

CENSUS OF ELECTRICAL INDUSTRIES: 1927

CENTRAL ELECTRIC LIGHT
AND POWER STATIONS

1927

U. S. DEPARTMENT OF COMMERCE
BUREAU OF MINING

U. S. DEPARTMENT OF COMMERCE
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FOREWORD

The following report on the census of Central Electric Light and Power Stations for 1927 is one of the series of the Census of Electrical Industries, which also includes reports on Electric Railways, Telephones, and Telegraphs.

The census of electrical industries has been taken quinquennially, beginning with the inquiry for the year 1902, under provisions of acts of Congress approved March 6, 1902, and July 7, 1906.

The collection of the data, the compilation of the statistics, and the preparation of the text of this report were done under the supervision of LeVerne Beales, chief statistician for manufactures, assisted by William W. Sawyer. The chapter on the technical developments of the industry was written by George F. Wittig, of New York City.

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THE ELECTRICAL INDUSTRIES

INTRODUCTION AND GENERAL EXPLANATIONS

Scope of the census.—The census of electrical industries, which has been taken quinquennially since 1902, covers four distinct industries, namely: (1) Central electric light and power stations; (2) Electric railways; (3) Telephones; (4) Telegraphs. This report presents a summary for all four industries and detailed statistics for central electric light and power stations. The reports for the other three industries are published separately.

Capitalization.—The capitalization figures for the electric-railway, telephone, and telegraph industries represent the book value (in most cases the par value) of capital stock, funded debt, and real-estate mortgages, except that mortgages were not included for 1902. For light and power stations, however, the value of plant and equipment, not the capitalization, is shown. The compilation has been made in this manner in order that the statistics for commercial plants may be presented on the same basis as those for municipal plants, from which it is impossible in many cases to obtain accurate data in regard to capitalization.

Light and power departments operated by electric railways.—The light and power industry comprises both commercial and municipal central electric stations, including light and power plants operated by electric-railway companies. At earlier censuses it was impossible in some cases to obtain separate and detailed returns for the light and power departments of electric railways (except in regard to income), and their energy output, capitalization, revenues, expenses, etc., were, therefore, credited in those reports entirely to electric railways, thus to a certain extent overstating the figures for that industry and understating them for the electric light and power industry. The revenues of these light and power departments were, however, tabulated separately. (See footnote 12, Table 1, of present report.) At the census for 1922 data for the light departments of 124 railways were included in the electric-railway report. For 1927, however, it was possible to obtain separate data for the light and power departments of all electric railway companies except 17 of the less important ones, which included their light and power data with those for their railway operations. Light and power departments making separate returns have been treated, for the purposes of this report, as independent light and power establishments.

Operating and lessor electric-railway companies.—The electric-railway industry embraces both operating and nonoperating, or lessor, companies. The lessor companies did not report the numbers and the compensation of employees, so that the statistics in regard to employees and their salaries and wages refer to operating companies only. The employees of the lessor companies (who are principally of the salaried class) are, however, relatively few in number. All organization and maintenance expenses of the lessor companies are included under "Expenses." The duplication in income and expenses arising from the payment, by operating companies to lessor companies, of rentals for leased roads (reported as expenses by operating companies and as income by lessor companies) has been eliminated.

GENERAL SUMMARY

Development since 1902.—The 25-year period covered by the statistics (1902 to 1927) was one of remarkable growth in the group of electrical industries as a whole and in each individual industry, except electric railways during the latter part of it. The value of plant and equipment was more than 5 times as large in 1927 as in 1902, income nearly 9 times, net income more than 6 times, number of employees about $3\frac{1}{2}$ times, and salaries and wages nearly 9 times. The rates of increase for various periods are given in Table 1.

In the individual industries the greatest growth occurred in electric light and power, which increased more than 1,700 per cent in value of plant and equipment, nearly 2,200 per cent in income, 1,680 per cent in salaries and wages, and nearly 730 per cent in number of employees. In most respects, but not in the number of employees or in salaries and wages, it has become the largest industry of the electrical group.

Telephones rank next in rate of growth, with increases of more than 1,000 per cent in income, nearly 800 per cent in value of plant and equipment, more than 350 per cent in number of employees, and over 1,200 per cent in salaries and wages. This industry leads the group in respect of the last two items.

Electric railways are second in number of employees, in salaries and wages, and in value of plant and equipment. A decrease in income during the 5-year period 1922–1927 caused them to fall to third place as regards income and to fourth in rate of increase for the 25-year period. This rate was about 90 per cent in number of employees, 400 per cent in salaries and wages, 285 per cent in income, and 86 per cent in value of plant and equipment.

The telegraph industry, fourth in magnitude as measured by number of employees, annual income, and value of plant and equipment, ranks third as to rate of increase in each of these items for the 25-year period.

Decreases in numbers of companies, establishments, or systems (Table 1).—The decreases in the number of central electric establishments between 1917 and 1927 and in the number of electric railways between 1917 and 1922 were caused principally by consolidations, and in the number of electric railways between 1922 and 1927 also by changes from railway to motor-bus operation. The declines shown in the number of telephone systems for 1907 in comparison with 1902 and for the period 1917–1922 are apparent, not real, the former having been due to the establishment of the \$5,000 minimum-income limit for 1907 and the latter to the increase of the limit from \$5,000 to \$10,000. (See footnote 1, Table 1.)

Rates of increase in numbers of employees and in salaries and wages (Table 1).—The advances in wage scales from census to census are brought out strikingly by the percentages of increase in Table 1. For every 5-year period and for every industry the rate of increase in salaries and wages was higher or (for electric railways between 1922 and 1927) the rate of decrease was lower than that in number of employees, and for the periods 1912–1917 and 1917–1922 the differences are pronounced. The combined rate for all industries for the 25-year period as a whole is more than three times as large for salaries and wages as for number of employees, and that relating to the 10-year period 1917–1927 is more than four times as large for salaries and wages as for number of employees.

Rate of increase in value of plant and equipment and in revenue (Table 1).—With some exceptions, the rates of increase in revenue have exceeded those in value of plant and equipment. In the period 1922-1927, however, the former were decidedly smaller than the latter for both commercial and municipal electric light and power establishments, for telephones, and for telegraphs, and were somewhat smaller for the group as a whole. For railways both decreased, the revenue less than the value of plant and equipment, there having been a marked decline in the last-named item.

Rates of increase in income and expenses (Table 1).—Until 1922, the rates of increase in expenses in general exceeded those in income, the net income having increased, therefore, at a smaller rate than the gross. In the period from 1922 to 1927, however, a reversal, anticipated during 1917-1922 in the electric light and power industry, occurred, and the income increased at a greater rate than the expenses. The telegraph industry did not participate in the change during the most recent period; and in the case of electric railways both decreased, expenses slightly more than revenue. This is the only instance, in any industry of the group and in any five-year period, of a recession in revenue, and it is clearly due to the enormous expansion in the use of automobiles and to the establishing of public motor-bus lines. (The figures for the electric-railway industry include data for bus lines operated *directly* by electric-railway companies but not for independent bus lines or for lines operated as subsidiaries or feeders for electric railways. For 1927, 482 bus lines, operating 2,064 buses were reported as operated directly by electric-railway companies.)

Statistics for municipal light and power plants and for telephones can not be included in comparisons of expenses for 1927 with those for earlier years, since the schedules used in canvassing such establishments for 1927 did not call for data on expenses.¹ As a consequence, the expenses given in the table for the group as a whole ("Aggregate," Table 1) for 1927 are not comparable with those for earlier years. The apparent decrease between 1922 and 1927 would be converted into a large increase if data for the omitted industries were included, and the apparent increase in net income would be correspondingly diminished.

During the entire 25-year period revenues increased at a greater rate than expenses in the commercial electric light and power industry, while the contrary is true for the electric-railway and telegraph industries.

Relative importance of industries (Table 1).—It will be seen from the "Per cent of aggregate" figures that the relative importance of the light and power industry has increased and that of the electric-railway industry has decreased from census to census. Until and including 1917 the electric-railway industry reported more than half the total value of plant and equipment, and for 1922 it reported a larger value than any other electrical industry. For 1927, however, the light and power industry was credited with 53.1 per cent of the total. The increases and decreases in the income percentages are especially noteworthy, the percentage for the light and power industry being much more than twice as large for 1927 as for 1902, while that for the electric-railway industry was less than half as large for the later year as for the earlier one. The telephone industry also has increased somewhat in relative importance.

Because of the omission for 1927 of certain data on expenses included for earlier years, the percentages of net income for that year would not be comparable with

¹ Data on expenses were collected from municipal light and power plants in cities having 25,000 inhabitants or more, but not from such plants in smaller cities. The expense items were omitted in preparing the schedules for the smaller municipal light and power companies and for telephone companies because of the impossibility of obtaining accurate and complete data for such companies.

those for earlier years. (See second paragraph under "Rates of increase in income and expenses.")

Comparison of prime movers in light and power plants and in electric-railway plants, 1907-1927 (Table 2).—During the period from 1907 to 1927 the horsepower of prime movers used by central electric light and power establishments increased nearly 800 per cent. The horsepower in electric-railway plants, on the other hand, after rising to its maximum in 1917, fell off slightly between that year and 1922, and during the subsequent half decade decreased by more than 50 per cent to an installation approximately 80 per cent as great as that of 1907. In the earlier year about 38 per cent of the total horsepower was in electric-railway plants; in 1927 only 5.4 per cent. The decrease during the last half decade is undoubtedly the result of two influences: First, a decrease in electric-railway operation due to the competition of the automobile and in particular of the public-utility motorbus;² second, the increasing tendency to centralize electric-power production in favorably located plants operated by electric light and power companies, which are thus in a position to supply energy to electric railways as well as to other large consumers.

Light and power compared with railway plants (Table 3).—The energy generated in light and power establishments increased greatly from 1917 to 1922 and from 1922 to 1927 in each of the nine geographic divisions. The maximum rate of increase between 1922 and 1927, 214.5 per cent, was recorded for the West South Central States. The energy generated in electric-railway plants, on the contrary, decreased in the United States as a whole during each half decade, and during the period from 1922 to 1927 decreased in each geographic division except the Middle Atlantic States.

This does not, however, imply a corresponding reduction in electric-railway operations. A large portion of the decrease is undoubtedly due to an increase in the tendency of electric railways and electrically operated sections of steam railroads to purchase their energy from power companies rather than to generate it in their own plants. The report for 1922 does not show separately the sales by electric light and power companies of energy for railway operations, so that it is therefore impossible to determine the amount by which such sales increased from 1922 to 1927. The increase may not have been equal to the reduction in output of electric-railway plants—almost precisely 3,500,000,000 kilowatt hours—but it probably went far toward counterbalancing that decrease.

Total generator rating and electrical output (Table 4).—The total generator rating shown by this table covers the installation both in public-utility and in private plants. In addition to the generators in use in central electric light and power stations, electric railways, electrified divisions of steam railroads, and manufacturing establishments, a considerable number are operated by mines and quarries, hotels, amusement parks, and other enterprises, principally for the purpose of generating current for their own use. In some cases establishments of this kind, such as mines, sell current, and where the quantity sold is sufficient to bring the establishment under the control of the Public Utilities Commission, according to the laws of the State in which located, the data are included in figures for central electric light and power stations. The statistics for "isolated" plants refer, therefore, to generators of 100-kilowatt capacity or more which are not operated for the commercial production of electric current.

In determining the total energy generated, certain estimates had to be made. The returns from manufacturing establishments obtained in the 1927 Census of Manufactures were substantially complete in respect of number and capacity

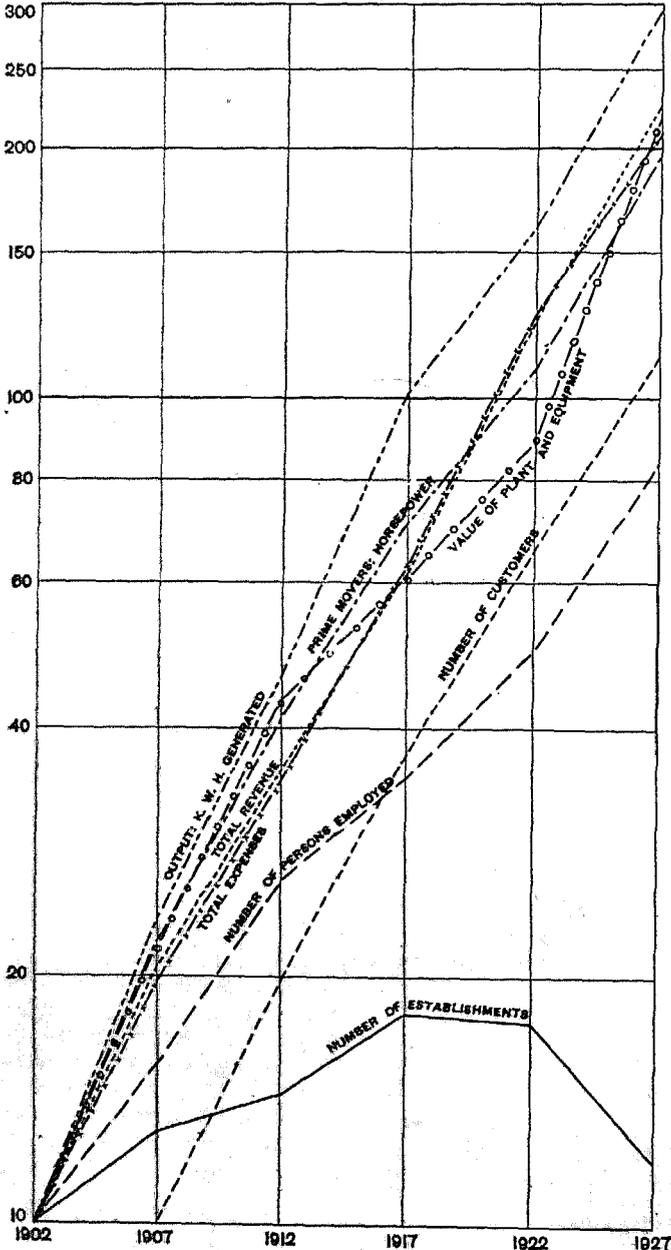
² See explanation in parentheses at end of paragraph entitled "Rates of increase in income and expenses," page 3.

of generators, but were incomplete in regard to output. The generator capacity reported by the establishments whose returns were complete amounted to a little more than 80 per cent of the generator capacity for all manufacturing establishments. It became necessary, therefore, to estimate the output for generators whose combined capacity was nearly 20 per cent of the total for manufacturing establishments. This was done on the assumption that the number of kilowatt-hours generated per kilowatt of rated capacity was the same for the generators for which no output was reported as for those for which the returns were complete. The estimated part of the output of manufacturing establishments amounts to approximately 4,000,000,000 kilowatt-hours, or only about 4 per cent of the aggregate for all classes of establishments.

Light and power compared with all electric installations (Table 4).—The capacity of generators in central electric light and power stations constituted 71.2 per cent of the total rated capacity of 36,275,001 kilowatts, as reported for all industries covered by Table 4, and they generated 72.7 per cent of the total of 102,759,753,811 kilowatt-hours.

GROWTH OF THE ELECTRIC LIGHT AND POWER INDUSTRY: 1902-1927

[This diagram shows the relative rates of increase or decrease for the leading factors during the period from 1902 to 1927. All increases are shown with reference to 1902 except for number of customers, which item was first reported for 1907. For the purpose of calculating the rate of increase in total expenses during the period from 1922 to 1927 it was necessary to estimate the expenses of municipal establishments for the later year. (See "Commercial and municipal," p. 14.) This estimate was based on the assumption that the ratio between expenses and income for municipal establishments remained unchanged from 1922 to 1927.]



CENTRAL ELECTRIC LIGHT AND POWER STATIONS

TABLE 1.—SUMMARY, BY INDUSTRIES: 1902 TO 1927

Number of companies, establishments, or systems.	Census year	CENTRAL ELECTRIC LIGHT AND POWER ESTABLISHMENTS			Electric rail-ways and bus lines operated directly by electric rail-way companies	Telephones ¹	Telegraphs ² (land and ocean)	PER CENT OF AGGREGATE			
		Total	Commercial	Municipal				Central electric light power establishments	Electric rail-ways	Tele-phones	Tele-graphs
6,409	1927	4,335	2,137	2,198	681	1,368	25	67.7	10.6	21.3	0.4
8,908	1922	6,355	3,774	2,581	1,200	1,323	25	71.4	13.5	14.8	0.3
10,076	1917	6,542	4,224	2,318	1,307	2,200	27	64.9	13.0	21.8	0.3
8,424	1912	5,221	3,059	1,562	1,260	1,916	27	62.0	15.0	22.7	0.3
7,612	1907	4,714	3,462	1,252	1,236	1,636	26	61.9	15.2	21.5	0.3
8,783	1902	3,620	2,805	1,815	1,987	4,151	25	41.2	11.2	47.3	0.3
Per cent of increase ³ :	1902-1927	-27.0	-23.8	169.7	-31.0	-67.0					
	1917-1927	-36.4	-49.4	-5.2	-47.9	-37.8	-7.4				
	1922-1927	-28.0	-43.4	-14.8	-43.2	3.4					
	1917-1922	-11.6	-10.7	11.3	-8.2	-39.0					
	1912-1917	19.6	15.4	48.4	3.7	14.8					
	1907-1912	10.7	5.7	24.8	1.9	17.1					
	1902-1907	-13.3	23.4	53.6	25.2	-60.6	4.0				
Employees, salaries, and wages:											
Number of employees.	1927	251,020	234,747	10,273	267,115	356,730	481,498	26.3	27.9	37.3	8.5
	1922	810,250	130,105	14,657	300,523	200,333	468,632	18.6	37.1	34.8	8.5
	1917	709,580	94,679	10,862	294,826	244,490	464,723	14.9	41.5	31.5	9.1
	1912	682,452	71,395	7,040	282,461	183,361	437,205	13.6	48.5	31.7	6.4
	1907	428,765	42,066	5,586	231,429	131,670	458,034	11.1	51.7	30.7	6.5
	1902	277,474	30,909	8,417	140,788	75,752	427,627	10.9	50.7	28.4	10.0

¹ Excludes systems reporting annual incomes of less than \$10,000 for 1922 and those reporting less than \$5,000 for 1917, 1912, and 1907, but includes for 1902 some systems reporting incomes of less than \$5,000. The total numbers of systems and lines reported in the several censuses were as follows: 1927, 60,148; 1922, 57,283; 1917, 53,234; 1912, 52,235; 1907, 22,971; 1902, 9,136.

² Includes Commercial Cable Co. of Cuba for 1927, 1922, 1917, 1922, and 1907; not reported for 1902. Does not include wireless systems. For statistics for wireless systems, see report on "Telegraphs."

³ A minus sign (-) denotes decrease.

⁴ Includes messengers.

⁵ Exclusive of 7,516 messengers.

CENTSUM OF ELECTRICAL INDUSTRIES: 1927

TABLE 1.—SUMMARY, BY INDUSTRIES: 1902 TO 1927—Continued

Census year	Aggregate	CENTRAL ELECTRIC LIGHT AND POWER ESTABLISHMENTS			Electric rail-ways and bus lines operated directly by electric rail-way companies	Telephones	Telegraphs (land and ocean)	PER CENT OF AGGREGATE			
		Total	Commercial	Municipal				Central light and power establishments	Electric rail-ways	Tele-phones	Tele-graphs
1902-1927	244.7	737.7	772.4	376.2	89.8	353.0	105.0				
1917-1927	34.8	137.8	147.9	48.8	-9.4	45.0	23.7				
1912-1927	18.0	66.5	72.5	11.0	-1.1	25.0	18.7				
1912-1917	14.2	42.8	43.8	34.9	1.9	18.8	18.0				
1907-1917	21.8	33.0	32.6	36.8	4.4	33.3	73.5				
1907-1912	35.8	66.6	68.7	42.7	27.6	39.3	33.0				
1902-1907	54.5	57.1	56.3	62.9	57.3	67.2	1.5				
1927	\$1,384,844,391	\$937,631,756	\$397,631,756	(9)	\$441,651,958	\$475,846,320	\$99,520,357				
1922	1,075,812,538	212,432,655	194,148,121	\$18,284,534	445,680,135	341,537,822	76,161,026	19.7			
1917	575,901,497	95,241,858	86,473,496	8,768,362	207,240,302	169,655,066	43,704,231	16.6			
1912	383,088,415	61,161,941	55,668,515	5,503,426	200,890,939	98,040,541	7,24,963,204	16.9			
1907	269,229,021	35,420,324	31,935,309	3,485,015	150,991,090	65,006,340	17,808,293	18.2			
1902	100,162,151	20,646,692	18,706,970	1,939,722	88,210,165	39,256,621	15,039,673	12.9			
1902-1927	764.8	1,080.6	1,858.9		401.0	1,212.5	591.7		41.4		7.1
1917-1927	140.5	286.0	325.1		65.4	180.5	127.4		46.4		7.6
1912-1927	28.7	78.1	89.4		-0.8	39.3	30.7		52.4		6.5
1917-1912	86.8	123.0	124.5		33.0	101.3	74.0		56.1		9.4
1912-1917	50.3	58.7	55.4	108.5	78.0	78.0	75.3		55.1		6.6
1907-1912	42.3	72.7	74.3	59.3	33.0	47.7	40.2				
1902-1907	68.1	71.6	70.2	85.4	71.2	79.3	18.4				
1927	\$17,496,102,107	\$8,297,438,856	\$8,850,291,499	\$417,166,857	\$4,295,743,053	\$3,475,201,956	\$426,698,742		24.6		2.4
1922	12,868,245,858	4,465,015,691	4,299,366,023	235,659,668	5,446,794,547	2,128,773,760	326,691,800		44.0		2.6
1917	10,271,886,533	3,060,392,141	2,933,016,941	127,375,200	5,552,223,318	1,435,912,142	243,358,432		53.9		2.4
1912	8,192,823,625	2,175,675,266	2,098,613,122	77,065,144	4,714,665,386	1,081,433,227	222,046,746		57.3		2.7
1907	5,906,208,490	1,096,913,622	1,054,094,175	42,876,447	3,778,831,801	820,417,068	210,045,959		68.0		3.6
1902	3,363,980,262	504,740,352	482,719,879	22,020,473	2,308,282,999	389,278,232	161,679,579		68.6		4.8
1902-1927	420.1	1,742.9	1,793.6	1,794.5	85.1	792.7	163.9				
1917-1927	70.3	203.8	202.8	227.5	-22.3	142.0	75.3				

TABLE 1.—SUMMARY, BY INDUSTRIES: 1902 TO 1927—Continued

Census year	Aggregate	CENTRAL ELECTRIC LIGHT AND POWER ESTABLISHMENTS			Electric rail-ways and bus lines operated directly by electric rail-way companies	Telephones	Telegraphs (land and ocean)	PER CENT OF AGGREGATE			
		Total	Commercial	Municipal				Central electric light and power establishments	Electric rail-ways	Tele-phones	Tele-ographs
1927	\$600,396,874	\$505,787,025	\$505,787,025	\$18,306,762	\$70,578,395	\$80,663,943	\$23,844,454	52.2	18.2	23.7	5.9
1922	407,232,237	212,494,792	194,188,030	8,819,307	74,206,021	23,867,471	23,867,471	38.7	31.5	22.9	6.9
1917	259,337,000	100,326,933	91,504,029	6,301,807	81,770,058	50,388,740	17,832,269	31.8	41.1	24.1	3.0
1913	213,061,221	97,696,121	61,394,207	3,695,379	87,654,884	51,226,325	6,383,891	25.7	42.7	25.6	6.0
1907	181,082,464	41,446,437	37,750,048	1,719,118	68,787,551	41,225,231	9,704,255	18.2	49.0	22.4	10.3
1902	96,619,922	17,619,280	15,900,112	(14)	47,357,923	21,660,765	9,982,004				
1909-1927	(15)	(15)	3,081.0	(15)	49.0	(15)	138.9				
1917-1927	(15)	(15)	462.7	(15)	-13.7	(15)	33.7				
1922-1927	(15)	(15)	160.5	(15)	-4.9	(15)	-0.1				
1917-1922	57.0	111.8	112.2	107.6	-0.3	62.7	33.8				
1913-1917	21.7	48.2	49.0	39.9	-6.7	15.7	179.3				
1907-1912	32.2	63.3	62.6	70.5	27.4	24.5	-34.2				
1902-1907	66.8	135.2	137.4	115.0	45.3	90.3	-2.8				

A minus sign (-) denotes decrease.
 14 Because of the inclusion of certain data on expenses in the figures for 1922 and earlier years and the omission of such data for 1927, it is impossible to calculate percentages for 1927, comparable with those for earlier years, for expenses and net income. Moreover, the comparability of the percentages for income is affected slightly by the inclusion of data for income other than operating income in the figures for 1922 and earlier years and the exclusion of such data from the 1927 figures for municipal light and power plants and for telephone companies.
 15 In order to have 1927 data comparable with those for prior years, a further deduction of \$4,801,550 should be made. This amount comprises excess of rents paid over rents received and amortization of franchises \$17,185,320 (called for as net items on the 1927 schedule); and appropriations from surplus for depreciation or retirement reserves, \$37,616,230.

TABLE 2.—PRIME MOVERS—NUMBER AND RATED HORSEPOWER, BY TYPE, FOR CENTRAL ELECTRIC LIGHT AND POWER ESTABLISHMENTS AND FOR ELECTRIC RAILWAYS: 1907 to 1927

CLASS OF ESTABLISHMENTS	AGGREGATE		STEAM				INTERNAL-COMBUSTION ENGINES		HYDROTURBINES				
	Number	Horsepower	Total		Engines		Number	Horsepower	Number	Horsepower			
			Number	Horsepower	Number	Horsepower							
Total:													
1927	12,452	37,735,940	5,497	27,269,923	3,008	25,884,761	2,489	1,415,162	3,188	555,988	3,767	9,880,088	
1922	14,750	23,970,166	7,704	17,408,880	2,868	15,210,557	4,836	2,198,823	3,303	335,490	3,743	6,225,796	
1917	15,905	17,136,947	8,228	9,070,091	2,263	9,070,091	6,965	2,022,900	2,987	288,700	3,690	4,905,256	
1912	14,691	11,191,439	10,105	8,115,666	1,496	4,517,196	8,069	3,898,470	1,164	135,225	3,222	2,940,538	
1907	14,635	6,618,011	11,422	5,104,800	629	1,352,814	10,993	3,751,986	1,504	72,163	2,769	1,441,048	
Light and power establishments:													
1927	12,030	35,710,128	5,131	25,317,577	2,864	24,323,304	2,267	994,273	3,177	648,288	3,722	9,844,263	
1922	13,240	19,850,860	6,505	13,725,847	2,330	12,354,551	4,175	1,371,290	3,256	302,985	3,481	5,822,018	
1917	13,795	12,936,755	7,487	8,440,076	1,099	6,747,399	5,788	1,701,677	2,934	210,406	3,374	4,277,273	
1912	11,902	7,630,044	7,847	4,046,778	1,034	3,084,396	6,813	1,701,677	1,116	111,035	2,939	2,463,231	
1907	10,995	4,068,188	8,054	2,693,273	377	817,410	7,677	1,875,863	463	55,828	2,481	1,349,087	
Electric railways:													
1927	422	2,025,821	366	1,982,346	144	1,561,457	222	420,889	11	7,700	45	35,775	
1922	1,598	4,119,306	1,199	3,683,033	538	2,856,004	661	827,027	47	29,495	262	403,778	
1917	2,110	4,200,192	1,741	3,543,915	564	2,322,682	1,177	1,221,223	53	28,264	316	627,983	
1912	2,689	3,661,385	2,258	3,165,888	462	1,462,800	1,796	1,703,088	48	24,190	383	471,307	
1907	3,537	2,519,823	3,368	2,411,527	252	1,535,404	3,116	1,376,123	41	16,335	228	91,961	
Total:													
1922-1927	-15.0	57.4	-28.0	56.8	4.9	70.2	-48.5	-35.6	-3.5	65.7	0.6	58.7	
1917-1922	-7.3	39.9	-10.5	45.2	20.7	67.7	-30.0	-24.8	10.6	40.5	1.4	56.9	
1912-1917	9.0	53.1	-8.7	47.8	100.8	100.8	-13.5	-13.5	196.0	76.9	11.1	66.8	
1907-1912	-0.3	69.1	-11.5	59.0	137.8	233.9	-20.2	-4.1	131.0	57.4	22.0	104.1	
Light and power establishments:													
1922-1927	-6.2	79.9	-21.1	84.5	22.0	96.9	-45.7	-27.5	-2.4	81.0	6.9	66.1	
1917-1922	-4.0	53.4	-13.1	62.5	37.1	83.1	-27.9	-19.4	11.0	44.0	3.2	39.1	
1912-1917	15.9	71.8	-4.0	64.3	64.3	120.9	-15.0	-10.2	162.9	89.5	14.8	73.2	
1907-1912	8.2	83.7	-2.6	83.8	174.3	273.7	-11.3	1.0	141.0	98.9	18.5	83.0	
Electric railways:													
1922-1927	-72.0	-50.8	-09.5	-46.2	-73.2	-45.3	-66.4	-46.1	-----	-76.3	-82.8	-91.1	
1917-1922	-28.5	-1.9	-31.1	3.9	-4.6	23.0	-43.8	-32.3	-----	14.8	-17.1	-35.7	
1912-1917	-21.5	14.7	-22.9	11.9	22.1	58.8	-34.5	-28.3	-----	17.5	-17.5	33.2	
1907-1912	-26.1	45.3	-33.0	31.3	83.3	173.2	-42.4	-9.2	-----	48.1	-68.0	412.5	

PER CENT OF INCREASE

1 A minus sign (-) denotes decrease. Per cent not computed where base is less than 100.

TABLE 3.—CURRENT GENERATED, KILOWATT-HOURS, ELECTRIC LIGHT AND POWER ESTABLISHMENTS, AND ELECTRIC RAILWAYS, BY GEOGRAPHIC DIVISIONS: 1927, 1922, AND 1917

DIVISION	Census year	Total	Light and power establishments (purely electric and composite)	Electric railways
United States.....	1927	77,662,241,303	74,686,378,010	2,975,863,293
	1922	46,764,987,136	40,291,536,435	6,473,450,701
	1917	32,678,806,061	25,438,303,272	7,240,502,789
New England.....	1927	5,228,269,056	4,750,193,632	478,075,424
	1922	3,598,451,235	2,969,971,441	628,479,794
	1917	2,642,446,330	1,835,584,072	800,862,258
Middle Atlantic.....	1927	21,094,636,133	19,281,644,834	1,812,991,299
	1922	12,459,796,668	10,765,515,044	1,694,281,624
	1917	9,331,673,441	7,659,317,763	1,672,355,678
East North Central.....	1927	18,366,146,055	18,211,894,585	154,251,470
	1922	10,781,058,214	9,368,260,227	1,412,797,987
	1917	7,532,355,405	5,757,150,135	1,775,205,270
West North Central.....	1927	4,868,765,906	4,549,263,907	319,501,999
	1922	3,584,644,522	2,968,756,855	615,887,667
	1917	2,454,144,137	1,776,475,523	677,668,614
South Atlantic.....	1927	8,486,453,712	8,445,216,788	41,236,924
	1922	4,826,310,894	3,789,434,350	1,036,876,538
	1917	2,587,663,188	1,745,295,143	842,368,045
East South Central.....	1927	2,832,442,342	2,777,268,044	55,174,298
	1922	1,545,083,914	1,419,833,684	125,250,230
	1917	1,252,280,629	1,048,814,771	203,465,858
West South Central.....	1927	3,346,057,716	3,275,021,117	71,036,599
	1922	1,493,620,350	1,041,392,651	452,227,699
	1917	788,185,132	482,045,862	305,539,270
Mountain.....	1927	3,433,146,636	3,389,551,356	43,595,280
	1922	2,317,937,714	2,209,444,164	108,493,550
	1917	2,135,949,169	2,036,194,737	99,754,432
Pacific.....	1927	10,006,323,747	10,000,323,747	-----
	1922	6,158,083,625	5,758,928,013	399,155,612
	1917	3,954,108,630	3,096,825,266	857,283,364

TABLE 4.—GENERATORS, NUMBER AND CAPACITY, AND OUTPUT OF ELECTRIC CURRENT, FOR THE ELECTRICAL INDUSTRIES, MANUFACTURING ESTABLISHMENTS, AND ISOLATED PLANTS,¹ BY GEOGRAPHIC DIVISIONS AND STATES: 1927

	GENERATORS		Current generated (kilowatt-hours)
	Number	Rated capacity (kilowatts)	
UNITED STATES, total.....	35,338	86,275,001	102,759,753,811
Central electric light and power stations.....	11,967	25,811,205	74,686,378,010
Electric railways.....	410	1,470,004	2,975,863,293
Electrified divisions of steam railroads.....	64	258,335	844,780,815
Manufacturing establishments.....	19,028	7,345,685	20,558,426,000
Isolated plants ¹	3,860	1,288,772	3,694,306,193
GEOGRAPHIC DIVISIONS:			
New England.....	3,880	3,538,788	7,567,722,431
Middle Atlantic.....	8,789	9,792,061	28,616,322,115
East North Central.....	8,355	9,023,224	28,234,130,767
West North Central.....	3,915	2,627,252	6,107,567,671
South Atlantic.....	3,284	4,027,014	10,758,869,050
East South Central.....	1,583	1,362,543	3,788,200,963
West South Central.....	2,607	1,442,315	4,286,225,490

¹ Mines and quarries, hotels, amusement parks, apartment houses, theaters, office buildings, etc., which operated generators of 100-kilowatt capacity or more. See text, p. 4.

² Estimated in part. See text, p. 4.

TABLE 4.—GENERATORS, NUMBER AND CAPACITY, AND OUTPUT OF ELECTRIC CURRENT, FOR THE ELECTRICAL INDUSTRIES, MANUFACTURING ESTABLISHMENTS, AND ISOLATED PLANTS,¹ BY GEOGRAPHIC DIVISIONS AND STATES: 1927—Continued

	GENERATORS		Current generated (kilowatt hours)
	Number	Rated capacity (kilowatts)	
GEOGRAPHIC DIVISIONS—Continued.			
Mountain.....	1, 470	1, 342, 791	4, 437, 541, 120
Pacific.....	1, 425	3, 117, 183	10, 983, 174, 204
NEW ENGLAND:			
Maine.....	444	301, 536	973, 843, 766
New Hampshire.....	412	279, 879	679, 847, 082
Vermont.....	258	173, 570	409, 819, 495
Massachusetts.....	1, 091	1, 769, 080	3, 313, 270, 365
Rhode Island.....	312	333, 463	670, 668, 445
Connecticut.....	763	681, 210	1, 515, 773, 278
MIDDLE ATLANTIC:			
New York.....	3, 344	4, 096, 609	13, 852, 904, 989
New Jersey.....	1, 466	1, 137, 560	2, 893, 234, 235
Pennsylvania.....	3, 989	3, 958, 822	11, 870, 182, 911
EAST NORTH CENTRAL:			
Ohio.....	2, 001	2, 579, 717	7, 244, 404, 198
Indiana.....	1, 058	1, 104, 281	3, 006, 574, 864
Illinois.....	2, 249	2, 613, 631	7, 596, 283, 632
Michigan.....	1, 665	1, 835, 939	5, 789, 716, 408
Wisconsin.....	1, 382	889, 656	2, 597, 151, 665
WEST NORTH CENTRAL:			
Minnesota.....	704	617, 382	1, 341, 119, 448
Iowa.....	627	601, 128	1, 841, 302, 227
Missouri.....	865	666, 208	1, 226, 779, 130
North Dakota.....	201	40, 492	67, 496, 194
South Dakota.....	213	63, 397	143, 936, 715
Nebraska.....	608	218, 124	491, 447, 070
Kansas.....	697	420, 521	995, 480, 887
SOUTH ATLANTIC:			
Delaware.....	89	55, 098	168, 280, 755
Maryland.....	391	431, 407	1, 012, 879, 632
District of Columbia.....	82	179, 202	435, 644, 034
Virginia.....	603	534, 036	1, 417, 662, 830
West Virginia.....	576	812, 881	2, 525, 069, 517
North Carolina.....	498	662, 822	2, 235, 778, 528
South Carolina.....	335	559, 796	1, 294, 554, 057
Georgia.....	608	446, 284	973, 583, 125
Florida.....	402	345, 738	695, 896, 572
EAST SOUTH CENTRAL:			
Kentucky.....	454	390, 744	876, 062, 584
Tennessee.....	477	420, 221	1, 189, 595, 502
Alabama.....	284	440, 643	1, 518, 993, 541
Mississippi.....	378	110, 935	183, 549, 330
WEST SOUTH CENTRAL:			
Arkansas.....	331	118, 152	220, 820, 148
Louisiana.....	538	298, 989	915, 252, 280
Oklahoma.....	470	281, 847	855, 910, 686
Texas.....	1, 218	743, 327	2, 294, 242, 376
MOUNTAIN:			
Montana.....	155	277, 048	1, 422, 578, 701
Idaho.....	170	223, 895	753, 500, 710
Wyoming.....	240	59, 195	131, 945, 610
Colorado.....	359	291, 187	745, 529, 031
New Mexico.....	143	41, 875	67, 139, 219
Arizona.....	198	263, 339	774, 557, 165
Utah.....	138	148, 727	375, 421, 540
Nevada.....	67	37, 525	160, 868, 144
PACIFIC:			
Washington.....	396	753, 370	2, 514, 329, 899
Oregon.....	237	275, 098	1, 040, 067, 576
California.....	792	2, 088, 745	7, 428, 776, 729

For footnote 1, See p. 12.

CENTRAL ELECTRIC LIGHT AND POWER STATIONS

GENERAL EXPLANATIONS

Definition of establishment.—In this report the term “establishment” has been used to signify the plant or plants and equipment operated under a single ownership. It may comprise one or more generating stations, together with distributing equipment; or it may comprise generating equipment only, in the case of establishments which sell their entire output to other establishments for distribution; or it may consist of distributing equipment only, in the case of establishments which purchase their entire output. Thus the number of establishments (4,335 in 1927) differs considerably from the number of separate generating stations (4,801), and the latter is more than twice the number of establishments generating all or a part of their current.

