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U. S. DEPARTMENT OF AGRICULTURE

Cost of Electricity and Liquefied Petroleum Gas

FOR COOKING REFRIGERATING and WATER HEATING

Facts for Extension and Home Service Leaders and Others Who Work With Consumers . . .

AGRICULTURE INFORMATION BULLETIN No. 141
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CONTENTS

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COST OF ELECTRICITY and LIQUEFIED PETROLEUM GAS

FOR COOKING REFRIGERATING AND WATER HEATING

By Earl C McCracken and Elizabeth Beveridge, *Home Economics Research Branch, Agricultural Research Service*

In many rural areas throughout the country both electricity and liquefied petroleum (LP) gas are available for household use. Factors to be considered in choosing between the two include kind and cost of appliance; cost of installation of fuel[1] supply and appliance; maintenance and operation, including fuel cost; and performance that meets the needs of an individual family.

This publication—intended mainly for use by extension and home service leaders, teachers, suppliers of electric service, dealers in LP-gas, and others who work with consumers—discusses chiefly the fuel cost of operating ranges, refrigerators, and water heaters with electricity and LP-gas.

Propane was the LP-gas used in the study on which this publication is based. Butane is also commonly available. Factors for conversion between these two gases are based on the assumption that butane burns with the same efficiency as propane. Performance and fuel costs for gas ranges may be quite different when they are operated on natural, manufactured, or mixed gases.

Expense for fuel is affected by the efficiency with which an appliance uses heat energy, by the conditions under which the appliance is operated, and the cost per unit of energy. The last is derived from the energy value of a purchase unit of fuel and its price.

UTILIZATION OF ENERGY BY RANGES, REFRIGERATORS, AND WATER HEATERS

The amount of energy an appliance uses in doing a given piece of work depends both on the design of the appliance and on the conditions under which it is used. However, variations occur among appliances that use the same source of energy, as well as among those that use different sources. As the design of equipment is improved to make more efficient use of energy, figures on utilization will, of course, change.

The figures used in this publication on the comparative consumption of energy by appliances were determined by studies of the performance of 4 electric and 4 LP-gas ranges, 4 electric and 4 LP-gas water heaters, and 6 refrigerators (4 of which were electric). These studies were conducted in the laboratory at the Agricultural Research Center, Beltsville, Md., where conditions of operation were kept as uniform as possible.[2]

[1] Although electricity is not, strictly speaking, a fuel, for simplicity of expression the word "fuel" is used throughout this publication to refer to both electricity and LP-gas.

[2] Beveridge, E., and McCracken, E. C Comparative utilization of energy by household electric and liquefied petroleum gas ranges, refrigerators, and water heaters. U. S. Dept. Agr. Tech. Bul. 1073, 54 pp., illus. 1953.

The appliances used were widely distributed products available in 1951 and 1952. The variables were the energy source—electricity and liquefied propane—and the models of equipment used. The equipment was operated under conditions that would give results applicable to home use.

Electric voltage and gas pressure were controlled throughout the study, and the amounts of electricity and gas used in test operations were recorded and from these figures were computed the energy values in British thermal units (B. t. u.'s). Ratios were then determined between the numbers of thermal units required to operate the appliances, using the two sources of energy.

Ranges

The four electric ranges were equipped with surface units differing in construction, but each unit was made of a high-efficiency, tubular heating element. Two of the ranges had one high-speed unit of the same diameter as the small regular-speed unit.

The four gas ranges were equipped with surface burners of the double-throat type, and all met or exceeded the 1953 recommendations of the American Gas Association Approval Requirements as to minimum burner inputs for LP-gas (7,000 B. t. u. per hour for standard burners and 9,000 for giant burners). Three of the four ranges had burners with inputs that exceeded these recommendations and met or approached the requirements for ranges using natural or manufactured gas—9,000 and 12,000 B. t. u. per hour for standard and giant burners, respectively. The surface burners had automatic ignition; 1 had electric ignition and the other 3 had constant-burning pilot lights.

To study the fuel consumption of the ranges, a home-type kitchen was set up in the laboratory and a series of 24 family meals (3 meals a day for 8 days) were cooked on each range.

Menus were planned to require 80 percent top-of-range and 20 percent oven cooking, a proportion commonly considered a normal distribution between surface and oven use. These percentages were applied to the number of cooking operations. The use that followed the turning on of the oven or a top unit or burner was counted as one operation. The length of time of the operation was not considered nor was the number of foods baked at one time. With this plan, each oven was turned on 14 times during the 8 days—an average of 1.75 times a day.

Separate records were kept of quantities of electricity and gas used in top-of-range and in oven cooking. Energy used for the ignition of gas burners was recorded separately.

