Estimates of Electricity Sales by Utilities, by County and Class of Service, Oklahoma, 1950 and 1960

by
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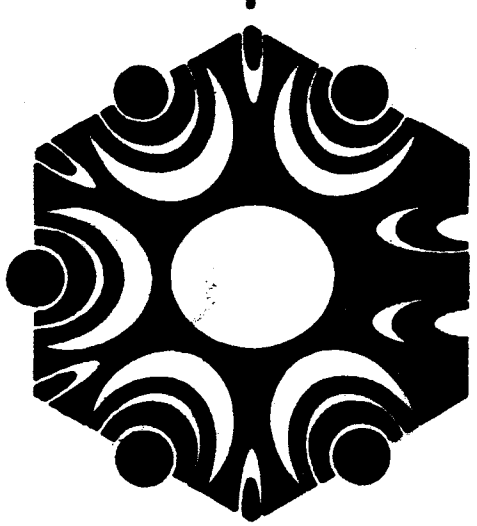

RESEARCH FOUNDATION

OKLAHOMA STATE UNIVERSITY

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PREFACE

The investigator has gained invaluable experience working on this project, and wishes to thank the Midwest Research Institute and Professors Nelson Peach and Richard Poole for the opportunity to participate in the stimulating environment of the Six-State Study.

This work would not have been possible without the considerable assistance received from various individuals associated with the electric utility industry. Both of the state's major investor-owned utilities went well beyond the dictates of public relations by providing internal records necessary to break out their sales on a county basis. Messrs. J. G. Cartwright and J. W. Magann of Oklahoma Gas & Electric Company, and Messrs. W. B. Carpenter and A. R. Sheesly of Public Service Company of Oklahoma provided assistance throughout the study. Equally cooperative were the state's electric cooperatives. Full coverage of the REA-financed cooperatives was obtained with the assistance of Mr. Czar Langston, General Manager of the Oklahoma Association of Rural Electric Cooperatives. Special thanks are due to Mr. D. V. Rains of the Central Rural Electric Cooperative of Stillwater for permitting the investigator to experiment with internal records. Mr. Leonard B. Young, Regional Engineer of the Federal Power Commission at Fort Worth, Texas, provided important information concerning the Commission's statistical activities. Charles Gibson, a graduate student at Oklahoma State University, assisted with the computations. Harold Warren, also a graduate student at Oklahoma State, worked on the project throughout the summer of 1963. Whatever merit the study may have is in large part due to the tireless efforts of Mr. Warren.

Responsibility for any errors must of course rest upon the principal investigator.

Larkin Warner

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PART I

INTRODUCTION

It is reasonable to hypothesize that within a state or multi-state area, electricity consumption is a good indicator of levels of economic activity. Although vast amounts of economic and social data are available on a county basis, no agency collects information on electricity consumption for such small geographic areas.[1] The objective of this study is to determine the extent to which it is possible to identify kilowatt-hour consumption on a county-by-county basis, so that data can be aggregated flexibly to meet the varigated requirements of regional economic analysis. This report describes in detail the procedures and results of this experimental exercise in data collection.

The report is divided into five main parts. This introductory section delineates the scope of the study, and presents a miscellany of background information relating to consumption units, consumer classes, and sources of published electricity data. In Part II, the statistical results showing county-by-county consumption for Oklahoma in 1950 and 1960 are presented and examined to identify changes in power markets and electricity-supplying industry structure. Part III provides an illustration of the economic revelance of the developed county electricity consumption data. In the fourth part, a detailed description of the collection and compilation of the data

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1 In connection with its index of industrial production, the Federal Reserve System is attempting to use industrial electricity consumption as a key indicator of regional industrial activity. This work focuses on Federal Reserve districts, or on large metropolitan areas. See "Electric Power as a Regional Economic Indicator," Economic Review of the Federal Reserve Bank of Cleveland, (September, 1964), p. 10.

will enable users to be fully aware of its strengths and weaknesses. The concluding part evaluates briefly the type of data collection effort undertaken in this study.

Scope of Study

It was apparent from the beginning that any attempt to gather annual electricity consumption data for county units was going to be a considerable task. Thus it was determined to attempt to get only two years' data for the state of Oklahoma. In retrospect, this appeared wise, because it required the work of two persons for most of one summer. The years 1950 and 1960 were chosen because they coincided with censuses of population and were sufficiently far apart to indicate clear-cut growth patterns.

Units of Measurement

Implicit in the introductory remarks was the fact that kilowatt-hour consumption is the basic unit used in this study. This unit of measure identifies in the most direct manner the location of electric power use. Other units of measurement are also relevant to describing the operations of the electric utility industry. These include generating capacity, output of generating stations, dollar value of sales, and customers served.

Generating capacity measured in kilowatts is a fundamental quantity placing a limit on total electricity production. However, capacity data is of no particular significance at the county level. Nor does kilowatt-hour output of generating stations by county tell much about economic activity at the county level. Major generating stations are linked together in grids extending over many hundreds of miles. Once such a system is energized, it becomes impossible to link a kilowatt-hour consumed at a certain location with any of the individual stations feeding power into the system.