Character of establishments canvassed.—The statistics in this report relate to all commercial or municipal public-service plants which were engaged during any portion of the calendar year 1927 in the generation and distribution of electric current to public or private consumers for light, power, and heat; or in the generation of current for sale in bulk to electric railways or to other light and power establishments for distribution; or in the distribution of current generated by plants under other ownership.

The large group of so-called “isolated” plants operated in connection with mines, factories, hotels, amusement parks, etc., or plants operated by the Federal government or by State governments, or plants which were idle throughout the year or were in process of construction at the end of the year, were canvassed by means of a short and simple schedule. Statistics for this group are presented in Table 27 but are not included in any of the other tables.

Classification of establishments.—In this report the light and power establishments are classified in four ways for the purposes of statistical analyses:

(1) *Commercial and municipal.*—This is the most common grouping. Establishments of the former class are operated by corporations, firms, and individuals; those of the latter, by municipalities. It is worthy of mention that municipal establishments issue no capital stock and rarely pay taxes. The schedules sent to the smaller municipal establishments did not call for data on operating expenses for the reason that, because of dissimilarities in accounting methods, the resulting statistics would not be comparable with those for commercial establishments. The schedule used in the canvass of municipal plants in cities having 25,000 inhabitants or more did, however, include this item. (Municipal establishments in cities having 25,000 inhabitants or more were canvassed by the same schedule as was used for commercial establishments.) The results are presented in Tables 66 and 69 of this report.

(2) *Purely electric and composite.*—The purely electric establishments are those engaged solely in the generation or in the distribution, or in both the generation and the distribution, of electrical energy. The composite establishments are those which carry on other industrial activities in connection with electric service, such as the operation of waterworks, the manufacture of gas or of ice, the operation of electric railways, etc. In some cases an establishment of this character keeps only one system of accounts, and as a result it was impossible to obtain exact data

for the light and power business separately from the other lines of work carried on. Where the nonelectrical business was merely incidental to the operation of the light and power plant, the report was accepted, with or without data covering such business, in accordance with the system of accounting employed by the reporting company. Where the nonelectrical business was of considerable importance, careful estimates were obtained, if possible, in order that the data might relate only to the operations of the light and power plant; but in a few cases of this kind it was found impracticable to make a satisfactory segregation of the data for the electrical business, and in such cases the returns necessarily covered all the activities of the establishments reporting.

When income was reported from steam heating, usually by surplus steam, no attempt was made to segregate the data for heating from those relating to electric service; and, since the sale of electrical supplies and the wiring of buildings, etc., form a part of the business of many light and power companies, the income from such sources was also included. Plants whose nonelectric income was derived only from these sources are not regarded as composite, and the income in question has invariably been tabulated under "All other sources."

(3) *Generating and purchasing.*—Generating establishments are those which produce all or any part (even though a minor part) of their output in their own generating stations. Purchasing establishments are those which purchased all the current distributed by them during the census year, even though they may have maintained generating equipment not in use. For the latter class, as compared with the former, the investment is normally much smaller in proportion to the amount of business done, and the statistics are in general much less complex.

(4) *Hydroelectric and other.*—No attempt has been made in this report to make an arbitrary classification of establishments into two mutually exclusive groups, one hydroelectric and one otherwise designated. Instead, in view of the fact that more than two-thirds of the industry's water-power development is found in establishments operating both hydroelectric and fuel-burning plants with widely varying ratios of rated power, statistics are presented in several groupings. These groupings are used in order to make possible a variety of comparisons, both between the groups and with previously published statistics, and therefore in some instances they overlap. The group "Establishments reporting water power of 1,000 horsepower or more" is presented for comparison with the "Hydroelectric establishments" for which statistics are given in the report for 1922. In the census for 1922 the group of establishments not classified as hydroelectric comprised (a) those which derived their power solely from steam engines or turbines or internal-combustion engines, (b) those which utilized any of these classes of primary-power machines and, in addition, water wheels or turbines rated at less than 1,000 horsepower, and (c) those which employed water power only but reported less than 1,000 horsepower.

Allocation of establishments to States.—In compiling the statistics for geographic divisions and for States each establishment which generated all or any part of its output was allocated to that State in which all or the greater part of the output of its generating stations was produced, and each establishment which purchased its entire output was allocated to that State in which its distributing station or stations were located, or, if it distributed in more than one State, to that State in which the greater part of its current was distributed. Thus it was sometimes necessary to allocate an establishment as a whole to a State in which it generated, or in which it distributed, only a part of its output. Moreover, in many cases an establishment, even though its entire output was generated or distributed in a single State, served customers in one or more adjoining States. The data for prime movers, generators, transmission lines, fuel consumption, energy output, energy disposal, customers, and revenue from disposal of energy were, however, reported separately for each State.

Area and period covered.—The census of electric light and power plants covered the 48 States and the District of Columbia, no canvass of the outlying possessions having been made. The statistics compiled from the returns of the recent census relate, as a rule, to the calendar year 1927. In some cases, however, returns were accepted for fiscal years ended late in 1927 or early in 1928, when it did not seem practicable to obtain accurate figures otherwise. Data have also been included for certain establishments which were in operation during periods of less than 12 months, namely: (1) New plants which began operations at some time within the calendar year; (2) plants which suspended operations during a part of the year because of accidents or for other reasons; (3) those which passed out of existence within the year; (4) those which were succeeded by other plants within the year. For the last-mentioned class, however, combined returns were prepared representing the entire year's operation.

The statistics in regard to equipment and the balance sheet relate to December 31, or to the last day of the business year covered by the report of each establishment. The number of employees was reported as of June 30, or the nearest representative day.

Earlier censuses.—The census of electric light and power stations has been taken at quinquennial intervals, beginning with 1902. Prior to that year, however, two partial canvasses of the industry had been made. The first, which was made in connection with the census of manufactures in 1890, covered only the State of New York and the city of St. Louis. At the second, which was made by the Commissioner of Labor in 1898, returns were obtained from 320 of the 460 known municipal plants and 632 of the 2,572 commercial plants then in existence.

The schedules used at the six quinquennial canvasses were similar in general scope, but numerous changes in detail have been made from census to census.

The most important revisions which appear in the schedule for 1927 as compared with that for 1922 are: (1) An extension of the provision for engineering data and (2) the omission of data on substations and on the operating expenses of municipal establishments in cities having fewer than 25,000 inhabitants. (Municipal establishments in cities having 25,000 inhabitants or more were canvassed by the same schedule as was used for commercial establishments.) The former change comprises a more detailed classification of prime movers, of generators, of transmission lines; a more detailed allocation of the energy output among the various classes of consumers; a classification by source; and the addition of statistics on fuel consumption.

Light, heat, and power.—Since in the cases of many customers using current both for light and for heat and power only one meter is used for measuring the consumption, it is impossible to show a complete distribution of current consumed in these two classes of service. Domestic service, while consisting largely of lighting, also includes the operation of small appliances in which current is used for heat and power. Moreover, there is evidence that this form of application of electrical energy is increasing, probably at a more rapid rate than is the use of energy for lighting in the home.

Commercial service is divided into two groups, "Small light and power (retail)" and "Large light and power (wholesale)." On the whole, lighting predominates in the former whereas it accounts for but a small percentage of the energy consumed under the latter heading. Energy sales at wholesale to ultimate consumers are almost invariably made for industrial purposes, i. e., the operation of mills and factories and, in cities, the lighting of large office buildings. They include electrical energy used for thermal or electrochemical processes.

Free service.—In earlier censuses an estimated value was put on free service rendered by establishments in supplying energy for lighting streets, parks, and public buildings. In the present report the amount of energy used for free service is stated (Table 23), but no value has been assigned to it.

Chapter I.—GROWTH OF THE ELECTRIC LIGHT AND POWER INDUSTRY

The most obvious characteristic of the electric light and power industry during the past 25 years has been its uninterrupted growth in magnitude from census to census (Table 5). This has been accompanied by a continual increase in mechanization and in the size both of the individual plant and of the generating units, involving a decided decrease in the number of establishments during the last decade of the period under review and an even more striking decrease in the number of those establishments which generate all or a part of their energy (as distinguished from those operated entirely on purchased energy). The group of establishments generating all or a part of their energy decreased from 4,389 to 2,331 during the final 5-year period.

Thus, comparing 1927 with 1902, the number of kilowatt hours generated was 30 times as large; the kilowatt capacity of generators, 21 times; the horsepower of prime movers, 19 times; the value of plant and equipment, 18 times; and the number of persons employed, 8 times. The customers were 11 times as numerous in 1927 as in 1907. (The number in 1902 was not reported.)

In this remarkable growth both classes of establishments, municipal and commercial, participated at an almost equal rate, so that the proportions between the two have not changed radically in 25 years; in the latter part of the period the rate for commercial has in most respects been somewhat greater than that for municipal systems. In 1927 the former generated 95.5 per cent of all the energy, had 90 per cent of the customers, and operated about 94 per cent of the prime-mover horsepower. Numerically, however, more than half the establishments were municipal, their average size, therefore, being much less than that of the commercial.

Although the horsepower of prime movers was 19 times as large at the end of the period as at the beginning, the number of units increased only 61 per cent, the average rating per unit having been about 12 times as high in 1927 as in 1902. In the case of generators, the rate of increase in average rating per unit nearly kept pace with that in the total kilowatt capacity, so that, although the combined capacity was multiplied by 21, the number, 12,000 in 1927, did not depart by more than 12 per cent from this figure at any enumeration within the 25-year period.

Total revenue and revenue from electric service (Table 5).—Total revenue includes, in addition to revenue from electric service, the net income from other than operating sources for purely electrical establishments and, for composite establishments, the net income from the operation of other utilities. In each group the revenue has greatly increased during each 5-year interval of the entire 25-year period. For the industry as a whole the growth in energy output has been even greater, except between 1917 and 1922, when a general rise of commodity prices occurred. Although the net nonelectric revenue has been increasing, and although it was nearly three times as great in 1927 as in 1922, it still constitutes only about 8 per cent of the total. For purely electric commercial establishments it was less (4.4 per cent). The larger ratio (10.8 per cent) for composite commercial establishments is accounted for in part by the \$85,248,300 (Table 25) net revenue from the operation of other utilities.

For municipal establishments, both purely electric and composite, the same figures appear in Table 5 for total revenue and for revenue from electric service. The schedules sent to municipal establishments in cities having fewer than 25,000 inhabitants did not call for data on nonelectric revenue. From the statistics for the larger cities (Tables 68 and 69) it appears that their nonelectric revenues amounted to \$1,664,620, which is about 3 per cent of the total revenues for this group. Of this, by far the larger part came from the operation of other utilities; the nonoperating revenue was only \$202,861. Since the electrical bureaus of municipalities do not in general engage in the merchandising of appliances, the omission of such data for the entire municipal group does not seriously affect the conclusions to be drawn from the statistics.

Revenue compared with investment (Table 14).—Compared with most other industries, the value of plant and equipment in the electric light and power industry per dollar of annual revenue is large. It has varied from census to census, but except in 1922 more than \$5 worth of plant was required to earn a dollar of revenue. From \$5.88 in 1902 the amount rose to \$7.31 in 1912, fell to \$4.31 in 1922, then increased again to \$5.09 in 1927. An unusually large fraction of the earnings is therefore consumed in meeting capital charges.

Steam and water power (Table 7).—The ratio of water power to power in other forms for the operation of prime movers has not varied greatly since 1907. Horsepower in hydroturbines constituted about 28 per cent of the total in 1927. This was the minimum for the 20-year period; the maximum was 33.1 per cent for 1917. In 1927 more than 68 per cent of the total horsepower was in the form of steam turbines. The horsepower in steam engines has decreased at each successive census since 1912. The horsepower in internal-combustion engines has been increasing rapidly, but still constituted only a very small proportion of the total in 1927—approximately 1.5 per cent.

Growth in plant and output (Tables 7 and 11).—The installed horsepower in central electric light and power plants has increased far more rapidly than the population, having risen from 0.02 horsepower per capita in 1902 to 0.30 in 1927.

The energy generated has also increased at a much more rapid rate than the population. During each of the first three 5-year periods it approximately doubled; during the last two it increased at a somewhat less rapid rate, but nevertheless rose in 1927 to 630 kilowatt-hours per capita. It is to be particularly noted that this figure takes into account energy generated by central electric light and power establishments only; it would be considerably larger if data for the output of the various other producers of electrical energy were included, as in Table 4.

The number of kilowatts of capacity per employee increased from 40 in 1902 to 103 in 1927; the output per employee, from 82,700 to 297,500 kilowatt-hours; and the number of customers per employee, from 41 in 1907 to 87 in 1927. (See Table 15.)

Increase in size of prime movers (Tables 7 and 8).—The average size of prime movers has increased rapidly, particularly during the last five years, when the combined average for all prime movers almost doubled. The increase occurred in all types, but is most noteworthy in the cases of the predominant types, steam turbines and hydroturbines. Steam engines have in large measure been superseded by steam turbines, the former having decreased in both number and horsepower during each 5-year period since 1912, while the horsepower of the latter multiplied eightfold and the number nearly trebled between that year and 1927.

Prime movers directly connected (Table 6).—In 1902, when it was still to some extent the practice to drive several generators by belts and shafting from one steam engine or water wheel, the generators outnumbered the prime movers by nearly 60 per cent. By 1917, direct connection of prime movers to generators

was the rule, with consequent elimination of mechanical-transmission losses; and from that time on the number of prime movers at each census has been nearly the same as the number of generators.

Power other than from steam (Table 7).—Water power first increased, then decreased, in relative importance. Hydroturbine horsepower rose from 23.7 per cent of the aggregate in 1902 to 33.1 per cent in 1917, then fell to 27.6 per cent in 1927. Horsepower in internal-combustion engines constitutes 1.5 per cent of the aggregate. It rose from 0.7 of 1 per cent in 1902 to 1.4 per cent in 1907, since which year there has been little variation in its proportion of the aggregate. In average size, internal-combustion engines are the smallest prime movers. In the central-station field their most important application is in providing service in small communities not reached by transmission lines.

Fuel consumption (Table 9).—Bituminous coal, constituting 84.6 per cent of the total in 1927, is and always has been the most important fuel. Next in order come natural gas, anthracite, and fuel oil with its derivatives. The use of the last-named class of fuels was about 16 per cent greater in 1927 than in 1917, but much less than in 1922, whereas the use of gas has been increasing rapidly, having more than trebled in the final 5-year period. In fact, the increase in the use of gas much more than counterbalanced the decrease in fuel-oil consumption.

Predominance of alternating-current generators (Table 10).—Although the aggregate generator rating was twenty-one times as great in 1927 as in 1902, direct-current installations, after increasing slightly between 1902 and 1907, have since decreased from census to census, until in 1927 they contributed only 1.1 per cent of the total generator capacity, as against 39 per cent in 1902. The frequency of 60 cycles per second predominates to the extent that the capacity at that frequency constitutes 84.2 per cent of the total, leaving 10.6 per cent at 25 cycles and the remainder at other frequencies.

Customers and ultimate consumers (Table 12).—The number of ultimate consumers is very nearly equal to the total number of customers. In 1927 the difference between the two was less than 4,000. In earlier years it was undoubtedly smaller, because the practice of intercompany sales on the part of generating companies and of the purchase of energy at wholesale for resale by local private or municipal establishments is of comparatively recent growth. The lack of statistics on the number of ultimate consumers for years prior to 1927 may therefore be safely ignored.

Sales to ultimate consumers (Table 12).—Sales to ultimate consumers nearly doubled between 1922 and 1927. An analysis of the increase by classes is impracticable. The classification used for 1927 was much more detailed than those for earlier census years and differed from them in that it provided not merely for a subdivision of older groups but in part for a different allocation of energy to conform to more modern accounting practice.

Reduction in transmission losses (Table 13).—The growing concentration of power-producing equipment in large plants, some of them at a distance from centers of consumption, and the increasing interchange of energy between systems made possible by interconnections, reflected in the large total of energy purchased for resale, might be expected to lead to an increase in transmission and distribution losses. The contrary is the fact, however. In 1922 losses in transmission, etc., constituted 17.3 per cent of the energy generated by the electric light and power industry plus that brought into it from other sources, but in 1927 the corresponding percentage had fallen to 15.9.

Kilowatt-hour output per kilowatt installed (Table 5).—During the 25 years covered by the several censuses the annual output per kilowatt of generator capacity has risen from 2,070 kilowatt-hours in 1902 to 2,890 kilowatt-hours in 1927. These figures represent 23.6 per cent and 33 per cent, respectively, of the

possible output if the entire equipment had been operated continuously at full load throughout the year.

The total installed capacity on a system is determined by the *maximum* load or *demand* at any given time plus a suitable allowance for reserve, including reserve for water-power plants to meet the contingencies of an inadequate water supply. The output is determined by the total energy taken during the year by all users plus the inevitable losses. Since the maximum demand continues during only a small part of each day, it follows that the actual output is in general much less than that which might be obtained from the generating equipment if it were operated continuously.

The increase in the output per kilowatt of generator capacity is to be ascribed mainly to the fact that the use of electric power has increased much more rapidly than the use of electricity for lighting. This has contributed materially to the reduction in the price at which energy is sold.

Value of plant and equipment compared with rated capacity and revenue (Table 14).—Notwithstanding the generally higher level of commodity prices in recent years, the average value of plant and equipment per kilowatt of generator capacity (\$360) was materially less in 1927 than in any census year prior to 1917. No great variations occurred from 1902 to 1912, in which year the average was \$421. The minimum reported was for 1922. A factor contributing to the subsequent increase may be found in the large amount of transmission-line construction that has taken place in recent years. This in turn has helped to make possible the larger output per kilowatt of rated generator capacity.

Employees, salaries, and wages (Table 15).—During the quarter century the number of employees of commercial stations multiplied ninefold and their salaries and wages about twentyfold. The change was accompanied by a pronounced shift from the wage earner to the salaried class; in 1902 the latter constituted less than 23 per cent of the total number; in 1927, 41 per cent.

As in other industries, the output per employee has been increasing, for eight times as many employees generated thirty times as much energy in 1927 as in 1902. The explanation is, of course, to be found chiefly in the progress of mechanization, which has been applied in all departments, whether in the form of automatic stokers in the boiler room or of office machinery in the accounting division. The rate of increase during the latest 5-year period fell slightly below that for 1907–1912, but much exceeded that for any other similar period.

The statistics on employees in the several groups shown in Table 2, purely electric and composite, commercial and municipal, do not readily lend themselves to valid comparisons because of changes that may from census to census have occurred within and between the groups, as, for instance, the varying proportions of operations on generated and on purchased energy, which would affect the number of employees for generation and transmission.

TABLE 5.—SUMMARY, PURELY ELECTRIC AND COMPOSITE ESTABLISHMENTS, COMMERCIAL AND MUNICIPAL: 1902 TO 1927

Census year	Aggregate	PURELY ELECTRIC			COMPOSITE		
		Total	Commercial	Municipal	Total	Commercial	Municipal
Number of establishments.....	4,335	2,674	1,426	1,248	1,601	711	950
	6,355	3,991	2,582	1,409	2,364	1,192	1,172
	6,642	3,877	2,787	1,090	2,605	1,437	1,168
	5,221	2,772	2,209	663	2,449	1,450	1,000
	4,714	2,648	2,127	521	2,066	1,335	731
	3,620	2,139	1,759	380	1,481	1,046	435
Per cent of increase 1.....	-31.8	-33.0	-44.8	-11.4	-29.7	-40.4	-18.9
	2.9	20.3	7.4	20.3	-11.3	-17.0	-4.0
	25.3	33.9	26.2	93.6	8.8	-0.9	22.9
	4.7	3.9	3.9	8.1	18.5	8.6	36.7
	30.2	23.8	20.9	37.1	39.5	27.6	68.0
Value of plant and equipment.....	\$11,003,983,330	\$2,944,924,348	\$2,681,435,195	\$263,489,153	\$8,059,068,982	\$7,905,391,278	\$1,533,677,704
	4,465,015,691	2,031,410,900	2,031,410,900	136,335,987	2,297,268,848	2,197,945,117	90,323,731
	3,089,392,141	1,733,705,700	1,672,794,913	60,910,787	1,326,686,441	1,260,222,028	66,464,413
	2,175,678,266	1,128,330,859	1,105,111,379	23,219,480	1,047,347,407	983,591,743	53,845,664
	1,006,913,622	602,926,914	639,437,274	23,489,640	433,986,708	414,596,901	19,389,807
	504,740,352	334,151,724	320,680,333	13,571,391	170,888,628	162,139,546	8,449,082
Per cent of increase 1.....	146.4	35.9	32.0	93.3	250.8	239.7	54.7
	45.9	25.0	21.4	123.8	73.2	74.4	49.4
	40.7	53.7	51.4	162.3	26.7	26.8	23.4
	98.3	70.2	72.8	73.1	141.3	139.6	177.7
	117.3	98.4	99.5	73.1	154.4	135.7	129.5
Total revenues.....	\$1,903,664,224	\$670,139,047	\$596,761,689	\$73,377,948	\$1,293,524,677	\$1,244,465,806	\$49,058,871
	1,626,119,883	541,801,922	495,882,625	45,919,367	1,530,317,891	1,490,891,634	39,516,243
	526,894,240	306,828,747	288,791,787	17,586,990	220,565,463	197,842,248	22,723,229
	302,273,338	159,343,653	151,673,537	6,670,116	142,929,745	127,380,873	15,548,873
	175,642,338	107,974,921	101,222,267	6,752,654	67,667,417	60,408,072	7,259,345
	85,700,005	53,663,406	54,455,737	4,147,069	27,097,199	24,279,783	2,817,436
Per cent of increase.....	83.2	23.7	20.3	59.8	143.9	133.6	24.1
	103.5	76.9	71.7	161.8	140.4	148.1	73.9
	74.3	92.2	90.4	128.6	54.3	55.3	46.1
	72.1	47.6	49.8	13.6	111.2	110.9	114.2
	104.9	84.2	85.9	62.8	149.7	148.8	157.7

1 A minus sign (-) denotes decrease.

2 Comprises: Electric light and power property, \$3,395,401,077; railway, \$482,323,896; gas, \$917,448,140; other, \$306,762,665; and property undistributed among the several utilities, \$902,057,276.

CENSUS OF ELECTRICAL INDUSTRIES: 1927

TABLE 5.—SUMMARY, PURELY ELECTRIC AND COMPOSITE ESTABLISHMENTS, COMMERCIAL AND MUNICIPAL: 1902 TO 1927—Continued.

Census year	Aggregate	PURELY ELECTRIC			COMPOSITE		
		Total	Commercial	Municipal	Total	Commercial	Municipal
1927	\$1,802,658,498	\$644,006,769	\$570,028,811	\$73,977,958	\$1,158,648,724	\$1,109,589,853	\$49,058,871
1922	1,030,439,038	617,130,938	472,316,311	44,804,627	503,318,100	464,535,968	38,782,732
1917	502,039,980	243,606,971	276,452,156	17,244,813	208,363,000	221,541,250	22,841,250
1912	287,138,657	152,751,014	145,276,466	7,474,548	134,387,643	119,198,483	15,189,160
1907	166,614,691	104,629,574	98,056,838	6,572,736	64,985,117	57,943,419	7,041,698
1902	84,186,005	57,470,597	53,394,158	4,075,439	26,716,068	23,855,581	2,760,517
1922-1927	76.7	24.5	20.8	63.8	130.2	138.9	26.5
1917-1922	103.2	76.1	70.8	159.8	141.6	149.7	73.0
1912-1917	74.8	92.3	90.3	130.7	55.0	56.1	117.0
1907-1912	69.3	46.0	48.2	131.7	106.8	105.7	113.7
1902-1907	101.5	82.1	83.6	61.2	143.2	141.9	153.1
1927	\$161,008,831	\$26,132,878	\$24,132,878	(1)	\$104,875,953	\$134,875,953	(9)
1922	51,680,845	24,681,054	23,566,314	\$1,114,740	25,909,791	26,265,280	\$733,511
1917	24,834,260	12,330,620	12,330,620	292,177	12,297,454	11,820,475	387,979
1912	15,134,741	6,592,639	6,397,071	195,568	8,542,102	8,520,380	360,719
1907	6,027,647	3,345,347	3,165,429	179,918	2,682,300	2,464,653	217,647
1902	1,514,000	1,132,809	1,061,576	71,230	381,191	324,172	57,019
1922-1927	211.5	5.9	10.9	390.5	413.5	413.5	92.0
1917-1922	108.1	95.4	91.0	121.3	192.2	192.2	44.6
1912-1917	64.1	91.6	92.9	49.4	44.6	44.6	6.2
1907-1912	151.1	97.1	102.1	8.7	218.5	222.0	69.3
1902-1907	208.1	105.3	198.2	152.0	603.7	600.3	281.7
1927	\$1,318,255,160	\$434,446,757	\$404,446,757	(9)	\$883,808,393	\$883,808,393	(9)
1922	850,626,001	438,753,977	402,038,620	\$36,715,357	430,871,114	300,457,623	\$50,413,491
1917	426,568,307	249,871,295	235,102,731	14,298,564	159,524,674	159,524,674	17,174,348
1912	234,577,277	122,322,845	116,574,701	5,747,584	112,254,932	103,085,951	9,168,981
1907	134,196,911	70,238,037	71,411,336	4,821,701	57,988,874	52,465,853	5,523,021
1902	68,081,375	45,313,789	43,282,764	3,021,025	21,767,586	19,542,624	2,224,962
1922-1927	53.4	1.0	8.1	157.3	110.0	126.4	77.1
1917-1922	101.5	75.6	70.6	138.2	144.8	144.8	53.7
1912-1917	81.8	104.3	102.1	148.3	57.4	57.4	108.5
1907-1912	74.8	60.4	63.2	97.1	92.7	92.7	146.7
1902-1907	97.1	64.6	64.9	59.8	166.3	168.5	7.520
1927	251,020	89,136	80,383	8,753	161,884	154,364	7,520
1922	150,732	77,141	69,436	7,706	73,621	60,669	6,952

Total revenues—Continued.

Electric service¹.....

Per cent of increase.....

All other sources.....

Per cent of increase.....

Total expenses.....

Per cent of increase¹.....

Number of persons employed.....

TABLE 5.—SUMMARY, PURELY ELECTRIC AND COMPOSITE ESTABLISHMENTS, COMMERCIAL AND MUNICIPAL: 1902 TO 1927—Continued

Census year	Aggregate	PURELY ELECTRIC			COMPOSITE		
		Total	Commercial	Municipal	Total	Commercial	Municipal
1922-1927	80.3	31.8	30.4	51.0	134.1	138.0	67.0
1917-1923	69.1	30.5	33.7	88.2	94.0	101.5	24.6
1912-1917	74.1	34.3	42.4	136.1	124.1	55.2	8.0
1907-1912	90.7	69.9	72.0	24.9	124.1	121.5	145.7
1902-1907	123.5	104.1	103.1	46.7	163.9	167.7	193.3
1927	74,086,378,010	30,767,411,540	28,570,171,633	2,197,239,907	43,918,906,470	42,736,967,905	1,182,208,565
1922	40,291,536,435	22,332,869,933	21,107,265,655	1,225,643,278	17,969,227,592	17,308,674,308	653,252,984
1917	25,488,303,273	16,784,824,183	16,214,874,887	569,947,296	8,633,751,089	8,184,103,208	499,673,793
1912	31,569,109,885	6,638,342,395	6,479,811,466	168,530,909	4,460,707,070	4,453,771,669	774,925,401
1907	5,862,276,737	3,880,087,887	3,734,978,340	148,109,547	1,952,188,380	1,827,532,609	144,353,211
1902	2,507,051,115	1,836,748,836	1,716,909,602	119,839,234	670,302,273	594,253,674	76,055,205
1922-1927	55.4	37.8	35.4	79.4	144.5	146.9	81.0
1917-1923	58.4	33.1	30.2	113.1	107.5	111.5	59.1
1912-1917	119.9	132.8	130.2	296.3	75.3	70.8	23.9
1907-1912	97.3	71.1	73.5	4.2	148.8	147.7	162.5
1902-1907	133.8	111.2	117.5	21.1	195.7	200.3	84.8
1927	22,142,255,709	7,314,835,501	6,537,028,323	777,809,178	14,827,430,208	14,454,894,745	372,523,463
1922	9,982,676,157	5,883,241,041	5,246,781,513	353,468,528	9,304,435,116	4,170,074,041	284,430,175
1917	5,605,745,962	3,404,346,116	3,419,880,274	70,458,842	2,115,005,843	1,949,318,980	192,687,554
1912	2,613,502,605	1,756,475,791	1,735,212,315	21,263,479	337,026,814	789,709,013	67,316,801
1922-1927	121.8	31.0	24.5	133.3	237.0	246.6	62.4
1917-1923	78.1	60.0	53.5	372.3	108.0	109.2	57.9
1912-1917	114.5	98.7	97.1	231.3	146.8	152.4	81.4
1927	21,790,298	7,657,028	6,489,794	1,167,234	14,133,230	13,171,666	961,564
1922	12,704,808	7,014,600	5,907,995	1,106,605	6,791,372	6,057,284	734,073
1917	7,178,703	3,673,513	3,272,756	400,757	3,493,190	2,928,433	564,757
1912	3,837,518	1,753,033	1,579,146	174,880	2,083,892	1,732,724	351,168
1907	1,946,979	(^c)					
1902	79,882,689	(^c)					
1922-1927	71.4	39.4	29.6	28.2	108.1	117.5	31.0
1917-1923	60.8	53.0	53.0	123.9	94.1	105.8	28.8
1912-1917	97.1	109.3	107.2	183.1	67.9	69.1	62.2
1902-1907	234.1						

^a Number of meters on consumption circuits.

^b No data.

^c No data for years prior to 1912.

TABLE 6.—SUMMARY: 1902 TO 1927

	1927	1922	1917
Number of establishments.....	4,335	6,355	6,542
Generating all or part of current.....	2,331	4,389	5,124
Purchasing all current.....	2,004	1,966	1,418
Number of separate generating stations.....	4,801	5,444	5,952
Value of plant and equipment.....	\$9,297,458,356	\$4,465,015,601	\$3,060,392,141
Total number of persons employed.....	251,020	150,762	105,541
Prime movers:			
Number of units.....	12,030	13,242	13,795
Rated capacity, horsepower.....	35,710,128	19,850,800	12,936,755
Generators:			
Number.....	11,967	12,701	13,428
Rated capacity, kilowatts.....	25,811,305	14,313,438	8,994,407
Current generated, kilowatt-hours.....	74,680,378,010	40,291,536,435	25,438,303,272
Current sold, kilowatt-hours.....	79,011,210,518	41,964,785,034	25,751,964,800
Number of customers.....	21,790,235	12,709,868	7,173,703

	1912	1907	1902
Number of establishments.....	5,221	4,714	3,620
Generating all or part of current.....	4,643	4,457	(?)
Purchasing all current.....	575	227	(?)
Number of separate generating stations.....	(?)	(?)	(?)
Value of plant and equipment.....	\$2,176,678,266	\$1,096,913,622	\$504,740,852
Total number of persons employed.....	79,335	47,632	30,325
Prime movers:			
Number of units.....	11,902	10,998	7,850
Rated capacity, horsepower.....	7,530,044	4,098,188	1,845,048
Generators:			
Number.....	12,610	12,173	12,484
Rated capacity, kilowatts.....	5,165,439	2,709,225	1,212,285
Current generated, kilowatt-hours.....	11,569,109,885	5,862,278,737	2,807,051,115
Current sold, kilowatt-hours.....	(?)	(?)	(?)
Number of customers.....	8,637,518	1,946,979	(?)

Includes \$902,057,279, value of plant and equipment owned by companies engaged in the operation of electric light and power plants and other public utilities, not distributed among the several utilities. Not reported.

TABLE 7.—PRIME MOVERS—NUMBER AND RATED HORSEPOWER, BY TYPE, ALL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	AGGREGATE		STEAM TURBINES		STEAM ENGINES	
	Number	Horsepower	Number	Horsepower	Number	Horsepower
1927.....	12,030	35,710,128	2,864	24,323,304	2,267	994,277
1922.....	13,242	19,850,800	2,330	12,354,551	4,175	1,371,296
1917.....	13,795	12,936,755	1,699	6,747,399	5,788	1,701,677
1912.....	11,902	7,530,044	1,034	3,054,306	6,813	1,895,382
1907.....	10,998	4,098,188	377	817,410	7,677	1,875,863
1902.....	7,850	1,845,048	(1)	(1)	6,295	1,394,396

CENSUS YEAR	INTERNAL-COMBUSTION ENGINES		HYDROTURBINES		Population ¹	Horsepower per capita
	Number	Horsepower	Number	Horsepower		
1927.....	3,177	548,288	3,722	9,844,263	118,628,000	0.30
1922.....	3,256	302,995	3,481	5,822,018	109,893,000	.18
1917.....	2,934	210,406	3,374	4,277,278	102,173,000	.13
1912.....	1,116	111,035	2,989	2,469,231	95,067,000	.08
1907.....	463	55,828	2,481	1,349,087	87,455,000	.05
1902.....	165	12,181	1,390	488,472	79,365,000	.02

¹For 1902, data for steam turbines were included in figures for steam engines. Bureau of the Census estimate as of July 1 for all years.

TABLE 8.—PRIME MOVERS—AVERAGE SIZE, BY TYPE, ALL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	Aggregate (horse-power)	Steam turbines (horse-power)	Steam engines (horse-power)	Internal-combustion engines (horse-power)	Hydro-turbines (horse-power)
1927.....	2,968	8,493	439	173	2,645
1922.....	1,499	5,302	328	93	1,673
1917.....	938	3,971	204	72	1,268
1912.....	633	2,954	273	99	840
1907.....	373	2,168	265	121	544
1902.....	235	(1)	233	74	315

¹ Data for steam turbines were included in figures for steam engines.

TABLE 9.—CONSUMPTION OF FUEL, BY KIND, ALL ESTABLISHMENTS: 1927, 1922, AND 1917

	Unit of measure	1927	1922	1917
Anthracite.....	Ton (2,240 lbs.).....	1,787,693	1,638,444	2,180,183
Bituminous coal.....	Ton (2,000 lbs.).....	35,681,314	24,492,421	19,885,090
Coke.....	do.....	31,623	36,699	63,137
Fuel oil, kerosene, or gasoline.....	Barrel (42 gals.).....	7,145,798	11,855,969	6,158,219
Gas:				
Manufactured.....	1,000 cu. ft.....	6,160,753	20,174,385	14,199,204
Natural.....	do.....	58,362,039		
Total fuel consumed, estimated in equivalent tons of coal. ¹	Ton (2,000 lbs.).....	42,215,342	30,200,529	24,038,709

¹ The quantities of the several fuels other than coal have been reduced to their equivalents in tons (of 2,000 pounds) of coal by the use of the following ratios supplied by the Bureau of Mines: Oil, 4 barrels; natural gas, 23,000 cubic feet; manufactured gas, 45,000 cubic feet; coke, 1.15 tons.

TABLE 10.—GENERATORS—RATED CAPACITY, BY TYPE, ALL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	KILOWATT CAPACITY OF GENERATORS		
	Total	Alternating-current	Direct-current
1927.....	25,811,305	125,537,726	273,579
1922.....	14,313,438	13,072,505	340,933
1917.....	8,994,407	8,557,720	436,687
1912.....	5,165,439	4,689,199	478,240
1907.....	2,709,225	2,221,773	487,452
1902.....	1,212,235	736,304	475,931

¹ 25-cycle, 2,743,123; 60-cycle, 21,744,481; other frequencies, 1,050,122.

TABLE 11.—CURRENT GENERATED AND CURRENT RECEIVED FROM OTHER SOURCES, AND GENERATED OUTPUT PER CAPITA, ALL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	OUTPUT (KILOWATT-HOURS)			Population ²	Generated output per capita (kilowatt-hours)
	Total ¹	Generated	Received from other sources		
1927.....	96,828,633,719	³ 74,686,378,010	22,142,255,700	118,628,000	630
1922.....	50,274,212,592	40,291,536,435	9,982,676,157	109,893,000	367
1917.....	31,044,049,234	25,438,303,272	5,605,745,962	102,173,000	249
1912.....	14,182,612,490	11,560,109,885	2,613,502,605	95,097,000	122
1907.....	5,862,276,737	5,862,276,737	(⁴)	87,455,000	67
1902.....	2,507,051,115	2,507,051,115	(⁴)	79,365,000	32

¹ Where energy "received from other sources" is included, duplication is involved as such energy was in large part purchased from other electric light and power companies and is therefore included under "generated."

² As estimated for July first of each year.

³ Generated by steam, 45,391,190,914 kilowatt-hours; by water, 28,718,138,409; by internal-combustion engines, 577,048,687.

⁴ Not reported.

TABLE 12.—CUSTOMERS PER 1,000 POPULATION, SALES PER CAPITA, AND CONSUMPTION PER CUSTOMER, ALL ESTABLISHMENTS: 1927, 1922, AND 1917

	1927	1922	1917
Number of customers.....	¹ 21,786,317	² 12,709,868	¹ 7,178,703
Kilowatt-hours sold to ultimate consumers.....	63,612,481,088	32,947,716,350	18,287,344,226
Population.....	118,628,000	109,893,000	102,173,000
Customers per 1,000 population.....	183.7	115.7	70.3
Kilowatt-hours sold per capita.....	536	300	179
Kilowatt-hours consumed per customer.....	2,920	2,592	2,547

¹ Ultimate consumers. In addition, 3,921 customers purchased current for resale.

² Total number of customers. (Schedules for 1922 and 1917 did not call for number of ultimate consumers.)