Table 1 shows that each of the 4 electric ranges used about the same number of B. t. u.'s for top-of-range cooking, but varied by more than 20 percent in the amounts of energy used for oven cooking. No attempt was made to determine the reason for the difference among ovens. The largest oven used the most energy, but the other 3 showed no consistent relationship between their size and the energy used.

The gas ranges were more variable in the amounts of energy used for top-of-range cooking than for oven cooking. A comparison of burner inputs and energy for cooking for each of the 4 ranges shows that the high-input burners were more economical in operation than the burners with the lower input.

It was also shown that the energy consumption of a gas range can be affected materially by the amount used for automatic ignition of surface burners. On the range with a single pilot, the flame was small and used about 6 percent as much gas as was used by that range for cooking all the meals. The divided-top ranges had 2 pilots which burned with larger flames; the 2 used about 20 percent as much gas as was used for cooking. The electric ignition on the one gas range used what would amount to a little more than 3½ kilowatt-hours of electrical energy a month.

When energy for gas-burning pilots was included, top-of-range cooking used from 1.60 to 2.34 times as much energy as did the electric ranges. For cooking the test meals (top-of-range and oven cooking in the 80–20 ratio), the gas ranges (including pilots) used from 1.82 to 2.33 times as much energy as did the electric ranges.

TABLE 1.—*Amount of energy used by 8 ranges in cooking 24 family meals*

Range	Top-of-range cooking	Oven cooking	Top-of-range and oven cooking [1]
Electric:	*1,000 B. t. u.*	*1,000 B. t. u.*	*1,000 B. t. u.*
1	56	66	122
2	59	70	129
3	57	60	117
4	57	56	113
LP-gas, including ignition:			
With high burner input—			
1 (electric ignition)	79	132	211
2 (1 pilot light)	95	140	234
3 (2 pilot lights)	116	134	250
With lower burner input—			
4 (2 pilot lights)	132	132	264

[1] In the ratio of 80 percent top-of-range and 20 percent oven cooking.

More heat energy was used in oven cooking than in top-of-range cooking in the test meals. The 4 gas-range ovens used about 538,000 B. t. u. and the 4 electric range ovens used about 252,000—a ratio of 2.13 to 1. Corresponding figures for top-of-range burners (exclusive of pilots) and units were 321,000 and 229,000, a ratio of 1.40 to 1. Hence, the more oven cooking and the less surface cooking a prospective buyer of ranges plans to do, the greater the difference that may be expected in the amount of energy consumed by gas and electric ranges.

Refrigerators

The study included 4 electric refrigerators of different makes and 2 gas refrigerators, both of the same make—the only gas refrigerator on the market. The nominal storage capacities were 8 and 9 cubic feet. Records were kept of energy consumed as they were used in conjunction with ranges during the preparation of meals. In addition, refrigerators were studied by means of engineering tests, in which room temperature was controlled, no food load was used, and the refrigerator doors were not opened during a test.

In the controlled engineering tests, records were kept of the 24-hour energy consumption required to maintain cabinets at 38° F. in a room temperature of 70°, at 43° in a room temperature of 90°, and at 46° in a room temperature of 110°. The energy-consumption figures are shown in table 2.

TABLE 2.—*Amount of energy used in 24 hours by 6 refrigerators to maintain standard cabinet temperatures at 3 specified room temperatures*

Refrigerator	Room and standard cabinet temperatures		
	70° F. room, 38° cabinet	90° F. room, 43° cabinet	110° F. room, 46° cabinet
Electric:			
9-cubic-foot:	*1,000 B.t.u.*	*1,000 B.t.u.*	*1,000 B.t.u.*
1	2. 3	3. 7	6. 2
2	2. 4	4. 2	7. 5
8-cubic-foot:			
3	1. 5	2. 6	4. 2
4	2. 6	4. 5	7. 4
LP-gas:			
8-cubic-foot	26. 8	42. 4	(1)
9-cubic-foot	39. 1	44. 7	54. 4

1 In a room temperature of 110° F., refrigerator would not maintain a 46° cabinet temperature.

The amounts of energy used by the 4 electric refrigerators varied considerably as did the amounts used by the 2 gas refrigerators. The difference between the gas and the electric appliances in the relative efficiency with which they used fuel energy was greater for refrigerators than for ranges or water heaters.

Under the closely controlled conditions of the engineering tests, gas refrigerators used from 10.5 to 18.4 times as many B.t.u.'s of energy as did the electric refrigerators to maintain an average cabinet temperature of 38° F. in a 70° room, from 9.4 to 16.2 times as many B.t.u.'s to maintain 43° in a 90° room, and from 7.3 to 8.7 times as many B.t.u.'s to maintain a 46° cabinet temperature in a 110° room.