Although dollar value of sales renders an important indication of the economic impact of the electric utility industry, rate differentials among customer types, and among the various power supplying organizations make revenue an imperfect measure of consumption.

Customers served may have some use as a secondary check on number of households, or business establishments in an area. Problems arise, however, from such possibilities as multiple family living units operating through one meter, or single firms using several meters.

Sources of Centrally-Collected Data

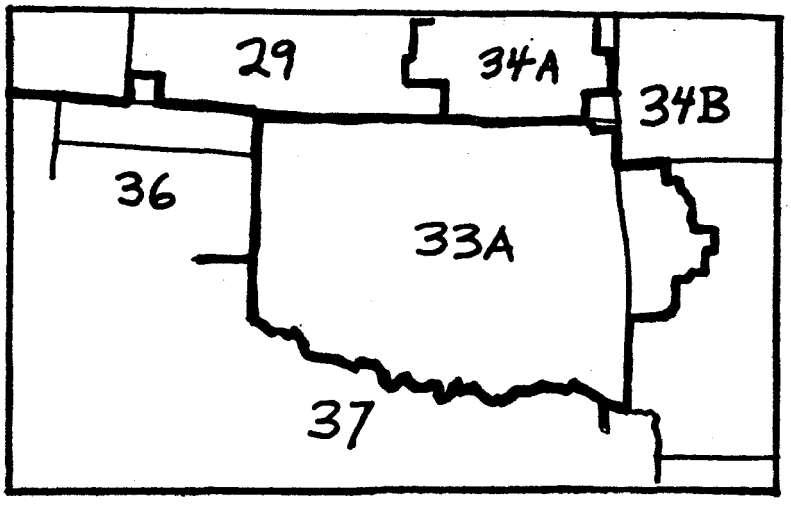
Data on the electric utility industry is processed at three main sources: (1) the Federal Power Commission, (2) the Rural Electrification Administration, and (3) the Edison Electric Institute. Although these organizations publish much other data relating to the industry, the following remarks will be limited to their treatment of kilowatt-hour consumption.

The Federal Power Commission publishes two important sources of kilowatt-hour consumption data. Its annual issues of Statistics of Electric Utilities in the United States presents kilowatt-hour sales for both publicly and privately owned utilities. These publications are based on Form 1 returns by utilities. Although they are listed by state in this document, utilities serving more than one state appear under the single state where most of their service is provided. Thus this document enables locational determination of kilowatt-hour consumption only in terms of individual utility systems.

In its monthly issues of Electric Power Statistics, the Federal Power Commission publishes kilowatt-hour consumption figures by state. Neither this document, nor any other currently published by the Commission contains annual kilowatt-hour consumption figures by state. It is, of course, possible

to add the twelve monthly figures from this document to get an annual total.

The best single source of Federal Power Commission data on kilowatt-hour consumption is not in published form at all. The investigator obtained from the Commission's regional office at Fort Worth, Texas, work sheets compiled from Form 12 reports submitted by virtually all power-supplying organizations in Oklahoma. These statistics are developed according to so-called "power supply areas" which do not conform to state boundaries. Nevertheless, such full coverage in a single document provided a very desirable point of departure for the determination of state and county consumption data. Power supply areas relevant to Oklahoma are shown below. Fortunately, power supply area 33A encompasses the major portion of the state and does not include a great deal of Arkansas.



Rural electric cooperatives that have borrowed funds from the Rural Electrification Administration must file annual reports with that agency. Its Annual Statistical Report, Rural Electrification Borrowers contains data on kilowatt-hour sales for each cooperative. This is the only published source of data on the cooperatives. Although the Federal Power Commission requires the cooperatives to submit FPC Form 12, it does not publish such data. Cooperatives are listed by state in the Annual Statistical Report,

but no attempt is made to identify cooperatives serving customers in more than one state.

The Edison Electric Institute's Statistical Year Book of the Electric Utility Industry is one of the handiest available sources of statistics on the electric utility industry. It is the only source of annual kilowatt-hour consumption data on a state-by-state basis.

It is well known that a considerable amount of electricity is generated and consumed at isolated industrial and institutional installations. Although the Federal Power Commission issues no published data on detailed operations of isolated plants, it does collect power-supply data from some. The Commission supplied copies of its data on Oklahoma isolated industrial plants for 1950 and 1960. Commission staff advises that coverage of this category of consumption may fall somewhat short of 100 per cent (See Table 2-7).

Classification of Consumption Type

By breaking kilowatt-hour consumption down into a simple classification of type of use, additional insights may develop concerning patterns of economic activity in an area. It appeared desirable to adopt a system familiar to users of electric utility statistics. However, several systems appear in the various statistical sources. While the classifications used by the Federal Power Commission, the Rural Electrification Administration, and the Edison Electric Institute have much in common, they also exhibit important differences. Table 1-2 and the following comments describe some of the problems in determining systems of classification and help to place the system used in this study into proper perspective.

In Table 1-2 the basic systems of customer classification in use by central data-gathering organizations during the period 1950-1960 are presented.