TABLE 13.—OUTPUT OF CURRENT, SALES, CONSUMPTION IN THE INDUSTRY, AND LOSSES IN TRANSMISSION: 1927 AND 1922

	KILOWATT-HOURS	
	1927	1922
Aggregate output: Current generated by the electric light and power industry and current purchased from other sources (including imports from Canada).....	78,457,778,214	41,257,142,908
Current sold to ultimate consumers.....	63,612,481,088	32,947,716,350
Current used by the industry and for free service.....	2,369,395,640	1,174,640,784
Current lost in transmission, etc.....	12,475,901,586	7,134,786,784
Per cent lost.....	15.9	17.3

TABLE 14.—VALUE OF PLANT AND EQUIPMENT, RATED CAPACITY OF GENERATORS, AND REVENUE FROM ELECTRIC SERVICE, ALL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	Value of plant and equipment	Rated capacity of generators (kilowatts)	Average value per kilowatt of generating capacity	Revenue from electric service ¹	Investment in plant and equipment per dollar of revenue from electric service
1927	\$0, 297, 458, 350	25, 811, 305	\$360	\$1, 824, 450, 912	\$5. 09
1922	4, 465, 015, 691	14, 313, 433	312	1, 034, 043, 401	4. 31
1917	3, 060, 392, 141	8, 994, 407	340	515, 018, 643	5. 90
1912	2, 175, 678, 266	5, 195, 439	421	297, 331, 649	7. 31
1907	1, 090, 913, 622	2, 709, 225	405	175, 642, 338	6. 24
1902	504, 740, 352	1, 212, 235	416	85, 700, 605	5. 88

¹ Includes revenue from sales of electric current to ultimate consumers, sales for resale, and miscellaneous electric revenue (sales of electric merchandise, etc.)

² Includes \$902,057,279, value of plant and equipment owned by companies engaged in the operation of electric light and power plants and other public utilities, not distributed among the several utilities.

³ Figure for 1927 includes \$135,609,922 for revenue from "Sales for resale" and also includes "Miscellaneous electric revenue" from commercial establishments only.

⁴ Figure for 1922 includes \$75,010,969 for revenue from "Sales for resale"; no corresponding figures for earlier years. Estimated value of free service is also included.

⁵ Includes estimated value of free service.

TABLE 15.—SALARIED EMPLOYEES, WAGE EARNERS, SALARIES, AND WAGES, COMMERCIAL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	ALL EMPLOYEES		SALARIED EMPLOYEES		WAGE EARNERS	
	Number	Salaries and wages	Number	Salaries	Number	Wages
1927	234, 747	\$367, 631, 758	95, 951	\$166, 340, 040	1 138, 796	\$201, 230, 810
1922	136, 105	194, 148, 121	50, 667	81, 338, 448	1 85, 438	112, 809, 873
1917	94, 679	86, 473, 496	32, 692	34, 438, 860	1 62, 037	52, 034, 630
1912	71, 395	55, 658, 515	23, 377	22, 637, 077	1 47, 518	33, 021, 438
1907	42, 066	31, 935, 309	11, 375	10, 738, 955	30, 691	21, 196, 354
1902	26, 909	18, 786, 970	6, 046	5, 206, 199	20, 863	13, 560, 771

¹ Number June 30, 1927, or nearest representative day.

² Number June 30, 1922, or nearest representative day.

³ Number Sept. 26, 1917, or nearest representative day.

⁴ Number Sept. 16, 1912, or nearest representative day.

Chapter II.—DETAILED STATISTICS FOR THE INDUSTRY

In this chapter detailed statistics on the industry are presented for 1927 in classified form. These cover physical equipment—prime movers, generators, and transmission lines; yearly consumption of current; allocations of sales and revenue by consumer groups; a consolidated balance sheet for commercial companies; and a consolidated income, operating revenue, and expense statement for commercial establishments.

Prime movers (Table 16).—Steam turbines have become the most important prime movers in respect of horsepower capacity, although outnumbered both by hydroturbines, which come next in horsepower, and by internal-combustion engines, which contribute only 1.5 per cent of the total horsepower. The horsepower of steam engines amounted to 3 per cent of the total. Of the total rating of the steam turbines, over half is in units of 20,000 horsepower and larger, while of the total for hydroturbines about 44 per cent is found in the 5,000–20,000 horsepower group.

The 1927 figures show a new group beginning at 20,000 horsepower, subdividing the group of larger units which in previous reports began at 5,000 horsepower. (See Table 30 of report for 1922.) Comparison of the two reports reveals a pronounced trend toward the larger sizes. In both steam turbines and hydroturbines, the total horsepower of the group of the smallest units (500 horsepower or under) decreased, while that of all the other groups increased.

Since 1922 the horsepower of steam turbines in the units of largest size more than doubled and that of the corresponding size of hydroturbine increased about 83 per cent. Meanwhile the total horsepower of steam engines in every group has decreased.

Fuel consumption per kilowatt hour (Table 17).—The increase in operating efficiency, resulting in a greatly increased output of electrical energy per pound of fuel consumed, is brought out inferentially by the census figures. The 1927 statistics show, for the first time, the average consumption of coal or its equivalent per kilowatt-hour of current generated—1.84 pounds. The census report for 1922 gives statistics on fuel consumption, but does not segregate the kilowatt-hours generated from fuel. Analysis indicates, however, that the fuel consumption per kilowatt-hour generated was probably between 32 and 36 per cent greater in that year than in 1927. Data from other sources indicate that 35 per cent may be assumed as a fair approximation, that the progress between 1917 and 1922 was even greater, and that the average amount of electrical energy produced per pound of fuel consumed in 1927 was probably between 90 and 100 per cent larger than it was 10 years earlier.

For earlier years data on which to base statistical averages are lacking. Engineering progress has been such, however, that it is probably conservative to say that the amount of fuel required to produce one kilowatt-hour of electrical energy has been reduced so that it is now between one-fifth and one-fourth of the amount required at the beginning of the quarter-century.

Generators (Tables 18 and 19).—Most generators are direct-connected to their prime movers; the numbers therefore correspond quite closely (Tables 16 and 18).

By far the predominating type of generators is the 60-cycle alternating, which contributes 84.2 per cent of the aggregate generator rating. Only about 1 per cent is found in direct-current generators.

Current generated and current obtained from other sources (Tables 20 and 27).—In addition to the energy generated in electric light and power plants, the industry obtains a certain amount of energy from outside sources by purchase, so that, of the total amount of energy accounted for, 95.2 per cent is generated within the industry and 4.8 per cent is obtained from other sources. Nearly all the latter amount is purchased by commercial establishments, more than one-third being imported from Canada and the remainder coming from manufacturing plants and other sources outside the electric light and power industry in the United States.

Furthermore, a very considerable amount of current is purchased from establishments within the industry, in part by the 2,004 plants that have no generating equipment but purchase all their energy at wholesale for retail distribution to other consumers, and in part by those which have generating equipment but find it expedient from time to time, because of the exigencies of their load and the limitations of their power equipment, to add to their own production. The amount of energy thus purchased by establishments within the industry has increased greatly, especially during the period from 1922 to 1927 (Table 11). Economically, it reflects a more efficient utilization of both water and steam power plants—of the former, by transmitting to a distance the energy which could not be utilized in the local market at times of abundant stream flow, and, of the latter, by making full use of the most efficient steam plants within a large area and transmitting energy from them at periods of deficient water power in the territory normally served by hydro plants. Physically it has been made possible by the extensive construction of high-tension transmission lines and the installation of large, economically operated power stations advantageously situated as to fuel supply and water.

The result is that, in addition to nearly 75,000,000,000 kilowatt-hours generated within the industry, another 22,000,000,000 kilowatt-hours (Table 5) is to be accounted for in arriving at the grand total of which disposal is made, constituted as follows: Sales to ultimate consumers; sales at wholesale to other domestic light and power establishments; energy used by the companies themselves for their own operations; and, finally, the inevitable transmission, conversion, and distribution losses. This additional 22,000,000,000 kilowatt-hours includes somewhat less than 4,000,000,000 representing purchases from manufacturing plants and other sources outside the light and power industry in the United States and from public-utility electric systems in Canada, and the remainder is duplication representing purchases for resale within the industry.

Transmission lines (Table 21).—It is known that in recent years there has been a great increase in the amount of transmission-line mileage, but statistics for measuring that increase are lacking. In the schedules for 1927 data were called for only for lines of 6,600 volts or more, and these are summarized by groups. In the schedule for 1922, however, the lowest voltage specified was "under 2,000 volts." Data for a great amount of mileage under 6,600 volts were therefore included in the figures for the earlier census and excluded from those for the later one. Moreover, owing to the incompleteness of the returns in respect of voltage, no segregation of the figures for the low-voltage groups was made. Thus it is impossible to draw any conclusion from a comparison of the 176,309 miles of line reported in the earlier census and the 185,449 miles on an entirely different basis shown in the later report.

The 1927 schedule called for data on the mileage of transmission lines, specifically excluding distribution lines. For this reason it should not be assumed that

the returns indicate the mileage of circuit of all electric light and power lines in the United States operated at 6,600 volts or more. Many companies have distribution circuits operated at more than 6,600 volts; in some instances lines at much higher voltages are considered parts of distribution systems. Under the terms of the schedule these were not reported.

The practice of carrying two high-tension circuits on one pole or power line is not uncommon; occasionally more than two circuits are so mounted. The line mileage is therefore somewhat less than the circuit mileage.

Three-wire circuits are generally used for transmission; the wire mileage is therefore approximately three times the reported circuit mileage.

Consumer groups (Tables 22, 23, and 24).—The present census divides the consumers into a much larger number of classes than was done in previous years. In place of the two groups, "lighting" and "power," shown for 1922, the sales now reported show domestic service (residential consumption), sales for "small light and power (retail)," sales for "large light and power (wholesale)," and sales for farm service. Some of the reporting companies failed to indicate the class of service. In such cases the aggregates of these figures are shown in the tables under the designation "Undistributed by class of service."

Considered merely on a numerical basis, domestic customers constitute by far the largest proportion of the total number of customers. It may be assumed without serious error that those returned as "undistributed by class of service" consist almost exclusively of two classes, namely, those receiving domestic service and small commercial users of light and power.

It is also reasonable to assume that the allocation between these two classes does not depart materially from the allocation between the same classes where they are separately reported. If the figures are adjusted on this basis, domestic customers constitute about 83.1 per cent of the total number, those receiving commercial service for light and power at retail constitute 14.4 per cent, and all others together 2.5 per cent. These ratios will necessarily vary somewhat, however, in the individual States.

Energy consumption by class of service (Table 22).—In respect of energy consumption, however, the ratios are very different. If the undistributed energy is allocated in the same manner as the customers, it is found that only 13.2 per cent of the total sales are for domestic service and 19.1 per cent are to the small commercial users of energy for light and power, while 52.6 per cent of the total sales are to wholesale consumers. The latter group consists mainly of large industries which depend on central-station service for their power.

Electric railways and electrified railroads take nearly 10 per cent. The farm service definitely reported accounts for 1.3 per cent, to which should be added an unknown but not large amount included in other classifications by companies that do not keep separate records of sales for farm use. As "farm service" combines energy used in irrigation and in other farm activities, the rates vary from very low to high. (For geographical variations, see Chapter III.)

Since the users of commercial service for "small light and power" are, in the main, mercantile establishments, offices, small factories, repair shops, and various minor industrial establishments, it is evident that an appreciable fraction of the energy reported as sold to such customers is used for power purposes, although the major portion is undoubtedly used for lighting. Of the "large light and power (wholesale)" sales of energy, only a small portion is used for lighting, most of it being utilized for mechanical power and electro-thermal and electro-chemical processes.

Retail commercial sales exceed domestic sales by a wide margin and wholesale energy sales exceed the two combined by an even wider margin. The ratios vary geographically. Wholesale energy stands out even more prominently in the

Middle Atlantic States (Table 34). The distinction between wholesale and retail energy is one of definition. There is no hard and fast dividing line; practice as between different companies is not uniform. These conditions must be borne in mind in interpreting the statistics.

The balance sheet (Table 25).—The schedule sent to commercial companies called for a balance sheet as of December 31, 1927. Municipal systems were asked to report on investment in plant and equipment for electric service and bonds outstanding against the electric plant. The consolidated balance sheet, therefore, applies to commercial companies only.

The existence of numerous composite establishments—that is, those rendering public-utility services other than the sale of electrical energy—makes it difficult to determine accurately the investment in the electric light and power industry. Nearly 4 establishments in 10 are composite (Table 5), and they are, on the average, much larger than the others; in fact, the 711 commercial composite establishments receive more than 61 per cent of the revenue for electric service reported for the entire industry. In many cases the allocation of the capital to the several kinds of utilities is impracticable if not impossible. The schedule therefore called for separate figures on the value of plant and equipment (estimated, if necessary) used for supplying electrical energy and on the value of that used for other purposes. In other respects the balance sheet was made to relate to the company as a whole. In some cases, representing in the aggregate about 9 per cent of the total value of plant and equipment, no such separation was made, the amount being given in the consolidated balance sheet as “undistributed.” If the undistributed item be omitted entirely, the average value of plant and equipment is \$397 per kilowatt of capacity; if the undistributed item be included in full, the value becomes \$434. These values are based on the total of 24,383,271 kilowatts of generating capacity in commercial establishments (Table 5). Since in general the electrical property constitutes by far the larger portion of the property of composite systems, the actual value per kilowatt is probably much nearer the latter than the former figure.

The aggregate capitalization of commercial establishments is 1.7 per cent less than the value of their plant and equipment.

Consolidated income, operating-revenue, and expense statement for commercial establishments (Table 26).—Schedules calling for returns on operating expenses were sent only to commercial companies and to those municipal systems serving cities having 25,000 inhabitants or more. The summary statistics in Table 26, relating to commercial establishments only, account for 94.7 per cent of the total revenue for electric service.

The revenue from the sale of electric current differs from that received from ultimate consumers only (Table 62) by the revenue received from other electric light and power establishments for energy purchased for resale.

Of the total electric operating revenue received by commercial establishments, fuel and taxes consume nearly equal shares, the former 9.3 and the latter 8.8 per cent; 8.4 per cent is spent for purchased power; and 6.3 per cent is allotted to depreciation or retirement expenses. Of “All other operating expenses, electric,” which item is equal to 26.4 per cent of the revenue, by far the larger share, \$367,631,756; or 21.6 per cent of the total revenue, is for salaries and wages (Table 15).

Energy crossing State lines (Table 27).—The 1927 schedule sent to commercial establishments called for data regarding energy crossing State lines. Such data were not, however, collected from municipal systems, which, in general, serve only local areas. Of the total for commercial systems, including what is generated within and what is purchased from sources outside the industry, 1.8 per cent is received from Canada (thus crossing an international line rather than one

between States), 4.3 per cent is received from plants of the same systems located in other States, and 7.3 per cent is purchased from public-utility electric companies, including street railways, in other States. In part, these quantities represent importations of energy into States because of inadequate local supplies, or corresponding exports because of physical or economic considerations. Freight rates on fuels, available water, and other factors have in a number of instances led light and power companies to operate important generating stations beyond the borders of the States in which most of the energy is consumed.

TABLE 16.—PRIME MOVERS—NUMBER AND HORSEPOWER, BY TYPE AND BY HORSEPOWER GROUPS, ALL ESTABLISHMENTS: 1927

SIZE GROUP	TOTAL				STEAM TURBINES	
	Number	Horsepower	Per cent distribution		Number	Horsepower
			Number	Horsepower		
Total.....	12,030	35,710,128			2,864	24,323,304
Per cent of total.....			100.0	100.0	23.8	68.1
Average h. p. of prime movers.....		2,968				8,493
500 h. p. or less.....	6,680	1,266,713	55.5	3.5	287	80,802
More than 500 h. p. but less than 2,000 h. p.....	2,676	2,605,184	22.2	7.5	935	1,022,338
2,000 h. p. or more but less than 5,000 h. p.....	1,030	3,265,472	8.6	9.1	557	1,744,708
5,000 h. p. or more but less than 20,000 h. p.....	1,174	11,985,704	9.8	33.6	712	7,521,136
20,000 h. p. or more.....	465	16,527,055	3.9	46.3	373	13,954,280

SIZE GROUP	STEAM ENGINES		INTERNAL-COMBUSTION ENGINES		HYDROTURBINES	
	Number	Horsepower	Number	Horsepower	Number	Horsepower
Total.....	2,267	904,273	3,177	548,288	3,722	9,844,293
Per cent of total.....	18.8	2.8	26.4	1.5	30.9	27.0
Average h. p. of prime movers.....		439		173		2,045
500 h. p. or less.....	1,812	416,248	2,989	403,004	1,592	306,560
More than 500 h. p., but less than 2,000 h. p.....	373	315,447	187	143,284	1,180	1,184,115
2,000 h. p. or more but less than 5,000 h. p.....	60	172,104	1	2,000	400	1,340,000
5,000 h. p. or more but less than 20,000 h. p.....	13	90,414			449	4,374,154
20,000 h. p. or more.....					92	2,572,825

TABLE 17.—CONSUMPTION OF FUEL, BY KIND, WITH COAL EQUIVALENT, ALL ESTABLISHMENTS: 1927

KIND	Unit of measure	Quantity	Equivalent tons of bituminous coal ¹	Per cent of total equivalent fuel
Anthracite.....	Ton (2,240 lbs.)...	1,787,693	2,062,217	4.7
Bituminous coal.....	Ton (2,000 lbs.)...	35,681,314	35,681,314	84.5
Coke.....	Ton (2,000 lbs.)...	31,623	27,498	0.1
Fuel oil, kerosene, or gasoline.....	Barrel (42 gals.)...	7,145,798	1,786,449	4.2
Gas, manufactured.....	1,000 cu. ft.....	6,160,753	135,906	0.3
Gas, natural.....	1,000 cu. ft.....	59,362,030	2,580,955	6.1
Total equivalent fuel.....	Ton (2,000 lbs.)...		42,215,342	100.0
Kilowatt-hours generated by fuel-burning generating stations.....	Kilowatt-hour.....	45,968,230,601		
Pounds of coal per kilowatt-hour of output.....			1.84	

¹ For conversion factors, coal equivalent, see footnote, Table 9.

TABLE 18.—GENERATORS—NUMBER AND KILOWATT CAPACITY BY TYPE OF PRIME MOVER, FOR ALTERNATING-CURRENT BY FREQUENCY GROUPS, AND FOR DIRECT-CURRENT, ALL ESTABLISHMENTS: 1927

TYPE OF PRIME MOVER	NUMBER					
	Aggregate	Alternating-current				Direct-current
		Total	25-cycle	60-cycle	Other frequencies	
Total.....	11,967	11,002	435	10,290	277	665
Steam turbines.....	2,886	2,832	143	2,647	42	54
Steam engines.....	2,294	1,978	54	1,903	21	310
Internal-combustion engines.....	3,189	2,720	32	2,658	36	403
Hydroturbines.....	3,598	3,463	206	3,052	178	132
PER CENT DISTRIBUTION						
Total.....	100.0	91.9	3.6	86.0	2.3	8.1
Steam turbines.....	24.1	98.1	5.0	91.7	1.4	1.0
Steam engines.....	19.2	88.2	2.3	85.0	0.9	13.8
Internal-combustion engines.....	26.6	85.6	1.0	83.4	1.1	14.6
Hydroturbines.....	30.1	96.3	5.7	85.7	4.9	3.7
CAPACITY (KILOWATTS)						
TYPE OF PRIME MOVER	Aggregate	Alternating-current				Direct-current
		Total	25-cycle	60-cycle	Other frequencies	
Total.....	25,811,305	25,537,726	2,743,123	21,744,481	1,050,122	273,570
Steam turbines.....	17,848,124	17,827,787	2,013,150	15,462,006	351,731	20,337
Steam engines.....	697,136	572,200	71,955	474,968	25,247	124,930
Internal-combustion engines.....	416,533	404,134	2,444	394,496	7,194	12,390
Hydroturbines.....	6,849,512	6,733,605	655,574	5,412,081	665,950	115,907
PER CENT DISTRIBUTION						
Total.....	100.0	98.9	10.6	84.2	4.1	1.1
Steam turbines.....	69.1	99.0	11.3	85.6	2.0	0.1
Steam engines.....	2.7	82.1	10.3	68.1	3.8	17.0
Internal-combustion engines.....	1.6	97.0	0.6	94.7	1.7	3.0
Hydroturbines.....	26.6	98.3	9.6	79.0	9.7	1.7

TABLE 19.—GENERATORS—AVERAGE SIZE BY TYPE OF PRIME MOVER, FOR ALTERNATING-CURRENT BY FREQUENCY GROUPS, AND FOR DIRECT-CURRENT, ALL ESTABLISHMENTS: 1927

[Based on Table 18]

	Aggregate	ALTERNATING-CURRENT				Direct-current
		Total	25-cycle	60-cycle	Other frequencies	
Total.....	2,157	2,321	6,306	2,113	3,791	284
Steam turbines.....	6,184	6,295	14,078	5,342	8,375	377
Steam engines.....	304	289	1,333	250	1,202	395
Internal-combustion engines.....	131	148	78	148	200	27
Hydroturbines.....	1,904	1,943	3,182	1,756	3,741	878

TABLE 20.—OUTPUT—CURRENT GENERATED BY ELECTRIC LIGHT AND POWER ESTABLISHMENTS, BY TYPE OF PRIME MOVER, AND CURRENT PURCHASED FROM SOURCES OUTSIDE THE INDUSTRY, ALL ESTABLISHMENTS: 1927

PRIME MOVER	Kilowatt-hours	Per cent of total
Total: Current generated by the electric light and power industry and current purchased from manufacturing plants and other sources (including imports from Canada).....	78,457,778,214	100.0
Total generated by the electric light and power industry.....	74,686,378,010	95.2
Steam.....	45,391,190,914	57.9
Water.....	28,718,138,409	36.6
Internal-combustion.....	577,048,687	0.7
Purchased from manufacturing plants and other sources outside the electric light and power industry and from public-utility electric systems in Canada.....	3,771,400,204	4.8
Population of the United States.....	118,628,000	
Kilowatt-hours per capita.....	661	
Rated generator capacity (kilowatts).....	25,811,305	
Kilowatt-hours per kilowatt of capacity (electric light and power industry).....	2,894	

TABLE 21.—TRANSMISSION LINES—MILES OF CIRCUIT, BY VOLTAGE CAPACITY, COMMERCIAL ESTABLISHMENTS: 1927

VOLTAGE CAPACITY	Miles of circuit	Per cent distribution
Total.....	185,449	100.0
6,600 or more but less than 11,000 volts.....	20,317	11.0
11,000 or more but less than 33,000 volts.....	62,969	34.0
33,000 or more but less than 66,000 volts.....	59,034	32.3
66,000 or more but less than 110,000 volts.....	24,791	13.4
110,000 or more but less than 220,000 volts.....	16,170	8.7
220,000 volts or more.....	1,268	0.6

TABLE 22.—CUSTOMERS (ULTIMATE CONSUMERS ONLY), CURRENT SOLD, AND REVENUE, BY CLASS OF SERVICE, WITH PER CENT DISTRIBUTION, ALL ESTABLISHMENTS: 1927

	CUSTOMERS		CURRENT SOLD		REVENUE	
	Number	Per cent distribution	Kilowatt-hours	Per cent distribution	Amount	Per cent distribution
Total.....	21,786,317	100.0	63,612,481,088	100.0	\$1,667,045,571	100.0
Farm service.....	168,450	0.8	835,271,354	1.3	17,282,957	1.0
Domestic service.....	16,039,066	73.6	7,105,619,723	11.2	481,509,354	28.9
Commercial service:						
Small light and power (retail).....	2,784,126	12.8	10,257,240,582	16.1	410,652,535	24.6
Large light and power (wholesale).....	342,256	1.6	33,471,610,198	52.6	456,472,907	27.4
Undistributed by class of service.....	2,424,283	11.1	3,192,886,952	5.0	154,705,419	9.3
Municipal street lighting ¹	22,232	0.1	1,741,423,872	2.7	77,198,896	4.6
Railroads—motive power:						
Street and interurban railways.....	822	(²)	6,254,081,223	9.8	58,860,539	3.5
Electrified steam - railroad divisions.....	38	(²)	518,169,041	0.8	5,339,485	0.3
Other service.....	5,074	(²)	236,178,143	0.4	5,023,479	0.3

¹ Includes all commercial service reported by municipal establishments.

² Includes all municipal service "for which a charge was made by the light and power department." municipal establishments.

³ Less than one-tenth of 1 per cent.

TABLE 23.—CURRENT SOLD PER CUSTOMER, REVENUE FROM ELECTRIC SERVICE PER CUSTOMER, AND AVERAGE REVENUE PER KILOWATT-HOUR SOLD, BY CLASS OF SERVICE, ALL ESTABLISHMENTS: 1927

[Based on Table 22]

	Kilowatt-hours per customer	Revenue per customer	Average revenue per kilowatt-hour sold (cents)
All services.....	2,920	\$77	2.6
Farm service (including power for irrigation).....	4,950	103	2.1
Domestic service.....	443	30	6.8
Commercial service:			
Small light and power (retail) ¹	3,684	147	4.0
Large light and power (wholesale).....	97,797	1,334	1.4
Undistributed by class of service.....	1,317	64	4.8
Municipal street lighting ²	78,330	3,472	4.4
Railroads—motive power:			
Street and interurban railways.....	7,608,371	71,606	0.9
Electrified steam-railroad divisions.....	13,636,027	140,513	1.0
Other service.....	48,547	990	2.1

¹ Includes all commercial service reported by municipal establishments.

² Includes all municipal service for which a charge was made by the light and power departments of municipal establishments.

TABLE 24.—TOTAL CURRENT; CURRENT SOLD TO ULTIMATE CONSUMERS; BALANCE NOT SOLD, ACCORDING TO DISPOSAL; PER CENT DISTRIBUTION; ALL ESTABLISHMENTS: 1927

	Kilowatt-hours	Per cent distribution
Total output: Current generated by the electric light and power industry, and current purchased from manufacturing plants and other outside sources (including imports from Canada).....	78,457,778,214	100.0
Current sold to ultimate consumers.....	63,612,481,088	81.1
Balance not sold.....	14,845,297,126	18.9
Free service.....	509,287,430	0.6
Current used by reporting company.....	1,860,108,110	2.4
Current lost in transmission, distribution, conversion, etc.....	12,475,901,586	15.9

TABLE 25.—CONSOLIDATED BALANCE SHEET FOR ALL COMMERCIAL COMPANIES REPORTING FOR THE CENSUS OF ELECTRIC LIGHT AND POWER STATIONS, INCLUDING ASSETS AND LIABILITIES OF ALLIED NONELECTRIC INDUSTRIES: 1927

ASSETS AND OTHER DEBITS		LIABILITIES AND OTHER CREDITS	
Kind	Amount	Kind	Amount
Plant and equipment, aggregate.....	\$10, 586, 826, 473	Total capitalization.....	\$10, 405, 013, 752
Specifically reported, total.....	\$9, 684, 769, 194	Capital stock.....	5, 095, 135, 415
Electric light and power.....	\$7, 978, 234, 220	Long-term debt.....	5, 309, 878, 337
Per cent of total specifically reported.....	82.4	Cash investments (for unincorporated companies).....	6, 605, 185
Electric railway.....	\$482, 323, 869	Current liabilities.....	671, 649, 928
Per cent of total specifically reported.....	5.0	Depreciation or retirement reserves.....	700, 162, 046
Gas.....	\$917, 448, 140	Other reserves.....	166, 548, 481
Per cent of total specifically reported.....	9.5	Other credit items.....	277, 547, 030
All other.....	\$306, 762, 965	Surplus.....	722, 861, 666
Per cent of total specifically reported.....	3.2		
Undistributed.....	\$902, 057, 279		
Nonoperating physical property.....	\$34, 269, 454		
Investments.....	\$622, 449, 110		
Current assets.....	\$982, 201, 237		
Unamortized debt discount and expense.....	\$302, 644, 874		
Other debit items.....	\$411, 414, 558		
Deficit.....	\$10, 582, 382		
Total assets and other debits.....	\$12, 950, 388, 088	Total liabilities and other credits.....	\$12, 950, 388, 088

TABLE 26.—CONSOLIDATED INCOME, OPERATING-REVENUE, AND EXPENSE STATEMENT, FOR COMMERCIAL ESTABLISHMENTS: 1927

I. INCOME FROM ELECTRIC OPERATIONS	
1. Operating revenues, electric:	
Sales of electric current.....	\$1, 680, 218, 664
Miscellaneous electric revenues.....	21, 801, 419
Total operating revenues, electric.....	\$1, 702, 020, 083
	<i>Revenue deductions</i>
2. Operating expenses, electric:	
Fuel.....	157, 912, 379
Purchased power.....	143, 710, 930
Depreciation or retirement expenses, electric property.....	107, 615, 698
All other operating expenses, electric.....	448, 860, 272
Uncollectible electric bills.....	6, 365, 315
Operating taxes, electric.....	150, 253, 276
Total revenue deductions, electric.....	1, 014, 717, 870
Total operating revenues.....	687, 302, 213
	<i>Other income items, electric</i>
Rents charged or credited to income, electric property (net).....	17, 122, 829
Amortization of limited-term franchises, rights, etc., for electric property only.....	62, 491
Net income from electric operations.....	670, 118, 893
II. INCOME FROM OTHER THAN ELECTRIC OPERATIONS	
Net income from operation of utilities other than light and power plants (gas, electric railway, water, etc.).....	85, 248, 300
Nonoperating income (net of debits and credits).....	53, 950, 112
GROSS INCOME.....	809, 324, 305

¹ This total includes \$125,612,127 representing revenue received from "Sales for resale."

TABLE 26.—CONSOLIDATED INCOME, OPERATING-REVENUE, AND EXPENSE STATEMENT, FOR COMMERCIAL ESTABLISHMENTS: 1927—Continued

III. DEDUCTIONS FROM GROSS INCOME			
Interest on funded and unfunded debt, amortization of debt discount and expense, and amortization of premium on debt (net).....			\$269, 601, 993
Other deductions from gross income.....			33, 035, 287
Total deductions from gross income.....			\$303, 537, 280
NET INCOME FOR THE YEAR from all sources.....			505, 787, 025
IV. APPROPRIATIONS DURING THE YEAR FROM CURRENT AND PREVIOUS YEARS' SURPLUS			
For dividends on stocks.....			Total \$338, 238, 580
	Electric property	Other properties	Undis-tributed
For depreciation or retirement reserve.....	\$24, 448, 362	\$8, 783, 145	\$4, 384, 723
Total appropriations from surplus.....			37, 616, 230
			375, 854, 810

¹This represents a rate of 6.6 per cent, based on the total of \$5,095,135,415 for capital stocks. (See Table 65, p. 79.)

TABLE 27.—TOTAL CURRENT GENERATED AND PURCHASED, AND AMOUNT AND PER CENT WHICH CROSSED STATE LINES, COMMERCIAL ESTABLISHMENTS: 1927

	Kilowatt-hours	Per cent distribution
Total output; Current generated by commercial electric light and power stations and current purchased from other sources (including imports from Canada).....	74, 034, 356, 496	100. 0
Generated.....	71, 306, 839, 538	95. 2
Imported from Canada.....	1, 342, 783, 327	1. 8
Purchased from manufacturing plants and other sources outside the electric light and power industry.....	2, 284, 733, 631	3. 0
Total current crossing State lines.....	10, 424, 662, 982	Per cent of total 13. 0
Purchased from public-utility electric systems, including street railways, in other States.....	5, 494, 383, 089	7. 1
Purchased from other sources (manufacturing plants, etc.) in other States.....	401, 817, 464	0. 5
Received from plants of same system located in other States.....	3, 185, 679, 102	4. 3
Imported from Canada.....	1, 342, 783, 327	1. 8

¹Figures may be incomplete.

Chapter III.—THE GEOGRAPHICAL DISTRIBUTION OF THE INDUSTRY

Prime movers by regions (Table 28).—The distribution of prime movers reflects the natural power resources available in the several sections of the country, as well as the natural conditions to be met. Table 28 brings out the preponderance of water power in the two Western divisions—the eight Mountain States and the three Pacific States. These 11 Western States, with 9 per cent of the country's population (as estimated for July 1, 1927), reported 38 per cent of the hydraulic horsepower. California alone had approximately 19 per cent and Washington 7 per cent, while New York, with 14 per cent, was second to California. Mississippi, North Dakota, and Arkansas are the only States reporting no installation in water-power plants.

Fuel-operated plants predominate in horsepower in each of the other geographic divisions. Pennsylvania and New York lead in the use of steam power, the former with more than 12 per cent of the country's total and the latter with nearly 11 per cent.

The two West Central divisions, though among the smaller ones in total horsepower of prime movers, lead in respect of internal-combustion engines because of their many small and widely separated communities and their ample supplies of oil. These two divisions reported 60 per cent of the total horsepower of such engines. Texas alone contributed about 18 per cent, and is followed by Kansas, Florida, Oklahoma, and Nebraska, in the order in which named.

Generator installations for electric light and power establishments compared with total installation (Table 29).—The percentage of electric-power installation in other than central stations is naturally largest in those geographic divisions that are notable for their manufacturing industries. Thus, by comparing the figures in Table 29 with those in Table 4, it is found that in New England the central stations contributed only 60.2 per cent of the total; in the Middle Atlantic States, 65.2 per cent; and in the East North Central States, 69.2 per cent; whereas they contributed 89.5 per cent of the total in the Pacific States.

Regional increase (Table 29).—The maximum regional increase in generator capacity, comparing 1927 with 1922, was 149.4 per cent in the West South Central States, followed by 131.8 per cent in the South Atlantic States. The same regions led also in their increase in kilowatt-hours generated, the first with 214.5 per cent, the second with 122.9 per cent. The greatest rate of growth in number of customers, 130.4 per cent, appears for the South Atlantic States; and in kilowatt-hours sold to ultimate consumers, 202.6 per cent, for the West South Central States. The last-named item is obviously the most reliable index to changes in the use of electrical energy.

In North Carolina much generator capacity was added during the period between 1922 and 1927. This was primarily to serve industrial establishments, but it also contributed somewhat to the supply of current available for public utilities, and was therefore covered by the statistics for 1927. Some of these plants operate many hours a day at high load, which accounts for the unusual increase of 403.5 per cent in generated output with a much smaller increase in generator rating—229.7 per cent.

The maximum increases in generator capacity (532 per cent), in generated kilowatt-hours (1,116.7 per cent), and in sales to ultimate consumers (644.9

per cent) are shown for Louisiana; the maximum increase in customers (244.9 per cent), for Virginia.

Fuels (Table 30).—Coal is the predominant fuel, its use being general except on the Pacific coast. Fuel oil or its refined products are used in all geographic regions, and (reduced to its equivalent in tons of coal) represented about 4 per cent of the aggregate fuel consumption in the United States in 1927 (Table 17). Natural gas contributed 6 per cent of the aggregate. Practically two-thirds of the total consumption of this fuel was reported from Kansas and the four States of the West South Central group; Texas alone consumed more than one-third. California reported nearly 12 per cent, and most of the remainder was used in Pennsylvania, Ohio, and West Virginia.

Aside from the increased efficiency in the use of fuel, discussed in connection with Table 9, there have been some pronounced shifts since 1922 in the types of fuel used in different parts of the country, which are worthy of brief discussion, although the present report does not give the 1922 figures for geographic divisions or States. The slight increase in the use of anthracite (Table 9) is fully accounted for by the gain in a single State, Pennsylvania, which reported 89 per cent of the total consumption of this type of fuel in 1927. Although the amount of anthracite used was nearly three times as large in that year as in 1922 in the East North Central States and was more than three times as large in the South Central States, the tonnage represented by the gains is relatively small and does not offset the loss in New England, where the consumption fell to about one-tenth of the quantity reported for 1922, and in the South Atlantic States, where it fell to less than one-third. The use of bituminous coal increased notably in every section except the Pacific States, where it is a relatively minor factor in the production of electric power.

Consumption of fuel oil decreased nearly 40 per cent in the 5-year period. In the important oil-consuming regions, the West North Central States, the West South Central States, and the Pacific States, the consumption was reduced to less than half, but in all these regions the reduction was more than counter-balanced by the increase in the consumption of natural gas.

The increase in the use of gas in the West South Central States is especially noteworthy. In 1922 these States used less than half of the total gas consumed by central stations in the United States. By 1927, although the gas consumption by central stations throughout the country had virtually tripled, considerably more than half of the total was used in the West South Central States. The East North Central States also show a considerable increase.

Relative hydro and other output (Tables 28 and 32).—The statistics indicate that wherever water power is available it usually carries the base loads, other prime movers being used as stand-by or to meet deficiency in the water supply. The output from water power during the year was 2,920 kilowatt-hours per horsepower; from steam, 1,795 kilowatt-hours, and from internal-combustion engines, 1,050 kilowatt-hours. Though the ratios differ, the same general relationships prevail in the several geographic divisions.

Voltage of transmission lines (Table 33).—Certain definite voltages have been generally adopted for transmission purposes. These are confined largely to the voltages specifically stated in the grouping of Table 33. Lines of voltages up to and including those in the "110,000 or more but less than 220,000 volts" group are found in all parts of the country. (It is probable that most of the lines in the last-named group are operated at or close to 110,000 volts, with a small percentage at somewhat higher voltages—around 132,000 volts.) Operation at 220,000 volts, however, is confined almost exclusively to the long lines of California.

Sales per customer (Table 36).—Of the several customer groups, by far the smallest use of energy per customer is found in that sold for domestic service.

The average small commercial user takes more than eight times as much as the average domestic customer. Wide variations appear in different parts of the country. The effect of abundant water power is evident, the averages for the Mountain and Pacific groups of States being higher than those for any other group. Among the States, Idaho leads, followed by Oregon and Washington.

The revenues per customer and per kilowatt-hour for a given class of service vary in different parts of the country, the latter between wider limits, proportionately, than the former.