The energy consumption of the refrigerators in the engineering test conducted in a 90° F. room was similar to that of refrigerators in normal use in the kitchen tests. In the latter, the room temperature ranged from 69° to 93° in the course of the study.

Water Heaters

Each of the 4 electric water heaters had a nominal 66-gallon storage capacity; 2 had heating units of the immersion type and 2 of the wrap-around type. Each of the 4 gas water heaters had a nominal 30-gallon storage capacity; 2 had internal flues and 2 had external flues. Electric heaters of the larger capacity were selected for comparison with the gas heaters of 30-gallon capacity in conformance with standard industry practices, which recognize general restrictions as to electrical energy input in the interests of economical and practical operation.

In the study of water heaters, three different schedules for water withdrawal were followed. The first schedule of 38 gallons, withdrawn at intervals during a 16-hour period of the day, was planned to represent average home use. The second schedule of 78 gallons was included to show the effects of greater demand for hot water which might be needed for large families, for the frequent use of an automatic washer, or for the washing of equipment and utensils used in the operation of a dairy. The third schedule of 112-gallon withdrawal is the American Standard test for electric water heaters of 66-gallon nominal capacity.

The amount of energy used by each heater in heating water is shown in table 3.

TABLE 3.—*Amount of energy used by 8 water heaters during 24 hours under 3 conditions of use*

Water heater	38-gallon drawoff	78-gallon drawoff	112-gallon drawoff
Electric:	*1,000 B.t.u.*	*1,000 B.t.u.*	*1,000 B.t.u.*
1	40	72	100
2	41	72	99
3	40	72	98
4	39	71	96
LP-gas:			
1	87	126	167
2	79	120	155
3	77	114	149
4	75	128	168

The gas heaters studied varied among themselves much more than did the electric. On the 38-gallon schedule, gas heaters used from 1.85 to 2.22 times as many B.t.u.'s of energy as did the electric heaters; on the 78-gallon schedule from 1.58 to 1.81 times as many; and on the 112-gallon schedule from 1.49 to 1.74.

Ratios of Energy Utilization, Gas to Electricity, for the Three Appliances

A summary of the ratios of energy utilization, gas to electricity, is shown in table 4 for each kind of appliance and each type of operation, together with the single ratio used in this publication in computing comparative costs of fuel.

FIGURING FUEL COSTS

The comparative cost of different fuels used in the operation of household appliances depends not only on the relative efficiency of the appliance in utilizing the energy (expressed in B.t.u.'s) as discussed in the previous section, but also on the relative costs of the fuel per B.t.u. Determining the latter is complicated by the fact that the usual units of purchase—such as kilowatt-hours of electricity, and decitherms, pounds, cubic feet, and gallons of liquefied petroleum gas—provide different amounts of energy in terms of B.t.u.'s. Furthermore, residential rate schedules generally are such that the more energy used, the less its price per unit, the reduction being brought about by a decrease in the rate per unit for successive blocks of energy used.

In the following discussion, various figures and values needed in working out fuel costs are given. Also a calculation is worked out as an example of figuring the cost of electricity or LP-gas for operating ranges, re-

TABLE 4.—*Ratios of energy utilization, gas to electricity, for ranges, refrigerators, and water heaters for specified types of operation*

Appliance and operation	Ratio of B. t. u.'s used, gas to electricity	
	Range of ratios	Figure suggested for computing fuel costs [1]
Ranges:		
Top-of-range cooking, excluding pilots	1.24–1.59 to 1	1.4 to 1.
Oven cooking	1.89–2.48 to 1	2.1 to 1.
Top-of-range and oven cooking in predetermined ratio: [2]		
Including energy used by constant-burning pilots.	1.82–2.33 to 1	*2.0 to 1.*
Excluding energy used by constant-burning pilots (to represent ranges with electric ignition).	1.61–1.97 to 1	1.8 to 1.
Refrigerators:		
Cabinet temperature 38° F., room temperature 70°.	10.5–18.4 to 1	15.2 to 1.
Cabinet temperature 43° F., room temperature 90° (corresponds to normal kitchen operation in 70° to 90° room).	9.4–16.2 to 1	*11.6 to 1.*
Cabinet temperature 46° F., room temperature 110°.	7.3–8.7 to 1	8.6 to 1.
Water heaters, daily withdrawal of:		
38 gallons	1.85–2.22 to 1	*2.0 to 1.*
78 gallons	1.58–1.81 to 1	1.7 to 1.
112 gallons	1.49–1.74 to 1	1.6 to 1.

[1] Figures in italics are ratios used for sample computations shown later in this publication. These ratios were derived from actual average fuel consumption of all applicances used in the study.
[2] 80 percent top-of-range, 20 percent oven.

frigerators, and water heaters for 1 month at Beltsville, where the study was conducted. The actual figures derived in this example are not, of course, applicable generally.

