$ self-sale of sector j/\$ sales to final demand from j, from vol. III, Ref. 8.

i = index of agricultural sectors, running from 101 to 300.

j = index of food processing sectors, running from 1401 to 1432.

Table A.1. Personal consumption expenditures for food in 1963

(a) Food purchased for off-premise consumption (million $)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	11.87	0.0	0.0	0.0	0.0	0.0	0.0	11.87
102	1195.72	1.11	63.19	0.0	0.0	102.73	155.93	1518.67
202	2.67	0.17	0.39	0.0	0.0	0.31	0.05	3.59
204	815.10	56.50	120.12	1.04	0.80	308.90	424.25	1726.72
205	936.33	108.08	156.36	0.05	0.0	230.93	754.70	2186.45
206	9.94	0.28	0.99	0.0	0.0	1.46	0.0	12.67
300	329.49	1.93	40.49	0.02	0.0	52.77	86.09	510.78
1000	1.95	0.36	0.11	0.06	0.0	0.06	0.0	2.54
1401	10805.56	86.79	123.29	3.48	0.47	798.67	3207.15	15025.41
1402	320.74	2.29	6.77	0.02	0.0	57.74	89.36	476.92
1403	552.78	3.09	3.62	0.09	0.0	85.80	133.84	779.22
1404	395.91	6.29	2.52	0.01	0.0	49.75	88.37	542.84
1405	943.80	0.11	0.11	0.0	0.0	110.06	374.84	1428.92
1406	4554.95	2.15	15.25	0.26	0.0	429.00	538.52	5540.13
1407	285.03	5.04	2.34	0.09	0.42	21.19	80.34	394.46
1408	879.64	6.19	12.83	0.14	0.0	86.73	185.05	1170.58
1409	2038.68	38.08	62.92	2.94	0.0	151.40	647.74	2941.76
1410	113.07	5.04	3.29	1.04	0.0	6.07	38.79	167.32
1411	446.96	4.11	11.17	0.02	0.0	43.10	170.04	675.40
1412	315.93	2.05	9.54	4.64	0.0	109.33	151.27	592.77
1413	1273.80	36.45	51.43	0.03	0.0	151.03	492.80	2005.53
1414	1074.26	28.53	4.45	0.24	0.0	97.46	223.02	1427.96
1415	509.05	6.98	1.58	0.06	0.0	22.35	116.80	656.82
1416	55.97	1.83	0.73	0.01	0.0	3.34	23.87	85.76
1417	15.38	1.22	0.14	0.01	0.0	0.75	3.52	21.03
1418	5077.81	14.85	4.12	0.14	0.0	617.42	867.64	6581.98
1419	764.64	18.54	8.05	2.49	0.0	22.52	142.33	958.58
1420	1581.69	16.33	42.54	0.28	1.14	182.77	696.80	2521.55
1421	3882.46	51.32	44.49	5.69	0.0	1221.81	1052.36	6258.13
1422	1518.15	0.66	1.34	0.13	0.0	132.26	327.41	1979.96
1423	44.41	0.25	3.76	0.34	0.00	2.03	65.18	115.97
1428	1195.52	0.0	0.0	0.0	0.0	69.00	248.39	1512.91
1429	543.97	4.41	9.96	0.09	0.0	71.56	133.71	763.69
1431	153.06	2.62	4.32	0.08	0.0	21.99	64.70	246.77
1432	1630.36	95.55	31.86	2.13	0.0	200.25	435.21	2395.37
2704	9.64	0.36	0.40	0.02	0.01	0.95	7.74	19.13
6503	24.54	0.0	0.0	0.0	0.0	0.0	0.0	24.54
7804	6.07	0.0	0.0	0.0	0.0	0.0	0.0	6.07
8001	1141.25	29.61	20.96	117.77	15.47	771.43	485.19	2581.68
Totals	45458.16	639.21	865.45	143.43	18.31	6234.93	12512.97	65872.44

Source: Ref. 4.

Table A.1. Personal consumption expenditures for food in 1963

(b) Purchased meals and beverages (million $)

I/O	Producer	Transportation				Ttade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
102	159.91	0.41	8.16	0.0	0.0	12.65	196.73	377.85
204	22.11	1.53	3.07	0.0	0.0	9.12	35.52	71.35
205	314.89	28.17	40.24	0.0	0.0	63.38	465.13	911.80
300	31.89	0.10	2.06	0.0	0.0	2.69	40.68	77.42
1401	2213.72	18.83	25.84	0.55	0.07	156.47	2579.75	4995.22
1402	300.79	1.97	5.84	0.01	0.0	49.79	393.98	752.39
1403	143.24	0.80	0.94	0.02	0.0	22.23	183.69	350.92
1404	35.61	0.57	0.23	0.0	0.0	4.47	44.99	85.87
1405	205.04	0.02	0.02	0.0	0.0	23.91	226.84	455.84
1406	521.78	0.20	1.43	0.02	0.0	40.15	463.43	1027.01
1407	39.72	0.70	0.33	0.01	0.06	2.95	40.16	83.94
1408	36.60	0.26	0.53	0.01	0.0	3.61	38.17	79.17
1409	255.99	4.78	7.90	0.37	0.0	19.01	236.72	524.77
1410	68.09	3.04	1.98	0.63	0.0	3.65	82.62	160.01
1411	78.83	0.72	1.97	0.00	0.0	7.60	88.78	177.91
1412	25.41	0.16	0.77	0.37	0.0	8.79	27.89	63.40
1413	83.03	2.38	3.35	0.00	0.0	9.84	105.65	204.26
1414	131.62	3.97	0.61	0.06	0.0	11.20	161.36	308.83
1416	63.66	2.09	0.83	0.01	0.0	3.80	77.25	147.65
1418	326.92	0.84	0.23	0.01	0.0	38.63	348.17	714.81
1419	72.93	1.50	0.66	0.17	0.0	1.91	75.19	152.36
1420	120.36	1.17	3.00	0.02	0.11	14.38	150.06	289.10
1421	1634.16	19.03	16.82	1.79	0.0	536.35	2475.71	4683.85
1422	486.86	0.21	0.43	0.04	0.0	42.41	588.85	1118.80
1423	180.64	1.01	15.29	1.36	0.02	8.25	225.36	431.93
1428	229.34	0.0	0.0	0.0	0.0	13.23	267.14	509.71
1429	106.08	0.86	1.94	0.02	0.0	13.95	134.27	257.12
1431	28.67	0.49	0.81	0.01	0.0	4.12	33.80	67.92
1432	78.38	4.59	1.53	0.10	0.0	9.63	97.15	191.39
2704	3.96	0.17	0.20	0.01	0.01	0.45	4.83	9.64
6902	399.50	0.0	0.0	0.0	0.0	0.0	0.0	399.50
Totals	8399.72	100.59	147.02	5.60	0.27	1138.64	9889.93	19681.77

Source: Ref. 4.