There appears to be no general relation among total energy consumption per year per customer, revenue per customer, and price per kilowatt-hour. These matters apparently depend largely on local conditions. Thus, in the case of domestic service, abundant water power, large consumption per customer, and low rates generally go together; and, conversely, a multiplicity of small plants rather than centralized service, or, if the latter prevails, widely separated small communities (and correspondingly high transmission-line costs, energy losses, and overhead expenses) are generally associated with small consumption per customer and high rates per kilowatt-hour.

Apparently, for similar reasons, the average rate for wholesale energy is lower in those States that have important industries using large amounts of electric energy during many hours of the day because of continuous operation; for example, the pulp and paper and the electro-chemical industries.

TABLE 28.—PRIME MOVERS—AGGREGATE HORSEPOWER, BY TYPE AND HORSEPOWER PER CAPITA, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	Total	Steam turbines	Steam engines	Internal-combustion engines	Hydro-turbines	Population	Horsepower per capita
UNITED STATES.....	35,710,128	24,323,304	994,273	548,288	0,844,263	118,628,000	0.30
GEOGRAPHIC DIVISIONS:							
New England.....	3,000,000	2,177,370	98,492	4,705	758,528	8,183,000	.37
Middle Atlantic.....	8,014,712	6,098,793	183,779	24,089	1,708,051	24,902,000	.35
East North Central.....	8,068,393	7,563,274	274,923	38,287	801,900	24,564,000	.35
West North Central.....	2,671,236	1,876,072	100,955	150,857	444,352	13,182,000	.20
South Atlantic.....	4,393,793	2,564,136	73,895	60,670	1,699,193	15,898,000	.28
East South Central.....	1,446,897	794,485	43,534	31,333	607,545	9,363,000	.16
West South Central.....	1,563,349	1,278,518	75,604	177,715	31,512	11,038,000	.13
Mountain.....	1,405,585	313,162	34,176	37,937	1,020,310	4,013,000	.35
Pacific.....	3,937,073	1,165,495	48,915	0,795	2,712,808	6,885,000	.57
NEW ENGLAND:							
Maine.....	252,316	49,000	700	775	201,841	793,000	.32
New Hampshire.....	157,331	53,289	0,073	1,835	95,534	455,000	.35
Vermont.....	204,036	15,008	4,085	-----	184,343	353,000	.58
Massachusetts.....	1,528,568	1,287,207	51,421	1,420	188,520	4,242,000	.36
Rhode Island.....	293,470	218,685	2,500	-----	2,285	704,000	.37
Connecticut.....	608,369	514,181	2,513	675	86,000	1,680,000	.37
MIDDLE ATLANTIC:							
New York.....	4,212,355	2,671,363	100,260	8,042	1,423,690	11,423,000	.37
New Jersey.....	1,093,561	969,140	33,863	3,307	7,251	3,749,000	.27
Pennsylvania.....	3,398,790	3,008,290	40,056	12,740	277,110	9,736,000	.35
EAST NORTH CENTRAL:							
Ohio.....	2,374,554	2,254,681	71,888	5,332	22,653	6,710,000	.35
Indiana.....	899,925	779,987	30,040	4,735	48,563	3,150,000	.28
Illinois.....	2,004,559	2,730,018	97,430	10,957	66,154	7,296,000	.40
Michigan.....	1,618,740	1,298,702	13,484	10,646	355,698	4,490,000	.36
Wisconsin.....	920,615	649,886	55,481	6,617	308,631	2,918,000	.32
WEST NORTH CENTRAL:							
Minnesota.....	516,124	302,140	33,525	6,717	173,789	2,686,000	.19
Iowa.....	648,807	373,271	49,589	23,047	205,900	2,425,000	.27
Missouri.....	648,028	561,320	34,805	20,787	22,137	3,510,000	.18
North Dakota.....	59,130	55,668	15,818	4,730	-----	641,000	.09
South Dakota.....	79,514	37,487	11,588	14,549	6,885	696,000	.10
Nebraska.....	260,055	169,307	25,077	33,453	21,618	1,896,000	.18
Kansas.....	481,572	390,024	22,093	47,014	14,076	1,828,000	.26

TABLE 28.—PRIME MOVERS—AGGREGATE HORSEPOWER, BY TYPE AND HORSE-POWER PER CAPITA, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927—Continued

DIVISION AND STATE	Total	Steam turbines	Steam engines	Internal-combustion engines	Hydro-turbines	Population	Horse-power per capita
SOUTH ATLANTIC:							
Delaware, District of Columbia, and Maryland	695,284	653,441	9,611	6,387	25,845	2,380,000	.20
Virginia	501,775	395,936	3,299	4,815	97,735	2,546,000	.20
West Virginia	755,268	658,036	5,837	6,734	84,661	1,696,000	.45
North Carolina	772,824	289,033	7,911	4,167	471,723	2,897,000	.27
South Carolina	790,433	148,763	14,054	1,278	536,338	1,845,000	.33
Georgia	698,772	111,600	19,514	4,052	473,546	3,171,000	.19
Florida	359,437	299,296	13,699	37,147	9,325	1,363,000	.26
EAST SOUTH CENTRAL:							
Kentucky	395,238	244,215	8,815	4,131	138,077	2,539,000	.16
Tennessee	455,965	262,710	17,563	3,454	172,238	2,485,000	.18
Alabama	508,240	139,300	6,465	5,245	357,230	2,549,000	.20
Mississippi	87,454	58,280	10,691	18,503		1,791,000	.05
WEST SOUTH CENTRAL:							
Arkansas	131,036	85,724	20,699	10,683	14,020	1,923,000	.07
Louisiana	270,900	243,238	3,375	30,287		1,634,000	.14
Oklahoma	299,789	228,315	24,043	35,113	2,318	2,384,000	.13
Texas	855,624	711,241	27,577	101,632	15,174	5,397,000	.16
MOUNTAIN:							
Montana	378,242	11,457	2,535	747	363,503	714,000	.53
Idaho	307,194	2,000	1,250	1,105	302,839	534,000	.58
Wyoming	48,166	34,334	5,340	4,769	3,723	241,000	.20
Colorado	268,404	173,579	11,836	4,050	78,939	1,074,000	.25
New Mexico	32,652	21,414	4,207	5,806	1,225	392,000	.08
Arizona	153,195	21,987	8,543	17,115	105,510	459,000	.33
Utah	198,546	48,240	50	1,950	148,600	522,000	.38
Nevada	18,976	201	415	2,395	15,965	77,000	.25
PACIFIC:							
Washington	847,526	141,492	6,200	1,405	698,729	1,562,000	.54
Oregon	308,561	129,730	7,175	2,380	169,216	890,000	.35
California	2,750,746	894,273	35,540	6,010	1,844,923	4,433,000	.63

1 Combined to avoid disclosing data for individual establishments.

TABLE 29.—GENERATOR CAPACITY, OUTPUT OF CURRENT, NUMBER OF CUSTOMERS, AND SALES TO ULTIMATE CONSUMERS, WITH PER CENT OF INCREASE, BY GEOGRAPHIC DIVISIONS AND STATES: 1927 AND 1922

DIVISION AND STATE	RATED GENERATOR CAPACITY (KILOWATTS)			CURRENT GENERATED (KILOWATT-HOURS)			NUMBER OF CUSTOMERS (ULTIMATE CONSUMERS)			CURRENT SOLD TO ULTIMATE CONSUMERS (KILOWATT-HOURS)		
	1927	1922	Per cent of increase	1927	1922	Per cent of increase	1927	1922	Per cent of increase	1927	1922	Per cent of increase
	UNITED STATES.....	25,811,805	14,313,438	80.3	74,080,378,010	40,291,530,435	85.4	21,786,317	112,709,808	71.4	63,612,481,088	32,947,716,350
GEOGRAPHIC DIVISIONS:												
New England.....	2,124,315	1,456,574	45.8	4,750,193,632	2,969,071,441	59.9	2,007,949	1,143,697	75.5	3,956,288,197	2,333,127,469	66.0
Middle Atlantic.....	6,373,454	3,604,986	73.9	19,281,894,885	10,785,515,044	79.1	6,012,563	3,242,775	86.0	17,260,064,651	9,576,802,943	89.6
East North Central.....	6,245,684	3,809,639	88.7	18,341,894,885	9,398,260,227	69.4	5,312,752	3,312,149	69.4	15,287,004,651	8,079,487,810	89.0
West North Central.....	1,950,096	1,171,496	60.5	4,540,293,907	2,968,750,855	53.2	5,187,518	1,561,211	40.1	4,060,736,790	2,518,263,262	61.2
South Atlantic.....	3,144,018	1,556,478	131.8	8,145,210,788	3,989,434,356	122.9	1,564,351	679,981	130.4	7,014,309,562	2,695,479,186	160.2
East South Central.....	1,049,765	673,788	83.0	2,775,021,117	1,041,833,084	85.6	1,721,482	362,982	98.8	2,455,204,623	948,621,243	158.8
West South Central.....	1,152,073	461,984	149.4	3,289,551,356	1,041,392,651	214.5	1,133,290	605,331	87.2	2,703,455,554	893,510,159	202.6
Mountain.....	980,828	661,376	48.3	3,889,623,747	2,209,444,164	53.4	1,597,460	445,270	34.2	2,856,940,800	1,784,104,574	60.1
Pacific.....	2,791,671	1,657,267	68.5	10,006,323,747	5,758,928,013	73.8	2,229,322	1,357,372	64.2	7,439,061,939	4,075,280,804	82.5
NEW ENGLAND:												
Maine.....	179,364	89,983	99.3	590,664,446	278,456,249	101.3	184,873	92,733	99.4	473,630,933	233,422,732	102.9
New Hampshire.....	115,554	51,617	123.9	226,444,199	94,893,042	138.7	106,215	64,158	65.6	150,824,272	80,478,020	87.4
Vermont.....	141,420	96,869	46.0	338,528,207	217,717,589	55.5	76,178	48,320	57.7	127,591,975	104,117,652	22.5
Massachusetts.....	1,077,337	794,420	35.6	2,245,301,081	1,493,328,246	50.4	1,077,818	697,563	77.4	2,018,841,347	1,285,437,628	57.1
Rhode Island.....	194,700	163,900	18.8	411,073,647	341,592,302	20.3	1,169,174	86,271	99.1	377,720,927	228,322,143	14.7
Connecticut.....	415,940	259,788	60.1	968,182,052	544,013,113	78.0	392,991	244,652	60.6	807,678,743	450,289,244	79.4
MIDDLE ATLANTIC:												
New York.....	3,157,015	1,858,890	69.9	9,917,085,550	5,430,771,804	82.6	3,193,782	1,700,418	81.4	9,378,300,989	5,041,885,371	86.0
New Jersey.....	683,876	356,443	91.9	1,668,089,763	858,089,737	76.0	981,117	498,984	128.7	1,687,616,398	854,146,140	97.6
Pennsylvania.....	2,531,963	1,449,553	74.7	7,501,974,521	4,276,653,503	75.4	1,888,154	1,053,423	76.4	6,803,147,264	3,680,791,352	84.8
EAST NORTH CENTRAL:												
Ohio.....	1,742,856	897,412	94.2	4,724,016,312	2,404,492,455	96.5	1,370,403	774,605	76.9	4,224,192,785	2,130,018,152	96.5
Indiana.....	2,635,063	335,450	94.7	1,746,153,163	795,271,188	119.6	1,038,575	405,249	57.6	1,521,799,893	641,146,847	137.3
Illinois.....	2,935,905	972,550	106.3	6,075,352,208	3,089,503,012	96.6	1,766,722	1,127,830	56.6	4,931,851,445	2,708,320,288	78.2
Michigan.....	1,188,880	691,080	72.0	3,773,630,019	2,102,686,483	73.5	981,544	639,233	48.9	3,224,951,826	1,769,852,136	82.3
Wisconsin.....	624,380	413,047	51.2	1,892,730,883	976,306,489	93.9	955,447	345,241	60.9	1,334,643,014	716,186,367	82.3
WEST NORTH CENTRAL:												
Minnesota.....	372,651	227,739	63.6	843,367,074	588,638,075	43.2	453,832	312,171	32.9	623,662,445	645,782,502	43.0
Iowa.....	422,122	236,610	104.3	1,429,100,707	838,542,809	68.5	469,688	298,171	57.9	688,865,230	385,147,071	77.8
Missouri.....	474,272	315,314	50.3	1,601,170,142	700,642,238	97.2	1,139,694	410,690	51.0	1,442,804,582	808,555,870	79.1
North Dakota.....	40,505	20,314	20.2	60,897,446	30,922,817	46.0	17,847	17,847	100.0	47,801,921	47,801,921	50.1
South Dakota.....	48,172	24,085	50.4	60,897,446	30,922,817	46.0	73,572	17,847	32.3	47,801,921	47,801,921	50.1
Nebraska.....	189,567	117,733	53.4	408,653,823	245,010,017	64.7	300,867	165,076	33.6	300,867,152	189,487,053	58.8
Kansas.....	358,218	204,131	75.5	830,163,312	473,670,278	73.6	312,640	236,202	32.4	384,167,777	411,155,153	42.1

Total number of customers. Schedule for 1922 did not call for number of ultimate consumers.

TABLE 39.—GENERATOR CAPACITY, OUTPUT OF CURRENT, NUMBER OF CUSTOMERS, AND SALES TO ULTIMATE CONSUMERS, WITH PER CENT OF INCREASE, BY GEOGRAPHIC DIVISIONS AND STATES: 1927 AND 1922—Continued

DIVISION AND STATE	RATED GENERATOR CAPACITY (KILOWATTS)			CURRENT GENERATED (KILOWATT-HOURS)			NUMBER OF CUSTOMERS (ULTIMATE CONSUMERS)			CURRENT SOLD TO ULTIMATE CONSUMERS (KILOWATT-HOURS)		
	1927	1922	Per cent of increase	1927	1922	Per cent of increase	1927	1922	Per cent of increase	1927	1922	Per cent of increase
SOUTH ATLANTIC												
Delaware, District of Columbia, and Maryland	488,204	300,108	62.0	1,102,187,068	622,388,609	77.1	486,013	209,647	102.9	1,288,511,185	606,579,837	108.7
Virginia	364,683	317,473	210.9	973,760,460	316,500,835	206.1	210,987	61,182	244.9	687,210,351	282,180,894	172.6
West Virginia	264,537	100,473	87.9	1,062,819,767	1,062,378,080	58.7	1,062,656	74,089	111.5	909,776,182	406,991,655	138.3
North Carolina	561,985	187,431	339.7	2,096,151,761	404,428,046	408.5	219,960	106,302	106.7	1,907,681,880	638,614,483	306.1
South Carolina	491,908	352,886	67.7	1,118,566,957	844,416,989	32.2	94,938	61,868	33.4	786,110,911	272,237,634	286.3
Georgia	880,180	107,213	264.0	1,746,074,406	268,268,128	178.1	196,163	73,937	168.2	980,468,683	273,884,846	257.9
Florida	268,242	71,121	312.3	607,978,880	181,390,283	332.3	289,946	91,849	183.0	494,563,258	97,940,157	343.7
EAST SOUTH CENTRAL												
Kentucky	398,089	103,391	138.3	808,694,086	331,606,893	118.4	247,935	146,482	65.6	547,678,714	221,634,381	147.1
Tennessee	338,412	101,781	102.9	930,874,283	402,546,599	90.2	223,560	114,434	95.2	747,805,833	325,924,671	139.3
Alabama	349,457	261,431	33.7	1,270,188,764	683,883,203	100.4	170,368	54,549	212.3	1,039,737,417	350,774,762	196.4
Mississippi	68,887	42,186	61.4	64,670,942	61,937,289	4.4	79,619	44,217	80.1	120,882,659	50,285,426	139.4
WEST SOUTH CENTRAL												
Arkansas	94,656	42,289	124.8	174,197,648	84,480,023	106.2	115,271	56,096	108.5	186,194,149	88,328,559	219.2
Louisiana	907,542	32,858	532.0	694,694,420	82,184,221	110.7	168,813	114,833	186.6	447,783,078	60,105,700	644.9
Oklahoma	227,575	265,907	87.9	684,513,285	242,508,790	109.0	184,689	55,000	58.0	596,683,540	236,613,408	152.2
Texas	622,001	263,900	134.0	1,811,715,884	662,485,617	173.0	609,408	335,665	81.6	1,472,894,481	588,462,492	173.5
MOUNTAIN												
Montana	268,609	227,233	18.2	1,398,749,279	988,009,191	41.6	80,905	62,646	29.1	1,196,737,475	842,539,123	42.0
Idaho	208,117	136,088	54.1	713,213,718	531,134,238	34.3	78,485	65,248	20.2	264,260,696	207,278,682	30.6
Wyoming	34,748	30,015	15.8	67,070,330	38,735,599	73.1	31,008	25,365	22.1	48,369,896	34,356,610	41.2
Colorado	198,919	112,500	76.7	498,536,961	290,081,677	72.2	197,242	128,708	48.6	396,522,278	218,360,599	81.6
New Mexico	24,080	16,178	68.7	382,674,286	227,362,386	46.2	27,213	18,834	44.5	26,882,248	14,694,634	80.9
Arizona	100,000	48,870	105.9	280,207,002	147,390,512	90.2	112,934	38,582	40.3	204,520,278	71,873,045	181.8
Utah	132,765	81,347	63.2	340,873,488	146,337,419	132.9	114,997	90,859	24.3	668,004,860	359,162,467	83.2
Nevada	13,090	11,035	18.6	57,137,292	46,303,145	23.9	15,578	11,008	41.5	63,934,729	40,939,494	56.2
PACIFIC												
Washington	603,084	362,576	66.5	2,105,288,534	1,144,068,589	84.0	392,666	200,610	50.7	1,620,981,418	842,667,300	92.3
Oregon	222,597	81,163	174.8	840,062,576	266,860,874	214.8	209,051	78,594	166.2	658,083,969	206,040,689	219.4
California	1,304,990	1,213,528	61.9	7,060,972,637	4,347,998,550	62.4	1,627,605	1,018,228	59.8	5,160,916,522	3,026,581,811	70.5

* Combined to avoid disclosing data for individual establishments.

TABLE 30.—CONSUMPTION OF FUEL, BY KIND, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

[For conversion factors, coal equivalent, see footnote 1, Table 9]

DIVISION AND STATE	COAL		Coke (tons of 2,000 lbs.)	Fuel oil (barrels of 42 gals.)	GAS	
	Anthra- cite (tons of 2,240 lbs.)	Bituminous (tons of 2,000 lbs.)			Manu- factured (1,000 cu. ft.)	Natural (1,000 cu. ft.)
UNITED STATES.....	1,787,603	35,681,314	31,623	7,145,798	6,160,753	59,362,039
GEOGRAPHIC DIVISIONS:						
New England.....	7,690	2,083,783	6,234	850,153		
Middle Atlantic.....	1,751,731	8,710,745	17,858	298,696	1,364	5,872,307
East North Central.....	11,905	14,618,876		150,684	1,226,545	4,295,961
West North Central.....	194	3,335,005	11	1,250,533	12,893	9,602,942
South Atlantic.....	3,837	3,630,640		1,674,106		228,684
East South Central.....	7,058	1,434,301	111	138,100	2	10,076
West South Central.....	5,278	1,341,635	284	1,280,071	4,919,949	31,814,200
Mountain.....		518,060	7,125	232,682		583,645
Pacific.....		2,239		1,270,773		6,954,234
NEW ENGLAND:						
Maine.....		1,905		31,317		
New Hampshire.....		42,689		1,633		
Vermont.....		3,853		30,856		
Massachusetts.....	2,325	1,205,828	116	616,596		
Rhode Island.....	5,365	270,000	1,342	167,884		
Connecticut.....		559,508	4,776	1,837		
MIDDLE ATLANTIC:						
New York.....	108,108	3,588,902	17,858	266,825	1,364	18,253
New Jersey.....	84,812	1,242,108		20,158		
Pennsylvania.....	1,558,811	3,885,735		11,713		5,854,054
EAST NORTH CENTRAL:						
Ohio.....	6,660	3,998,766		31,452	1,226,545	4,295,701
Indiana.....		2,021,385		18,227		250
Illinois.....		5,813,995		64,808		
Michigan.....	5,245	1,996,432		22,526		
Wisconsin.....		788,298		13,671		
WEST NORTH CENTRAL:						
Minnesota.....	194	413,944		13,294		
Iowa.....		851,013	11	63,550	12,893	
Missouri.....		967,947		848,538		
North Dakota.....		216,420		11,990		
South Dakota.....		118,103		44,053		
Nebraska.....		418,029		137,603		
Kansas.....		349,549		636,505		8,602,942
SOUTH ATLANTIC:						
Delaware, District of Co- lumbia, and Maryland ¹		866,890		25,698		
Virginia.....		629,653		13,500		
West Virginia.....		1,508,346		15,381		228,684
North Carolina.....	570	199,185		6,942		
South Carolina.....		305,618		101,509		
Georgia.....	3,267	95,199		1,510,392		
Florida.....		25,749				
EAST SOUTH CENTRAL:						
Kentucky.....		494,196		13,114		10,076
Tennessee.....		512,217	111	25,336		
Alabama.....	7,058	330,189		13,831		
Mississippi.....		97,699		85,819	2	
WEST SOUTH CENTRAL:						
Arkansas.....		116,051		76,703		1,360,038
Louisiana.....	365	253,568		216,836	4,919,949	782,225
Oklahoma.....	4,913	320,622		178,995		8,600,156
Texas.....		651,394	284	807,537		21,071,782
MOUNTAIN:						
Montana.....		24,523		2,246		318,458
Idaho.....		106		556		
Wyoming.....		105,166		15,350		265,187
Colorado.....		361,269	7,125	13,834		
New Mexico.....		21,684		67,039		
Arizona.....		125,585		7,686		
Utah.....		13,542		386		
Nevada.....		1,800				
PACIFIC:						
Washington.....		960		161,583		
Oregon.....		1,279		15,829		
California.....				1,098,361		6,954,234

¹ Combined to avoid disclosing data for individual establishments.

TABLE 31.—GENERATOR CAPACITY, FOR ALTERNATING-CURRENT BY FREQUENCY, AND FOR DIRECT-CURRENT, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	Aggregate	ALTERNATING-CURRENT				Direct-current
		Total	25-cycle	60-cycle	Other frequencies	
UNITED STATES.....	25,811,305	27,537,726	2,743,123	21,744,451	1,050,122	273,579
GEOGRAPHIC DIVISIONS:						
New England.....	2,124,315	2,111,571	11,500	2,062,236	37,535	12,744
Middle Atlantic.....	6,373,454	6,254,154	1,690,001	4,473,854	120,332	119,300
East North Central.....	6,245,084	6,183,935	605,850	5,489,501	81,275	61,149
West North Central.....	1,950,096	1,923,234	243,554	1,678,746	909	26,860
South Atlantic.....	3,144,019	3,124,287	219,109	2,789,823	105,355	10,733
East South Central.....	1,049,765	1,034,434	570	1,033,833	30	15,332
West South Central.....	1,132,073	1,117,785	1,787	1,139,730	6,268	4,288
Mountain.....	980,828	976,033	313	962,197	13,529	4,789
Pacific.....	2,791,671	2,782,286	40	2,100,254	681,692	9,385
NEW ENGLAND:						
Maine.....	179,344	178,969	5,700	143,260	30,000	395
New Hampshire.....	115,554	114,519	4,500	110,019	1,000	1,035
Vermont.....	141,420	141,395	-----	140,395	-----	25
Massachusetts.....	1,077,337	1,067,987	-----	1,067,687	-----	9,050
Rhode Island.....	194,700	193,700	1,000	192,100	-----	1,000
Connecticut.....	415,940	415,301	-----	408,700	0,535	639
MIDDLE ATLANTIC:						
New York.....	3,157,615	3,054,600	1,412,515	1,622,843	119,332	102,925
New Jersey.....	683,876	671,801	25,200	646,601	-----	12,675
Pennsylvania.....	2,531,963	2,527,663	222,349	2,304,414	900	4,800
EAST NORTH CENTRAL:						
Ohio.....	1,742,856	1,717,331	124,900	1,592,331	100	25,525
Indiana.....	633,063	631,242	30,823	620,419	-----	1,521
Illinois.....	2,045,905	2,020,673	374,640	1,645,788	350	15,227
Michigan.....	1,188,880	1,157,241	39,400	1,063,916	83,925	1,539
Wisconsin.....	624,380	607,443	30,093	571,340	-----	10,937
WEST NORTH CENTRAL:						
Minnesota.....	372,651	369,692	44,562	325,130	-----	2,050
Iowa.....	482,122	475,037	130	474,867	-----	7,065
Missouri.....	472,272	467,618	125,347	342,351	250	4,324
North Dakota.....	30,094	32,795	-----	32,780	-----	3,200
South Dakota.....	43,172	47,440	-----	47,440	-----	732
Nebraska.....	190,567	179,309	85	176,007	217	4,258
Kansas.....	358,218	353,995	73,400	280,171	424	4,223
SOUTH ATLANTIC:						
Delaware, District of Columbia, and Maryland.....	498,284	493,584	218,000	275,584	-----	4,710
Virginia.....	364,633	357,472	860	355,047	665	7,161
West Virginia.....	564,827	561,599	-----	561,599	-----	2,928
North Carolina.....	551,985	551,810	23	465,181	86,000	175
South Carolina.....	491,206	491,006	-----	473,068	17,940	200
Georgia.....	350,130	375,992	220	375,622	150	4,133
Florida.....	293,242	282,822	-----	292,822	-----	420
EAST SOUTH CENTRAL:						
Kentucky.....	298,099	297,352	115	297,437	-----	487
Tennessee.....	326,412	328,880	-----	328,880	-----	9,532
Alabama.....	349,427	348,387	455	347,912	80	1,030
Mississippi.....	63,887	59,604	-----	59,604	-----	4,233
WEST SOUTH CENTRAL:						
Arkansas.....	94,955	91,955	1,500	90,455	-----	3,000
Louisiana.....	207,542	207,500	65	206,835	600	42
Oklahoma.....	227,575	227,323	222	227,101	-----	252
Texas.....	622,001	621,007	-----	615,330	5,668	694
MONTANA:						
Montana.....	268,509	267,554	-----	267,519	35	955
Idaho.....	208,117	208,101	-----	208,101	-----	16
Wyoming.....	34,748	34,582	-----	34,582	30	150
Colorado.....	196,919	196,020	38	182,518	13,464	2,890
New Mexico.....	24,080	23,440	-----	23,440	-----	650
Arizona.....	100,606	100,494	50	100,444	-----	109
Utah.....	132,755	132,748	-----	132,748	-----	7
Nevada.....	13,090	13,090	225	12,865	-----	-----
PACIFIC:						
Washington.....	603,684	598,158	-----	598,158	-----	5,526
Oregon.....	222,967	220,497	-----	216,667	3,930	2,500
California.....	1,964,990	1,963,631	40	1,285,529	678,062	1,350

1 Combined to avoid disclosing data for individual establishments.

TABLE 32.—CURRENT GENERATED, BY TYPE OF PRIME MOVER, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	Total (kilowatt-hours)	KILOWATT-HOURS GENERATED BY—		
		Steam	Water	Internal-combustion
UNITED STATES.....	74,686,378,010	45,391,190,914	28,718,138,400	577,048,687
GEOGRAPHIC DIVISIONS:				
New England.....	4,750,193,632	2,802,792,278	1,944,884,927	2,516,427
Middle Atlantic.....	19,281,644,834	13,083,455,101	6,179,284,557	18,904,876
East North Central.....	18,211,894,585	15,751,890,339	2,425,967,470	34,036,776
West North Central.....	4,549,263,907	2,879,683,627	1,510,667,006	153,013,274
South Atlantic.....	8,445,216,788	5,350,992,949	3,014,997,205	79,226,634
East South Central.....	2,777,268,044	1,129,360,049	1,617,401,610	30,505,785
West South Central.....	3,275,021,117	3,014,667,414	63,617,819	196,835,884
Mountain.....	3,389,551,356	413,902,239	2,923,262,470	52,386,647
Pacific.....	10,006,323,747	964,046,318	9,032,055,045	9,622,384
NEW ENGLAND:				
Maine.....	500,664,446	3,825,420	550,343,354	495,672
New Hampshire.....	226,444,199	30,143,231	195,751,913	540,055
Vermont.....	338,528,207	7,103,957	331,424,250	—
Massachusetts.....	2,245,301,081	1,692,105,034	581,846,797	1,350,250
Rhode Island.....	411,073,647	405,975,264	5,098,383	—
Connecticut.....	968,182,052	693,639,821	274,421,230	121,450
MIDDLE ATLANTIC:				
New York.....	9,917,685,550	4,664,528,080	5,240,394,835	6,762,635
New Jersey.....	1,861,984,763	1,823,975,873	33,748,540	7,260,350
Pennsylvania.....	7,501,974,521	6,594,951,148	899,141,482	4,881,891
EAST NORTH CENTRAL:				
Ohio.....	4,724,016,312	4,670,969,928	48,364,410	4,681,974
Indiana.....	1,746,153,163	1,685,608,712	154,562,534	5,981,917
Illinois.....	6,075,352,208	5,845,598,055	218,221,252	11,532,901
Michigan.....	3,773,636,019	2,701,499,104	1,065,076,878	7,060,037
Wisconsin.....	1,892,736,883	948,214,540	939,742,396	4,779,947
WEST NORTH CENTRAL:				
Minnesota.....	843,357,074	306,142,525	534,024,386	3,190,163
Iowa.....	1,429,169,797	599,762,136	809,308,227	20,096,434
Missouri.....	891,179,442	779,934,185	82,739,580	28,505,677
North Dakota.....	59,409,194	56,629,848	—	2,779,346
South Dakota.....	90,407,255	62,345,089	11,696,429	16,365,737
Nebraska.....	405,055,838	334,186,492	40,843,271	30,026,070
Kansas.....	830,685,312	740,583,352	38,055,113	52,046,847
SOUTH ATLANTIC:				
Delaware, District of Columbia, and Maryland ¹	1,102,187,568	1,065,398,607	30,162,238	6,626,723
Virginia.....	973,766,450	697,494,191	273,711,490	2,560,769
West Virginia.....	1,902,819,767	1,697,067,592	200,072,693	5,679,422
North Carolina.....	2,036,121,761	952,292,287	1,079,961,168	3,868,306
South Carolina.....	1,116,266,957	336,901,431	777,097,976	2,267,550
Georgia.....	746,074,405	100,156,811	643,754,310	2,163,284
Florida.....	567,979,880	501,682,030	10,237,330	56,060,520
EAST SOUTH CENTRAL:				
Kentucky.....	505,564,056	394,144,593	109,461,413	1,958,050
Tennessee.....	936,874,282	361,655,214	570,437,172	4,781,896
Alabama.....	1,270,168,764	329,048,108	937,503,025	3,607,631
Mississippi.....	64,670,942	44,512,734	—	20,158,208
WEST SOUTH CENTRAL:				
Arkansas.....	174,197,548	113,822,031	45,975,990	9,399,527
Louisiana.....	634,594,420	601,238,945	—	33,355,475
Oklahoma.....	664,513,265	608,698,314	5,010,230	40,809,721
Texas.....	1,811,715,884	1,685,813,124	12,631,599	113,271,161
MOUNTAIN:				
Montana.....	1,398,749,279	11,476,728	1,386,872,584	399,967
Idaho.....	713,213,718	19,085	713,042,195	152,438
Wyoming.....	67,070,330	62,957,324	2,626,120	1,486,886
Colorado.....	499,565,961	275,586,901	221,077,917	2,921,143
New Mexico.....	32,674,286	26,887,396	1,475,485	4,311,405
Arizona.....	230,267,002	20,063,416	219,041,198	41,162,388
Utah.....	340,873,488	16,626,149	324,130,539	117,800
Nevada.....	67,137,292	306,240	54,996,432	1,834,620
PACIFIC:				
Washington.....	2,105,288,534	63,329,671	2,041,240,701	712,162
Oregon.....	840,062,576	235,281,436	602,375,530	2,405,610
California.....	7,060,972,637	666,035,211	6,388,432,814	6,504,612

¹Combined to avoid disclosing data for individual establishments.

TABLE 33.—TRANSMISSION LINES—MILES OF CIRCUIT, BY VOLTAGE CAPACITY,
COMMERCIAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	TRANSMISSION LINES						
	Total	6,600 or more but less than 11,000 volts	11,000 or more but less than 33,500 volts	33,000 or more but less than 66,000 volts	66,000 or more but less than 110,000 volts	110,000 or more but less than 220,000 volts	220,000 or more
UNITED STATES.....	125,449	29,317	62,969	59,934	24,791	10,170	1,268
GEOGRAPHIC DIVISIONS:							
New England.....	8,604	641	3,525	2,320	1,798	320	
Middle Atlantic.....	21,300	1,433	12,011	5,123	2,650	3,013	65
East North Central.....	39,813	8,311	13,068	10,743	4,603	3,188	
West North Central.....	33,207	6,207	14,034	11,557	883	646	
South Atlantic.....	19,854	762	5,109	5,358	6,417	2,208	
East South Central.....	8,069	479	2,174	2,232	900	2,284	
West South Central.....	22,256	1,278	8,180	9,556	2,381	882	
Mountain.....	12,238	605	2,878	6,073	1,751	919	12
Pacific.....	14,898	601	1,981	6,987	3,498	2,730	1,191
NEW ENGLAND:							
Maine.....	1,889	125	532	1,198	34		
New Hampshire.....	908	178	247	331	152		
Vermont.....	1,084	147	344	553	40		
Massachusetts.....	4,470	138	1,913		1,099	320	
Rhode Island.....	485		300	94	71		
Connecticut.....	788	53	189	144	402		
MIDDLE ATLANTIC:							
New York.....	10,737	762	5,133	2,317	539	1,986	
New Jersey.....	2,290	19	1,503	540	152	160	
Pennsylvania.....	11,183	682	5,375	2,271	1,959	861	65
EAST NORTH CENTRAL:							
Ohio.....	10,868	4,334	2,866	1,321	1,270	727	
Indiana.....	5,549	819	1,063	2,778	685	404	
Illinois.....	9,901	1,711	2,667	4,123	965	435	
Michigan.....	6,719	289	4,070	1,030	231	1,070	
Wisconsin.....	7,176	1,308	2,402	1,482	1,432	562	
WEST NORTH CENTRAL:							
Minnesota.....	6,508	1,048	2,938	1,846	296	380	
Iowa.....	7,652	2,265	2,473	2,713	201		
Missouri.....	5,201	778	2,082	2,044	247	52	
North Dakota.....	3,023	236	1,085	1,702			
South Dakota.....	2,549	802	1,084	603			
Nebraska.....	3,123	402	1,861	860			
Kansas.....	5,256	623	2,511	1,769	139	214	
SOUTH ATLANTIC:							
Delaware, District of Columbia, and Maryland ¹	2,137	298	1,256	235	322	15	
Virginia.....	2,235	218	630	209	474	707	
West Virginia.....	2,543	48	740	1,041	446	284	
North Carolina.....	4,333	95	1,001	1,507	1,604	116	
South Carolina.....	2,023	41	474	1,268	1,102	40	
Georgia.....	2,622	23	610	474	588	1,027	
Florida.....	3,074	38	492	624	1,881	39	
EAST SOUTH CENTRAL:							
Kentucky.....	2,549	314	616	1,116	503		
Tennessee.....	2,305	130	640	868	397	473	
Alabama.....	1,945	18	115	448		1,808	
Mississippi.....	1,266	20	803			443	
WEST SOUTH CENTRAL:							
Arkansas.....	2,623	200	794	902	381	348	
Louisiana.....	1,605	303	503	492	163	144	
Oklahoma.....	7,811	161	3,483	3,930	227		
Texas.....	10,225	314	3,399	4,232	1,610	370	
MOUNTAIN:							
Montana.....	3,071	161	134	1,985	779		12
Idaho.....	2,529	20	604	1,178	236	491	
Wyoming.....	326	79	102	136	18		
Colorado.....	1,948	132	1,040	468	308		
New Mexico.....	206	20	112	74			
Arizona.....	1,171	29	554	371	87	130	
Utah.....	2,169	36	156	1,559		298	
Nevada.....	878		176	302	323		
PACIFIC:							
Washington.....	3,782	334	551	1,689	584	594	
Oregon.....	2,222	210	885	825	329	8	
California.....	10,894	37	545	4,473	2,495	2,133	1,191

¹ Combined to avoid disclosing data for individual establishments.