Facts Needed for Estimating Fuel Costs

B. t. u. Values of Electricity and LP-gas

The heat energy value of 1 kilowatt-hour of electricity is 3,415 B.t.u. Different LP-gases vary in heat content. Moreover, an LP-gas from different batches may vary in B.t.u value, since it may be slightly different in chemical content. The following values, which have been set as a standard by one State (Pennsylvania) and which are close to the average of several large producers, are used in this publication for converting from one purchase unit of gas to another, and from one gas to the other:

	B. t. u. value for—	
Purchase unit:	*Propane*	*Butane*
Pound	21,560	21,180
Cubic foot	2,522	3,261
Decitherm	10,000	10,000
Gallon	91,500	102,600

The number of purchase units of propane gas that are equivalent to 1 kilowatt-hour of electricity for each of the 3 appliances and various operations under the conditions of the study reported are shown in table 5. These numbers are based on both the fuel energy value per unit and the ratios of energy utilization summarized in table 4.

TABLE 5.—*Units of propane gas equivalent to 1 kilowatt-hour of electricity for three kinds of appliances and various operations*

Appliance and operation	Propane equivalent to 1 kilowatt-hour electricity [1]			
	Pounds	Cubic feet	Deci-therms	Gallons
Ranges:				
Top-of-range cooking, excluding pilots	0.2218	1.8957	0.4780	0.0523
Oven cooking	.3326	2.8436	.7172	.0784
Top-of-range and oven cooking in predetermined ratio: [2]				
Including energy for constant-burning surface pilots	*.3168*	*2.7082*	*.6830*	*.0746*
Excluding energy for constant-burning surface pilots (to represent ranges with electric ignition)	.2851	2.4324	.6147	.0672
Refrigerators:				
Cabinet temperature 38° F., room temperature 70°	2.4076	20.5823	5.1908	.5673
Cabinet temperature 43° F., room temperature 90°	*1.8374*	*15.7074*	*3.9614*	*.4329*
Cabinet temperature 46° F., room temperature 110°	1.3622	11.6451	2.9369	.3210
Water heaters, daily withdrawal of:				
38 gallons	*.3168*	*2.7082*	*.6830*	*.0746*
78 gallons	.2693	2.3019	.5806	.0634
112 gallons	.2534	2.1665	.5464	.0597

[1] Figures in italics are ratios used in computations, p. 9.
[2] 80 percent of operations top-of-range, 20 percent oven.

Amount of Electricity or LP-gas Used Monthly

To calculate the comparative monthly costs of electricity and LP-gas in communities where rates vary with the amount used, it is necessary to estimate the amount of each fuel that would be used by each appliance. The calculations in this publication are based on the energy consumption figures obtained in the Department's laboratory study. These figures may differ somewhat from those of home consumption.

Ranges.—Suppliers of electric service report that in the usual operation of ranges, families use from 100 to 150 kilowatt-hours of electricity per month. On the basis of the Department study in which 3 regular meals were cooked each day (see p. 2), the average consumption would amount to about 130 kilowatt-hours.

Refrigerators.—Electric refrigerators maintaining a 43° F. cabinet temperature in a 90° room used about 35 kilowatt-hours of electricity. This figure is in line with the results of field tests of home use as reported by manufacturers, utility companies, and experiment station workers.

Water heaters.—Available records from power suppliers on energy consumption of water heaters in home use show an average of about 300 kilowatt-hours a month. This amount of electrical energy will produce an amount of hot water approximating that for the 38-gallon drawoff of the Department study.

On the basis of the figures from table 5 for conversion, the amounts of propane needed monthly to do a job comparable to that of electricity in operating these 3 types of appliances are shown in table 6. The electric range was compared with the gas range equipped with the constant-burning surface pilot.

TABLE 6.—*Amount of propane comparable to that of electricity used in 1 month to operate 3 types of appliances at Beltsville, Md.*

Appliance and consumption	Propane			
	Pounds	Cubic feet	Deci-therms	Gallons
Range (130 kilowatt-hour)	41	352	89	9.7
Refrigerator (35 kilowatt-hour)	64	550	139	15.1
Water heater (300 kilowatt-hour)	95	812	205	22.4
Total	200	1,714	433	47.2

In summary, for the calculations in this publication, amounts of energy estimated to be needed monthly to operate the 3 appliances are 465 kilowatt-hours of electricity and 200 pounds, 47.2 gallons, 433 decitherms, or 1,714 cubic feet of propane.

Fuel Rates

The first section of this publication reports that, in the Department study, LP-gas equipment required more B. t. u.'s than equivalent electrical equipment to do identical jobs. However, the cost of a B. t. u. from LP-gas is generally much less than the cost of a B. t. u. from electricity.