Table A.1. Personal consumption expenditures for food in 1963

(c) Food furnished government and commercial employees (million $)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
102	26.91	0.07	1.37	0.0	0.0	2.13	0.0	30.48
204	12.81	0.89	1.78	0.0	0.0	5.28	0.0	20.75
205	26.98	2.41	3.45	0.0	0.0	5.43	0.0	38.27
300	12.38	0.04	0.80	0.0	0.0	1.04	0.0	14.27
1401	372.59	3.07	4.37	0.10	0.01	26.52	0.0	406.67
1402	8.15	0.05	0.16	0.0	0.0	1.35	0.0	9.73
1403	26.11	0.15	0.17	0.00	0.0	4.05	0.0	30.48
1404	2.82	0.04	0.02	0.0	0.0	0.35	0.0	3.24
1405	19.75	0.00	0.00	0.0	0.0	2.30	0.0	22.05
1406	128.53	0.05	0.35	0.00	0.0	9.89	0.0	138.80
1407	16.48	0.29	0.14	0.00	0.02	1.22	0.0	18.16
1408	7.53	0.05	0.11	0.00	0.0	0.74	0.0	8.43
1409	43.81	0.82	1.35	0.06	0.0	3.25	0.0	49.29
1410	8.56	0.38	0.25	0.08	0.0	0.46	0.0	9.73
1411	25.24	0.23	0.63	0.00	0.0	2.43	0.0	28.54
1412	5.11	0.03	0.15	0.07	0.0	1.77	0.0	7.13
1413	10.92	0.31	0.44	0.0	0.0	1.29	0.0	12.97
1414	27.75	0.89	0.12	0.01	0.0	2.35	0.0	31.13
1416	2.35	0.08	0.03	0.0	0.0	0.14	0.0	2.59
1418	148.80	0.81	0.22	0.01	0.0	21.39	0.0	171.23
1419	12.87	0.26	0.12	0.03	0.0	0.34	0.0	13.62
1420	93.20	0.90	2.32	0.02	0.09	11.13	0.0	107.67
1422	17.28	0.01	0.01	0.00	0.0	1.50	0.0	18.81
1423	6.24	0.03	0.53	0.05	0.00	0.28	0.0	7.13
1428	49.06	0.0	0.0	0.0	0.0	2.83	0.0	51.89
1429	16.24	0.13	0.30	0.00	0.0	2.14	0.0	18.81
1431	6.00	0.10	0.17	0.00	0.0	0.86	0.0	7.13
1432	27.51	1.61	0.54	0.04	0.3	3.38	0.0	33.08
2704	1.07	0.05	0.05	0.00	0.00	0.12	0.0	1.30
8001	36.60	0.0	0.0	0.0	0.0	0.0	0.0	36.60
Totals	1199.64	13.78	19.96	0.49	0.13	116.00	0.0	1350.00

Source: Ref. 4.

Table A.1. Personal consumption expenditures for food in 1963

(d) Food produced and consumed on farms (million $)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	177.65	0.0	0.0	0.0	0.0	0.0	0.0	177.65
102	77.46	0.0	0.0	0.0	0.0	0.0	0.0	77.46
204	67.64	0.0	0.0	0.0	0.0	0.0	0.0	67.64
205	270.95	0.0	0.0	0.0	0.0	0.0	0.0	270.95
206	0.62	0.0	0.0	0.0	0.0	0.0	0.0	0.62
1401	329.13	0.0	0.0	0.0	0.0	0.0	0.0	329.13
1402	29.79	0.0	0.0	0.0	0.0	0.0	0.0	29.79
1419	0.44	0.0	0.0	0.0	0.0	0.0	0.0	0.44
Totals	953.68	0.0	0.0	0.0	0.0	0.0	0.0	953.68

Source: Ref. 4.