TABLE 34.—NUMBER OF CUSTOMERS (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	Total ¹	Farm service (see "Farm customers," p. 65)	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting ³	Street and inter-urban rail-ways (motive power)
				Small light and power (retail) ²	Large light and power (wholesale)			
UNITED STATES.....	21,786,317	168,450	16,039,066	2,784,126	342,256	2,424,253	22,232	822
GEOGRAPHIC DIVISIONS:								
New England.....	2,007,249	9,344	1,520,348	260,857	42,925	142,432	1,232	52
Middle Atlantic.....	6,032,953	23,207	4,383,367	609,163	47,307	663,546	4,487	326
East North Central.....	5,312,752	50,782	4,208,000	720,578	59,610	206,770	4,901	163
West North Central.....	2,187,518	21,290	1,603,849	284,210	62,578	211,612	3,312	58
South Atlantic.....	1,504,351	3,013	1,046,885	194,036	40,279	277,040	1,950	50
East South Central.....	721,432	696	548,278	129,259	13,597	28,300	822	22
West South Central.....	1,133,230	1,871	852,163	195,854	32,003	49,181	1,603	37
Mountain.....	597,400	3,451	470,869	99,026	3,195	19,344	646	17
Pacific.....	2,220,322	54,196	1,344,717	260,243	40,792	520,022	3,189	91
NEW ENGLAND:								
Maine.....	184,873	3,703	74,741	11,424	20,337	491,298	328	13
New Hampshire.....	106,215	210	87,320	11,145	2,740	4,583	140	(⁴)
Vermont and Rhode Island ⁶	245,352	1,014	194,106	39,829	4,237	5,230	332	(⁷)
Massachusetts.....	1,077,818	3,401	808,183	154,305	10,270	41,321	305	28
Connecticut.....	892,991	407	295,998	74,154	5,392	(⁴)	127	11
MIDDLE ATLANTIC:								
New York.....	3,193,782	11,938	1,971,770	278,442	15,175	(⁹)	1,249	70
New Jersey.....	981,017	(⁸)	(⁸)	58,020	(⁸)	(⁹)	647	(⁸)
Pennsylvania.....	1,858,154	11,260	2,411,597	272,101	32,132	(⁹)	2,591	247
EAST NORTH CENTRAL:								
Ohio.....	1,370,463	10,224	1,116,673	167,029	19,788	55,086	1,543	56
Indiana.....	638,575	14,968	408,415	78,504	5,777	40,091	781	28
Illinois.....	1,706,722	6,958	1,435,939	265,505	10,193	39,528	1,368	45
Michigan.....	981,545	8,218	813,738	144,801	2,685	11,490	628	20
Wisconsin.....	556,447	10,414	408,840	64,739	15,217	60,575	581	14
WEST NORTH CENTRAL:								
Minnesota.....	453,832	2,041	341,209	54,802	(¹⁰)	42,194	605	
Iowa.....	430,188	9,335	326,761	71,018	10,953	24,087	921	
Missouri.....	619,694	2,374	490,167	69,080	27,022	20,851	518	
North Dakota.....	60,486	226	42,341	11,758	11,012	4,629	233	(¹¹)
South Dakota.....	79,712	249	55,925	13,990	(¹¹)	6,981	304	
Nebraska.....	221,606	1,322	145,925	24,673	(¹¹)	45,748	380	
Kansas.....	312,640	5,743	201,474	38,229	8,691	58,122	345	
SOUTH ATLANTIC:								
Delaware, District of Columbia, Maryland, and West Virginia ⁶	582,600	145	370,650	66,800	28,490	(⁹)	574	19
Virginia.....	216,987	1,794	179,278	23,792	3,050	(⁹)	202	13
North Carolina.....	219,969	1,037	92,890	23,802	982	(⁹)	208	13
South Carolina.....	94,626	451	52,137	10,541	615	(⁹)	113	(¹¹)
Georgia.....	196,169	13,198	139,728	34,451	13,542	6,542	240	5
Florida.....	259,946	(¹²)	212,247	35,060	(¹²)	(¹²)	613	6
EAST SOUTH CENTRAL:								
Kentucky.....	247,935	(¹⁴)	190,945	39,568	2,872	13,612	240	5
Tennessee.....	225,560	14,600	173,326	39,328	5,944	4,520	161	12
Alabama.....	179,398	(¹⁵)	129,810	(¹⁵)	4,781	3,762	182	(¹⁶)
Mississippi.....	79,619	136	54,191	50,365	(¹⁶)	6,412	230	6

¹ Data for "Electrified steam-railroad divisions" and "Other services" are included in the items in the "Total" column but not elsewhere in the table.

² Includes all "Commercial service" reported by municipal establishments.

³ Includes all "Municipal service" reported by municipal establishments.

⁴ Connecticut included with Maine to avoid disclosing data for individual establishments.

⁵ New Hampshire included with Maine to avoid disclosing data for individual establishments.

⁶ Combined to avoid disclosing data for individual establishments.

⁷ Vermont and Rhode Island included with Connecticut to avoid disclosing data for individual establishments.

⁸ New Jersey included with Pennsylvania to avoid disclosing data for individual establishments.

⁹ Statistics for States can not be shown without disclosing data for individual establishments.

¹⁰ Minnesota included with Iowa to avoid disclosing data for individual establishments.

¹¹ South Dakota and Nebraska included with North Dakota to avoid disclosing data for individual establishments.

¹² South Carolina included with North Carolina to avoid disclosing data for individual establishments.

¹³ Florida included with Georgia to avoid disclosing data for individual establishments.

¹⁴ Kentucky included with Tennessee to avoid disclosing data for individual establishments.

¹⁵ Alabama included with Mississippi to avoid disclosing data for individual establishments.

¹⁶ Mississippi included with Alabama to avoid disclosing data for individual establishments.

TABLE 34.—NUMBER OF CUSTOMERS (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927—Continued.

DIVISION AND STATE	Total ¹	Farm service (see "Farm customers," p. 63)	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting ²	Street and inter-urban rail-ways (motive power)
				Small light and power (retail) ³	Large light and power (wholesale)			
WEST SOUTH CENTRAL:								
Arkansas.....	115,271		83,199	28,128	1,981	(?)	215	} (?)
Louisiana.....	168,813		128,764	27,390	(18)	17 10,577	211	
Oklahoma.....	239,738	(?)	176,120	38,349	13,480	14,079	342	
Texas.....	609,408		464,080	101,987	16,542	24,525	925	
MOUNTAIN:								
Montana and Utah ⁴	153,839	599	153,971	33,522		4,772	278	} (?)
Idaho.....	78,485	508	61,594	14,839		1,175	119	
Wyoming.....	31,008	44	23,053	3,870		3,454	32	
Colorado.....	197,240	(19)	156,254	34,627	(?)	20 5,497	145	
New Mexico.....	27,213	845	21,667	4,354		(20)	27	
Arizona.....	54,097	905	41,930	8,714	(21)	21 4,446	18	
Nevada.....	15,578	550	12,381	(21)		(21)	18	
PACIFIC:								
Washington.....	362,666	(22)	322,562	53,074	12,990		268	27
Oregon.....	299,051	6,291	85,642	30,602	(21)	(?)	215	(21) 64
California.....	1,627,605	47,905	936,513	175,567	27,802		2,706	

¹ Data for "Electrified steam-railroad divisions" and "Other service" are included in the items in the "Total" column but not elsewhere in the table.

² Includes all "Commercial service" reported by municipal establishments.

³ Includes all municipal service reported by municipal establishments.

⁴ Combined to avoid disclosing data for individual establishments.

⁵ Statistics for States can not be shown without disclosing data for individual establishments.

⁶ Arkansas included with Louisiana to avoid disclosing data for individual establishments.

⁷ Louisiana included with Oklahoma to avoid disclosing data for individual establishments.

⁸ Colorado included with New Mexico to avoid disclosing data for individual establishments.

⁹ New Mexico included with Colorado to avoid disclosing data for individual establishments.

¹⁰ Nevada included with Arizona to avoid disclosing data for individual establishments.

¹¹ Washington included with Oregon to avoid disclosing data for individual establishments.

¹² Oregon included with Washington to avoid disclosing data for individual establishments.

TABLE 35.—CURRENT SOLD (TO ULTIMATE CONSUMERS ONLY), KILOWATT-HOURS, BY CLASS OF SERVICE, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	Total	Farm service	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting*	Street and interurban railways (motive power)
				Small light and power (retail)†	Large light and power (wholesale)			
UNITED STATES.....	63, 612, 481, 088	585, 271, 354	7, 105, 619, 723	10, 287, 240, 582	33, 471, 610, 198	3, 192, 886, 952	1, 741, 423, 872	6, 254, 081, 223
GEOGRAPHIC DIVISIONS:								
New England.....	3, 956, 288, 197	3, 969, 009	576, 283, 055	757, 528, 988	2, 176, 316, 237	124, 870, 537	150, 240, 798	176, 976, 256
Middle Atlantic.....	17, 869, 094, 651	12, 635, 800	1, 889, 580, 937	1, 813, 512, 670	10, 138, 146, 714	1, 778, 017, 819	400, 712, 535	1, 559, 998, 821
East North Central.....	15, 267, 328, 963	23, 633, 538	1, 907, 368, 783	2, 709, 780, 580	7, 409, 898, 530	228, 273, 423	573, 254, 131	2, 249, 773, 031
West North Central.....	4, 060, 726, 769	12, 876, 577	885, 109, 670	881, 802, 150	1, 779, 236, 094	123, 373, 423	163, 908, 142	489, 292, 849
South Atlantic.....	7, 014, 309, 562	1, 679, 319	403, 721, 852	785, 611, 540	4, 746, 897, 498	35, 538, 078	134, 031, 524	157, 854, 244
East South Central.....	2, 455, 304, 623	1, 156, 031	204, 576, 065	330, 470, 211	1, 045, 253, 232	32, 630, 284	58, 137, 683	306, 713, 073
West South Central.....	2, 708, 455, 554	10, 348, 577	330, 610, 010	425, 787, 985	1, 466, 013, 539	18, 334, 633	85, 972, 426	78, 267, 533
Mountain.....	2, 856, 940, 800	9, 910, 522	227, 925, 670	333, 947, 410	1, 813, 011, 352	18, 334, 633	45, 972, 426	78, 267, 533
Pacific.....	7, 439, 061, 939	760, 061, 951	780, 598, 791	2, 046, 648, 838	2, 237, 277, 121	439, 642, 084	180, 135, 584	833, 463, 903
NEW ENGLAND:								
Maine.....	473, 630, 933	1, 257, 070	29, 230, 425	18, 999, 046	341, 171, 640	4 67, 534, 381	10, 063, 122	4 45, 405, 109
New Hampshire.....	160, 824, 272	82, 805	30, 092, 730	33, 471, 066	54, 831, 013	9 498, 230	8 630, 725	(C)
Vermont and Rhode Island †	505, 312, 902	659, 891	67, 649, 756	54, 755, 336	323, 097, 709	9 403, 543	18, 982, 173	(C)
Massachusetts.....	2, 018, 841, 347	1, 735, 189	296, 151, 005	386, 597, 289	1, 105, 800, 100	10 42, 575, 874	85, 906, 647	92 082, 630
Connecticut.....	807, 678, 743	234, 481	153, 125, 139	213, 746, 221	349, 745, 775	(C)	26, 638, 061	7 39, 488, 517
MIDDLE ATLANTIC:								
New York.....	9, 378, 300, 989	9, 220, 410	794, 621, 302	945, 863, 833	5, 252, 933, 719	(P)	109, 234, 459	524, 740, 840
New Jersey.....	1, 687, 616, 398	(P)	(P)	215, 997, 022	(P)	(P)	70, 245, 574	(P)
Pennsylvania.....	6, 803, 147, 264	3, 416, 390	1, 094, 920, 685	651, 651, 815	3 4, 883, 212, 995	(P)	140, 242, 502	3 1, 032, 257, 481
EAST NORTH CENTRAL:								
Ohio.....	4, 294, 102, 785	3 971, 347	519, 416, 138	618, 242, 046	2 332, 712, 294	58, 726, 006	136, 684, 900	539, 915, 243
Indiana.....	1, 521, 704, 893	6 311, 920	224, 093, 233	397, 300, 211	2 514, 901, 746	62 691, 160	72, 530, 841	244, 211, 056
Illinois.....	4 931, 831, 449	2 552, 226	633, 577, 854	792, 792, 161	3 132, 847, 413	68, 748, 395	81, 132, 137	1, 092, 690, 469
Michigan.....	3 224, 931, 829	4 860, 325	389, 331, 481	733, 002, 406	1 709, 347, 165	9 396, 400	100, 637, 454	213, 240, 122
Wisconsin.....	1 354, 643, 014	5 937, 720	200, 938, 077	168, 453, 976	7 730, 889, 802	64, 355, 248	34, 652, 841	144, 718, 141
WEST NORTH CENTRAL:								
Minnesota.....	923, 682, 445	1 144, 228	141, 671, 858	144, 944, 893	(P)	44, 728, 576	43, 881, 248	(P)
Iowa.....	684, 865, 290	4 729, 336	109, 883, 076	169, 107, 777	10 814, 653, 350	26 076, 225	26 078, 732	(P)
Missouri.....	1 452, 304, 582	7 720, 336	207, 497, 073	302, 977, 755	11 681, 940, 118	27 547, 928	41 614, 340	(P)
North Dakota.....	47 519, 292	16 521, 787	18 473, 064	18 473, 064	1 715, 777	2 989, 381	2 989, 381	(P)
South Dakota.....	67 320, 391	87 047	19 036, 870	20 991, 624	3 896, 438	7 404, 977	7 404, 977	(P)
Nebraska.....	300 887 152	794 137	63 608 819	73 951 580	30 841 838	3 896 438	26 841 838	(P)
Kansas.....	584 167 777	5 871 670	76 989 387	121 372 517	252 402 551	39 466 639	39 466 639	(P)

See corresponding footnotes, Table 34.

TABLE 35.—CURRENT SOLD (TO ULTIMATE CONSUMERS ONLY), KILOWATT-HOURS, BY CLASS OF SERVICE, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927.—Continued

DIVISION AND STATE	Total	Farm service	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting	Street and interurban railways (motive power)
				Small light and power (retail):	Large light and power (wholesale)			
SOUTH ATLANTIC:								
Delaware, District of Columbia, Maryland and West Virginia	3,308,257,377	54,392	161,093,814	274,132,338	1,209,515,006	(¹)	37,908,153	288,213,555
Virginia	957,210,361	894,153	82,267,785	122,619,751	304,052,348		12,189,095	65,673,181
North Carolina	1,907,051,660	328,370	46,113,590	57,027,271	1,043,383,054		15,103,329	12,34,108,891
South Carolina	986,410,811	1,384,640	23,890,884	80,487,197	631,897,243		10,216,226	(¹¹)
Georgia	484,463,288	11,261,282	61,708,270	124,669,969	778,319,808		16,293,020	85,091,884
Florida	494,463,288	(¹²)	112,627,543	126,773,013	(¹³)		42,261,701	16,735,738
EAST SOUTH CENTRAL:								
Kentucky	547,078,714	(¹⁴)	66,180,608	85,897,631	337,321,408		21,696,365	13,746,040
Tennessee	747,605,853	11,149,941	63,894,290	116,356,874	464,673,743		15,531,218	84,377,599
Alabama	1,039,737,417	(¹⁵)	53,974,113	116,356,874	843,287,991		8,174,183	(¹⁶)
Mississippi	1,130,322,659	13,6,090	20,618,954	115,121,221,600	(¹⁷)		12,765,917	19,50,730,055
WEST SOUTH CENTRAL:								
Louisiana	186,194,149	(¹⁸)	25,220,787	39,056,772	80,154,058		5,188,064	
Oklahoma	447,733,078	(¹⁹)	62,016,654	85,981,925	(²⁰)		18,248,824	
Texas	596,663,840	(²¹)	67,310,841	81,859,795	18,568,153,265		13,723,956	
MOUNTAIN:								
Montana and Utah	1,472,864,481	(²²)	185,461,728	218,879,493	517,700,210		46,760,335	
Idaho	1,854,742,335	785,388	74,852,181	135,394,577	(²³)		15,116,909	
Wyoming	264,200,096	1,701,305	59,702,724	62,377,717	4,895,000		7,423,893	
Colorado	48,369,836	25,068	9,522,561	14,190,173	4,895,000		2,063,457	
New Mexico	396,522,278	(²⁴)	54,427,517	242,073,268	26,416,730		15,571,876	
Arizona	26,652,248	19,174,900	8,427,392	15,522,061	(²⁵)		2,537,980	
Nevada	202,629,278	5,187,010	14,284,619	21,820,004,014	(²⁶)		2,883,169	
Utah	63,034,729	463,621	6,708,676	(²⁷)	(²⁸)		1,271,812	
PACIFIC:								
Washington	1,620,061,418	(²⁹)	204,663,224	422,142,475	23,013,037,078		26,974,139	23,197,151,239
Oregon	658,058,399	74,231,551	169,356,451	169,356,451	(³⁰)		177,856,239	(³¹)
California	5,160,916,622	734,472,506	441,054,016	1,455,149,932	1,384,240,043		135,305,225	636,312,644

See corresponding footnotes, Table 34.

TABLE 36.—CURRENT SOLD—AVERAGE KILOWATT-HOURS PER CUSTOMER (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

[Based on Tables 34 and 35]

DIVISION AND STATE	Total 1	Farm service (see "Farm consumers," p. 65)	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting 2	Street and interurban railways (motive power)
				Small light and power (retail) 3	Large light and power (wholesale)			
UNITED STATES.....	2,920	4,959	443	3,684	97,797	1,317	78,330	7,608,371
GEOGRAPHIC DIVISIONS:								
New England.....	1,971	425	379	2,536	50,700	877	121,949	3,403,389
Middle Atlantic.....	2,962	544	431	2,977	214,305	1,846	91,311	4,776,068
East North Central.....	2,872	465	461	3,761	124,298	1,108	104,724	13,802,301
West North Central.....	1,856	605	396	2,997	28,433	819	49,516	6,969,127
South Atlantic.....	4,484	465	472	4,049	117,850	1,263	68,734	8,746,837
East South Central.....	3,403	224	373	2,711	121,003	1,148	70,751	7,175,195
West South Central.....	2,396	5,531	388	2,174	45,809	949	50,751	8,289,559
Mountain.....	4,782	2,872	484	5,364	572,844	948	71,165	4,603,973
Pacific.....	3,337	14,024	580	7,864	56,817	836	56,487	9,158,944
NEW ENGLAND:								
Maine.....	2,562	339	391	1,663	16,776	4740	30,680	3,492,701
New Hampshire.....	1,420	378	345	3,003	19,837	2,079	61,648	(5)
Vermont and Rhode Island 6.....	2,060	409	349	2,128	76,721	995	57,175	(7)
Massachusetts.....	1,873	510	341	2,505	107,673	1,030	281,060	3,288,665
Connecticut.....	2,055	575	517	2,882	65,594	(4)	209,906	73,589,865
MIDDLE ATLANTIC:								
New York.....	2,936	772	403	3,397	346,157	(6)	159,507	6,642,289
New Jersey.....	1,720	(8)	(8)	3,685	(8)	(9)	108,571	(8)
Pennsylvania.....	3,661	303	454	2,395	152,036	(10)	54,127	3,479,180
EAST NORTH CENTRAL:								
Ohio.....	3,082	388	465	3,701	117,885	1,066	88,584	9,891,344
Indiana.....	2,383	422	449	5,092	89,130	1,549	92,869	8,721,823
Illinois.....	2,792	367	441	2,936	131,035	863	123,354	24,282,010
Michigan.....	3,286	591	478	5,062	648,709	818	160,251	10,662,006
Wisconsin.....	2,439	570	498	2,602	48,011	1,071	59,643	10,408,439
WEST NORTH CENTRAL:								
Minnesota.....	2,035	561	415	2,642	(11)	1,060	72,531	(12)
Iowa.....	1,559	442	336	2,362	19,422,726	1,207	28,316	(13)
Missouri.....	2,342	303	423	4,386	20,842	923	80,337	(14)
North Dakota.....	786	587	390	1,571	11,832	371	12,830	(15)
South Dakota.....	845	350	340	1,500	(11)	558	24,358	(16)
Nebraska.....	1,357	601	435	2,998	(11)	587	45,739	(17)
Kansas.....	1,868	1,022	382	3,175	29,042	679	70,650	(18)
SOUTH ATLANTIC:								
Delaware, District of Columbia, Maryland, and West Virginia 6.....	3,785	379	435	4,098	45,613	(19)	66,147	15,169,134
Virginia.....	3,257	440	459	5,154	107,960	(20)	60,342	5,051,783
North Carolina.....	8,673	317	486	2,447	1,673,506	(21)	72,612	12,623,769
South Carolina.....	8,445	642	458	7,636	1,029,987	(22)	90,409	(23)
Georgia.....	4,998	1,082	442	3,616	118,973	(24)	67,838	17,018,277
Florida.....	1,672	(12)	564	3,616	(13)	(25)	68,942	2,789,290
EAST SOUTH CENTRAL:								
Kentucky.....	2,209	(14)	347	2,171	117,452	1,474	90,152	2,749,328
Tennessee.....	3,344	1,227	368	2,882	78,175	764	96,778	7,031,467
Alabama.....	6,103	(15)	416	(15)	16,176,383	643	44,913	(16)
Mississippi.....	1,512	169	380	3,003	(16)	1,024	53,414	11,946,011
WEST SOUTH CENTRAL:								
Arkansas.....	1,615	(17)	303	2,100	40,461	(17)	24,130	(18)
Louisiana.....	2,652	(18)	409	2,409	(18)	17,822	86,487	(19)
Oklahoma.....	2,489	(19)	382	2,135	42,148	799	45,976	(20)
Texas.....	2,417	(20)	400	2,146	49,432	1,089	50,552	(21)
MOUNTAIN:								
Montana and Utah 6.....	9,598	1,311	486	4,045	(21)	1,732	54,375	(22)
Idaho.....	3,367	3,350	969	3,530	(22)	1,401	62,402	(23)
Wyoming.....	1,560	591	413	3,669	(23)	741	86,420	(24)
Colorado.....	2,010	(24)	345	6,991	(24)	(25)	105,323	(25)
New Mexico.....	977	2,066	389	2,102	(25)	29,892	45,849	(26)
Arizona.....	3,744	5,732	341	9,479	(26)	520	106,784	(27)
Nevada.....	4,104	843	542	(27)	(27)	(28)	70,656	(28)
PACIFIC:								
Washington.....	4,126	(28)	821	7,954	70,288	(29)	100,850	7,301,898
Oregon.....	3,148	4,052	867	5,524	(29)	(30)	83,052	(30)
California.....	3,171	15,334	472	8,241	49,789	(31)	50,002	9,942,385

See corresponding footnotes, Table 34.

TABLE 37.—REVENUE FROM ELECTRIC SERVICE (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

Division and State	Total	Farm service	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting	Street and interurban railways (motive power)
				Small light and power (retail)	Large light and power (wholesale)			
UNITED STATES.....								
	\$1,667,046,571	\$17,262,957	\$481,609,354	\$410,662,586	\$456,472,907	\$184,705,419	\$77,198,896	\$58,860,539
GEOGRAPHIC DIVISIONS:								
New England.....	138,140,370	200,671	46,151,580	57,253,886	37,262,793	6,243,353	8,338,079	2,394,419
Middle Atlantic.....	476,197,388	1,005,179	140,265,118	96,017,884	119,320,321	96,842,606	22,960,201	14,334,442
East North Central.....	405,176,556	1,879,540	131,907,088	130,206,283	137,216,463	10,043,546	17,132,200	30,658,765
West North Central.....	140,750,328	1,047,275	46,110,465	59,100,268	56,724,723	10,771,903	7,493,683	4,058,743
South Atlantic.....	183,894,033	34,772,316	34,772,316	32,364,401	18,811,868	18,811,868	6,672,872	4,177,616
South Middle Atlantic.....	89,819,804	16,305	10,267,824	24,013,433	27,519,282	2,506,852	2,506,852	1,200,394
East South Central.....	89,947,267	234,827	17,047,242	17,856,485	13,912,656	2,632,094	3,122,788	3,665,940
West South Central.....	51,196,457	32,000,000	14,047,242	17,856,485	13,912,656	1,030,094	2,127,788	742,331
Mountain.....	186,026,472	12,276,240	34,478,134	46,311,442	26,689,225	20,816,671	6,545,025	7,000,389
NEW ENGLAND:								
Maine.....	9,818,715	101,019	2,146,675	1,011,387	3,167,360	4,3,652,593	567,723	\$ 556,346
New Hampshire.....	6,697,399	7,561	2,016,838	1,560,993	901,377	348,328	562,101	(6)
Vermont and Rhode Island ¹	17,347,483	44,828	5,801,595	4,118,993	6,265,625	220,840	849,084	(1)
Massachusetts.....	75,942,894	117,945	24,418,010	22,541,599	20,488,006	2,021,562	4,933,782	1,250,922
Connecticut.....	28,333,966	18,618	10,868,702	7,992,514	6,429,825	(1)	1,426,389	7,587,151
MIDDLE ATLANTIC:								
New York.....	242,432,408	647,502	58,050,445	42,975,510	41,946,334	(1)	11,890,439	4,580,992
New Jersey.....	68,506,652	(6)	(1)	9,418,944	(1)	(1)	4,366,411	(1)
Pennsylvania.....	194,208,525	\$357,677	\$ 82,214,673	33,623,430	\$ 77,374,187	(1)	6,471,351	\$ 9,744,450
EAST NORTH CENTRAL:								
Ohio.....	111,877,518	391,841	33,046,965	26,000,093	39,100,182	2,655,966	5,394,201	5,211,446
Indiana.....	45,288,252	484,729	15,691,679	12,403,013	9,201,425	2,562,191	2,543,976	2,372,722
Illinois.....	128,474,291	217,424	40,441,007	35,695,444	1,698,424	1,698,424	3,778,629	8,960,799
Michigan.....	79,039,505	283,917	20,839,275	27,256,111	22,831,524	8,099,830	3,699,830	2,892,103
Wisconsin.....	38,406,990	601,629	11,928,160	8,014,668	17,327,913	2,676,531	1,720,657	1,248,695
WEST NORTH CENTRAL:								
Minnesota.....	31,044,740	101,688	10,492,919	7,404,531	8,816,344	2,279,939	1,792,991	(1)
Iowa.....	26,521,239	483,934	9,794,224	8,816,344	12,900,936	1,314,797	1,494,690	(1)
Missouri.....	41,978,450	51,266	12,609,785	12,137,385	11,198,483	1,281,246	1,716,010	(1)
North Dakota.....	3,798,984	11,744	1,580,331	1,414,243	11,276,026	(1)	246,304	(1)
South Dakota.....	4,796,790	11,032	1,916,991	1,506,065	(1)	392,896	416,909	(1)
Nebraska.....	12,637,150	62,941	4,562,353	3,186,868	(1)	820,270	1,918,677	(1)
Kansas.....	19,985,005	324,400	5,223,850	4,727,272	5,158,078	2,369,397	1,006,669	(1)

SOUTH ATLANTIC:									
District of Columbia, Maryland, and	53,095,710	10,626,248	10,007,466	20,903,732	2,214,808	2,385,698			
West Virginia.....	17,110,764	5,141,610	5,235,443	5,513,408	540,553	540,553			
Virginia.....	27,312,847	9,084,321	2,624,321	15,147,405	700,285	700,285			2,384,210
North Carolina.....	13,084,511	1,800,618	2,150,946	6,946,035	436,841	436,841			12,352,525
South Carolina.....	22,466,103	4,655,656	5,671,807	13,10,735,680	710,377	710,377			(1)
Georgia.....	22,807,097	9,433,863	6,084,283	13,10,735,680	2,369,748	2,369,748			802,108
Florida.....	17,685,898	5,307,909	4,540,603	5,945,328	934,194	934,194			252,066
EAST SOUTH CENTRAL:									
Kentucky.....	18,284,245	4,941,305	5,410,904	6,311,745	688,109	688,109			96,008
Tennessee.....	17,789,772	4,025,395	(9)	9,062,216	408,764	408,764			(10)
Alabama.....	6,099,888	1,989,015	1,834,007	(9)	508,773	508,773			(10)
Mississippi.....	8,420,578	2,726,156	3,297,457	1,894,963	281,454	281,454			(9)
Arkansas.....	14,412,739	4,647,891	3,652,592	(9)	608,109	608,109			(9)
Louisiana.....	20,691,518	5,873,055	5,348,311	13,133,683	1,846,880	1,846,880			(9)
Oklahoma.....	40,422,432	14,372,749	12,313,683	15,136,902	1,503,894	1,503,894			(9)
Texas.....	20,428,084	4,252,644	4,722,672		656,475	656,475			(9)
MOUNTAIN:									
Montana and Utah.....	5,405,000	2,040,804	1,872,367		267,400	267,400			
Idaho.....	2,352,424	4,226,528	7,246,290	(9)	162,766	162,766			
Wyoming.....	13,012,466	4,634,800	7,680,518		760,185	760,185			
Colorado.....	1,012,466	1,343,040	2,532,214		80,723	80,723			
New Mexico.....	1,273,330	1,343,040	(21)	21,315,922	142,085	142,085			
Arizona.....	5,273,330	475,137			58,154	58,154			
Nevada.....	1,666,878	24,851							
PACIFIC:									
Washington.....	25,408,132	8,612,487	8,372,859	33,351,051	615,352	615,352			1,478,591
Oregon.....	13,808,136	2,637,750	4,499,539	(21)	581,356	581,356			(21)
California.....	115,624,204	23,227,887	33,439,044	18,338,174	5,348,307	5,348,307			5,521,798

See corresponding footnotes, Table 34.

TABLE 38.—REVENUE FROM ELECTRIC SERVICE—AVERAGE PER CUSTOMER (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

[Based on Tables 34 and 37]

DIVISION AND STATE	Total ¹	Farm service (see "Farm Customers," p. 66)	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting ²	Street and inter-urban railroads (motive power)
				Small light and power (retail) ²	Large light and power (wholesale)			
UNITED STATES.....	\$77	\$103	\$30	\$147	\$1,334	\$64	\$3,472	\$71,606
GEOGRAPHIC DIVISIONS:								
New England.....	69	31	30	123	568	44	6,768	46,047
Middle Atlantic.....	79	43	32	141	2,526	93	5,117	43,971
East North Central.....	76	27	29	153	2,000	49	3,493	128,907
West North Central.....	64	49	29	133	507	43	2,263	80,323
South Atlantic.....	68	28	33	167	1,471	57	3,578	74,600
East South Central.....	83	22	30	130	1,568	53	3,050	54,586
West South Central.....	79	152	32	126	362	54	1,844	99,079
Mountain.....	86	100	50	179	4,390	54	3,294	48,067
Pacific.....	70	227	26	178	654	40	2,052	76,927
NEW ENGLAND:								
Maine.....	53	27	29	89	156	40	1,731	\$42,796
New Hampshire.....	63	35	33	141	323	72	4,015	(¹)
Vermont and Rhode Island.....	71	28	30	103	1,479	42	2,557	(¹)
Massachusetts.....	70	35	28	146	1,956	49	10,176	44,675
Connecticut.....	72	46	37	108	1,206	(¹)	11,224	53,377
MIDDLE ATLANTIC:								
New York.....	76	54	29	154	2,764	(²)	3,520	58,101
New Jersey.....	70	(³)	(⁴)	161	(⁵)	(⁶)	7,107	(⁷)
Pennsylvania.....	88	82	34	124	2,414	(⁸)	2,498	39,451
EAST NORTH CENTRAL:								
Ohio.....	82	38	30	158	1,970	48	3,496	93,062
Indiana.....	71	32	31	153	1,003	64	3,257	84,740
Illinois.....	73	31	28	137	2,204	42	2,768	199,129
Michigan.....	81	36	26	188	8,665	43	5,891	144,005
Wisconsin.....	69	43	30	124	810	44	2,902	80,193
WEST NORTH CENTRAL:								
Minnesota.....	60	50	31	135	(⁹)	54	2,964	(¹⁰)
Iowa.....	68	52	30	123	10,002	55	1,623	(¹¹)
Missouri.....	68	22	26	170	401	43	3,313	(¹²)
North Dakota.....	62	32	37	120	11,400	46	1,057	(¹³)
South Dakota.....	60	44	24	108	(¹⁴)	56	1,371	(¹⁵)
Nebraska.....	57	43	31	128	(¹⁶)	42	2,125	(¹⁷)
Kansas.....	64	56	26	124	593	41	2,918	(¹⁸)
SOUTH ATLANTIC:								
Delaware, District of Columbia, Maryland, and West Virginia.....	91	31	29	151	734	(¹⁹)	3,569	125,016
Virginia.....	81	42	29	220	1,511	(²⁰)	2,076	29,555
North Carolina.....	124	26	33	113	15,425	(²¹)	3,367	11,271,117
South Carolina.....	138	43	35	204	11,294	(²²)	3,866	(²³)
Georgia.....	104	66	33	165	11,641	(²⁴)	2,900	186,422
Florida.....	86	(²⁵)	44	191	(²⁶)	(²⁷)	3,888	42,011
EAST SOUTH CENTRAL:								
Kentucky.....	71	(²⁸)	28	115	2,070	55	3,892	19,202
Tennessee.....	82	22	29	138	1,062	53	4,063	54,414
Alabama.....	104	(²⁹)	31	(³⁰)	11,895	44	2,251	(³¹)
Mississippi.....	76	16	37	136	(³²)	55	2,129	90,384
WEST SOUTH CENTRAL:								
Arkansas.....	73	(³³)	33	117	957	(³⁴)	1,309	(³⁵)
Louisiana.....	63	(³⁶)	35	133	(³⁷)	17 52	3,166	(³⁸)
Oklahoma.....	84	(³⁹)	33	139	18 782	52	1,956	(⁴⁰)
Texas.....	78	(⁴¹)	31	121	915	55	1,628	(⁴²)
MOUNTAIN:								
Montana and Utah.....	105	47	28	141	(⁴³)	28	2,361	(⁴⁴)
Idaho.....	66	78	33	126	(⁴⁵)	48	2,247	(⁴⁶)
Wyoming.....	82	47	38	207	(⁴⁷)	67	5,086	(⁴⁸)
Colorado.....	71	(⁴⁹)	27	209	(⁵⁰)	28 55	5,243	(⁵¹)
New Mexico.....	70	106	39	158	(⁵²)	(⁵³)	2,990	(⁵⁴)
Arizona.....	97	177	32	291	(⁵⁵)	11 71	5,262	(⁵⁶)
Nevada.....	107	45	39	(⁵⁷)	(⁵⁸)	(⁵⁹)	3,231	(⁶⁰)
PACIFIC:								
Washington.....	55	(⁶¹)	27	158	11 643	(⁶²)	2,296	54,763
Oregon.....	66	32	31	147	(⁶³)	(⁶⁴)	2,704	(⁶⁵)
California.....	71	245	25	189	600	(⁶⁶)	1,976	36,273

See corresponding footnotes, Table 34.

CENTRAL ELECTRIC LIGHT AND POWER STATIONS

TABLE 39.—REVENUE FROM ELECTRIC SERVICE (ULTIMATE CONSUMERS ONLY)—
AVERAGE PER KILOWATT-HOUR, BY CLASS OF SERVICE, ALL ESTABLISHMENTS,
BY GEOGRAPHIC DIVISIONS AND STATES: 1927
(Based on Tables 35 and 37)

DIVISION AND STATE	Total	Farm service	Domestic service	COMMERCIAL SERVICE		Undis-tributed by class of service	Municipal street lighting	Street and inter-urban rail-ways (motive power)
				Small light and power (retail)	Large light and power (wholesale)			
	Cents 2.6	Cents 2.1	Cents 6.8	Cents 4.0	Cents 1.4	Cents 4.8	Cents 4.4	Cents 0.9
UNITED STATES.....								
GEOGRAPHIC DIVISIONS:								
New England.....	3.5	7.3	8.0	5.0	1.7	5.0	5.5	1.4
Middle Atlantic.....	2.7	8.0	7.4	4.7	1.2	4.9	5.0	0.9
East North Central.....	2.6	8.0	6.2	4.1	1.6	4.4	3.3	0.9
West North Central.....	2.5	8.1	7.3	4.6	1.8	5.6	4.6	1.2
South Atlantic.....	2.2	8.3	7.0	4.1	1.2	4.5	5.2	0.8
East South Central.....	2.4	9.8	7.9	4.8	1.3	5.6	4.3	1.2
West South Central.....	3.3	2.8	8.3	5.8	1.9	5.7	3.6	0.9
Mountain.....	1.8	3.5	6.2	3.3	.8	4.7	4.6	0.8
Pacific.....	2.1	1.6	4.4	2.8	1.2		3.6	
NEW ENGLAND:								
Maine.....	2.1	8.1	7.3	5.3	.9	5.4	5.6	1.2
New Hampshire.....	4.4	9.1	9.7	4.7	1.7	3.7	6.5	(9)
Vermont and Rhode Island.....	3.4	6.8	8.6	4.9	1.9	4.2	4.5	(7)
Massachusetts.....	3.8	6.8	8.2	5.3	1.9	4.7	5.7	1.4
Connecticut.....	3.5	8.0	7.1	3.7	1.8	(4)	5.3	1.5
MIDDLE ATLANTIC:								
New York.....	2.0	7.0	7.3	4.5	.8	(9)	6.0	0.9
New Jersey.....	4.1	(9)	(9)	4.4	1.6	(9)	6.5	(9)
Pennsylvania.....	2.4	10.5	7.5	5.2			4.8	0.9
EAST NORTH CENTRAL:								
Ohio.....	2.6	9.9	6.3	4.2	1.7	4.5	3.9	1.0
Indiana.....	3.0	7.7	7.0	3.1	1.8	4.1	3.5	1.0
Illinois.....	2.6	8.5	6.3	4.6	1.7	4.9	2.2	0.8
Michigan.....	2.5	5.8	6.4	3.7	1.3	5.2	3.7	1.3
Wisconsin.....	2.8	8.4	5.9	4.8	1.7	4.1	5.0	0.9
WEST NORTH CENTRAL:								
Minnesota.....	3.4	8.9	7.4	5.1	(10)	5.1	4.1	
Iowa.....	3.9	11.7	8.8	6.2	1.5	4.6	5.7	
Missouri.....	2.9	7.1	6.1	4.0	1.9	4.6	4.1	(9)
North Dakota.....	8.0	8.9	6.6	7.7	12.1	12.5	3.2	
South Dakota.....	7.1	12.7	10.1	7.2	(11)	10.1	5.6	
Nebraska.....	4.2	7.9	7.1	4.3	(11)	7.1	4.6	
Kansas.....	3.4	5.5	6.8	3.9	2.0	6.0	4.1	
SOUTH ATLANTIC:								
Delaware, District of Columbia, Maryland, and West Virginia.....	2.4	8.1	6.6	3.7	1.6		5.8	0.8
Virginia.....	2.5	9.4	6.3	4.3	1.4	(9)	4.4	0.8
North Carolina.....	1.4	8.3	6.8	4.6	.9		4.6	1.0
South Carolina.....	1.6	6.7	7.7	2.7	1.1		4.3	(12)
Georgia.....	2.1	8.0	7.5	4.8	1.4		4.4	0.9
Florida.....	5.2	(12)	7.9	5.3	(12)		5.6	1.5
EAST SOUTH CENTRAL:								
Kentucky.....	3.2	(14)	8.0	5.3	1.8	3.8	4.3	0.7
Tennessee.....	2.4	9.8	7.7	4.8	1.4	6.9	4.2	0.8
Alabama.....	1.7	(15)	7.6	5.1	1.1	8.9	5.0	(13)
Mississippi.....	5.0	9.6	9.6	4.5	(16)	5.4	4.0	0.8
WEST SOUTH CENTRAL:								
Arkansas.....	4.5	(17)	10.8	5.6	2.4	(17)	5.4	(9)
Louisiana.....	3.2	(18)	8.6	5.5	(18)	6.3	3.7	
Oklahoma.....	3.5	(19)	8.7	6.5	1.9	6.5	4.3	
Texas.....	3.2		7.7	5.6		6.0	3.2	
MOUNTAIN:								
Montana and Utah.....	1.1	3.6	5.7	3.5		5.3	4.3	
Idaho.....	2.0	2.3	3.1	3.6		2.4	3.6	
Wyoming.....	5.2	8.0	7.8	5.7		4.8	5.0	(9)
Colorado.....	3.5	(20)	9.9	3.0	(9)	7.5	6.5	
New Mexico.....	7.2	5.1	9.4	7.4	(20)	6.9	6.5	
Arizona.....	2.6	3.1	9.4	3.1	(21)		4.9	
Nevada.....	2.6	5.4	7.1	7.1	(21)		4.6	
PACIFIC:								
Washington.....	1.6	(22)	3.5	2.0	3.9	(9)	2.3	0.7
Oregon.....	2.1	2.0	3.6	2.7	(22)	1.3	2.3	(23)
California.....	2.2	1.6	5.5	2.3			4.0	0.9

See corresponding footnotes, Table 34.