To estimate costs of actual operation, rates for each type of fuel that apply within a particular community must be obtained.

Electric rates may be learned from the power supplier or taken from an electric bill. In many places there is a special water-heater rate, which is less than the regular rate; in some such cases the water heater is metered separately.

LP-gas dealers will supply information as to the unit by which gas is sold, the price per unit, and whether the rate varies with the amount used. The rate may also be obtained from a gas bill. In some places gas rates vary with the season of the year.

The rate schedules for the Beltsville community for electricity and LP-gas (including the basic adjustment charge) are—

	Cents per kilowatt-hour
Electricity:	
First 40 kilowatt-hours	4.75
Next 210 kilowatt-hours	2.47
All kilowatt-hours over 250	1.62
	Cents per decitherm
LP-gas:	
First 40 decitherms	7.08
Next 35 decitherms	4.45
All decitherms over 75	2.70

Fuel Costs for Three Appliances

As an example, costs of operating appliances were calculated according to the rate schedule for the Beltsville community. Different schedules for other communities can be substituted in the example.

In figuring the cost of electricity, 40 kilowatt-hours for lighting and small appliances is added for the calculation. Then, after the total cost for 505 kilowatt-hours is determined, the cost of the initial 40 kilowatt-hours is deducted; the remainder is the total cost of electricity for the 3 appliances.

From the amounts of energy used by the appliances in the Department study, the costs of operating the 3 appliances (range, refrigerator, and water heater) for 1 month at Beltsville were as follows:

Electricity

40 kw.-hr. @ 4.75¢	$1. 90
210 kw.-hr. @ 2.47¢	5. 18
255 kw.-hr. @ 1.62¢	4. 13
505 kw.-hr	11. 21
Minus cost of first 40 kw.-hr. (lights, etc.)	1. 90
Total for range, refrigerator, and water heater	9. 31
Average per kw.-hr. for 3 appliances	. 02

LP-gas

40 decitherms @ 7.08¢	$2. 83
35 decitherms @ 4.45¢	1. 56
358 decitherms @ 2.70¢	9. 67
433 decitherms	14. 06
Total for range, refrigerator, and water heater	14. 06
Average per unit for 3 appliances:	
Per decitherm	. 032
Per pound	. 070
Per cubic foot	. 008
Per gallon	. 298

For communities with other rate schedules, the costs may be quite different. According to a recent report[3] the average price for LP–gas bought by the pound in 1950 was 7.9 cents per pound; the lowest State average, 3.5 cents. For gas bought by the gallon, the average price was 12 cents per gallon; the lowest State average, 9.5 cents; and the average for all purchases, 15.8 cents. In localities near the source of supply the cost is as low as 8.5 cents a gallon. With LP-gas at these prices, the cost for operation of the three appliances would be as follows:

Price of LP-gas:	*Cost for 1 month*
7.9 cents per pound	$15. 80
3.5 cents per pound	7. 00
12.0 cents per gallon	5. 66
9.5 cents per gallon	4. 48
15.8 cents per gallon	7. 46
8.5 cents per gallon	4. 01

Federal Power Commission figures show that in 1950 the average cost of 500 kilowatt-hours of electricity for towns with populations under 1,000 was $10.75,[4] an average cost of 2.15 cents per kilowatt-hour. For 505 kilowatt-hours the average cost would be $10.86. Deducting $2 (estimated charge for the first 40 kilowatt-hours for lighting and small appliances), the average cost for 465 kilowatt-hours needed for the 3 appliances would be $8.86. In one community where the bill for 500 kilowatt-hours is exactly $10.75, the cost for 505 kilowatt-hours would be $10.86. The cost for the first 40 kilowatt-hours is $2.40, making the cost for the 3 appliances $8.46. In at least one locality, the average cost per kilowatt-hour for 500 kilowatt-hours is 1 cent and the cost for the first 40, $1. The cost for 505 kilowatt-hours would then be $5.05, the deduction for the first 40 making the fuel cost for the 3 appliances $4.05.

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[3] Brodell, A. P., and Kendall, A. R. farm consumption of liquefied petroleum gases. U. S. Bur. Agr. Econ. FM 87, 7 pp. 1951. [Processed.]

[4] Unpublished data, Federal Power Commission 1951.

Fuel Costs for Individual Appliances

The calculations in the foregoing section are for the total cost of operation of range, refrigerator, and water heater. In this section, the fuel cost for each of the three appliances is calculated.

To determine the cost of operation of an individual appliance, it is necessary to know, in addition to the amount of energy required, the rate block or blocks in which its energy use falls. The rate block or blocks applicable depend upon the amount of energy being used at the time purchase of the additional equipment is being considered; that is, if the appliances are purchased separately, the amount each will add to the bill may vary by order of purchase.