Table A.1. Personal consumption expenditures for food in 1963

(e) Sum of preceding four tables (million $)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	189.52	0.0	0.0	0.0	0.0	0.0	0.0	189.52
102	1460.00	1.58	72.72	0.0	0.0	117.50	352.67	2004.48
202	2.67	0.17	0.39	0.0	0.0	0.31	0.05	3.59
204	917.65	58.92	124.96	1.04	0.80	323.30	459.78	1886.46
205	1549.14	138.66	200.05	0.05	0.0	299.74	1219.83	3407.46
206	10.56	0.28	0.99	0.0	0.0	1.46	0.0	13.29
300	373.76	2.07	43.35	0.02	0.0	56.50	126.77	602.46
1000	1.95	0.36	0.11	0.06	0.0	0.06	0.0	2.54
1401	13721.00	108.69	153.50	4.12	0.55	981.66	5786.90	20756.42
1402	659.49	4.32	12.77	0.03	0.0	108.88	483.35	1268.84
1403	722.13	4.03	4.73	0.12	0.0	112.09	317.52	1160.62
1404	434.34	6.90	2.76	0.01	0.0	54.57	133.36	631.95
1405	1168.59	0.14	0.13	0.0	0.0	136.27	601.68	1906.81
1406	5205.23	2.41	17.03	0.29	0.0	479.04	1001.95	6705.93
1407	341.23	6.04	2.81	0.11	0.51	25.37	120.51	496.57
1408	923.77	6.50	13.47	0.15	0.0	91.08	223.22	1258.19
1409	2338.48	43.68	72.17	3.37	0.0	173.66	884.47	3515.83
1410	189.72	8.46	5.53	1.75	0.0	10.18	121.41	337.06
1411	551.03	5.07	13.77	0.03	0.0	53.14	258.82	881.85
1412	346.44	2.25	10.46	5.09	0.0	119.89	179.16	663.30
1413	1367.76	39.14	55.22	0.03	0.0	162.17	598.45	2222.76
1414	1233.63	33.39	5.19	0.31	0.0	111.01	384.38	1767.92
1415	509.05	6.98	1.58	0.06	0.0	22.35	116.80	656.82
1416	121.97	4.00	1.60	0.03	0.0	7.28	101.12	236.01
1417	15.38	1.22	0.14	0.01	0.0	0.75	3.52	21.03
1418	5553.54	16.50	4.57	0.15	0.0	677.44	1215.81	7468.02
1419	850.89	20.30	8.83	2.69	0.0	24.77	217.52	1125.00
1420	1795.24	18.41	47.86	0.32	1.34	208.29	846.86	2918.32
1421	5516.62	70.35	61.30	7.48	0.0	1758.15	3528.07	10941.97
1422	2022.29	0.88	1.79	0.18	0.0	176.18	916.26	3117.57
1423	231.29	1.30	19.58	1.74	0.02	10.57	290.53	555.03
1428	1473.92	0.0	0.0	0.0	0.0	85.07	515.53	2074.51
1429	666.29	5.40	12.19	0.11	0.0	87.65	267.99	1039.62
1431	187.73	3.22	5.30	0.09	0.0	26.98	98.50	321.82
1432	1736.25	101.76	33.93	2.27	0.0	213.25	532.36	2619.84
2704	14.68	0.58	0.66	0.03	0.02	1.53	12.57	30.07
6503	24.54	0.0	0.0	0.0	0.0	0.0	0.0	24.54
6902	399.50	0.0	0.0	0.0	0.0	0.0	0.0	399.50
7804	6.07	0.0	0.0	0.0	0.0	0.0	0.0	6.07
8001	1177.85	29.61	20.96	117.77	15.47	771.43	485.19	2618.28
Totals	56011.19	753.58	1032.44	149.53	18.71	7489.57	22402.90	87857.75

Source: Ref. 4.

Table A.2. Primary and electric energy coefficients

I/O	Industry name	Energy coefficients (Btu/$) Direct	Energy coefficients (Btu/$) Total	Electricity coefficients (kWhr/$) Direct	Electricity coefficients (kWhr/$) Total
101	DAIRY FARM PRODUCTS	10360.	56600.	0.443	1.154
102	POULTRY & EGGS	18970.	75170.	0.245	1.195
103	MEAT, ANIMALS & MISC. PRODUCTS	5480.	51520.	0.196	0.932
201	COTTON	25130.	60640.	0.595	1.336
202	FOOD FEED GRAINS & GRASS SEEDS	31560.	69120.	0.165	0.911
203	TOBACCO	26160.	52100.	0.272	0.788
204	FRUITS & TREE NUTS	13850.	38680.	0.303	0.815
205	VEGETABLES, SUGAR & MISC. CROPS	15020.	40570.	0.227	0.759
206	OIL BEARING CROPS	31700.	63120.	0.266	0.844
207	FOREST, GREENHOUSE, NURSERY PRODUCTS	28960.	45630.	0.155	0.431
300	FORESTRY & FISHERY PRODUCTS	1590.	29400.	0.004	0.530
400	AGRICULTURAL, FORESTRY & FISHERY SERVICES	4510.	49450.	0.019	0.768
1000	CHEMICAL & FERTILIZER MINERAL MINING	149050.	188160.	2.386	3.059
1401	MEAT PRODUCTS	6180.	56860.	0.147	1.034
1402	CREAMERY BUTTER	13860.	77260.	0.220	1.362
1403	CHEESE, NATURAL & PROCESSED	10630.	62280.	0.209	1.298
1404	CONDENSED & EVAPORATED MILK	25510.	82950.	0.231	1.310
1405	ICE CREAM & FROZEN DESSERTS	11090.	59190.	0.542	1.439
1406	FLUID MILK	11760.	60070.	0.289	1.245
1407	CANNED & CURED SEA FOODS	2660.	42440.	0.113	0.762
1408	CANNED SPECIALTIES	17090.	71020.	0.159	1.058
1409	CANNED FRUITS & VEGETABLES	13520.	72250.	0.171	1.102
1410	DEHYDRATED FOOD PRODUCTS	17150.	63490.	0.250	1.102
1411	PICKLES, SAUCES & SALAD DRESSINGS	4900.	73110.	0.168	1.321
1412	FRESH OR FROZEN PACKAGED FISH	3400.	40420.	0.221	0.864
1413	FROZEN FRUITS & VEGETABLES	16430.	68690.	0.482	1.702
1414	FLOUR & CEREAL PREPARATIONS	3040.	64170.	0.387	1.207
1415	PREPARED FEEDS FOR ANIMALS & FOWLS	8080.	72730.	0.244	1.354
1416	RICE MILLING	4880.	64410.	0.192	1.040
1417	WET CORN MILLING	77290.	122450.	0.284	0.856
1418	BAKERY PRODUCTS	11840.	50190.	0.196	0.870
1419	SUGAR	41010.	79450.	0.080	0.437
1420	CONFECTIONERY & RELATED PRODUCTS	9540.	54910.	0.289	0.976
1421	ALCOHOLIC BEVERAGES	12730.	43090.	0.156	0.680
1422	BOTTLED & CANNED SOFT DRINKS	7740.	55150.	0.175	0.935
1423	FLAVORING EXTRACTS & SIRUPS, NEC	3780.	52860.	0.065	0.794
1424	COTTENSEED OIL MILLS	23480.	89410.	1.265	2.722
1425	SOYBEAN OIL MILLS	20840.	83090.	0.403	1.277
1426	VEGETABLE OIL MILLS, NEC	13020.	57100.	0.472	1.154
1427	ANIMAL & MARINE FATS & OILS	43140.	102220.	0.443	1.357
1428	ROASTED COFFEE	3320.	24340.	0.097	0.437
1429	SHORTENING & COOKING OILS	24170.	94210.	0.297	1.623
1430	MANUFACTURED ICE	62620.	94510.	5.402	6.443
1431	MACARONI & SPAGHETTI	9630.	60170.	0.365	1.301
1432	FOOD PREPARATIONS, NEC	11660.	58700.	0.184	0.987
2704	MISCELLANEOUS CHEMICAL PRODUCTS	182430.	285800.	0.530	2.901
6501	RAILROADS & RELATED SERVICES	53530.	79520.	0.182	0.530
6502	LOCAL, SUBURBAN & INTERURBAN HIGHWAY PASSENGER TRANS	56530.	87740.	0.187	1.283
6503	MOTOR FREIGHT TRANSPORTATION & WAREHOUSING	64260.	84040.	0.151	0.478
6504	WATER TRANSPORTATION	117390.	138870.	0.105	0.437
6505	AIR TRANSPORTATION	130700.	152370.	0.071	0.486
6506	PIPE LINE TRANSPORTATION	484440.	488020.	1.064	1.386
6507	TRANSPORTATION SERVICES	30700.	37830.	0.460	0.709
6901	WHOLESALE TRADE	14680.	33260.	0.267	0.639
6902	RETAIL TRADE	21790.	32720.	0.647	0.946
7804	OTHER FEDERAL GOVT. ENTERPRISES	14630.	23280.	0.432	0.650
8001	DIRECTLY ALLOCATED IMPORTS	0.	0.	0.0	0.0