Chapter IV.—FUEL-BURNING AND HYDROELECTRIC GENERATING STATIONS

Data for hydroelectric plants were first tabulated separately at the census for 1912. At that census and at those for 1917 and 1922, only those establishments which reported water power of 1,000 horsepower or more (including some which reported both water and other power) were treated as hydroelectric. In this way a small amount of steam power was necessarily included, as in the case of establishments combining steam and moderately large water-power developments, while, on the other hand, smaller water-power plants were excluded.

In the present report, establishments reporting water power are shown in several groupings—those reporting water power of 1,000 horsepower or more; those reporting 50 per cent or more of their current generated by means of water power; all establishments reporting water power; and establishments reporting water power only. Some of these groups obviously overlap (Table 40). In Tables 41 to 45, however, separate figures are given for generators driven by power derived from fuel and for those driven by water power, regardless of the classification of the establishments themselves.

Combination of hydroelectric and fuel-burning plants.—The economic advantages, and in some cases the necessity, of combining water-power and fuel-burning plants in single systems have been increasingly recognized. Establishments reporting water power alone now represent only a little more than 8 per cent of the total prime-mover horsepower for all establishments and less than 30 per cent of the total hydraulic horsepower.

Comparison with earlier census years (Table 41).—The most significant comparison that can be made with earlier census years relates to the rated capacity. From 1917 to 1927 there was a marked increase in the kilowatt rating of generators driven by water power, but this group's proportion of the total capacity decreased, especially during the period 1922–1927.

Comparison by regions (Tables 43 and 44).—Only in the two geographic divisions of the far West does the rated capacity of generators driven by water power constitute more than 50 per cent of the total; as to individual States, this statement applies only to those of northern New England, those of the southern Appalachian region, five of the Rocky Mountain States, and the three on the Pacific coast. California is by far the predominant water-power State. Even where water power is abundant, however, experience shows that it must be supplemented by steam. Nine and five-tenths per cent of California's output came from fuel (Table 44).

On the whole, the first cost of hydro plants is relatively higher than that of steam plants, but the operating cost is lower. Where both kinds of power are available, it is therefore of advantage to obtain maximum output from the water-power plant, using steam to make up the balance. This practice is reflected in Tables 43 and 44. With some exceptions, the output from the hydro plants constitutes a larger percentage of the total output than might be expected from the proportion of the total capacity; that is, the number of kilowatt-hours generated per kilowatt of capacity is larger for the hydro plants than for those using fuel.

TABLE 40.—SUMMARY, ALL ESTABLISHMENTS¹ AND HYDROELECTRIC ESTABLISHMENTS: 1927

	All establish-ments ¹	All establish-ments report-ing water power	Establish-ments report-ing 50 per cent or more cur-rent generated by water power	Establish-ments report-ing water power of 1,000 h. p. or more	Establish-ments report-ing water power only
Number of establishments.....	4,335	745	626	322	303
Value of plant and equipment.....	\$9,297,458,350	\$5,122,082,393	\$3,020,566,844	\$4,059,157,701	\$582,771,490
Total revenues:					
Electric service.....	\$1,802,055,403	\$824,144,350	\$440,847,418	\$722,332,224	\$85,236,330
All other sources.....	\$161,008,831	\$78,831,040	\$33,520,793	\$67,122,182	\$3,870,205
Total expenses.....	\$1,318,255,150	\$617,516,502	\$302,556,772	\$534,470,237	\$44,034,070
Total number of persons em-ployed.....	251,020	105,549	52,850	88,769	7,977
Prime movers:					
Number.....	12,030	5,925	3,977	4,553	1,291
Horsepower.....	35,710,128	19,258,489	12,016,402	17,071,613	2,021,883
Steam turbines—					
Number.....	2,864	1,069	406	858	-----
Horsepower.....	24,323,304	8,930,883	2,770,309	7,008,497	-----
Steam engines—					
Number.....	2,267	611	240	410	-----
Horsepower.....	994,273	371,843	117,252	280,000	-----
Internal-combustion en-gines—					
Number.....	3,177	523	192	272	-----
Horsepower.....	648,288	111,500	41,815	60,244	-----
Hydroturbines—					
Number.....	3,722	3,722	3,130	3,007	1,291
Horsepower.....	9,844,263	9,844,263	0,087,026	9,716,806	2,021,883
Generators:					
Number.....	11,067	5,827	3,858	4,484	1,264
Kilowatt capacity.....	25,811,305	13,847,147	8,465,819	13,677,449	2,023,884
Current generated, kilowatt-hours.....	74,086,378,010	41,560,963,066	29,387,011,305	30,575,266,628	8,718,393,987
Number of customers.....	21,700,238	8,905,749	4,677,425	7,048,704	799,288

¹ Includes establishments which purchased all current distributed.

² Includes following amounts reported by composite establishments (see "Purely electric and composite establishments," p. 14), not distributed as between the electric light and power industry and other industries: For "All establishments," \$902,057,279; for "Establishments reporting water power of 1,000 h. p. or more," \$403,194,047; for "Establishments reporting 50 per cent or more current generated by water power," \$3,443,142; for "All establishments reporting water power," \$411,333,061; for "Establishments reporting water power only," \$250,000.

³ Miscellaneous electric revenues, net income from utilities other than electric, and nonoperating income. Does not include amount of rents credited to income nor amortization of franchises (called for as net items in 1927 schedule).

⁴ Operating expenses, interest, and other deductions from gross income. Does not include amount of net payments for lease of plant, equipment, etc., and amortization of franchises (called for as net items in 1927 schedule). Does not include expenses of municipal plants.

TABLE 41.—GENERATOR CAPACITY OF FUEL-BURNING AND OF HYDROELECTRIC EQUIPMENT, ALL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	RATED CAPACITY (KILOWATTS)			PER CENT OF TOTAL	
	Total	Fuel	Hydro	Fuel	Hydro
27.....	25,811,305	18,961,793	6,849,512	73.5	26.5
22.....	14,313,438	9,962,781	4,350,657	69.6	30.4
17.....	8,994,407	6,208,510	2,785,897	69.0	31.0
12.....	5,165,439	(1)	(1)	-----	-----
7.....	2,709,225	(1)	(1)	-----	-----
2.....	1,212,235	(1)	(1)	-----	-----

¹ No data.

TABLE 42.—GENERATOR CAPACITY OF FUEL-BURNING AND OF HYDROELECTRIC EQUIPMENT, BY CLASS AND BY FREQUENCY GROUPS, ALL ESTABLISHMENTS: 1927

TYPE OF GENERATOR	RATED CAPACITY (KILOWATTS)			PER CENT OF TOTAL	
	Total	Fuel	Hydro	Fuel	Hydro
Total.....	25,811,305	18,961,793	6,840,512	73.5	26.5
Alternating current.....	25,537,726	18,804,121	6,733,005	73.6	26.4
25-cycle.....	2,743,123	2,087,649	655,574	76.1	23.9
60-cycle.....	21,744,481	16,332,400	5,412,081	75.1	24.9
Other frequencies.....	1,050,122	384,172	665,950	36.6	63.4
Direct current.....	273,579	157,672	115,907	57.6	42.4

TABLE 43.—GENERATOR CAPACITY OF FUEL-BURNING AND OF HYDROELECTRIC EQUIPMENT, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	RATED CAPACITY (KILOWATTS)			PER CENT OF TOTAL	
	Total	Fuel	Hydro	Fuel	Hydro
UNITED STATES.....	25,811,305	18,961,793	6,840,512	73.5	26.5
GEOGRAPHIC DIVISIONS:					
New England.....	2,124,315	1,605,270	510,045	75.6	24.4
Middle Atlantic.....	6,373,454	5,174,367	1,199,087	81.2	18.8
East North Central.....	6,245,084	5,694,224	550,860	91.2	8.8
West North Central.....	1,950,096	1,632,732	317,364	83.7	16.3
South Atlantic.....	3,144,019	2,003,013	1,141,006	63.7	36.3
East South Central.....	1,049,765	575,519	474,246	54.8	45.2
West South Central.....	1,152,073	1,127,860	24,213	97.9	2.1
Mountain.....	980,828	237,127	693,701	29.3	70.7
Pacific.....	2,791,671	861,661	1,930,020	30.9	69.1
NEW ENGLAND:					
Maine.....	179,364	37,703	141,661	21.0	79.0
New Hampshire.....	115,554	61,844	53,710	44.9	55.1
Vermont.....	141,420	13,410	128,010	9.5	90.5
Massachusetts.....	1,077,337	949,693	127,644	88.2	11.8
Rhode Island.....	194,700	192,950	1,750	99.1	0.9
Connecticut.....	415,940	359,670	56,270	86.5	13.5
MIDDLE ATLANTIC:					
New York.....	3,157,615	2,166,567	991,048	68.6	31.4
New Jersey.....	683,876	678,546	5,330	99.2	0.8
Pennsylvania.....	2,631,963	2,329,284	202,679	92.0	8.0
EAST NORTH CENTRAL:					
Ohio.....	1,742,856	1,726,781	16,125	99.1	0.9
Indiana.....	653,063	618,273	34,790	94.7	5.3
Illinois.....	2,035,905	1,995,610	40,295	98.0	2.0
Michigan.....	1,188,880	986,222	202,658	78.7	21.3
Wisconsin.....	624,380	417,388	206,992	66.8	33.2
WEST NORTH CENTRAL:					
Minnesota.....	372,651	249,490	123,161	67.0	33.0
Iowa.....	482,122	329,062	153,060	68.3	31.7
Missouri.....	472,272	459,872	12,400	97.4	2.6
North Dakota.....	36,094	36,094		100.0	
South Dakota.....	48,172	43,912	4,260	91.2	8.8
Nebraska.....	180,667	106,126	14,442	92.0	8.0
Kansas.....	358,218	348,177	10,041	97.2	2.8
SOUTH ATLANTIC:					
Delaware, District of Columbia, and Maryland ¹	498,294	478,154	20,140	96.0	4.0
Virginia.....	364,633	287,740	76,893	78.9	21.1
West Virginia.....	564,627	507,765	56,862	89.9	10.1
North Carolina.....	551,985	222,745	329,240	40.4	59.6
South Carolina.....	491,208	121,613	369,595	24.8	75.2
Georgia.....	380,130	97,244	282,876	25.6	74.4
Florida.....	293,242	287,742	5,500	98.1	1.9
EAST SOUTH CENTRAL:					
Kentucky.....	298,039	195,004	103,035	65.4	34.6
Tennessee.....	338,412	210,931	127,481	62.3	37.7
Alabama.....	349,427	105,697	243,730	30.2	69.8
Mississippi.....	63,887	63,887		100.0	

¹ Combined to avoid disclosing data for individual establishments.

TABLE 43.—GENERATOR CAPACITY OF FUEL-BURNING AND OF HYDROELECTRIC EQUIPMENT, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927—Continued

DIVISION AND STATE	RATED CAPACITY (KILOWATTS)			PER CENT OF TOTAL	
	Total	Fuel	Hydro	Fuel	Hydro
WEST SOUTH CENTRAL:					
Arkansas.....	94,955	84,650	10,275	89.2	10.8
Louisiana.....	207,542	207,542	-----	100.0	-----
Oklahoma.....	227,575	225,875	1,700	99.3	0.7
Texas.....	622,001	609,763	12,238	98.0	2.0
MOUNTAIN:					
Montana.....	268,509	9,758	258,751	3.6	96.4
Idaho.....	208,117	3,630	204,487	1.7	98.3
Wyoming.....	34,748	32,435	2,313	93.3	6.7
Colorado.....	198,919	145,231	53,688	73.0	27.0
New Mexico.....	24,000	23,135	865	96.0	4.0
Arizona.....	100,600	33,912	66,688	33.7	66.3
Utah.....	132,755	37,051	95,704	27.9	72.1
Nevada.....	13,090	1,975	11,115	15.1	84.9
PACIFIC:					
Washington.....	603,684	100,437	503,247	16.6	83.4
Oregon.....	222,997	104,545	118,452	46.9	53.1
California.....	1,964,990	656,669	1,308,321	33.4	66.6

TABLE 44.—CURRENT GENERATED BY FUEL-BURNING AND BY HYDROELECTRIC EQUIPMENT, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	CURRENT GENERATED (KILOWATT-HOURS)			PER CENT OF TOTAL	
	Total	Fuel	Hydro	Fuel	Hydro
UNITED STATES.....	74,686,378,010	45,968,239,601	28,718,138,409	61.5	38.5
GEOGRAPHIC DIVISIONS:					
New England.....	4,750,193,632	2,805,358,705	1,944,834,927	59.1	40.9
Middle Atlantic.....	19,281,644,834	13,102,369,077	6,179,274,857	68.0	32.0
East North Central.....	18,211,894,585	15,785,927,115	2,425,967,470	86.7	13.3
West North Central.....	4,549,293,907	3,032,590,901	1,516,697,006	66.7	33.3
South Atlantic.....	8,445,216,788	5,430,219,583	3,014,997,205	64.3	35.7
East South Central.....	2,777,268,044	1,159,856,434	1,617,401,610	41.8	58.2
West South Central.....	3,275,021,117	3,211,403,298	63,617,819	98.1	1.9
Mountain.....	3,389,551,356	466,288,886	2,923,262,470	13.8	86.2
Pacific.....	10,006,323,747	674,268,702	9,332,055,045	9.7	90.3
NEW ENGLAND:					
Maine.....	560,664,446	4,321,092	556,343,354	0.8	99.2
New Hampshire.....	226,444,199	30,692,286	195,751,913	13.6	86.4
Vermont.....	338,528,207	7,103,957	331,424,250	2.1	97.9
Massachusetts.....	2,245,301,081	1,663,455,284	581,845,797	74.1	25.9
Rhode Island.....	411,073,647	405,975,264	5,098,383	98.8	1.2
Connecticut.....	968,182,052	603,760,822	274,421,230	71.7	28.3
MIDDLE ATLANTIC:					
New York.....	9,917,685,560	4,671,290,715	5,246,394,835	47.1	52.9
New Jersey.....	1,861,984,763	1,828,236,223	33,748,540	98.2	1.8
Pennsylvania.....	7,501,974,521	6,002,833,039	899,141,482	88.0	12.0
EAST NORTH CENTRAL:					
Ohio.....	4,724,016,312	4,675,651,902	48,364,410	99.0	1.0
Indiana.....	1,746,153,163	1,591,660,629	154,562,534	91.1	8.9
Illinois.....	6,075,352,208	5,857,130,956	218,221,252	96.4	3.6
Michigan.....	3,773,636,019	2,708,559,141	1,065,076,878	71.8	28.2
Wisconsin.....	1,892,736,883	952,994,487	939,742,396	50.4	49.6
WEST NORTH CENTRAL:					
Minnesota.....	843,357,074	309,332,688	534,024,386	36.7	63.3
Iowa.....	1,429,169,797	619,861,570	809,308,227	43.4	56.6
Missouri.....	891,179,442	808,439,862	82,739,580	90.7	9.3
North Dakota.....	59,409,194	59,409,194	-----	100.0	-----
South Dakota.....	90,407,255	78,710,826	11,696,429	87.1	12.9
Nebraska.....	405,055,833	364,212,562	40,843,271	89.9	10.1
Kansas.....	830,685,312	792,630,199	38,055,113	95.4	4.6

TABLE 44.—CURRENT GENERATED BY FUEL-BURNING AND BY HYDROELECTRIC EQUIPMENT, ALL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927—Continued

DIVISION AND STATE	CURRENT GENERATED (KILOWATT-HOURS)			PER CENT OF TOTAL	
	Total	Fuel	Hydro	Fuel	Hydro
SOUTH ATLANTIC:					
Delaware, District of Columbia, and Maryland ¹	1,102,187,568	1,072,025,330	30,162,238	97.3	2.7
Virginia.....	973,766,450	700,054,960	273,711,490	71.9	28.1
West Virginia.....	1,902,819,767	1,702,747,074	200,072,693	89.5	10.5
North Carolina.....	2,036,121,761	956,160,593	1,079,961,168	47.0	53.0
South Carolina.....	1,116,260,957	339,168,981	777,097,976	30.4	69.6
Georgia.....	746,074,405	102,320,095	643,754,310	13.7	86.3
Florida.....	567,979,880	557,742,550	10,237,330	98.2	1.8
EAST SOUTH CENTRAL:					
Kentucky.....	505,564,056	396,102,643	109,461,413	78.3	21.7
Tennessee.....	936,874,282	366,437,110	570,437,172	39.1	60.9
Alabama.....	1,270,158,764	332,655,739	937,503,025	26.2	73.8
Mississippi.....	64,670,942	64,670,942	-----	100.0	-----
WEST SOUTH CENTRAL:					
Arkansas.....	174,197,548	128,221,558	45,975,990	73.6	26.4
Louisiana.....	634,594,420	634,594,420	-----	100.0	-----
Oklahoma.....	654,513,265	649,503,035	5,010,230	99.2	0.8
Texas.....	1,811,715,884	1,799,084,285	12,631,599	99.3	0.7
MOUNTAIN:					
Montana.....	1,398,749,279	11,876,695	1,386,872,584	0.8	99.2
Idaho.....	713,213,718	171,523	713,042,195	(?)	100.0
Wyoming.....	67,070,330	64,444,210	2,626,120	96.1	3.9
Colorado.....	499,565,961	278,488,044	221,077,917	55.7	44.3
New Mexico.....	32,674,286	31,198,801	1,475,485	95.5	4.5
Arizona.....	280,267,002	61,225,804	219,041,198	21.8	78.2
Utah.....	340,873,488	16,742,949	324,130,539	4.9	95.1
Nevada.....	57,137,292	2,140,860	54,996,432	3.7	96.3
PACIFIC:					
Washington.....	2,105,288,534	64,041,833	2,041,246,701	3.0	97.0
Oregon.....	840,062,576	237,687,046	602,375,530	28.3	71.7
California.....	7,060,972,637	672,539,823	6,388,432,814	9.5	90.5

¹ Combined to avoid disclosing data for individual establishments.

² Less than one-tenth of 1 per cent.

TABLE 45.—GENERATOR CAPACITY, OUTPUT OF CURRENT, AND OUTPUT PER KILOWATT, FOR FUEL-BURNING AND FOR HYDROELECTRIC EQUIPMENT, ALL ESTABLISHMENTS: 1927

	Fuel	Hydro
Rated generator capacity (kilowatts).....	18,961,793	6,849,512
Current generated (kilowatt-hours).....	45,968,239,801	28,718,138,409
Kilowatt-hours generated per kilowatt of capacity:		
Per annum.....	2,424	4,198
Per diem.....	6.6	11.5

Chapter V.—COMMERCIAL AND MUNICIPAL ESTABLISHMENTS

Number and size of establishments (Tables 46, 47, 49, and 50).—Although the municipal establishments for the first time slightly outnumber the commercial establishments, they average much smaller in size. In 1927 they had 5.8 per cent of the total horsepower and generated 4.5 per cent of the total energy. During the past half decade both municipal and commercial establishments increased greatly in capacity and in output. Both decreased in number, the commercial establishments far more than the municipal. Many of the former serve large areas and the decrease in their number was due to consolidations of companies serving contiguous areas. Municipal plants generally serve individual communities, and consolidations with other municipal establishments are not usually practicable. The numerical decrease represents an excess of absorptions by commercial systems over the increase due to the establishing of new municipal systems. The number of commercial establishments reached its peak in 1917, the number of municipal in 1922, and the number of both combined in 1917. From 1922 to 1927 the commercial establishments fell off so greatly in number that they became fewer than in 1902.

A different situation prevails with reference to municipal systems. Most of these are relatively small, though there are important exceptions; a change of ownership usually, if not always, requires the sanction of a popular vote. Most of them are separated from one another. As a rule, each serves only one community and perhaps, when legal authority exists, its immediate environs. The decrease in the number of municipal establishments did not set in until the latest 5-year period, and then the rate, 14 per cent, was much lower than that for commercial establishments, 43 per cent (Table 49). Since the total horsepower of prime movers in municipal plants increased by 60 per cent, it appears that for the most part the numerical decrease was in the establishments with small generating plants or none at all, i. e., those purchasing all their energy. Of these, several hundred were absorbed into commercial systems. The exact number can not be stated, since the statistics do not reveal how many new plants came into existence during the interval.

Establishments with generating equipment and those operating exclusively on purchased energy (Tables 46 and 47).—The following summary, based on Tables 46 and 47 and on corresponding data in the census report for 1922, shows that only 53.8 per cent of the establishments reporting generated all or any part of their energy in 1927, the percentage being somewhat greater for the commercial than for the municipal systems, nearly half of which operated entirely on purchased energy. Moreover, in both classes the percentage of those purchasing all their energy was decidedly larger in 1927 than in 1922.

	All establishments	Generating energy	Not generating energy	Per cent generating	Per cent not generating
1927					
Total establishments.....	4,335	2,331	2,004	53.8	46.2
Commercial.....	2,137	1,218	919	57.0	43.0
Municipal.....	2,198	1,113	1,085	50.6	49.4
1922					
Total establishments.....	6,355	4,389	1,966	69.1	30.9
Commercial.....	3,774	2,650	1,124	70.2	29.8
Municipal.....	2,581	1,739	842	67.4	32.6

The shrinkage in the aggregate number between 1922 and 1927, which occurred in every group—purely electric as well as composite (see Table 2), and municipal (with the exception of "Municipal, not generating") as well as commercial—reflects the trend toward the elimination of small operating units by consolidation and the increasing distribution of power to many communities over extensive areas from large advantageously located plants. The increase in the ratio of the number operating on purchased energy to the aggregate number is another manifestation of the same trend.

The number of establishments increased considerably during each 5-year period until 1917, but decreased slightly between 1917 and 1922 and fell sharply during the following 5-year period. (See "Definition of establishment," p. 14.) The number of generating stations also decreased considerably between 1917 and 1927, and especially during the period 1922-1927. (See Table 5, p. 21.)

Fuel consumption and size of plants (Tables 47, 48, and 49).—The differences in magnitude, especially as to area served and size of plants, lead to other differences between commercial and municipal plants. Relatively, oil is a far more important fuel than coal, and the internal-combustion engine a far more important form of prime mover, for the municipal than for the commercial plant (Tables 48 and 49). The prairie States, in particular, abound in small municipal plants. Whereas the average prime-mover rating of commercial generating plants for the country as a whole is about 26,500 horsepower, the corresponding average for municipal generating plants is only 1,766, and for the 409 plants in the West North Central States it is only 829 (Table 47). In North Dakota the average is 210 horsepower, in South Dakota 412, and in Nebraska 585. In the South, Georgia has 53 plants, averaging 283 horsepower.

In aggregate horsepower rating of municipal establishments the State of Washington leads, closely followed by California, each with more than 250,000 horsepower; next in order come Michigan and Ohio. Nebraska has the largest number, 105, or 9 per cent of all municipal establishments in the United States. Rhode Island has none; several States, among them Montana, have two each.

In number of commercial establishments and in aggregate rating, New York leads and Pennsylvania is second.

Energy output (Tables 49, 50, and 51).—The largest proportion which the output of municipal establishments formed of the total was that reported at the Census for 1902—7.8 per cent. It fell to 4.9 per cent in 1907 and continued to fall until it reached its minimum, 4.1 per cent in 1917, then rose to 4.7 per cent in 1922, and fell to 4.5 per cent in 1927.

Measured by energy output compared with the total output by geographic divisions, municipal plants are most important in the Pacific States and least important in the Middle Atlantic States (Table 51). The West North Central division ranks second. Nearly 40 per cent of the municipally generated energy is produced in the three States on the Pacific coast.

Parallel development (Table 52).—The ratios of the totals for municipal establishments to the aggregate for the industry have undergone moderate changes during the past 25 years. The revenue in 1902 constituted 8.2 per cent of the total; it fell off slightly, but rose again to the same figure in 1922, then fell to 6.8 per cent in 1927. The record of number of customers goes back only to 1907. Municipal establishments reported 14.6 per cent of the total number for that year; there was a gradual decrease to 12.9 per cent in 1922, followed by a pronounced decrease to 9.8 per cent in 1927. Kilowatt-hours sold have been recorded only since 1917. The output of municipal establishments formed 4 per cent of the total for that year, 4.9 per cent in 1922, and 4.6 per cent in 1927.

Regional distribution (Table 53).—The region showing the largest percentage of municipal business is the Pacific division, where three important cities are

thus served. The percentages for municipal establishments compared with the entire industry in this region, are as follows:

	Per cent
Number of customers.....	21. 1
Kilowatt hours sold.....	16. 1
Revenue.....	19. 1

At the other end of the scale stands the Middle Atlantic division, where the corresponding percentages are 2.1, 0.7, and 1.3. The West North Central division ranks second. Compared with municipal operations in the country as a whole, the Pacific States reported 41 per cent of the number of kilowatt-hours sold and 27 per cent of the revenue.

Effect of "undistributed" items on comparisons between commercial and municipal establishments.—Because of the disproportionately large "undistributed" sales, it is difficult to make comparisons between commercial and municipal establishments in respect of average receipts per kilowatt-hour for residential service and for "small light and power (retail)." Thus, in the United States as a whole the revenue per kilowatt-hour for energy reported as "Undistributed by class of service" is slightly larger than that for the higher revenue class, the residential, in the case of municipal establishments, but it is materially smaller in the case of commercial establishments. Most of this energy for which a separate classification was not possible is used for domestic lighting and "small light and power (retail)." The former sold probably at a rate somewhat in excess of the average for the group and the latter at a somewhat lower rate. The inclusion of the undistributed sales, had it been possible to put them into their proper classes, would therefore have correspondingly affected the average receipts per kilowatt-hour for residential service and for "small light and power (retail)."

Farm customers (Tables 56, 57, 60, and 61).—The actual number of farm customers is probably understated in the returns, since not all companies have separate records for this type of service. Of those reported, 32.1 per cent are on the Pacific coast and 30 per cent in the East North Central States. Most of the Pacific coast farm customers are served from commercial establishments, while this class of customers served from municipal establishments is largest in the East North Central division.

Commercial service.—Average receipts per kilowatt-hour for commercial service as furnished by commercial establishments and by municipal establishments can not be compared, on the basis of the published statistics, because for the former class of establishments this service appears under two classifications, retail and wholesale, while for the latter no such distribution is shown.

Employees (Table 64).—The electric light and power industry differs in one important respect—the human element—from those industries in which material commodities are manufactured. The former is concerned not with the production of tangible goods but with the conversion and distribution of energy. The human function is confined to the supervision and control of the apparatus by means of which these operations are performed and to the commercial activities necessary in carrying on the business of the industry. Contrasted with the great magnitude of the industry in other respects, the number of persons employed is remarkably small. In installed horsepower the industry approaches within 9 per cent of the total for manufacturing establishments (including in the latter total the power of electric motors driven by purchased current), but in number of employees it is only a little more than one-twentieth as great. In the manufacturing industries the wage earners outnumber the salaried officers and employees more than six to one; in the electric light and power industry the salaried employees are more than two-thirds as numerous as the wage earners in the commercial establishments and half as numerous in the municipal establishments.

In both groups (commercial and municipal), as technical progress has reduced the amount of manual labor to be performed, there has been a gradual shift toward a larger ratio of salaried employees to wage earners.

Comparison of commercial plants with municipal plants in cities having 25,000 inhabitants or more (Tables 65-69).—The number of municipal establishments situated in places having 25,000 inhabitants or more constitutes only 2.5 per cent of the total number of municipal establishments, but in most other respects they exceed all the rest in importance. They reported 56.1 per cent of the total value of plant and equipment for all municipal establishments; with 54.5 per cent of the generator rating, they produced 66.6 per cent of the output; they received 41.7 per cent of the revenue (indicating that their average revenue per kilowatt-hour was somewhat less than two-thirds of the corresponding average for all municipal plants); and their customers represented 32.7 per cent of the total for municipal establishments (Table 69).

The only consolidated balance sheet and consolidated income, operating-revenue, and expense statements available for municipal plants are those applying to such plants in places having 25,000 inhabitants or more, and these do not completely reflect conditions for the municipal group as a whole. The advantage naturally lies on the side of the large, adequately staffed, and efficiently operated establishments.

The only comparison that can be made, therefore, is between this selected group of municipal establishments and *all* commercial establishments (Tables 65-68).

The average value of plant and equipment for this group of municipal establishments is \$305 per kilowatt of generator capacity; that for the commercial establishments is somewhere between \$327 and \$364 per kilowatt, depending on the amount of the "undistributed" value in Table 65 that may be assigned to electric plants.

It should be distinctly noted that these figures apply in all cases to the entire equipment—generating plants, transmission lines, substations, and distribution systems, including usually the meters on the consumers' premises—and not merely to generating equipment alone. The latter constitutes only a relatively small portion of the total.

Allocation of expenses (Tables 67 and 68).—Certain similarities and certain differences are evident from a comparison between the revenues and expenses of all commercial establishments and those of municipal establishments in places having 25,000 inhabitants or more. Expressed in percentages of total electric revenues, the fuel costs are 9.3 and 8.6 per cent, respectively, for the two groups; the cost of purchased power, 8.4 and 8.1 per cent; depreciation, 6.3 and 10.7 per cent; other operating expenses, 26.3 and 39 per cent. Operating taxes for the former consumed 8.8 per cent of the total revenue as against only 1.1 per cent for the latter. Many municipal establishments pay no taxes.

TABLE 46.—NUMBER OF ESTABLISHMENTS AND AGGREGATE HORSEPOWER OF PRIME MOVERS, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	NUMBER OF ESTABLISHMENTS			AGGREGATE HORSEPOWER OF PRIME MOVERS		
	Total	Commer- cial	Municipal	Total	Commercial	Municipal
1927.....	4,335	2,137	2,198	35,710,128	33,661,406	2,048,722
1922.....	6,355	3,774	2,681	19,850,860	18,570,732	1,280,128
1917.....	6,542	4,224	2,318	12,936,755	12,077,657	859,098
1912.....	5,221	3,659	1,562	7,530,044	6,970,716	559,328
1907.....	4,714	3,462	1,252	4,098,188	3,776,837	321,351
1902.....	3,620	2,805	815	1,845,048	1,685,020	160,028

TABLE 47.—NUMBER OF ESTABLISHMENTS REPORTING GENERATING EQUIPMENT, AND AGGREGATE HORSEPOWER OF PRIME MOVERS, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	NUMBER OF ESTABLISHMENTS REPORTING GENERATING EQUIPMENT			AGGREGATE HORSEPOWER OF PRIME MOVERS		
	Total	Commercial	Municipal	Total	Commercial	Municipal
UNITED STATES.....	2,431	1,271	1,160	35,710,128	33,661,406	2,048,722
GEOGRAPHIC DIVISIONS:						
New England.....	170	139	31	3,009,090	2,928,727	80,363
Middle Atlantic.....	210	160	50	8,614,712	8,521,506	93,206
East North Central.....	431	193	238	8,668,393	8,075,806	592,587
West North Central.....	617	208	409	2,671,236	2,332,200	338,976
South Atlantic.....	312	151	161	4,393,793	4,192,921	200,872
East South Central.....	149	86	63	1,446,897	1,392,218	54,679
West South Central.....	249	122	127	1,563,349	1,451,929	111,420
Mountain.....	200	138	62	1,405,585	1,363,246	42,339
Pacific.....	93	74	19	3,937,073	3,402,793	534,280
NEW ENGLAND:						
Maine.....	34	28	6	252,316	250,559	1,757
New Hampshire.....	22	20	2	157,331	156,106	1,225
Vermont.....	32	24	8	204,036	192,520	11,516
Massachusetts.....	50	44	12	1,528,508	1,475,319	53,249
Rhode Island.....	3	3		263,470		
Connecticut.....	23	20	3	603,369	590,733	12,616
MIDDLE ATLANTIC:						
New York.....	102	79	23	4,212,355	4,162,311	50,044
New Jersey.....	16	9	7	1,003,561	995,829	7,732
Pennsylvania.....	92	72	20	3,398,796	3,363,366	35,430
EAST NORTH CENTRAL:						
Ohio.....	82	33	49	2,364,554	2,196,718	157,836
Indiana.....	62	27	35	869,925	762,390	107,545
Illinois.....	91	32	59	2,904,559	2,791,410	113,149
Michigan.....	105	48	57	1,618,740	1,436,811	181,929
Wisconsin.....	91	63	38	920,615	888,487	32,128
WEST NORTH CENTRAL:						
Minnesota.....	74	27	47	516,124	460,463	55,661
Iowa.....	86	24	62	648,807	601,913	46,894
Missouri.....	78	39	39	648,028	603,115	44,913
North Dakota.....	62	37	25	56,136	50,890	5,246
South Dakota.....	52	23	29	70,514	58,580	11,934
Nebraska.....	147	42	105	250,055	188,748	61,307
Kansas.....	118	16	102	481,572	368,551	113,021
SOUTH ATLANTIC:						
Delaware, District of Columbia, and Maryland ¹	31	18	13	695,284	683,742	11,542
Virginia.....	42	28	14	501,775	475,163	26,612
West Virginia.....	29	24	5	755,268	754,288	980
North Carolina.....	55	24	31	772,824	737,267	35,557
South Carolina.....	31	18	13	700,433	694,352	6,081
Georgia.....	73	20	53	608,772	593,748	15,024
Florida.....	51	19	32	359,437	254,361	105,076
EAST SOUTH CENTRAL:						
Kentucky.....	35	29	6	395,238	385,643	9,595
Tennessee.....	38	22	16	455,965	438,458	17,507
Alabama.....	23	14	9	508,240	502,495	5,745
Mississippi.....	53	21	32	87,454	65,622	21,832
WEST SOUTH CENTRAL:						
Arkansas.....	34	21	13	131,036	118,829	12,207
Louisiana.....	49	17	32	276,900	250,925	25,975
Oklahoma.....	75	26	49	299,789	264,649	35,140
Texas.....	91	58	33	855,624	817,526	38,098
MOUNTAIN:						
Montana.....	20	18	2	378,242	378,142	100
Idaho.....	24	21	3	307,194	303,654	3,540
Wyoming.....	28	22	6	48,166	46,646	1,520
Colorado.....	55	26	29	268,404	240,980	27,424
New Mexico.....	19	17	2	32,652	32,192	460
Arizona.....	22	18	4	163,105	152,200	905
Utah.....	23	9	14	198,846	190,816	8,030
Nevada.....	9	7	2	18,976	18,616	360
PACIFIC:						
Washington.....	31	25	6	847,826	576,386	271,440
Oregon.....	26	19	7	308,501	299,681	8,820
California.....	36	30	6	2,780,746	2,526,726	254,020

¹ Combined to avoid disclosing data for individual establishments.

TABLE 48.—CONSUMPTION OF FUEL, BY KIND, WITH COAL EQUIVALENT, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS: 1927

KIND	Unit of measure	QUANTITY		
		Total	Commercial	Municipal
Anthracite.....	Ton (2,240 lbs.).....	1,787,693	1,743,068	44,625
Bituminous coal.....	Ton (2,000 lbs.).....	35,681,314	33,344,093	2,337,221
Coke.....	Ton (2,000 lbs.).....	31,623	31,623	
Fuel oil, kerosene, or gasolene.....	Barrel (42 gals.).....	7,145,798	5,246,539	1,899,259
Gas, manufactured.....	1,000 cu. ft.....	6,160,753	6,147,860	12,893
Gas, natural.....	1,000 cu. ft.....	59,362,039	55,736,131	3,625,908
Total equivalent fuel.....	Ton (2,000 lbs.).....			
Kilowatt hours generated by fuel-burning generating stations.....	Kilowatt-hours.....	45,968,239,601	44,202,993,927	1,765,245,674
Pounds of coal equivalent per kilowatt-hour of output.....				