TABLE 7.—*Fuel costs of operating each of 3 appliances, by 2 orders of purchase, for 1 month at Beltsville, Md.*

Cost by order of purchase			
Range, water heater, refrigerator		Refrigerator, range, water heater	
Electricity			
Lights and small appliances, 40 kw.-hr. (40 kw.-hr. @ 4.75¢=$1.90.)	$1.90	Lights and small appliances, 40 kw.-hr. (40 kw.-hr. @ 4.75¢=$1.90.)	$1.90
Range, 130 kw.-hr. (130 kw.-hr. @ 2.47¢=$3.21.)	3.21	Refrigerator, 35 kw.-hr. (35 kw.-hr. @ 2.47¢=$0.86.)	.86
Water heater, 300 kw.-hr. (80 kw.-hr. @ 2.47¢=$1.97, 220 kw.-hr. @ 1.62¢=$3.56.)	5.53	Range, 130 kw.-hr. (130 kw.-hr. @ 2.47¢=$3.21.)	3.21
Refrigerator, 35 kw.-hr. (35 kw.-hr. @ 1.62¢=$0.57.)	.57	Water heater, 300 kw.-hr. (45 kw.-hr. @ 2.47¢=$1.11, 255 kw.-hr. @ 1.62¢=$4.13.)	5.24
LP-gas			
Range, 89 decitherms (40 decitherms @ 7.08¢= $2.83, 35 decitherms @ 4.45¢= $1.56, 14 decitherms @ 2.70¢= $0.38.)	$4.77	Refrigerator, 139 decitherms (40 decitherms @ 7.08¢= $2.83, 35 decitherms @ 4.45¢= $1.56, 64 decitherms @ 2.70¢= $1.73.)	$6.12
Water heater, 205 decitherms (205 decitherms @ 2.70¢= $5.54.)	5.54	Range, 89 decitherms (89 decitherms @ 2.70¢= $2.40.)	2.40
Refrigerator, 139 decitherms (139 decitherms @ 2.70¢= $3.75.)	3.75	Water heater, 205 decitherms (205 decitherms @ 2.70¢= $5.54.)	5.54

Two orders of purchase are considered in the computations of fuel costs of individual appliances in table 7. The first order, range-water heater-refrigerator, is that in which the 3 gas appliances are usually purchased, according to current sales information. The second order, refrigerator-range-water heater, is that in which the 3 electric appliances are usually purchased.

The rate schedules (see p. 9) and amounts of fuel (see p. 8) are those used in estimating the total cost of operating the appliances.

UNIT PRICES OF FUEL

Unit Price for Electricity and Propane Gas at Which Costs of Operating Specified Appliances Are Equal

The range of rates for electricity and LP-gas at which operating costs for the three appliances are about equal can be derived from figures 1, 2, and 3.

In each chart the upper line is based on the highest ratio of energy use found in laboratory tests for the particular set of conditions described; the bottom line is based on the lowest ratio for the same conditions. If either the price per kilowatt-hour for electricity or the price per pound for propane is known, the corresponding price for the other can be found quickly.

For example, to obtain corresponding rates for electric ranges and gas ranges with constant-burning surface pilots, if the price of a kilowatt-hour of electricity is 2.5 cents, locate the 2.5-cent point on the vertical