Source: Ref. 5.

Table A.3. Primary energy use for personal consumption of food in 1963

(a) Food purchased for off-premise consumption (trillion Btu)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	0.67	0.0	0.0	0.0	0.0	0.0	0.0	0.67
102	89.88	0.09	5.31	0.0	0.0	3.42	5.10	103.80
202	0.18	0.01	0.03	0.0	0.0	0.01	0.00	0.24
204	31.53	4.49	10.10	0.15	0.12	10.27	13.88	70.54
205	37.99	8.59	13.14	0.01	0.0	7.68	24.69	92.10
206	0.63	0.02	0.08	0.0	0.0	0.05	0.0	0.78
300	9.69	0.15	3.40	0.00	0.0	1.75	2.82	17.82
1000	0.37	0.03	0.01	0.01	0.0	0.00	0.0	0.41
1401	614.40	6.90	10.36	0.48	0.07	26.56	104.94	763.72
1402	24.78	0.18	0.57	0.00	0.0	1.92	2.92	30.38
1403	34.43	0.25	0.30	0.01	0.0	2.85	4.38	42.22
1404	32.84	0.50	0.21	0.00	0.0	1.65	2.89	38.10
1405	55.86	0.01	0.01	0.0	0.0	3.66	12.26	71.81
1406	273.62	0.17	1.28	0.04	0.0	14.27	17.62	306.99
1407	12.10	0.40	0.20	0.01	0.06	0.70	2.63	16.11
1408	62.47	0.49	1.08	0.02	0.0	2.88	6.05	73.00
1409	147.29	3.03	5.29	0.41	0.0	5.04	21.19	182.25
1410	7.18	0.40	0.28	0.15	0.0	0.20	1.27	9.47
1411	32.68	0.33	0.94	0.00	0.0	1.43	5.56	40.94
1412	12.77	0.16	0.80	0.65	0.0	3.64	4.95	22.97
1413	87.50	2.90	4.32	0.00	0.0	5.02	16.12	115.87
1414	68.93	2.27	0.37	0.03	0.0	3.24	7.30	82.15
1415	37.02	0.56	0.13	0.01	0.0	0.74	3.82	42.28
1416	3.60	0.15	0.06	0.00	0.0	0.11	0.78	4.71
1417	1.88	0.10	0.01	0.00	0.0	0.03	0.12	2.13
1418	254.86	1.18	0.35	0.02	0.0	20.54	28.39	305.33
1419	60.75	1.47	0.68	0.35	0.0	0.75	4.66	68.65
1420	86.85	1.30	3.57	0.04	0.17	6.08	22.80	120.81
1421	167.30	4.08	3.74	0.79	0.0	40.64	34.43	250.98
1422	83.73	0.05	0.11	0.02	0.0	4.40	10.71	99.02
1423	2.35	0.02	0.32	0.05	0.00	0.07	2.13	4.93
1428	29.10	0.0	0.0	0.0	0.0	2.30	8.13	39.52
1429	51.25	0.35	0.84	0.01	0.0	2.38	4.38	59.20
1431	9.21	0.21	0.36	0.01	0.0	0.73	2.12	12.64
1432	95.70	7.60	2.68	0.30	0.0	6.66	14.24	127.18
2704	2.76	0.03	0.03	0.00	0.00	0.03	0.25	3.11
6503	2.06	0.0	0.0	0.0	0.0	0.0	0.0	2.06
7804	0.14	0.0	0.0	0.0	0.0	0.0	0.0	0.14
8001	0.0	2.35	1.76	16.35	2.36	25.66	15.88	64.36
Totals	2526.34	50.83	72.73	19.92	2.79	207.37	409.42	3289.41