KIND	Unit of measure	EQUIVALENT TONS OF BITUMINOUS COAL		
		Total	Commercial	Municipal
Anthracite.....	Ton (2,240 lbs.).....	2,002,217	1,952,237	49,980
Bituminous coal.....	Ton (2,000 lbs.).....	35,681,314	33,344,093	2,337,221
Coke.....	Ton (2,000 lbs.).....	27,498	27,498	
Fuel oil, kerosene, or gasolene.....	Barrel (42 gals.).....	1,786,449	1,311,534	474,815
Gas, manufactured.....	1,000 cu. ft.....	136,906	136,619	287
Gas, natural.....	1,000 cu. ft.....	2,580,968	2,423,310	157,648
Total equivalent fuel.....	Ton (2,000 lbs.).....	42,215,342	39,195,391	3,019,951
Kilowatt hours generated by fuel-burning generating stations.....	Kilowatt-hours.....			
Pounds of coal equivalent per kilowatt-hour of output.....		1.84	1.77	3.42

TABLE 49.—CURRENT GENERATED, BY TYPE OF PRIME MOVER, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS: 1927

TYPE OF PRIME MOVER	GENERATED OUTPUT (KILOWATT HOURS)			PER CENT DISTRIBUTION	
	Total	Commercial	Municipal	Commercial	Municipal
Total.....	74,686,378,010	71,306,839,538	3,379,538,472	100.0	100.0
Steam.....	45,391,190,914	43,886,864,568	1,504,326,346	61.5	44.5
Water.....	28,718,138,499	27,103,845,611	1,614,292,798	38.0	47.8
Internal-combustion.....	577,048,687	316,129,359	260,919,328	0.5	7.7

TABLE 50.—CURRENT GENERATED, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	GENERATED OUTPUT (KILOWATT HOURS)			PER CENT OF TOTAL	
	Total	Commercial establishments	Municipal establishments	Commercial establishments	Municipal establishments
1927.....	74,686,378,010	71,306,839,538	3,379,538,472	95.5	4.5
1923.....	40,291,536,435	38,413,240,163	1,878,296,272	95.3	4.7
1917.....	25,438,303,272	24,398,983,183	1,039,320,089	95.0	4.1
1912.....	11,569,109,885	11,031,583,155	537,526,730	95.4	4.6
1907.....	5,862,276,737	5,572,813,949	289,462,788	95.1	4.9
1902.....	2,507,051,115	2,311,146,676	195,904,439	92.2	7.8

TABLE 51.—CURRENT GENERATED, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	GENERATED OUTPUT (KILOWATT-HOURS)			PER CENT OF TOTAL	
	Total	Commercial	Municipal	Com- mercial	Municipal
UNITED STATES.....	74,686,378,010	71,306,839,538	3,379,538,472	95.5	4.5
GEOGRAPHIC DIVISIONS:					
New England.....	4,750,193,632	4,660,208,506	89,985,124	98.1	1.9
Middle Atlantic.....	19,281,644,834	19,158,065,800	123,579,034	99.4	0.6
East North Central.....	18,211,894,585	17,328,325,389	883,569,196	95.1	4.9
West North Central.....	4,549,263,907	4,134,377,320	414,886,587	90.9	9.1
South Atlantic.....	8,445,216,788	8,187,173,196	258,043,592	96.9	3.1
East South Central.....	2,777,268,044	2,706,203,700	71,064,344	97.4	2.6
West South Central.....	3,275,021,117	3,122,448,936	152,572,181	95.3	4.7
Mountain.....	3,389,551,356	3,328,836,288	60,715,068	98.2	1.8
Pacific.....	10,006,323,747	8,681,200,401	1,325,123,346	86.8	13.2
NEW ENGLAND:					
Maine.....	500,664,446	557,305,107	3,359,339	99.4	0.6
New Hampshire.....	226,444,199	225,627,874	816,325	99.6	0.4
Vermont.....	338,528,207	321,589,909	16,938,298	95.0	5.0
Massachusetts.....	2,245,301,081	2,181,830,841	63,470,240	97.2	2.8
Rhode Island.....	411,073,647	411,073,647
Connecticut.....	968,182,052	962,781,130	5,400,922	99.4	0.6
MIDDLE ATLANTIC:					
New York.....	9,917,685,550	9,840,198,097	77,487,453	99.2	0.8
New Jersey.....	1,861,984,763	1,852,384,553	9,600,210	99.5	0.5
Pennsylvania.....	7,501,974,521	7,466,483,160	36,491,371	99.5	0.5
EAST NORTH CENTRAL:					
Ohio.....	4,724,016,312	4,428,252,244	295,764,068	93.7	6.2
Indiana.....	1,746,153,163	1,590,194,567	155,958,596	91.1	8.9
Illinois.....	6,075,852,208	5,876,016,966	199,835,252	96.7	3.2
Michigan.....	3,773,636,019	3,597,123,077	176,512,942	95.3	4.7
Wisconsin.....	1,892,736,883	1,836,738,545	55,998,338	97.0	3.0
WEST NORTH CENTRAL:					
Minnesota.....	843,357,074	783,991,792	59,365,282	93.0	7.0
Iowa.....	1,429,169,797	1,375,245,007	53,924,790	96.2	3.8
Missouri.....	891,179,442	838,918,824	52,260,618	94.1	5.9
North Dakota.....	59,409,194	55,427,943	3,981,251	93.3	6.7
South Dakota.....	90,407,255	75,078,576	15,328,679	83.0	17.0
Nebraska.....	405,056,833	340,207,948	64,847,885	84.0	16.0
Kansas.....	830,685,312	665,507,230	165,178,082	80.1	19.9
SOUTH ATLANTIC:					
Delaware, District of Columbia, and Maryland ¹	1,102,187,568	1,065,262,941	16,924,627	98.5	1.5
Virginia.....	973,766,450	933,033,657	40,732,793	95.8	4.2
West Virginia.....	1,902,819,767	1,901,907,005	912,762	100.1	(²)
North Carolina.....	2,036,121,761	1,996,590,580	39,531,181	98.1	1.9
South Carolina.....	1,116,266,957	1,111,968,630	4,298,327	99.6	0.4
Georgia.....	746,074,405	733,125,052	12,949,353	98.3	1.7
Florida.....	567,979,880	425,285,331	142,694,549	74.9	25.1
EAST SOUTH CENTRAL:					
Kentucky.....	505,564,056	487,360,101	18,203,955	96.4	3.6
Tennessee.....	936,874,282	913,778,660	23,095,622	97.5	2.5
Alabama.....	1,270,158,764	1,263,765,766	6,392,998	99.5	0.5
Mississippi.....	64,670,942	41,299,173	23,371,769	63.9	36.1
WEST SOUTH CENTRAL:					
Arkansas.....	174,197,548	161,338,781	12,858,767	92.6	7.4
Louisiana.....	634,594,420	597,529,381	37,065,039	94.2	5.8
Oklahoma.....	654,513,265	604,580,286	49,932,980	92.4	7.6
Texas.....	1,811,715,884	1,759,000,489	52,715,395	97.1	2.9
MOUNTAIN:					
Montana.....	1,398,749,279	1,398,693,762	55,517	100.0	(²)
Idaho.....	713,213,718	703,921,898	9,291,820	98.7	1.3
Wyoming.....	67,070,330	65,390,697	1,679,633	97.5	2.5
Colorado.....	499,565,961	465,451,688	34,114,273	93.2	6.8
New Mexico.....	32,674,286	31,729,582	944,704	97.1	2.9
Arizona.....	280,267,002	279,385,628	881,374	99.7	0.3
Utah.....	340,873,488	327,565,047	13,308,441	96.1	3.9
Nevada.....	57,137,292	56,697,991	439,301	99.2	0.8
PACIFIC:					
Washington.....	2,105,288,534	1,638,646,671	466,641,863	77.8	22.2
Oregon.....	840,062,576	809,959,058	30,103,518	96.4	3.6
California.....	7,060,972,637	6,232,594,672	828,377,965	88.3	11.7

¹ Combined to avoid disclosing data for individual establishments.² Less than one-tenth of 1 per cent.

TABLE 52.—NUMBER OF CUSTOMERS, CURRENT SOLD, AND REVENUE FROM ELECTRIC SERVICE, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS: 1902 TO 1927.

	1927	1922	1917
Number of customers.....	21,790,238	12,709,868	7,178,703
Commercial.....	19,661,370	11,065,124	6,202,189
Municipal.....	2,128,868	1,644,744	976,514
Current sold, ¹ kilowatt-hours.....	79,011,210,518	41,964,785,034	25,751,964,806
Commercial.....	75,344,545,709	39,912,345,239	24,722,517,379
Municipal.....	3,666,664,809	2,052,439,795	1,029,447,421
Revenue from electric service ¹	\$1,802,655,493	\$1,020,439,038	\$502,059,980
Commercial.....	\$1,680,218,664	\$936,851,670	\$482,473,917
Municipal.....	\$122,436,829	\$83,587,369	\$39,586,063

	1912	1907	1902
Number of customers.....	3,837,518	1,946,979	(?)
Commercial.....	3,311,870	1,663,354	(?)
Municipal.....	525,648	283,625	(?)
Current sold, ¹ kilowatt-hours.....	(?)	(?)	(?)
Commercial.....	(?)	(?)	(?)
Municipal.....	(?)	(?)	(?)
Revenue from electric service ¹	\$287,138,657	\$169,614,691	\$84,186,605
Commercial.....	\$264,474,949	\$156,000,257	\$77,349,749
Municipal.....	\$22,663,708	\$13,614,434	\$6,836,856

¹ These figures for current sold include kilowatt-hours sold for resale and are therefore somewhat larger than the figures for the consumption of current by the ultimate consumers. For 1927, the total sales of 79,011,210,518 kilowatt-hours include 15,398,729,430 kilowatt-hours which were sold for resale, and revenue from electric service includes revenue amounting to \$135,609,922 received from sales to other electric companies. For earlier years figures for this separation are not available.

² Not called for on schedule.

TABLE 53.—NUMBER OF CUSTOMERS, CURRENT SOLD, AND REVENUE FROM ELECTRIC SERVICE, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927

DIVISION AND STATE	NUMBER OF CUSTOMERS 1			CURRENT SOLD, KILOWATT-HOURS 1			REVENUE FROM ELECTRIC SERVICE 1		
	Total	Commercial	Municipal	Total	Commercial	Municipal	Total	Commercial	Municipal
UNITED STATES.....	21,799,238	19,601,370	2,128,868	79,011,210,518	75,344,545,709	3,666,664,809	\$1,802,655,483	\$1,080,218,064	\$129,430,829
GEOGRAPHIC DIVISIONS:									
New England.....	2,007,649	1,859,224	148,425	5,824,848,911	5,681,217,199	163,129,712	156,793,084	149,827,248	6,965,816
Middle Atlantic.....	6,033,437	5,909,412	127,025	19,287,528,285	18,134,187,680	1,529,340,605	493,401,097	463,430,735	6,470,272
East North Central.....	5,313,705	4,820,222	493,483	15,997,253,058	13,188,246,707	2,809,006,351	433,585,150	406,911,456	28,678,700
West North Central.....	2,188,683	1,775,451	413,232	4,613,673,403	4,217,701,834	396,112,569	100,836,340	130,081,173	20,232,063
South Atlantic.....	1,664,711	1,328,078	336,633	3,878,913,650	3,638,157,909	208,328,268	109,703,088	135,780,079	13,422,989
South Middle Atlantic.....	721,576	659,442	62,134	3,628,022,423	3,149,703,116	478,888,514	69,094,181	68,614,242	3,409,959
East South Central.....	1,133,458	1,013,450	120,008	3,265,201,460	2,914,199,664	351,001,796	65,846,049	89,071,043	6,739,650
West South Central.....	597,576	538,394	59,182	3,477,894,897	2,914,199,664	563,695,233	52,463,049	49,796,402	2,948,044
Mountain.....	2,229,503	1,759,687	469,816	9,271,168,651	7,773,480,209	1,497,688,442	172,782,313	139,659,652	33,082,086
Pacific.....									
NEW ENGLAND:									
Maine.....	184,924	181,272	3,652	514,155,820	511,908,347	2,247,473	10,238,772	10,122,504	116,298
New Hampshire.....	106,240	102,650	3,590	177,496,182	175,216,085	2,280,097	6,394,848	6,835,008	159,840
Vermont and Rhode Island 2	245,424	233,605	11,819	1,070,019,108	1,038,873,330	17,146,773	22,369,359	21,803,786	566,173
Massachusetts.....	1,078,007	969,077	108,930	3,907,466,632	2,836,110,447	1,227,376,186	56,521,247	81,438,270	5,082,977
Connecticut.....	368,046	374,420	18,625	1,049,119,204	1,036,108,380	19,010,214	30,068,838	29,627,080	1,041,158
MIDDLE ATLANTIC:									
New York.....	3,194,904	3,126,857	67,047	11,055,629,466	10,956,694,839	98,934,627	283,276,359	249,783,977	3,482,382
New Jersey.....	981,040	865,110	115,930	1,730,041,722	1,726,798,761	12,811,861	63,073,352	68,194,232	869,026
Pennsylvania.....	1,868,368	1,812,245	56,123	8,492,257,697	8,456,795,080	41,464,017	177,501,116	176,452,252	2,118,864
EAST NORTH CENTRAL:									
Ohio.....	1,370,823	1,205,626	165,197	4,023,630,756	4,038,891,119	232,808,637	118,733,885	109,515,267	9,218,618
Indiana.....	638,727	594,679	44,048	1,622,573,090	1,633,321,255	49,301,803	49,301,803	48,676,571	5,624,981
Illinois.....	1,766,926	1,709,724	57,192	6,370,347,115	6,086,491,433	184,983,682	142,621,361	138,710,380	3,904,981
Michigan.....	981,606	896,239	85,367	3,272,215,315	3,272,215,315	204,088,837	81,663,422	78,087,307	6,516,915
Wisconsin.....	561,622	489,044	65,679	1,896,306,872	1,806,457,382	87,866,890	43,264,715	39,915,401	3,349,254
WEST NORTH CENTRAL:									
Minnesota.....	453,900	370,223	83,707	1,029,211,462	946,103,684	74,017,823	32,687,367	28,327,841	4,360,026
Iowa.....	439,473	377,101	62,372	865,119,077	816,020,408	49,088,669	29,511,938	26,617,021	2,894,517
Missouri.....	620,113	570,455	49,658	1,576,439,977	1,526,785,218	49,653,759	43,526,149	41,307,573	2,218,576
North Dakota.....	60,540	54,859	5,681	57,401,586	57,401,586	3,216,917	41,021,684	3,780,213	271,379
South Dakota.....	64,182	61,182	3,000	70,239,877	64,736,722	14,566,255	5,196,027	4,259,289	944,758
Nebraska.....	231,872	146,840	75,032	370,231,020	305,790,359	63,701,391	14,000,749	10,246,866	3,813,883
Kansas.....	312,878	191,791	121,087	683,969,697	507,122,970	146,846,127	21,277,916	16,578,462	5,696,454

1 Includes figures relating to "Sales for resale", as follows: Number of customers, 3,520 (commercial), 401 (municipal); kilowatt-hours sold, 14,807,604,398 (commercial), 591,125,037 (municipal); revenue from electric service, \$128,612,127 (commercial), \$9,897,735 (municipal).
 2 Combined to avoid disclosing data for individual establishments.

TABLE 53.—NUMBER OF CUSTOMERS, CURRENT SOLD, AND REVENUE FROM ELECTRIC SERVICE, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS AND STATES: 1927—Continued

DIVISION AND STATE	NUMBER OF CUSTOMERS 1			CURRENT SOLD, KILOWATT-HOURS 1			REVENUE FROM ELECTRIC SERVICE 1		
	Total	Commer- cial	Municipal	Total	Commer- cial	Municipal	Total	Commer- cial	Muni- cipal
SOUTH ATLANTIC:									
Delaware, District of Columbia, Maryland, and West Virginia.....	882,741	555,137	17,604	3,454,308,952	3,454,567,641	16,828,211	\$61,032,302	\$60,300,386	\$731,916
Virginia.....	211,011	183,573	17,438	702,466,644	673,681,203	26,785,441	17,280,593	16,288,266	1,002,328
North Carolina.....	230,071	151,501	68,570	2,276,819,731	2,093,915,050	21,903,680	31,574,513	28,428,677	3,145,836
South Carolina.....	94,064	73,714	21,370	964,346,800	883,917,411	20,428,389	13,440,477	13,440,477	1,000,000
Georgia.....	196,256	142,756	43,470	1,121,094,115	1,074,607,392	46,486,723	53,054,032	52,690,371	3,363,661
Florida.....	259,968	192,288	67,680	1,459,798,367	1,337,801,688	121,996,679	23,353,702	17,731,423	5,622,279
EAST SOUTH CENTRAL:									
Kentucky.....	247,965	228,828	19,137	718,800,530	701,790,650	17,009,880	19,573,370	18,866,490	706,871
Tennessee.....	223,692	211,562	12,030	1,018,638,636	1,005,277,195	13,361,471	20,540,986	19,840,554	690,432
Alabama.....	170,394	156,637	13,757	1,836,533,017	1,824,707,533	11,825,482	22,802,982	22,084,620	718,362
Mississippi.....	79,625	62,415	17,210	124,030,240	106,387,659	17,642,681	6,106,831	4,813,600	1,293,231
WEST SOUTH CENTRAL:									
Arkansas.....	115,232	103,304	11,978	222,487,225	212,593,780	9,893,445	8,823,857	8,246,840	576,987
Louisiana.....	168,827	143,298	25,529	590,336,185	565,458,130	26,878,049	15,649,154	14,094,865	1,554,289
Oklahoma.....	239,802	194,927	44,865	668,466,640	625,826,765	42,639,875	21,769,568	19,181,481	2,588,086
Texas.....	609,457	571,921	37,536	1,784,001,419	1,747,724,438	36,276,984	49,061,166	47,563,857	2,047,309
MOUNTAIN:									
Montana and Utah 1.....	163,854	177,709	16,175	1,875,385,096	1,864,017,811	11,367,285	20,694,278	20,213,370	480,908
Idaho.....	78,500	71,870	6,636	285,561,107	270,931,185	14,629,922	5,545,785	5,129,304	416,481
Wyoming.....	31,014	27,266	3,745	55,721,062	52,327,655	3,393,407	2,743,822	2,535,884	207,938
Colorado.....	197,263	170,802	26,371	413,783,280	387,251,771	26,531,510	14,268,208	12,860,095	1,408,113
New Mexico.....	27,214	26,137	1,077	28,480,164	27,361,771	1,118,393	1,963,424	1,895,959	77,465
Arizona.....	54,112	50,304	3,808	248,251,552	242,877,421	5,374,131	5,811,790	5,594,515	217,275
Nevada.....	15,653	14,133	1,400	70,622,327	68,875,051	1,747,276	1,729,739	1,637,275	92,464
PACIFIC:									
Washington.....	392,709	256,010	136,690	1,788,733,410	1,431,763,776	356,969,634	26,892,249	20,511,380	6,380,869
Oregon.....	209,078	197,343	11,735	706,120,782	681,441,877	24,678,905	14,251,921	13,587,246	664,675
California.....	1,627,710	1,306,335	321,381	6,766,315,459	5,660,274,556	1,106,040,903	131,638,148	105,601,066	26,037,142

See footnotes on p. 71.

TABLE 54.—NUMBER OF CUSTOMERS, CURRENT SOLD, AND REVENUE FROM ELECTRIC SERVICE (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS: 1927

	NUMBER OF CUSTOMERS		
	Total	Commercial	Municipal
Sales to ultimate consumer, total.....	21,786,317	19,657,850	2,128,467
Farm service.....	168,460	152,384	16,066
Domestic service.....	16,039,066	14,595,774	1,443,292
Commercial service:			
Small light and power (retail).....	2,784,126	2,569,911	1,214,215
Large light and power (wholesale).....	342,256	342,256	-----
Undistributed by class of service.....	2,424,253	1,970,509	453,744
Municipal street lighting ¹	22,232	21,251	981
Railroads (motive power):			
Street and interurban.....	822	804	18
Electrified steam-railroad divisions.....	38	32	6
Other service.....	5,074	4,929	145
	CURRENT SOLD, KILOWATT-HOURS		
	Total	Commercial	Municipal
Sales ultimate consumer, total.....	63,612,461,088	60,536,941,316	3,075,539,772
Farm service.....	835,271,354	826,831,462	8,439,892
Domestic service.....	7,105,619,723	6,273,316,235	832,303,488
Commercial service:			
Small light and power (retail).....	10,257,240,582	8,901,389,129	1,355,851,453
Large light and power (wholesale).....	33,471,610,198	33,471,610,198	-----
Undistributed by class of service.....	3,192,886,952	2,837,213,753	355,673,199
Municipal street lighting ¹	1,741,423,872	1,288,162,128	453,261,744
Railroads (motive power):			
Street and interurban.....	6,254,081,223	6,189,525,706	64,555,517
Electrified steam-railroad divisions.....	518,169,041	518,081,703	87,338
Other service.....	236,178,143	230,811,002	5,367,141
	REVENUE FROM ELECTRIC SERVICE		
	Total	Commercial	Municipal
Sales to ultimate consumer, total.....	\$1,667,045,571	\$1,554,606,537	\$112,439,034
Farm service.....	17,282,957	16,708,121	574,836
Domestic service.....	481,509,354	435,537,969	45,971,385
Commercial service:			
Small light and power (retail).....	410,652,535	376,550,255	134,102,280
Large light and power (wholesale).....	456,472,907	456,472,907	-----
Undistributed by class of service.....	154,705,419	134,868,526	19,836,893
Municipal street lighting ¹	77,198,896	66,141,258	11,057,638
Railroads (motive power):			
Street and interurban.....	58,860,539	58,131,530	729,009
Electrified steam-railroad divisions.....	5,339,485	5,336,013	3,472
Other service.....	5,023,479	4,859,958	163,521

¹ Includes large light and power.² Includes all municipal service "for which a charge was made by the light and power department," municipal establishments.

TABLE 55.—CURRENT SOLD PER CUSTOMER, REVENUE FROM ELECTRIC SERVICE PER CUSTOMER, AND AVERAGE REVENUE PER KILOWATT-HOUR SOLD, BY CLASS OF SERVICE, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS: 1927

	CURRENT SOLD PER CUSTOMER		
	Total (kilowatt hours)	Commercial (kilowatt hours)	Municipal (kilowatt hours)
Total sales to ultimate consumers.....	2,920	3,080	1,445
Farm service (including power for irrigation).....	4,959	5,426	525
Domestic service.....	443	430	577
Commercial service:			
Small light and power (retail).....	3,684	3,464	1,6329
Large light and power (wholesale).....	97,797	97,797	-----
Undistributed by class of service.....	1,317	1,440	784
Municipal street lighting ²	78,830	60,617	462,041
Railroads (motive power):			
Street and interurban.....	7,608,371	7,698,415	3,586,418
Electrified steam-railroad divisions.....	13,636,027	16,190,053	14,556
Other service.....	46,547	46,827	37,015

	REVENUE FROM ELECTRIC SERVICE, PER CUSTOMER		
	Total (dollars)	Commercial (dollars)	Municipal (dollars)
Total sales to ultimate consumers.....	77	79	53
Farm service (including power for irrigation).....	103	110	36
Domestic service.....	30	30	32
Commercial service:			
Small light and power (retail).....	147	146	1159
Large light and power (wholesale).....	1,334	1,334	-----
Undistributed by class of service.....	64	68	44
Municipal street lighting ²	3,472	3,112	11,272
Railroads (motive power):			
Street and interurban.....	71,606	72,803	40,501
Electrified steam-railroad divisions.....	140,513	166,750	579
Other service.....	990	986	1,128

	REVENUE PER KILOWATT-HOUR		
	Total (cents)	Commercial (cents)	Municipal (cents)
Total sales to ultimate consumers.....	2.6	2.6	3.7
Farm service (including power for irrigation).....	2.1	2.0	6.8
Domestic service.....	6.8	6.9	5.5
Commercial service:			
Small light and power (retail).....	4.0	4.2	12.5
Large light and power (wholesale).....	1.4	1.4	-----
Undistributed by class of service.....	4.3	4.8	5.6
Municipal street lighting ²	4.4	5.1	2.4
Railroads (motive power):			
Street and interurban.....	0.9	0.9	1.1
Electrified steam-railroad divisions.....	1.0	1.0	4.0
Other service.....	2.1	2.1	3.0

¹ Combined rate; includes large light and power.

² Includes all municipal service "for which a charge was made by the light and power department," municipal establishments.

TABLE 56.—NUMBER OF CUSTOMERS (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, COMMERCIAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS: 1927

DIVISION	Total ¹	Farm service (see "Farm customers," p. 65)	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting
				Small light and power (retail)	Large light and power (wholesale)		
United States.....	19,657,850	152,384	14,595,774	2,569,911	342,256	1,970,509	21,251
Geographic divisions:							
New England.....	1,858,852	6,476	1,417,801	276,736	42,925	114,145	1,162
Middle Atlantic.....	5,905,934	22,726	4,297,340	604,150	47,307	928,138	4,415
East North Central.....	4,819,310	44,422	3,939,718	676,879	59,610	92,586	4,657
West North Central.....	1,775,496	17,566	1,374,456	246,712	62,578	70,607	2,934
South Atlantic.....	1,327,748	2,237	893,812	173,938	40,279	215,119	1,857
East South Central.....	659,350	606	509,252	126,056	13,597	8,623	794
West South Central.....	1,013,327	1,461	785,555	178,372	32,003	18,801	1,671
Mountain.....	538,294	3,148	427,928	93,905	3,165	9,479	602
Pacific.....	1,759,539	53,842	950,412	193,163	40,792	518,013	3,159

¹ Includes data for "Street and interurban railways," "Electrified steam-railroad divisions," and "Other service" not distributed by geographic divisions.

TABLE 57.—NUMBER OF CUSTOMERS (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, MUNICIPAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS: 1927

DIVISION	Total ¹	Farm service (see "Farm customers," p. 65)	Domestic service	Commercial service ²	Undistributed by class of service	Municipal street lighting ³
United States.....	2,128,467	16,066	1,443,292	214,215	453,744	981
Geographic divisions:						
New England.....	148,397	2,868	103,047	14,121	28,287	70
Middle Atlantic.....	127,019	481	86,027	5,013	35,410	72
East North Central.....	403,442	6,360	328,832	43,699	114,184	244
West North Central.....	412,022	3,724	220,393	37,498	141,005	378
South Atlantic.....	236,603	1,376	153,073	20,098	61,921	93
East South Central.....	62,132	190	39,026	3,203	19,683	28
West South Central.....	119,903	410	66,608	17,482	35,380	22
Mountain.....	59,166	303	42,931	6,021	9,865	44
Pacific.....	469,783	354	394,305	67,080	8,009	30

¹ Includes data for "Electrified steam-railroad divisions," "Street and interurban railways," and "Other service," not distributed by geographic divisions.

² Includes "Small light and power (retail)" and "Large light and power (wholesale)," not shown separately on schedule.

³ Includes all municipal service, "for which a charge was made by the light and power department."

TABLE 58.—CURRENT SOLD (TO ULTIMATE CONSUMERS ONLY), KILOWATT-HOURS, BY CLASS OF SERVICE, COMMERCIAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS: 1927

DIVISION	Total ¹ (kilowatt-hours)	Farm Service	Domestic service
United States.....	60,536,941,316	826,831,462	6,273,316,235
Geographic divisions:			
New England.....	3,800,635,188	2,478,575	535,324,310
Middle Atlantic.....	17,741,475,931	12,380,847	1,837,859,022
East North Central.....	14,363,153,375	20,653,287	1,753,073,019
West North Central.....	3,682,153,808	11,106,363	531,908,737
South Atlantic.....	6,714,232,257	886,155	391,254,735
East South Central.....	2,393,459,359	112,108	180,219,633
West South Central.....	2,588,230,251	10,197,340	288,605,688
Mountain.....	2,796,272,665	9,555,973	207,574,428
Pacific.....	6,449,328,482	759,460,754	547,496,663

DIVISION	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting
	Small light and power (retail)	Large light and power (wholesale)		
United States.....	8,901,389,129	33,471,610,198	2,837,213,753	1,238,162,128
Geographic divisions:				
New England.....	667,944,405	2,176,316,237	106,768,138	131,474,985
Middle Atlantic.....	1,781,149,959	10,138,146,714	1,753,986,600	391,579,570
East North Central.....	2,378,563,351	7,409,398,330	143,609,672	265,624,999
West North Central.....	730,288,761	1,779,256,084	63,980,080	123,224,684
South Atlantic.....	682,106,915	4,746,867,459	294,116,626	103,156,799
East South Central.....	339,126,598	1,645,283,232	17,365,793	49,674,418
West South Central.....	388,686,657	1,466,013,669	16,902,573	79,753,214
Mountain.....	514,946,833	1,813,051,352	9,847,120	37,488,037
Pacific.....	1,418,576,620	2,297,277,121	430,637,261	106,185,422

¹ Includes data for "Street and interurban railways," "Electrified steam-railroad divisions," and "Other service," not distributed by geographic divisions.

TABLE 59.—CURRENT SOLD (TO ULTIMATE CONSUMERS ONLY), KILOWATT-HOURS, BY CLASS OF SERVICE, MUNICIPAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS: 1927

DIVISION	Total ¹ (kilowatt-hours)	Farm service	Domestic service	Commercial service ²	Undistributed by class of service	Municipal street lighting ³
United States.....	3,075,539,772	8,439,992	832,363,488	1,355,851,463	355,673,199	453,261,744
Geographic divisions:						
New England.....	149,663,009	1,490,434	40,633,745	69,584,553	18,102,399	18,765,743
Middle Atlantic.....	127,682,720	254,953	51,691,915	32,362,681	24,430,819	18,132,965
East North Central.....	894,176,588	2,960,251	214,226,764	331,227,449	85,591,279	247,629,132
West North Central.....	378,572,991	1,770,214	103,200,833	121,603,389	109,263,341	40,773,458
South Atlantic.....	300,077,305	793,164	102,467,117	103,504,625	55,863,883	30,874,725
East South Central.....	59,845,264	43,863	24,356,422	11,343,613	15,142,221	8,483,205
West South Central.....	115,225,363	151,237	42,004,322	37,101,328	29,756,711	6,107,905
Mountain.....	60,668,135	354,549	20,351,242	21,050,577	8,487,718	8,484,389
Pacific.....	989,733,457	601,227	233,072,128	628,073,238	9,004,833	73,950,162

¹ Includes data for "Electrified steam-railroad divisions," "Street and interurban railways," and "Other service," not distributed by geographic divisions.

² Includes "Small light and power (retail)" and "Large light and power (wholesale)," not shown separately on schedule.

³ Includes all municipal service, "for which a charge was made by the light and power department."

TABLE 60.—CURRENT SOLD—AVERAGE KILOWATT-HOURS PER CUSTOMER (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, COMMERCIAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS: 1927

[Based on Tables 56 and 58]

DIVISION	Total ¹	Farm service (see "Farm consumers," p. 65)	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting
				Small light and power (retail)	Large light and power (wholesale)		
United States.....	3,080	5,426	430	3,464	97,797	1,440	60,617
Geographic divisions:							
New England.....	2,048	383	378	2,414	50,700	935	113,145
Middle Atlantic.....	3,004	545	428	2,948	214,305	1,890	88,693
East North Central.....	2,980	465	445	3,514	124,298	1,551	57,038
West North Central.....	2,074	632	387	2,960	28,433	906	41,999
South Atlantic.....	5,057	396	438	3,922	117,850	1,367	55,550
East South Central.....	3,633	222	354	2,690	121,003	2,014	62,562
West South Central.....	2,554	6,980	367	2,179	45,809	1,225	47,728
Mountain.....	5,195	3,036	485	5,484	572,844	1,039	62,272
Pacific.....	3,665	14,105	576	7,844	56,317	831	33,614

¹ Includes data for "Street and interurban railways," "Electrified steam-railroad divisions," and "Other service," not distributed by geographic divisions.

TABLE 61.—CURRENT SOLD—AVERAGE KILOWATT-HOURS PER CUSTOMER (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, MUNICIPAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS: 1927

[Based on Tables 57 and 59]

DIVISION	Total ¹	Farm service (see "Farm consumers," p. 65)	Domestic service	Commercial service ²	Undistributed by class of service	Municipal street lighting ³
Geographic divisions:						
New England.....	1,008	520	397	4,928	640	268,082
Middle Atlantic.....	1,004	530	601	6,466	690	251,847
East North Central.....	1,812	469	551	7,580	750	1,014,873
West North Central.....	919	475	450	3,243	775	107,886
South Atlantic.....	1,268	576	669	5,160	902	331,986
East South Central.....	963	231	624	3,542	769	302,974
West South Central.....	961	369	631	2,122	841	280,359
Mountain.....	1,025	1,170	474	3,496	860	192,827
Pacific.....	2,107	1,698	591	9,363	1,124	2,465,005

¹ Includes data for "Electrified steam-railroad divisions," "Street and interurban railways," and "Other service," not distributed by geographic divisions.

² Includes "Small light and power (retail)" and "Large light and power (wholesale)," not shown separately on schedule.

³ Includes all municipal service, "for which a charge was made by the light and power department."

TABLE 62.—REVENUE FROM ELECTRIC SERVICE (ULTIMATE CONSUMERS ONLY) BY CLASS OF SERVICE, COMMERCIAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS: 1927

DIVISION	Total ¹	Farm service	Domestic service	COMMERCIAL SERVICE		Undistributed by class of service	Municipal street lighting
				Small light and power (retail)	Large light and power (wholesale)		
United States.....	\$1,554,606,537	\$18,708,121	\$435,537,909	\$370,550,255	\$450,472,907	\$134,868,520	\$66,141,258
Geog. divs.:							
New England.....	131,295,049	297,573	43,355,099	34,984,946	37,262,793	5,218,729	7,685,680
Mid. Atlantic.....	498,841,421	983,152	137,180,924	84,908,572	119,520,521	85,279,720	22,337,050
E. N. Central.....	374,672,681	1,635,859	111,165,559	102,058,680	119,210,488	5,489,040	12,479,201
W. N. Central.....	121,131,148	895,315	38,775,197	34,812,684	31,729,523	3,513,308	6,022,893
South Atlantic.....	140,090,731	86,229	28,261,677	29,300,002	59,246,170	12,877,937	6,025,392
E. S. Central.....	50,410,612	10,270	14,398,656	16,256,395	21,319,239	728,797	2,284,720
W. S. Central.....	83,202,936	273,945	24,420,139	23,040,651	27,576,242	793,160	2,955,900
Mountain.....	48,271,584	330,039	12,725,300	16,977,111	13,912,656	601,227	1,912,596
Pacific.....	130,090,375	12,265,206	25,249,418	34,151,211	26,689,225	20,426,002	4,437,626

¹ Includes data for "Street and interurban railways," "Electrified steam-railroad divisions," and "Other service," not distributed by geographic divisions.

TABLE 63.—REVENUE FROM ELECTRIC SERVICE (ULTIMATE CONSUMERS ONLY), BY CLASS OF SERVICE, MUNICIPAL ESTABLISHMENTS, BY GEOGRAPHIC DIVISIONS: 1927

DIVISION	Total ¹	Farm service	Domestic service	Commercial service ²	Undistributed by class of service	Municipal street lighting ³
United States.....	\$112,439,034	\$574,836	\$45,971,385	\$34,102,280	\$19,836,893	\$11,057,638
Geographic divisions:						
New England.....	6,845,321	82,998	2,796,461	2,248,940	1,024,624	652,399
Middle Atlantic.....	6,356,164	22,027	3,084,194	1,049,312	1,502,883	623,151
East North Central.....	28,503,875	224,151	10,741,627	8,150,537	4,553,909	4,653,089
West North Central.....	19,619,180	150,960	7,335,206	4,848,004	6,258,595	1,470,790
South Atlantic.....	13,743,301	62,604	6,510,639	3,164,264	2,933,929	947,180
East South Central.....	3,409,192	5,035	1,858,968	529,016	780,676	222,103
West South Central.....	6,744,331	10,879	3,093,712	1,572,602	1,898,871	166,835
Mountain.....	2,887,573	14,962	1,321,942	879,374	438,737	214,892
Pacific.....	24,330,097	11,220	9,228,716	12,160,231	384,669	2,107,499

¹ Includes data for "Electrified steam-railroad divisions," "Street and interurban railways," and "Other service," not distributed by geographic divisions.

² Includes "Small light and power (retail)" and "Large light and power (wholesale)," not shown separately on schedule.

³ Includes all municipal service, "for which a charge was made by the light and power department."

TABLE 64.—SALARIED EMPLOYEES AND WAGE EARNERS, NUMBER, COMMERCIAL AND MUNICIPAL ESTABLISHMENTS: 1902 TO 1927

CENSUS YEAR	NUMBER OF EMPLOYEES					
	Total		Commercial		Municipal	
	Salaried employees	Wage earners	Salaried employees	Wage earners	Salaried employees	Wage earners
1927.....	101,415	149,605	95,951	¹ 138,796	5,404	10,809
1922.....	55,112	95,650	50,667	¹ 85,438	4,445	10,212
1917.....	35,406	70,135	32,592	² 62,087	2,814	8,048
1912.....	28,063	53,242	23,877	³ 47,515	2,216	5,724
1907.....	12,990	34,642	11,375	30,691	1,615	3,951
1902.....	6,996	23,330	6,046	20,863	950	2,467

¹ Number June 30, 1927, or nearest representative day.

² Number June 30, 1922, or nearest representative day.

³ Number Sept. 29, 1917, or nearest representative day.

⁴ Number Sept. 16, 1912, or nearest representative day.