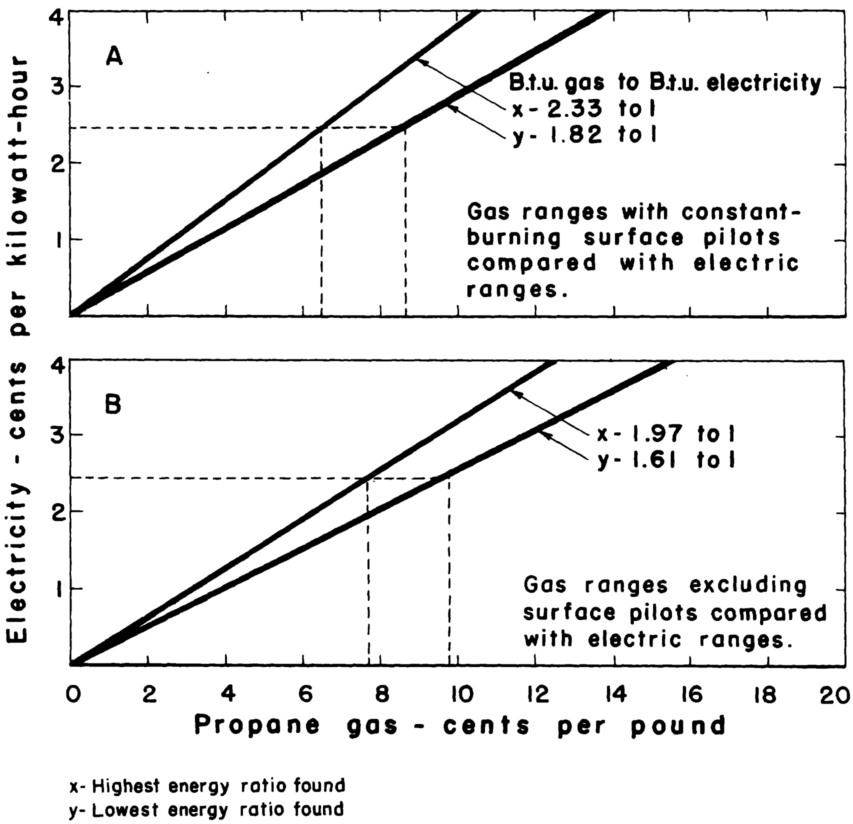

Figure 1.—HOUSEHOLD RANGES: Charts for determining rates at which costs for electricity and propane gas for operation are approximately equal. Dotted lines show range of rates per pound of propane gas comparable to a rate of 2½ cents per kilowatt-hour of electricity. (Charts based on energy-utilization ratios of gas to electricity for cooking specified series of meals.)

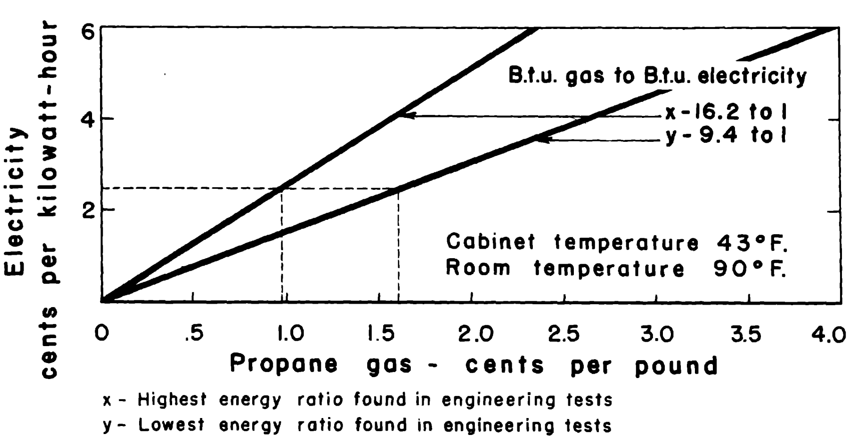

Figure 2.—HOUSEHOLD REFRIGERATORS: Chart for determining rates at which costs for electricity and propane gas for operation are approximately equal. Dotted lines show range of rates per pound of propane gas comparable to a rate of 2½ cents per kilowatt-hour of electricity. (Chart based on energy-utilization ratio of gas to electricity for maintaining specified cabinet temperature. Energy consumption corresponds to that of normal kitchen operation in a room in which temperature ranges from 70° to 90° F.)

axis of the top chart (fig. 1), and draw a horizontal line across the ratio lines of the chart. Then from the points of intersection, drop vertical lines to the horizontal axis. The meeting points on the horizontal axis represent the prices per pound of propane gas that correspond to the 2.5-cent rate for electricity for the two different energy-use ratios. These points show that the gas rate could fall anywhere between 6.6 and 8.8 cents per pound. The range is due to possible differences in the utilization of energy by the appliances themselves.

If the price per pound of propane gas is known, the chart can be used in a similar manner to find the corresponding price of electricity. Locate on the horizontal axis the point that indicates the price per pound of propane, draw a vertical line through the lines of the chart, and horizontal lines from the points of intersection to the vertical axis.

Price of Other Units of Propane

The charts show the price of propane by the pound, a common unit of purchase.[5] If propane gas is bought by some other unit, a conversion factor to be used in finding the equivalent price for that unit can be computed from the ratio of the number of B. t. u.'s in each unit. For example, from page 6, the number of B. t. u.'s in a pound and a gallon of propane are 21,560 and 91,500, respectively. The conversion factor is 91,500 divided by 21,560, or 4.24. For the cubic foot and the decitherm the conversion factors are 0.117 and 0.464, respectively.

If you have found from the chart the price per pound of propane that corresponds to a given price per kilowatt-hour of electricity, multiply the price per pound of propane by the applicable conversion factor to get the price for the different purchase unit of propane.

[5] More than half the families that use propane purchase it by the pound though, in terms of volume, the largest share is sold in other purchase units.