Table A.3. Primary energy use for personal consumption of food in 1963

(b) Purchased meals and beverages (trillion Btu)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
102	12.02	0.03	0.69	0.0	0.0	0.42	6.44	19.60
204	0.86	0.12	0.26	0.0	0.0	0.30	1.16	2.70
205	12.77	2.24	3.38	0.0	0.0	2.11	15.22	35.72
300	0.94	0.01	0.17	0.0	0.0	0.09	1.33	2.54
1401	125.87	1.50	2.17	0.08	0.01	5.20	84.41	219.24
1402	23.24	0.16	0.49	0.00	0.0	1.66	12.89	38.44
1403	8.92	0.06	0.08	0.00	0.0	0.74	6.01	15.82
1404	2.95	0.05	0.02	0.0	0.0	0.15	1.47	4.64
1405	12.14	0.00	0.00	0.0	0.0	0.80	7.42	20.36
1406	31.34	0.02	0.12	0.00	0.0	1.34	15.16	47.98
1407	1.69	0.06	0.03	0.00	0.01	0.10	1.31	3.19
1408	2.60	0.02	0.04	0.00	0.0	0.12	1.25	4.03
1409	18.49	0.38	0.66	0.05	0.0	0.63	7.75	27.97
1410	4.32	0.24	0.17	0.09	0.0	0.12	2.70	7.64
1411	5.76	0.06	0.17	0.00	0.0	0.25	2.90	9.14
1412	1.03	0.01	0.06	0.05	0.0	0.29	0.91	2.36
1413	5.70	0.19	0.28	0.00	0.0	0.33	3.46	9.96
1414	8.45	0.32	0.05	0.01	0.0	0.37	5.28	14.47
1416	4.10	0.17	0.07	0.00	0.0	0.13	2.53	6.99
1418	16.41	0.07	0.02	0.00	0.0	1.28	11.39	29.17
1419	5.79	0.12	0.06	0.02	0.0	0.06	2.46	8.52
1420	6.61	0.09	0.25	0.00	0.02	0.48	4.91	12.36
1421	70.42	1.51	1.41	0.25	0.0	17.84	81.01	172.43
1422	26.85	0.02	0.04	0.01	0.0	1.41	19.27	47.59
1423	9.55	0.08	1.29	0.19	0.00	0.27	7.37	18.75
1428	5.58	0.0	0.0	0.0	0.0	0.44	8.74	14.76
1429	9.99	0.07	0.16	0.00	0.0	0.46	4.39	15.08
1431	1.73	0.04	0.07	0.00	0.0	0.14	1.11	3.08
1432	4.60	0.37	0.13	0.01	0.0	0.32	3.18	8.61
2704	1.13	0.01	0.02	0.00	0.00	0.02	0.16	1.34
6902	13.07	0.0	0.0	0.0	0.0	0.0	0.0	13.07
Totals	454.93	8.00	12.36	0.78	0.04	37.87	323.60	837.57

Table A.3. Primary energy use for personal consumption of food in 1963

(c) Food furnished government and commercial employees (trillion Btu)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
102	2.02	0.01	0.12	0.0	0.0	0.07	0.0	2.21
204	0.50	0.07	0.15	0.0	0.0	0.18	0.0	0.89
205	1.09	0.19	0.29	0.0	0.0	0.18	0.0	1.76
300	0.36	0.00	0.07	0.0	0.0	0.03	0.0	0.47
1401	21.19	0.24	0.37	0.01	0.00	0.86	0.0	22.69
1402	0.63	0.00	0.01	0.0	0.0	0.04	0.0	0.69
1403	1.63	0.01	0.01	0.00	0.0	0.13	0.0	1.79
1404	0.23	0.00	0.00	0.0	0.0	0.01	0.0	0.25
1405	1.17	0.00	0.00	0.0	0.0	0.08	0.0	1.25
1406	7.72	0.00	0.03	0.00	0.0	0.33	0.0	8.08
1407	0.70	0.02	0.01	0.00	0.00	0.04	0.0	0.78
1408	0.53	0.00	0.01	0.00	0.0	0.02	0.0	0.57
1409	3.17	0.07	0.11	0.01	0.0	0.11	0.0	3.46
1410	0.54	0.03	0.02	0.01	0.0	0.02	0.0	0.62
1411	1.85	0.02	0.05	0.00	0.0	0.08	0.0	2.00
1412	0.21	0.00	0.01	0.01	0.0	0.06	0.0	0.29
1413	0.75	0.02	0.04	0.0	0.0	0.04	0.0	0.86
1414	1.78	0.07	0.01	0.00	0.0	0.08	0.0	1.94
1416	0.15	0.01	0.00	0.0	0.0	0.00	0.0	0.16
1418	7.47	0.06	0.02	0.00	0.0	0.71	0.0	8.26
1419	1.02	0.02	0.01	0.00	0.0	0.01	0.0	1.07
1420	5.12	0.07	0.20	0.00	0.01	0.37	0.0	5.77
1422	0.95	0.00	0.00	0.00	0.0	0.05	0.0	1.01
1423	0.33	0.00	0.04	0.01	0.00	0.01	0.0	0.39
1428	1.19	0.0	0.0	0.0	0.0	0.09	0.0	1.29
1429	1.53	0.01	0.02	0.00	0.0	0.07	0.0	1.64
1431	0.36	0.01	0.01	0.00	0.0	0.03	0.0	0.41
1432	1.61	0.13	0.05	0.00	0.0	0.11	0.0	1.91
2704	0.31	0.00	0.00	0.00	0.00	0.00	0.0	0.32
8001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	66.12	1.10	1.68	0.07	0.02	3.86	0.0	72.83

Table A.3. Primary energy use for personal consumption of food in 1963

(d) Food produced and consumed on farms (trillion Btu)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	10.06	0.0	0.0	0.0	0.0	0.0	0.0	10.06
102	5.82	0.0	0.0	0.0	0.0	0.0	0.0	5.82
204	2.62	0.0	0.0	0.0	0.0	0.0	0.0	2.62
205	10.99	0.0	0.0	0.0	0.0	0.0	0.0	10.99
206	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.04
1401	18.71	0.0	0.0	0.0	0.0	0.0	0.0	18.71
1402	2.30	0.0	0.0	0.0	0.0	0.0	0.0	2.30
1419	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.03
Totals	50.58	0.0	0.0	0.0	0.0	0.0	0.0	50.58