TABLE 65.—CONSOLIDATED BALANCE SHEET FOR ALL COMMERCIAL COMPANIES REPORTING FOR THE CENSUS OF ELECTRIC LIGHT AND POWER STATIONS, INCLUDING ASSETS AND LIABILITIES OF ALLIED NONELECTRIC INDUSTRIES: 1927

[This table is a duplicate of Table 25, p. 37]

ASSETS AND OTHER DEBITS		LIABILITIES AND OTHER CREDITS	
Kind	Amount	Kind	Amount
Plant and equipment, aggregate.....	\$10,586,826,473	Total capitalization.....	\$10,495,013,752
Specifically reported, total.....	\$9,684,769,194	Capital stock.....	5,095,135,415
Electric light and power.....	\$7,978,234,220	Long-term debt.....	5,309,878,337
Per cent of total specifically reported.....	82.4	Cash investments (for unincorporated companies).....	6,605,185
Electric railway.....	\$482,323,860	Current liabilities.....	671,049,928
Per cent of total specifically reported.....	5.0	Depreciation or retirement reserves.....	700,162,046
Gas.....	\$917,448,140	Other reserves.....	166,548,481
Per cent of total specifically reported.....	9.5	Other credit items.....	277,647,030
All other.....	\$306,762,965	Surplus.....	722,861,668
Per cent of total specifically reported.....	3.2		
Undistributed.....	\$902,057,279	Total liabilities and other credits.....	12,950,388,088
Nonoperating physical property.....	\$34,269,454		
Investments.....	\$622,449,110		
Current assets.....	\$982,201,237		
Unamortized debt discount and expense.....	\$302,044,874		
Other debit items.....	\$411,414,558		
Deficit.....	\$10,582,382		
Total assets and other debits.....	12,950,388,088		

TABLE 66.—CONSOLIDATED BALANCE SHEET FOR MUNICIPAL ESTABLISHMENTS IN CITIES HAVING 25,000 INHABITANTS OR MORE: 1927

ASSETS AND OTHER DEBITS		LIABILITIES AND OTHER CREDITS	
Kind	Amount	Kind	Amount
Plant and equipment.....	\$237,042,453	Cash investments.....	\$19,184,202
Electric light and power.....	234,210,945	Long-term debt.....	135,543,667
All other.....	2,831,508	Current liabilities.....	15,062,730
Nonoperating physical property.....	540,582	Depreciation or retirement reserves.....	37,422,812
Investments.....	6,745,028	Other reserves.....	2,442,735
Current assets.....	37,978,280	Other credit items.....	15,709,180
Unamortized debt discount and expense.....	1,798,436		
Other debit items.....	10,688,204	Surplus.....	79,439,128
Deficit.....	12,601	Total liabilities and other credits.....	294,805,484
Total assets and other debits.....	294,805,484		

TABLE 67.—CONSOLIDATED INCOME, OPERATING REVENUE, AND EXPENSE STATEMENT, FOR COMMERCIAL ESTABLISHMENTS: 1927

[This table is a duplicate of Table 26, p. 37]

I. INCOME FROM ELECTRIC OPERATIONS	
1. Operating revenues, electric:	
Sales of electric current.....	\$1,680,218,664
Miscellaneous electric revenues.....	21,801,419
Total operating revenues, electric.....	\$1,702,020,083

¹ This total includes \$125,812,127 representing revenue received from "Sales for resale."

TABLE 67.—CONSOLIDATED INCOME, OPERATING REVENUE, AND EXPENSE STATEMENT, FOR COMMERCIAL ESTABLISHMENTS: 1927—Continued

[See note at head of this table, p. 79]

I. INCOME FROM ELECTRIC OPERATIONS—Continued	
<i>Revenue deductions</i>	
2. Operating expenses, electric:	
Fuel.....	\$157,912,379
Purchased power.....	143,710,930
Depreciation or retirement expenses, electric property.....	107,615,098
All other operating expenses, electric.....	448,860,272
Uncollectible electric bills.....	6,365,315
Operating taxes, electric.....	150,253,276
Total revenue deductions, electric.....	\$1,014,717,870
Total operating revenues.....	687,302,213
<i>Other income items, electric</i>	
Rents charged or credited to income, electric property (net).....	17,122,829
Amortization of limited-term franchises, rights, etc., for electric property only.....	62,491
Net income from electric operations.....	670,110,893
II. INCOME FROM OTHER THAN ELECTRIC OPERATIONS	
Net income from operation of utilities other than light and power plants (gas, electric railway, water, etc.).....	85,248,300
Nonoperating income (net of debits and credits).....	53,959,112
GROSS INCOME.....	809,324,305
III. DEDUCTIONS FROM GROSS INCOME	
Interest on funded and unfunded debt, amortization of debt discount and expense, and amortization of premium on debt (net).....	\$209,601,993
Other deductions from gross income.....	33,935,287
Total deductions from gross income.....	303,537,280
NET INCOME FOR THE YEAR from all sources.....	505,787,025
IV. APPROPRIATIONS DURING THE YEAR FROM CURRENT AND PREVIOUS YEARS' SURPLUS	
	Total
For dividends on stocks.....	\$ 338,238,580
For depreciation or retirement reserve.....	37,616,230
Total appropriations from surplus.....	375,854,810
¹ This item represents a rate of 6.6 per cent, based on the total of \$5,095,135,415 for capital stocks. (See Table 65, p. 79.)	

TABLE 68.—CONSOLIDATED INCOME, OPERATING REVENUE, AND EXPENSE STATEMENT, FOR MUNICIPAL ESTABLISHMENTS IN CITIES HAVING 25,000 INHABITANTS OR MORE: 1927

I. INCOME FROM ELECTRIC OPERATIONS	
1. Operating revenues, electric:	
Sales of electric current.....	\$51,032,219
Miscellaneous electric revenues.....	383,706
Total operating revenues, electric.....	\$51,465,925
<i>Revenue deductions</i>	
2. Operating expenses, electric:	
Fuel.....	4,420,114
Purchased power.....	4,185,589
Depreciation or retirement expenses, electric property.....	5,537,220
All other operating expenses, electric.....	20,010,430
Uncollectible electric bills.....	162,987
Operating taxes, electric.....	570,934
Total revenue deductions, electric.....	34,887,274
Total operating revenues.....	16,578,651
<i>Other income items, electric</i>	
Rents charged or credited to income, electric property (net).....	4,838
Amortization of limited-term franchises, rights, etc.—for electric property only.....	361,100
Net income from electric operations.....	16,223,389
¹ This total includes \$9,030,668 representing revenue received from "Sales for resale."	

TABLE 68.—CONSOLIDATED INCOME, OPERATING REVENUE, AND EXPENSE STATEMENT, FOR MUNICIPAL ESTABLISHMENTS IN CITIES HAVING 25,000 INHABITANTS OR MORE: 1927—Continued.

II. INCOME FROM OTHER THAN ELECTRIC OPERATIONS		
Net income from operation of utilities other than light and power plants (gas, electric railway, water, etc.).....	\$1,078,053	
Nonoperating income (net of debits and credits).....	202,861	
GROSS INCOME.....	17,503,803	
III. DEDUCTIONS FROM GROSS INCOME		
Interest on funded and unfunded debt, amortization of debt discount and expense, and amortization of premium on debt (net).....	\$5,237,621	
Other deductions from gross income.....	375,815	
Total deductions from gross income.....	5,613,436	
NET INCOME FOR THE YEAR from all sources.....	11,889,867	
IV. APPROPRIATIONS DURING THE YEAR FROM CURRENT AND PREVIOUS YEARS' SURPLUS		
For dividends on stocks.....	Total	
For depreciation or retirement reserve.....	Electric property Other properties	
	\$1,711,834	1,711,834

TABLE 69.—SUMMARY, ALL MUNICIPAL ESTABLISHMENTS AND MUNICIPAL ESTABLISHMENTS IN CITIES HAVING 25,000 INHABITANTS OR MORE, WITH PER CENT OF TOTAL: 1927

	Total, all municipal establishments	MUNICIPAL ESTABLISHMENTS IN CITIES HAVING 25,000 INHABITANTS OR MORE	
		Amount	Per cent of total
Number of establishments.....	2,108	54	2.5
Generating all or part of current.....	1,113	48	4.3
Purchasing all current.....	1,085	6	0.6
Number of separate generating stations.....	1,212	65	5.4
Value of plant and equipment.....	\$417,166,857	\$234,210,945	56.1
Total revenues.....		\$52,746,830	
Electric service.....	\$122,436,820	\$51,082,219	41.7
All other sources.....	(1)	² \$1,664,620	
Total expenses.....	(1)	³ \$40,600,710	
Total number of persons employed.....	16,273	6,756	35.4
Prime movers:			
Number of units.....	2,883	234	8.1
Rated capacity, horsepower.....	2,048,722	1,097,021	58.5
Generators:			
Number.....	2,904	227	7.8
Rated capacity, kilowatts.....	1,428,034	777,833	54.5
Output of current, kilowatt hours, total.....	4,529,871,113	2,733,043,318	60.3
Generated.....	3,379,538,472	2,249,435,064	66.6
Purchased.....	1,150,332,641	483,007,654	42.0
Current sold, kilowatt-hours, total.....	3,666,664,809	2,256,630,591	61.5
To ultimate consumers.....	3,075,539,772	1,704,030,017	55.4
For resale.....	591,125,037	552,600,574	93.5
Number of customers.....	2,128,868	695,510	32.7

¹ Not called for on municipal schedule. Special inquiry made for cities having 25,000 or more inhabitants.
² Miscellaneous electric revenues, net income from utilities other than electric, and nonoperating income. Does not include amount of rents credited to income nor amortization of franchises (called for as net items on the 1927 schedule).
³ Operating expenses, interest, and other deductions from gross income. Does not include amount of rent payments for lease of plant, equipment, etc.

TECHNICAL DEVELOPMENTS

By GEORGE F. WITTIG

In the census reports for 1902, 1907, and 1912 the development of the electric light and power industry up to the time of each report is reviewed. Subsequent developments have included not only a great increase in its magnitude and marked changes in the organization of the industry but also important changes in its relation to the economic, industrial, and social structure of the nation, as well as important technical advances.

A brief summary of what has taken place during the fifteen-year period from 1912 to 1927 must confine itself to broad outlines, and at that must involve many omissions. In view of the general use of electric devices in the home and in industry, those aspects which are now a matter of common knowledge can well be passed over lightly, attention being directed rather to those features with which the general reader may be less familiar.

PRIME MOVERS AND GENERATORS

General.—The most obvious change that has come about in power production has been the rapidly increasing concentration of power, not for the sake of mere magnitude but with a view to greater economies. Boilers, turbines, water wheels, generators, transformers, and the power stations themselves have in the course of 15 years increased greatly in rating.

A parallel change, with the same objective, has been the rise in steam pressures and steam temperatures used, and, toward the end of the period, the experimental introduction of a second working fluid in an independent cycle supplementing that of the steam. By these successive innovations, the quantity of energy usefully converted into electrical form per unit of fuel consumed has grown steadily larger. The upshot has been that while the output from fuel-burning plants has multiplied several-fold, as the statistics indicate, the consumption of fuel, notably of coal, has advanced in much smaller ratio.

Specific data on this point covering the entire period under review are not available; there is clear evidence, however, that if the efficiency in 1927 had been merely the same as in 1912, at least twice as much coal would have been required as was actually burned—more probably two and a half to three times as much. The conservation of one of our national resources, coal, thus brought about during the intervening period runs into hundreds of millions of tons.

Contemporaneously, greater refinement of design has resulted also in the more efficient utilization of water power, but here the opportunity for improvement was more restricted, as the efficiency had already approached much closer to the theoretical maximum than in the case of processes involving combustion.

A third change, in harmony with the trend of American industry generally, has been the increasing mechanization of the power plant. Where formerly the firing of the boilers had been a matter of human muscle, and the tossing of coal into the furnaces by the shovelful had called for exhausting labor on the part of a host of firemen, the modern power plant uses mechanical stokers, or pulverized fuel is blown in by an air blast. The rate of feed, the adjustment of the draft, and other operations are performed automatically. The human function, no

longer that of a laborer, has become the supervisory one of insuring the proper operation of the apparatus that performs the physical work.

Transition from the steam engine to the turbines.—In 1912 the steam turbine was still competing with the reciprocating engine as a prime mover for power plants; turbines of 20,000 kilowatts had, however, become an accomplished fact; no power plant had a reciprocating engine approaching this rating. The change was rapid. By the end of the year the turbine was considered the normal type. The year 1912 may therefore be considered to mark, as well as such gradual changes can be marked, the transition to the newer form of prime mover.

For a time the two devices were in numerous instances operated in combination; the steam was expanded in a reciprocating engine, approximately to atmospheric pressure, was then additionally expanded in a "low-pressure" turbine, there giving up more of its thermal energy, and was finally exhausted into a condenser where a fairly high vacuum was maintained. The condensate was pumped back into the boiler in the usual manner. Instances of parallel operation were, of course, common; to increase the capacity of a station, room could often be found for a turbine side by side with the existing engines.

The earlier turbines were largely of the vertical-shaft type. About this same time, however, horizontal machines were being developed, and they eventually became the accepted form. The huge modern machines, that constitute so striking a triumph of engineering skill, are of this type exclusively.

A few examples will illustrate the growth in size. A complete list would constitute a catalogue of the machinery in dozens of great power plants, with a capacity aggregating millions of kilowatts.

By 1914 the maximum turbine rating was 35,000 kilowatts, and units of 50,000 kilowatts were in contemplation but not yet constructed. The reciprocating engine was by no means obsolete, for mixed-pressure turbine operation was attracting increased attention, and turbines were operated either singly on high-pressure steam or in combination with a reciprocating engine on exhaust steam. At this time also there was a growing tendency toward the automatic operation or control of the draft, damper, water feed, and fuel supply.

In 1921 a second 70,000-kilovolt-ampere compound turbine was installed in a plant in Pittsburgh. Machines installed in 1926 and 1927 include two 60,000-kilowatt (equivalent to 80,000 horsepower) single-cylinder units in New York and a similar one in Buffalo, which shows how much power was now being concentrated on a single shaft. Other large machines were: A 52,000-kilowatt tandem compound unit in Chicago; and one of 80,000 kilowatts, cross-compound, i. e., with two shafts and two electric generators, in Brooklyn. The largest under construction¹ was one for a station in Indiana, near Chicago, consisting of three elements—one high-pressure and two low-pressure turbines—driving three main generators. The combined rating (including that of two service generators) is 208,000 kilowatts. Also under construction in 1927 were units of 165,000 kilowatts, 160,000 kilowatts, 104,000 kilowatts, and others.

In contrast with these magnitudes, the following table, published in 1913, shows the maximum rating in certain earlier years:

YEAR	MAXIMUM RATING IN KILOWATTS	
	At 3,600 r. p. m. [sic]	At 1,800 r. p. m. [sic]
1904.....	400	1,500
1909.....	2,500	10,000
1912.....	5,000	20,000

It was put into operation in the summer of 1929.

Steam boilers.—Changes in steam turbines have entailed complementary changes in boilers, in the direction of greater size, higher steam pressures, and higher temperatures. Two hundred pounds per square inch had formerly been considered virtually the upper limit, but in about 1915 plans were made which contemplated the use of pressures up to 600 or 700 pounds per square inch. At the same time the rate of evaporation was being forced up, so that it became common practice to operate boilers at several times their rating assigned to them on the old basis, namely, the area of the heating surface. In 1922, a 35,000-kilowatt turbine, to be operated on steam at 500 pounds per square inch and a temperature of 725 degrees F., was being built for the American Gas & Electric Company. These values for steam pressure and temperature were reported at that time as being thus far unapproached. At the same period it was stated that boilers for use up to 600 pounds per square inch were on order.

In 1924 a steam pressure of 550 pounds per square inch was adopted for stations in Philadelphia, in Chicago, and elsewhere. The Weymouth plant in Boston inaugurated the use of a pressure of 1,200 pounds per square inch. By 1927 a 7,000-kilowatt turbine in Milwaukee and one of 3,000 kilowatts in Boston were being operated at a pressure of 1,200 pounds per square inch. At the same date steam temperatures up to 750° F. were in use.

Steam plants.—The huge turbines and generators to which reference has been made are constituents of correspondingly vast power plants, each comprising a number of such units. The steady growth of the electric power load has necessitated a program of incessant building to meet its ever-growing demands.

Again a few individual illustrations, confined to the immediate past, must suffice to exemplify what has been going on throughout the land, on a scale scarcely less striking.

In 1926 the "Lake Shore" plant at Cleveland, Ohio, with a rating of 288,000 kilowatts and an output exceeding 1,000,000,000 kilowatt-hours annually, was stated to be the largest steam-electric plant in the United States. By the end of 1927 the Crawford Avenue station in Chicago had a rating of 325,000 kilowatts. Almost equal in magnitude to the Cleveland plant, the Hell Gate station in New York City had 285,000 kilowatts in operation in 1927, and had on order two 160,000-kilowatt units in addition. Before the close of 1929 the installing of the latter had increased the station rating to 605,000 kilowatts, a capacity unsurpassed anywhere in the world. In the same class may be listed the Hudson Avenue plant in Brooklyn; its 230,000 kilowatts of 1927 grew to 340,000 kilowatts during 1928 by the addition of a single power unit.

Great as they are, none of these plants is the sole source of supply to the city it serves. Each is only one of several, perhaps of nearly equal magnitude.

Progress in plant practice.—Among other features that have gradually entered to a greater or less extent into steam-plant practice are the following:

The cooling of the furnace walls by means of air or water; the preheating of the air supply to the furnace; the use of high-refractory brick around the fuel and clinker lines of the furnace side walls; the reheating of the steam at some point in its passage through the turbine; the bleeding of steam from the turbine at a certain stage in its expansion and the utilization of its heat in another stage of the process; the burning of pulverized coal.

The progress in the period under review can scarcely be better summarized than by quoting from a recently published annual report of an operating company. The company is one known to be progressive and to have kept pace with the developments of successive years.

The report refers to two plants, which may be designated as A and B. Construction on plant A was started in 1913 and on plant B in 1927, and each went into operation within about two years. Plant B had recently gone into operation

when this was written. To quote: "Plant B uses a steam pressure almost twice that used by A; operates with higher superheat of steam; has generators each two and one-half times as large as the A generators of 15 years ago; requires about 25 per cent less coal for a given output; and, finally, requires half as many man-hours for a given daily output as does the older plant." The report further points out that these are only some of the factors which permit electric service to be sold now at lower prices than obtained 15 years ago.

The mercury-vapor turbine.—The combination of a mercury-vapor turbine and a steam turbine in the plant of the Hartford Electric Light Co. appears to be the first commercial application of a binary cycle in the production of power from fuel. Mercury is evaporated in a special boiler, whence it passes to the turbine, then to the condenser, and finally by gravity back to the boiler. These three elements are electrically welded together. The weight of the mercury column, determined by the difference in elevation between condenser and boiler, obviates the need of a pump. In the condenser the heat of the mercury vapor is imparted to water through the walls of the tubes containing the vapor. The mercury condenser is, therefore, at the same time a steam boiler. From this source a steam turbine is driven in the usual way.

An experimental installation, having a maximum capacity of about 2,000 kilowatts, was made in the fall of 1923 and was used for a number of years for purposes of research, being redesigned during that time to incorporate improvements. The scheme was proposed and developed by W. L. R. Emmet, consulting engineer of the General Electric Co. By the end of 1927 a larger equipment was under construction, with a mercury unit rated at 10,000 kilowatts. It was put into operation in November, 1928, but at that time was still on test, further changes being made subsequently. According to the design data, this mercury turbine was to have a speed of 720 revolutions per minute; 1,150,000 pounds of mercury was to be vaporized per hour at 884° F., 70 pounds gauge pressure; 28-inch vacuum in the mercury condenser; mercury exhaust at 458° F.

The steam produced in the mercury condenser is additionally heated to a temperature of 700° F., 350 pounds gauge pressure, and supplied to the steam turbine in the usual way. The computed efficiency of the mercury-vapor-steam combination is 9,400 B. t. u. per kilowatt-hour, whereas with steam alone the production of a kilowatt-hour from 14,000 B. t. u. is excellent. The former figure is equivalent to a kilowatt-hour for about eight-tenths of a pound of coal—considerably less than half the average fuel consumption per kilowatt-hour of electric light and power plants in the United States.

The internal-combustion engine.—The chief field for the internal-combustion engine in the electrical industry is in the smaller communities not served by transmission lines. Its use has also been advocated as a reserve, for instance, to meet deficiencies in water power or to meet occasional peak-load demands, but in view of the relatively small sizes in which this type of engine has thus far been developed, and the magnitude of the inter-connected systems which it might be used to supplement, the latter application is not at present of importance. Most of the horsepower in this category is in machines of the Diesel type, generally in units of a few hundred to a few thousand horsepower, and occasionally larger.

The use of the internal-combustion engine has been increasing at a fairly rapid rate, but it still supplies only a very small proportion of the total horsepower in the industry—1.5 per cent in 1927. As early as 1914 it was reported that its fuel consumption per kilowatt-hour at full load and under favorable conditions had been brought down to four-tenths of a pound of heavy oil.

Water power.—The first two decades of the century witnessed important technical advances in water-power utilization. In 1914 it was stated that the efficiency of hydroturbines had increased 10 to 15 per cent during the preceding

10 years. Improvements in hydraulic and electrical machinery had led to the greater utilization of the available power; with installed efficiencies as high as 85 per cent for water wheels, 97 per cent for generators, and 98 per cent for stationary transformers, a very large proportion of the energy in the water could be put on the transmission lines.

Even this performance was not the obtainable maximum at that time; in one case, at least, a turbine efficiency of 93.7 per cent at full load—the highest on record—had been obtained, giving 88 per cent efficiency from water to bus bars.

The increasing development of streams having occasional heavy floods brought other problems to be solved. During these freshets the restricted channel below the dam usually causes the water level to rise more in that part of the river than it does in the pool above the dam. Thus the available head is decreased during the period of most abundant water. At Hale's Bar, on the Tennessee River, heads varying between 19 and 40 feet are met by using three turbines on the generator shaft, two when the head is fairly high and three on the lowest head, during flood.

Another method of overcoming the same difficulty is in use at the Mitchell Dam of the Alabama Power Co., started December 19, 1921, and put into operation March 26, 1923. In this installation, by the employment of a "back-water suppressor," the rush of waste water over the dam is used to assist in the removal of the tail water, in effect lowering the level in the tail race near the turbine and thus increasing the effective head.

These specific instances illustrate a general trend. Hydraulic efficiency has been increased not only by turbine design but also by the guiding of the water outside the turbine itself, notably in the draft tube—for example, by conical structures extending up into the latter.

Automatic hydroelectric plants.—The economic development of certain small waterpower sites has been rendered possible by the introduction of automatic or remote control. The expense of having an attendant continuously on duty is thus avoided. These plants are designed to start or stop with variations in the available water supply, to connect and disconnect themselves to and from the transmission line, and to meet such contingencies as line disturbances or failure of any part of the mechanism. In addition, they are usually arranged to be started or stopped by an operator in a distant station.

Examples of hydroelectric development.—Some typical or striking developments of the period under review are as follows:

The Big Creek development of the Pacific Light & Power Co., of Los Angeles, Calif., was inaugurated in 1913. It consists of two plants, both for very high hydraulic head, 1,900 feet and 1,780 feet, respectively.

A 14,000-horsepower reaction turbine was installed about 1920 for the Mount Shasta Power Corporation. It was designed for a head of 421 feet, the highest head for turbines (as distinguished from wheels) thus far built.

Two vertical-shaft Francis turbines for a head of 806 feet, the highest head up to that time for that type, were installed shortly afterwards in the plant known as "Kern River No. 3" of the Southern California Edison Co.

Two of the largest impulse wheels in the world, with a rating of 30,000 horsepower each on a 1,008-foot head, were installed in the Caribou plant of the Great Western Power Co. This achievement was exceeded the next year (1922) by the installation of two 44,000-horsepower impulse wheels for a head of 2,495 feet in the Balch powerhouse of the San Joaquin Light & Power Corporation in California.

Illustrative of the ruggedness of hydroelectric machinery is the statement published in 1923 that a vertical reaction turbine of 25,000 horsepower at the Kern River plant, with a head of 810 feet, had run almost continuously for 18 months.

Low-head plants of great magnitude and requiring huge volumes of water, installed during the period under review, include one on the Mississippi River at Keokuk (1913), the head being about 40 feet, one on the Tennessee River at Muscle Shoals, constructed during the war, and one on the lower Susquehanna River at Conowingo, Md., still under construction in 1927. The last-named is designed for an ultimate capacity exceeding 500,000 horsepower. Its 54,000-horsepower turbines are unprecedented in physical dimensions, according to the builders. The runners are 17 feet 9 inches in the largest diameter and weigh about 100 tons each. The operating speed is 31.8 revolutions per minute under a normal head of 89 feet. By the early part of 1928 two of these units had been installed, and several others were under construction. In all, 11 are to be used eventually.

Generators.—The changes in generators can be treated more briefly than those in turbines, with which they are necessarily correlated. They include the decreased importance of direct-current and the increased importance of alternating-current machinery, a change from low to high speed, corresponding to the change from reciprocating engines to turbines, a marked increase in size, special provisions for cooling and for reducing the fire hazard, and the decreasing importance of 25-cycle apparatus, accompanied by a great increase in that of 60 cycles.

The gradual elimination of direct-current generators was a necessary consequence of the increase in concentration of power and in high-tension transmission and interconnection.

Direct-current generators are built with a stationary field-magnet system, within which another member, called the armature, is made to revolve by an external source of power. In the armature is induced the electromotive force that sends current through the working circuit, in general consisting of the devices to be electrically operated. For technical reasons the relationship is usually reversed in the construction of alternating-current generators. The armature is made the outer stationary member; within it the field magnets are made to revolve, their poles projecting outwards.

The introduction of the steam turbine involved radical changes in design. To generate alternating current of 60 cycles it is necessary that 60 pairs of poles per second shall pass a given conductor on the armature. With low speeds this necessitated the construction of machines having a large number of poles, for which a structure of large diameter was necessary.

For large reciprocating engines 100 revolutions per minute is a relatively high speed. Large steam turbines, on the other hand, operate at a speed often as high as 1,800 revolutions per minute, and in the case of units somewhat smaller but still having a rating of several thousand kilowatts, a speed of 3,600 revolutions per minute is not uncommon. A speed of 1,800 revolutions per minute calls for only two pairs of poles (four poles). To avoid excessive centrifugal pull, the rotating parts must be kept relatively small in diameter, and consequently must be of greater length for a given output. The earlier type resembled a large wheel with the working part readily accessible; the new form is a completely inclosed horizontal cylinder.

Hydraulic turbines rotate in a much lower range of speeds than those using steam. Consequently their generators are much larger both in diameter and otherwise than those of corresponding ratings driven by steam turbines. The vertical-shaft arrangement is generally used.

Generator and turbine ratings generally correspond. There are no generators, however, with a rating equal to that of the very largest turbines, because these latter have more than one shaft, each driving a separate generator.

Cooling and fire prevention.—The increasing compactness of steam turbo-generators has necessitated special provisions for cooling them. To carry away the heat generated by the unavoidable electrical and magnetic losses, methods of forced ventilation were developed, the entire machine being enclosed and a

current of cold air being blown through it. Closed-circuit ventilation and water sprays for cooling the air were in use by 1922. Lately the use of hydrogen instead of air has been under consideration as a better medium for removing the heat. With completely inclosed cooling systems provision can be made for the injection and circulation of inert gases to combat fires if the insulation becomes ignited.

TRANSMISSION AND DISTRIBUTION

Summary of changes.—In the early days of electric lighting generating stations had to be close to their loads. With the low-voltage direct-current systems then in use, long-distance transmission was not feasible. The introduction of alternating current made high-voltage transmission and low-voltage distribution possible. The distance over which power could be economically transmitted was thereby increased, and the power station could be located at a considerable distance from the point of consumption.

This had two important consequences: Waterpower sites remote from centers of population could be utilized; for steam plants sites could be selected that were advantageous as to fuel supply and abundance of cooling water. The latter is particularly important for steam-turbine operation.

High-tension transmission had attained considerable magnitude before 1912. Since that time the maximum of transmission voltage has been raised and many new lines have been built. Thus great systems have grown up, the energy from numerous power plants flowing into a network of high-voltage lines by means of which it is carried into numerous centers of distribution throughout the area served and there "stepped down" to a lower voltage for local distribution.

Frequently these systems are interconnected with adjacent systems. When this is done it is possible to meet a deficiency of power (due to scarcity of water for example) in one area by transmission from a distance, frequently from another State.

Other changes during the fifteen-year period include an increase in the size of transformers, the development of large mercury-arc rectifiers for converting alternating to direct current, and, very recently, important advances in transmission by means of underground cable.

Transmission voltages.—In 1911 the maximum transmission voltage had reached 140,000; 110,000 volts was coming into use as a standard, whereas the standard had previously been 66,000 volts. This was the situation at the beginning of the 15-year period of this review. In the latter part of 1913 transmission at 135,000 volts was begun over the first of two 240-mile transmission lines of the Big Creek development of the Pacific Light & Power Co., of Los Angeles. The lines were designed for parallel operation at 150,000 volts and the transmission of 120,000 kilowatts. This was by far the world's highest operated voltage and the longest straightaway transmission yet undertaken. Meanwhile three or four systems in the Southern Appalachian region were using 100,000 to 110,000 volts, and lines in Connecticut were being built for 120,000 volts. These high voltages became possible chiefly because of the introduction of the suspension insulator. By the beginning of 1916 interconnection had been increasing so rapidly that systems existed which comprised nearly 1,000 miles of high-tension lines, along which power plants and load points were distributed. The most noteworthy high-tension lines undertaken in 1922 were those of the Southern California Edison Co. and the Pacific Gas & Electric Co., in California, for operation at 220,000 volts. To the same period belongs a 165,000-volt line for the Great Western Power Co., also in California.

Up to the present time 220,000 remains the maximum operating voltage, though the mileage at this high voltage has been greatly extended not only in California but elsewhere.

Cables.—The operating voltage of underground and underwater cable has been gradually increasing. The most recent development is the oil-filled cable, which has made possible in underground urban distribution voltages approaching those of the high-tension lines used in overhead transmission. Lines of 132,000 volts, using single-conductor, lead-covered, oil-filled cable, have recently been put into service in New York and Chicago.

Substations.—The most notable innovation in this feature of the industry has been the development of outdoor substations and switching stations. In 1913 this type was still new. Previously it had been considered essential to put the apparatus indoors. At first tried out in those parts of the country having a mild climate, the use of the outdoors substation subsequently became general. Its most conspicuous advantage is the wide spacing possible on the high-tension side without the expense of a large building.

Conversion from alternating to direct current.—Though alternating current has replaced direct-current machinery in many fields of power application, there are some in which direct current still finds wide application. One of these is the operation of street railways. Usually the conversion of alternating to direct current takes place by means of motor-generator sets or rotary converters. The latter were readily built for alternating current at 25 cycles, but in the beginning difficulties were encountered in designing them for 60 cycles. Early in the period under review these difficulties were overcome, and the converters for street-railway operation could take their energy from the 60-cycle light and power circuits.

For the same purpose a device operating on an entirely different principle has lately been introduced. The mercury-arc rectifier has been known for many years. With a glass chamber it has found wide application for such purposes as the charging of storage batteries from alternating-current circuits. These units were too small for general power purposes, but eventually a form was developed in which the chamber was of steel instead of glass. This greatly increased the possible output, and made the device suitable for supplying current at 600 to 1,500 volts for railway operation. Installations on a commercial scale were begun in Europe in 1912, and then only in capacities of 100 kilowatts, but the first installation in America came a number of years later.

By the end of 1927 mercury-arc rectifiers up to 750 kilowatts in rating were being used in this country, and at least one such unit rated at 1,000 kilowatts, 600 volts direct current, was in operation in the vicinity of Chicago. Subsequently two 750-kilowatt rectifiers were installed in Portland, Oreg., for railway operation, converting 11,000-volt, 3-phase, 60-cycle current to 1,350-volt direct current.

LIGHTING EQUIPMENT

As a light source the tungsten incandescent lamp has virtually superseded all other forms of electric illumination. Devices for redirecting the light, in the form of shades and reflectors of various types, have been increasingly developed and have come into general use. Very recently the neon light has been introduced, its use being confined chiefly to purposes of display and advertising.

The tungsten lamp.—The development of the gas-filled tungsten lamp was announced in 1913, when its manufacture on a commercial scale began. At first it was made only in large sizes—750 and 1,000 watts—for multiple operation. Prior to that time the carbon, the tantalum, and the tungsten filament had been sealed into a vacuum. The improvement consisted in filling the bulb with an inert gas. This reduced the tendency of the filament to evaporate and permitted the operation of the lamp at a somewhat higher temperature. A larger proportion

of the radiation was within the visible spectrum; the efficiency of the lamp was therefore increased, and the light produced was more nearly white. The carbon filament lamp had required from 3.1 to 3.5 watts per mean horizontal candle power, but the largest size of the new lamp required only 0.5 watt for the same amount of radiation. For replacing the arc lamp in projectors, tungsten lamps are made with helical filaments compactly arranged so that a large quantity of light is emitted from a comparatively small area.

Recently a process has come into use for etching the inside surface of lamp bulbs. The light from the filament is thereby diffused while the outer surface of the bulb is smooth and easily kept clean.

Arc lamps.—The carbon-arc lamp was gradually superseded by the type known as the "flame-arc." Unlike the former, this emitted more light from the incandescent vapor between the electrodes than from the tips of the electrode themselves. The color of the light was determined by the metallic compound in the electrodes.

For street-lighting purposes the magnetite arc lamp was widely used for a number of years. Its name was derived from that of the iron oxide used in the electrode. It gave a brilliant white light and required infrequent trimming compared with its predecessor, the carbon arc. The light source itself was generally inclosed in a diffusing globe. The magnetite lamp has been generally superseded by the tungsten lamp, operated singly or in cluster, usually with diffusing glassware, mounted on a standard close to the curb line. The earlier type (magnetite) has, however, by no means been abandoned. To the casual observer little difference is seen between it and the newer tungsten street lamp which it resembles as to the color of the light and which it approaches in steadiness although it shows an occasional flicker.

Light-controlling devices.—The general introduction of the rugged drawn wire-filament tungsten lamp made possible for the first time in human history an appreciation of the esthetic possibilities of illumination. It now made it possible to go far beyond the earlier requirement of providing enough light by which to see during the hours of darkness. It led to far-reaching researches relating to vision, from which, in turn, sprang many technical developments.

It was an early observation that a powerful, exposed light source in the field of vision was objectionable. Hence various forms of partly-inclosing reflectors were devised for redirecting the light, prominent among which were those of mirrored or prismatic glass. Then came "indirect" lighting, whereby the rays were caused to fall first upon a large diffusing surface, like a ceiling, which served as the source of general illumination.

In the lighting of industrial establishments, diffusing bowls of enameled steel with or without diffusing glassware, have come into extensive use. Many other forms of lighting equipment have been devised to meet specific conditions—local or general illumination, high or low intensity, utilitarian or artistic purpose. Some are suitable for controlling the light from small lamps; others, that from lamps rated at several thousand watts.

Flood lighting.—With tungsten lamps, outdoor lighting on a large scale has become possible. Monuments and the façades of buildings are illuminated by means of groups of flood lights, usually concealed from observation. Each flood light consists of a powerful lamp mounted before an accurately shaped concave reflector, so that a concentrated beam of light is emitted, the whole being inclosed in a weather-proof metallic casing.

Mercury-arc lamps are still in use, particularly for photographic purposes, but no radical changes have been made. In motion-picture studios they are arranged in batteries, equivalent to artificial windows.

Neon lamps.—It has long been known that a gas at low pressure can be made to emit light by sending an electric discharge through it. An application of this knowledge was made early in the present century by using carbon dioxide in long glass tubes for general illumination, but it was not widely employed. The arrival of the tungsten lamp caused it to be abandoned for practical purposes.

The idea of obtaining "cold light" was, however, never entirely dropped. Further researches, combined with the discovery of neon as one of the constituents of the atmosphere and the development of methods for obtaining it in a pure state, have in recent years brought into existence two distinct types of lamps utilizing this gas. One is rapidly coming into use for sign lighting. The gas, at a suitably low pressure, is inclosed in long glass tubes, usually 15 millimeters or less in diameter, formed into letters or other shapes. For 50 feet of tubing, 5,000 to 10,000 volts are required, with a current of 25 milliamperes. The reddish color stands out conspicuously, even in daylight. Other colors are obtainable by the use of other gases. As a rule, the usual house current, alternating, at 110 or 115 volts, is brought to the sign terminal. Within the sign the current passes through a step-up transformer to develop the necessary voltage.

The other form of neon lamp is made for direct connection to the ordinary lighting circuit. At this low voltage (about 115) the electrodes have to be very close together. The lamp, which operates with a very small consumption of current, glows with a dim reddish light, too feeble for purposes of ordinary illumination but useful as a marker. Its employment has been suggested for such purposes as to indicate the location of a switch.

DIVERSIFICATION OF USES

Residential, commercial, and industrial uses of electric current have increased in variety and have greatly increased in magnitude, not so much by radical innovations as by the normal extension of methods and principles that have long been known. In the household there has been a more extensive use of a multiplicity of appliances: Flatirons, vacuum cleaners, electrically-operated sewing machines, toasters, coffee percolators, washing machines, heating pads, ironing machines, and numerous others. Recent years have added motor-driven oil burners for residential heating, electrically operated refrigerators, and electric ranges, while electric water heaters are being introduced which consume current at a low rate continuously or during predetermined periods, the heat being stored in the water within an insulated tank.

In industrial establishments the electric motor has largely eliminated belts and line shafting, especially since it became the practice for each machine to have its own motor.

In detail, the industrial applications are almost as numerous as the industrial processes themselves, but standard motors are generally used for actuating the mechanical processes. Methods of automatic and remote control have been greatly extended.

Electric heating.—Because of its cleanness and the refinement possible in temperature control, electric heating has found wide application; for example, in ovens for enameling metal parts.

Electrometallurgical processes are carried on by means of arc and induction furnaces for melting metals and for producing alloys. For small melts, particularly of precious metals, the high-frequency induction furnace has become available. With it, operations can be carried on in a controlled atmosphere, high-frequency current being induced in the charge by transformer action from similar current supplied to a primary winding and without the use of an iron core. The primary current is, in turn, obtained from an ordinary power current by way of a suitable converting device—e. g., a motor-driven high-frequency generator.

Electrically generated steam.—In localities where water power is cheap and fuel expensive, steam for industrial purposes is being generated from surplus hydroelectric energy. Thus it has recently been reported that one company is producing surplus hydro energy worth 3.02 to 3.82 mills per kilowatt-hour for steam heating. This electrically generated steam has also been found economical in the pulp and paper industry, which very commonly utilizes water power.



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