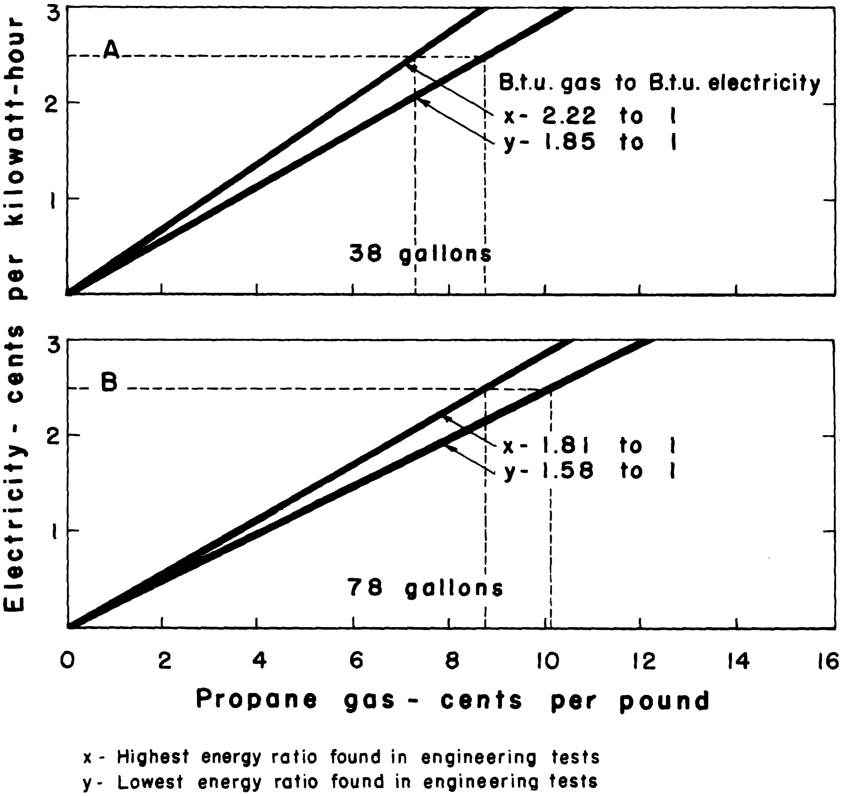

Figure 3.—HOUSEHOLD AUTOMATIC WATER HEATERS: Charts for determining rates at which costs for electricity and propane gas for operation are approximately equal. Dotted lines show range of rates per pound of propane gas comparable to a rate of 2½ cents per kilowatt-hour of electricity. (Charts based on energy-utilization ratios of gas to electricity for specified daily drawoffs.)

If, on the other hand, you want to use this chart to find the price per kilowatt-hour of electricity starting with a given price per pound of propane, but know only the price of propane for a unit other than a pound, divide the known price by the applicable conversion factor given to get the price per pound.

Price of Butane

To use the chart to find corresponding rates for butane and electricity, multiply the price per pound of propane by the applicable conversion factor given below to find the price per unit of butane; or divide the price per unit of butane by the applicable conversion factor to find the price per pound of propane:

Unit of butane:	*Conversion factor*
Pound	0.982
Cubic foot	.151
Decitherm	.464
Gallon	4.76

These figures are based on the assumption that butane burns with the same efficiency as propane. No tests were made with butane in the Department study.

OTHER FACTORS TO CONSIDER

The comparative cost of electricity and LP-gas, discussed in the foregoing pages of this publication, is but one of the factors to be considered in choosing between the two types of fuel. Following are other questions that need to be studied before a decision is made.

Anticipated Uses for Electricity or LP-gas

Though only a single appliance may be under consideration at the time, are there further uses that might be made of either type of fuel in the future?

Installation Problems and Costs

For electric appliances, will it be necessary to add a 3-wire service entrance, additional fuses or circuit breakers, or more house circuits? If so, does the power supplier pay all or part of the installation costs? For gas, what is the cost of storage facilities, and is it included in the cost of service or must these facilities be purchased or rented?

Dependability and Convenience of Service

Are power plant facilities such as to maintain a consistent adequate voltage? Is electric service often interrupted? If so, are interruptions taken care of quickly by power supplier? Does the LP-gas dealer have a regular schedule for refilling storage tanks or must he be notified when the supply needs replenishing? Is he prepared to give quick and dependable service in emergencies?

Cost and Choice of Appliance

How do purchase prices of appliances compare? Are the prospects for servicing of appliances equally good for the two types?

Is there a preference as to convenience of one type over the other? If so, is the preference based on fact? People who have used ranges of only one fuel type often have definite opinions as to relative speed of cooking with the two types. Data from the study show that, if well-designed flat-bottomed utensils are used, there is no time advantage for either one over the other. Time differences between ranges within each type were greater than differences between average times for gas and electric ranges. When the 8 ranges used in the study were ranked according to total time for cooking the meals, ranges of the 2 types were intermingled, with the same type at both top and bottom. For top-of-range cooking, gas ranges equipped with high-input burners were noticeably faster than the gas range with burners of standard input.

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