Table A.3. Primary energy use for personal consumption of food in 1963

(e) Sum of preceding four tables (trillion Btu)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	10.73	0.0	0.0	0.0	0.0	0.0	0.0	10.73
102	109.75	0.13	6.11	0.0	0.0	3.91	11.54	131.43
202	0.18	0.01	0.03	0.0	0.0	0.01	0.00	0.24
204	35.49	4.69	10.50	0.15	0.12	10.75	15.04	76.75
205	62.85	11.03	16.81	0.01	0.0	9.97	39.91	140.58
206	0.67	0.02	0.08	0.0	0.0	0.05	0.0	0.82
300	10.99	0.16	3.64	0.00	0.0	1.88	4.15	20.83
1000	0.37	0.03	0.01	0.01	0.0	0.00	0.0	0.41
1401	780.18	8.64	12.90	0.57	0.08	32.65	189.35	1024.37
1402	50.95	0.34	1.07	0.00	0.0	3.62	15.82	71.81
1403	44.97	0.32	0.40	0.02	0.0	3.73	10.39	59.83
1404	36.03	0.55	0.23	0.00	0.0	1.82	4.36	42.99
1405	69.17	0.01	0.01	0.0	0.0	4.53	19.69	93.41
1406	312.68	0.19	1.43	0.04	0.0	15.93	32.78	363.06
1407	14.48	0.48	0.24	0.01	0.08	0.84	3.94	20.08
1408	65.61	0.52	1.13	0.02	0.0	3.03	7.30	77.61
1409	168.95	3.47	6.07	0.47	0.0	5.78	28.94	213.68
1410	12.05	0.67	0.46	0.24	0.0	0.34	3.97	17.74
1411	40.29	0.40	1.16	0.00	0.0	1.77	8.47	52.09
1412	14.00	0.18	0.88	0.71	0.0	3.99	5.86	25.62
1413	93.95	3.11	4.64	0.00	0.0	5.39	19.58	126.68
1414	79.16	2.66	0.44	0.04	0.0	3.69	12.58	98.57
1415	37.02	0.56	0.13	0.01	0.0	0.74	3.82	42.28
1416	7.86	0.32	0.13	0.00	0.0	0.24	3.31	11.86
1417	1.88	0.10	0.01	0.00	0.0	0.03	0.12	2.13
1418	278.73	1.31	0.38	0.02	0.0	22.53	39.78	342.76
1419	67.60	1.61	0.74	0.37	0.0	0.82	7.12	78.27
1420	98.58	1.46	4.02	0.05	0.20	6.93	27.71	138.95
1421	237.71	5.59	5.15	1.04	0.0	58.48	115.44	423.41
1422	111.53	0.07	0.15	0.02	0.0	5.86	29.98	147.61
1423	12.23	0.10	1.65	0.24	0.00	0.35	9.51	24.08
1428	35.88	0.0	0.0	0.0	0.0	2.83	16.87	55.57
1429	62.77	0.43	1.02	0.02	0.0	2.92	8.77	75.92
1431	11.30	0.26	0.45	0.01	0.0	0.90	3.22	16.13
1432	101.92	8.09	2.85	0.32	0.0	7.09	17.42	137.69
2704	4.19	0.05	0.06	0.00	0.00	0.05	0.41	4.77
6503	2.06	0.0	0.0	0.0	0.0	0.0	0.0	2.06
6902	13.07	0.0	0.0	0.0	0.0	0.0	0.0	13.07
7804	0.14	0.0	0.0	0.0	0.0	0.0	0.0	0.14
8001	0.0	2.35	1.76	16.35	2.36	25.66	15.88	64.36
Totals	3097.96	59.92	86.77	20.77	2.85	249.10	733.02	4250.38

Table A.4. Electricity use for personal consumption of food in 1963

(a) Food purchased for off-premise consumption (million kWhr)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	13.71	0.0	0.0	0.0	0.0	0.0	0.0	13.71
102	1429.41	0.59	30.18	0.0	0.0	65.62	147.57	1673.36
202	2.43	0.09	0.19	0.0	0.0	0.20	0.05	2.95
204	663.93	29.96	57.37	0.46	0.39	197.31	401.51	1350.92
205	710.55	57.32	74.68	0.02	0.0	147.50	714.24	1704.31
206	8.39	0.15	0.48	0.0	0.0	0.93	0.0	9.94
300	174.74	1.02	19.34	0.01	0.0	33.70	81.47	310.28
1000	5.96	0.19	0.05	0.03	0.0	0.04	0.0	6.26
1401	11176.07	46.03	58.88	1.52	0.23	510.14	3035.21	14828.08
1402	437.00	1.22	3.24	0.01	0.0	36.88	84.57	562.90
1403	717.51	1.64	1.73	0.04	0.0	54.80	126.66	902.38
1404	518.52	3.34	1.20	0.00	0.0	31.77	83.63	638.47
1405	1357.77	0.06	0.05	0.0	0.0	70.30	354.74	1782.93
1406	5672.05	1.14	7.28	0.11	0.0	274.02	509.65	6464.24
1407	217.13	2.67	1.12	0.04	0.21	13.54	76.03	310.74
1408	930.43	3.28	6.13	0.06	0.0	55.40	175.13	1170.42
1409	2245.98	20.20	30.05	1.28	0.0	96.70	613.02	3007.22
1410	124.57	2.67	1.57	0.46	0.0	3.88	36.71	169.86
1411	590.63	2.18	5.33	0.01	0.0	27.53	160.92	786.60
1412	273.07	1.09	4.56	2.03	0.0	69.83	143.16	493.74
1413	2168.43	19.33	24.56	0.01	0.0	96.47	466.38	2775.18
1414	1296.80	15.13	2.13	0.11	0.0	62.25	211.06	1587.47
1415	689.08	3.70	0.76	0.03	0.0	14.28	110.54	818.38
1416	58.21	0.97	0.35	0.01	0.0	2.13	22.59	84.27
1417	13.16	0.65	0.07	0.01	0.0	0.48	3.33	17.70
1418	4418.76	7.88	1.97	0.06	0.0	394.37	821.12	5644.15
1419	333.82	9.83	3.85	1.09	0.0	14.39	134.70	497.67
1420	1543.23	8.66	20.32	0.12	0.55	116.75	659.44	2349.08
1421	2639.14	27.22	21.25	2.48	0.0	780.42	995.94	4466.44
1422	1418.97	0.35	0.64	0.06	0.0	84.48	309.86	1814.36
1423	35.26	0.13	1.80	0.15	0.00	1.30	61.68	100.32
1428	521.93	0.0	0.0	0.0	0.0	44.07	235.07	801.08
1429	882.98	2.34	4.75	0.04	0.0	45.71	126.54	1062.36
1431	199.11	1.39	2.06	0.03	0.0	14.05	61.23	277.88
1432	1609.84	50.68	15.22	0.93	0.0	127.91	411.88	2216.44
2704	27.97	0.19	0.19	0.01	0.00	0.61	7.32	36.30
6503	11.72	0.0	0.0	0.0	0.0	0.0	0.0	11.72
7804	3.95	0.0	0.0	0.0	0.0	0.0	0.0	3.95
8001	0.0	15.70	10.01	51.41	7.53	492.75	459.18	1036.57
Totals	45142.15	338.99	413.33	62.62	8.91	3982.50	11842.09	61790.60

Table A.4. Electricity use for personal consumption of food in 1963

(b) Purchased meals and beverages (million kWhr)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
102	191.16	0.22	3.90	0.0	0.0	8.08	186.19	389.54
204	18.01	0.81	1.46	0.0	0.0	5.82	33.62	59.73
205	238.96	14.94	19.22	0.0	0.0	40.48	440.19	753.79
300	16.91	0.05	0.99	0.0	0.0	1.72	38.50	58.16
1401	2289.63	9.99	12.34	0.24	0.03	99.94	2441.45	4853.61
1402	409.81	1.05	2.79	0.00	0.0	31.80	372.86	818.32
1403	185.92	0.42	0.45	0.01	0.0	14.20	173.84	374.84
1404	46.63	0.30	0.11	0.0	0.0	2.86	42.58	92.48
1405	294.98	0.01	0.01	0.0	0.0	15.27	214.68	524.96
1406	649.75	0.11	0.68	0.01	0.0	25.65	438.59	1114.78
1407	30.26	0.37	0.16	0.01	0.03	1.89	38.01	70.72
1408	38.71	0.14	0.26	0.00	0.0	2.30	36.13	77.53
1409	282.01	2.54	3.77	0.16	0.0	12.14	224.03	524.66
1410	75.01	1.61	0.95	0.27	0.0	2.33	78.19	158.37
1411	104.17	0.38	0.94	0.00	0.0	4.86	84.02	194.38
1412	21.96	0.09	0.37	0.16	0.0	5.62	26.40	54.59
1413	141.35	1.26	1.60	0.00	0.0	6.29	99.99	250.49
1414	158.89	2.11	0.29	0.02	0.0	7.16	152.71	321.18
1416	66.22	1.11	0.40	0.01	0.0	2.43	73.11	143.27
1418	284.49	0.45	0.11	0.00	0.0	24.68	329.51	639.24
1419	31.84	0.80	0.32	0.07	0.0	1.22	71.16	105.41
1420	117.43	0.62	1.43	0.01	0.06	9.18	142.01	270.75
1421	1110.83	10.09	8.03	0.78	0.0	342.59	2342.99	3815.31
1422	455.05	0.11	0.20	0.02	0.0	27.09	557.28	1039.76
1423	143.43	0.54	7.30	0.59	0.01	5.27	213.28	370.42
1428	100.12	0.0	0.0	0.0	0.0	8.45	252.81	361.39
1429	172.19	0.46	0.93	0.01	0.0	8.91	127.08	309.57
1431	37.30	0.26	0.39	0.01	0.0	2.63	31.99	72.58
1432	77.39	2.44	0.73	0.04	0.0	6.15	91.95	178.70
2704	11.50	0.09	0.10	0.00	0.00	0.29	4.57	16.56
6902	378.09	0.0	0.0	0.0	0.0	0.0	0.0	378.09
Totals	8179.96	53.35	70.22	2.45	0.13	727.29	9359.69	18393.12

Table A.4. Electricity use for personal consumption of food in 1963

(c) Food furnished government and commercial employees (million kWhr)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
102	32.17	0.04	0.66	0.0	0.0	1.36	0.0	34.23
204	10.43	0.47	0.85	0.0	0.0	3.37	0.0	15.13
205	20.47	1.28	1.65	0.0	0.0	3.47	0.0	26.87
300	6.57	0.02	0.38	0.0	0.0	0.67	0.0	7.64
1401	385.37	1.63	2.09	0.04	0.01	16.94	0.0	406.07
1402	11.12	0.03	0.08	0.0	0.0	0.86	0.0	12.09
1403	33.89	0.08	0.08	0.00	0.0	2.59	0.0	36.64
1404	3.70	0.02	0.01	0.0	0.0	0.23	0.0	3.96
1405	28.41	0.00	0.00	0.0	0.0	1.47	0.0	29.88
1406	160.02	0.03	0.17	0.00	0.0	6.32	0.0	166.53
1407	12.55	0.15	0.06	0.00	0.01	0.78	0.0	13.57
1408	7.96	0.03	0.05	0.00	0.0	0.47	0.0	8.52
1409	48.26	0.43	0.65	0.03	0.0	2.08	0.0	51.45
1410	9.43	0.20	0.12	0.03	0.0	0.29	0.0	10.08
1411	33.35	0.12	0.30	0.00	0.0	1.55	0.0	35.33
1412	4.41	0.02	0.07	0.03	0.0	1.13	0.0	5.67
1413	18.59	0.17	0.21	0.0	0.0	0.83	0.0	19.80
1414	33.50	0.47	0.06	0.01	0.0	1.50	0.0	35.54
1416	2.44	0.04	0.01	0.0	0.0	0.09	0.0	2.59
1418	129.49	0.43	0.11	0.00	0.0	13.66	0.0	143.69
1419	5.62	0.14	0.06	0.01	0.0	0.22	0.0	6.04
1420	90.93	0.48	1.11	0.01	0.04	7.11	0.0	99.68
1422	16.15	0.00	0.01	0.00	0.0	0.96	0.0	17.12
1423	4.95	0.02	0.25	0.02	0.00	0.18	0.0	5.43
1428	21.42	0.0	0.0	0.0	0.0	1.81	0.0	23.22
1429	26.36	0.07	0.14	0.00	0.0	1.36	0.0	27.94
1431	7.80	0.05	0.08	0.00	0.0	0.55	0.0	8.49
1432	27.17	0.86	0.26	0.02	0.0	2.16	0.0	30.45
2704	3.10	0.02	0.03	0.00	0.00	0.08	0.0	3.23
8001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	1195.67	7.31	9.53	0.22	0.06	74.09	0.0	1286.88

Table A.4. Electricity use for personal consumption of food in 1963

(d) Food produced and consumed on farms (million kWhr)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	205.08	0.0	0.0	0.0	0.0	0.0	0.0	205.08
102	92.60	0.0	0.0	0.0	0.0	0.0	0.0	92.60
204	55.09	0.0	0.0	0.0	0.0	0.0	0.0	55.09
205	205.62	0.0	0.0	0.0	0.0	0.0	0.0	205.62
206	0.52	0.0	0.0	0.0	0.0	0.0	0.0	0.52
1401	340.41	0.0	0.0	0.0	0.0	0.0	0.0	340.41
1402	40.58	0.0	0.0	0.0	0.0	0.0	0.0	40.58
1419	0.19	0.0	0.0	0.0	0.0	0.0	0.0	0.19
Totals	940.11	0.0	0.0	0.0	0.0	0.0	0.0	940.11

Table A.4. Electricity use for personal consumption of food in 1963

(e) Sum of preceding four tables (million kWhr)

I/O	Producer	Transportation				Trade		Total
		Railroad	Truck	Water	Air	Wholesale	Retail	
101	218.79	0.0	0.0	0.0	0.0	0.0	0.0	218.79
102	1745.35	0.84	34.73	0.0	0.0	75.05	333.76	2189.73
202	2.43	0.09	0.19	0.0	0.0	0.20	0.05	2.95
204	747.46	31.25	59.68	0.46	0.39	206.50	435.13	1480.87
205	1175.60	73.53	95.54	0.02	0.0	191.46	1154.43	2690.58
206	8.91	0.15	0.48	0.0	0.0	0.93	0.0	10.46
300	198.21	1.10	20.70	0.01	0.0	36.09	119.97	376.08
1000	5.96	0.19	0.05	0.03	0.0	0.04	0.0	6.26
1401	14191.48	57.64	73.31	1.80	0.27	627.03	5476.66	20428.18
1402	898.52	2.29	6.10	0.01	0.0	69.55	457.43	1433.90
1403	937.32	2.14	2.26	0.05	0.0	71.60	300.50	1313.86
1404	568.86	3.66	1.32	0.00	0.0	34.86	126.21	734.91
1405	1681.16	0.07	0.06	0.0	0.0	87.04	569.42	2337.77
1406	6481.81	1.28	8.13	0.13	0.0	305.98	948.23	7745.55
1407	259.95	3.20	1.34	0.05	0.25	16.21	114.05	395.03
1408	977.10	3.45	6.43	0.06	0.0	58.18	211.26	1256.47
1409	2576.25	23.17	34.47	1.47	0.0	110.92	837.05	3583.33
1410	209.01	4.49	2.64	0.77	0.0	6.50	114.90	338.31
1411	728.15	2.69	6.57	0.01	0.0	33.94	244.95	1016.31
1412	299.45	1.19	5.00	2.22	0.0	76.58	169.56	554.00
1413	2328.38	20.76	26.37	0.01	0.0	103.58	566.37	3045.46
1414	1489.19	17.71	2.48	0.14	0.0	70.91	363.77	1944.20
1415	689.08	3.70	0.76	0.03	0.0	14.28	110.54	818.38
1416	126.87	2.12	0.76	0.01	0.0	4.65	95.70	230.12
1417	13.16	0.65	0.07	0.01	0.0	0.48	3.33	17.70
1418	4832.74	8.75	2.18	0.07	0.0	432.71	1150.63	6427.07
1419	371.47	10.77	4.22	1.18	0.0	15.82	205.86	609.31
1420	1751.60	9.76	22.86	0.14	0.65	133.04	801.46	2719.51
1421	3749.98	37.31	29.28	3.27	0.0	1123.00	3338.93	8281.75
1422	1890.17	0.47	0.85	0.08	0.0	112.53	867.14	2871.24
1423	183.65	0.69	9.35	0.76	0.01	6.75	274.96	476.17
1428	643.47	0.0	0.0	0.0	0.0	54.34	487.89	1185.69
1429	1081.53	2.86	5.82	0.05	0.0	55.99	253.62	1399.87
1431	244.22	1.71	2.53	0.04	0.0	17.23	93.22	358.95
1432	1714.39	53.97	16.21	0.99	0.0	136.21	503.82	2425.59
2704	42.58	0.31	0.31	0.01	0.01	0.97	11.90	56.09
6503	11.72	0.0	0.0	0.0	0.0	0.0	0.0	11.72
6902	378.09	0.0	0.0	0.0	0.0	0.0	0.0	378.09
7804	3.95	0.0	0.0	0.0	0.0	0.0	0.0	3.95
8001	0.0	15.70	10.01	51.41	7.53	492.75	459.18	1036.57
Totals	55457.88	399.65	493.08	65.28	9.10	4783.88	21201.78	82410.63

Table A.5. Primary and electric energy use within agriculture in 1963

I/O	Primary energy (trillion Btu)		Electricity (million kWhr)	
	Total	to PCE	Total	to PCE
101	214.60	10.73	4377.07	218.79
102	222.22	109.75	3533.96	1745.35
103	428.32	0.0	7746.23	0.0
201	0.0	0.0	0.0	0.0
202	54.39	0.18	717.06	2.43
203	0.0	0.0	0.0	0.0
204	59.98	35.49	1263.18	747.46
205	88.85	62.85	1661.91	1175.60
206	6.88	0.67	91.99	8.91
207	0.0	0.0	0.0	0.0
300	18.24	10.99	329.10	198.21
Totals	1093.49	230.66	19720.50	4096.75

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