TABLE 1-2

Systems of Final Consumer Classification Used in Major Sources of Statistics on Kilowatt-hour Consumption, 1950-1960

Federal Power Commission			Rural Electrification Administration[d]	Edison Electric Institute[e]
a	b	c		
Rural	Residential or domestic	Residential	Residential service farm and nonfarm	Residential
Irrigation	Rural	Commercial	Commercial & industrial	Rural
Residential	Commercial & industrial	Industrial	Other electric service	Commercial and industrial
Commercial	Public street and highway lighting	Other		Small light and power
Industrial	Other public authorities			Large light and power
Street lighting	Railroads and railways			Street and highway lighting
Electrified transportation	Interdepartmental			Other public authorities
All other	Others			Railroads and railways
				Interdepartmental

[a] Photostat (Form 12 reports) work sheet, Federal Power Commission regional office, Fort Worth, Texas.

[b] Statistics of Electric Utilities in the United States, (Form 1 reports).

[c] Electric Power Statistics.

[d] Annual Statistical Report, Rural Electrification Borrowers.

[e] Statistical Yearbook of the Electric Utility Industry.

Aside from degree of detail such as the inclusion of railroad or transport consumption, the systems differ in two basic respects. The Federal Power Commission systems labeled "a" and "b" on Table 1-2 and the Edison Electric Institute report identify a separate "rural" category of consumption. This attempts to identify "energy supplied to rural and farm customers and billed under distinct rural or farm rates."[2] Since 1960, the published reports of the Federal Power Commission and the Edison Electric Institute have not identified a separate rural consumption category. Thus data for the remaining classifications more accurately reflect their relative magnitudes. For instance, commercial power use in a non-urban area is no longer reported as "rural," but appears rather as "commercial."

The second basic respect in which the classifications differ relates to whether or not commercial and industrial consumption are reported separately. Although such a distinction appears highly desirable, certain industry practices indicate the merit of the Edison Electric Institute's approach. The Institute's discussion of this classification illustrates the problem.

> A large number of companies classify such customers as either Commercial or Industrial, using the Standard Industrial Classification or predominant kwhr use as yardsticks; others classify as Industrial all electricity supplied to customers where the demand is generally 50 kw or more or the annual use is 180,000 kwhr, or as near these quantities as a utility's rate subclassification will conveniently accommodate.

In 1961 both the Rural Electrification Administration and the Federal Power Commission in its Statistics of Electric Utilities began to use the same sort of small-large power breakdown as the Edison Electric Institute. The

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2 Federal Power Commission, Uniform System of Accounts Prescribed for Public Utilities and Licensees, (Washington: U.S. Government Printing Office, 1957), p. 99.

Federal Power Commission, however, notes that the distinction between small and large light and power is to be 1,000 kilowatts of demand, unless the reporting utility follows a different practice.[3] There is an obvious lack of uniformity in the meaning of terms used in the commercial and industrial category. The user of published statistics cannot be absolutely sure that a "commercial-industrial" breakdown is accurate, or that a "small-large" power distinction corresponds perfectly with commercial sales and industrial sales. Nevertheless, it appears that for the most part, "small power" or "commercial" sales are in fact to commercial establishments, and that "large power" or "industrial" sales are to industrial firms. Possibly this problem will be alleviated as the utilities make increasing use of the Standard Industrial Classification.

On occasion a somewhat similar problem develops regarding distinguishing residential and commercial consumption. Where such a question arises, the practice is to examine the predominance of type of use, and to place the customer's account wholly in either the residential or the commercial category.

The system chosen for use in this study is that of the Federal Power Commission's Electric Power Statistics. It is composed of four classes: Residential, Commercial, Industrial, and Other. This classification follows current practice in not attempting to distinguish farm from other types of consumption. It suffers from the above noted ambiguity regarding commercial and industrial data. The "other" category encompasses sales to public agencies without distinguishing street and highway lighting. Nevertheless, it is a

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3 Federal Power Commission, Uniform System of Accounts Prescribed for Public Utilities and Licensees, (Washington: U.S. Government Printing Office, 1961), p. 70.

simple system that identifies broad functional outlines of the types of economic activity in which electric energy is consumed.

PART II

ELECTRICITY CONSUMPTION ESTIMATES BY COUNTY

Table 2-1 presents estimates of kilowatt-hour sales by county and consumption type for 1950 and 1960. Work sheets from which this table was developed further break down the county data by type of power-supplying agency. Tables 2-2 through 2-7 present some of the more important features of Oklahoma power consumption data.

Tables 2-2 and 2-3 describe aggregate consumption patterns on the basis of relatively homogeneous groupings of counties. Slightly more than one-third of the state's consumption occurred in Tulsa and Oklahoma counties in both years. The overall geographic pattern of power use based on the county groupings in Figure 2-1 appears rather stable between 1950 and 1960, with only three of the nine areas showing a share changing by more than one percentage point.

Tables 2-4, 2-5, and 2-6 describe the broad outlines of patterns of state consumption by class of consumer and by power-supplying organization. The investor-owned utilities' share of state sales declined from 83.3 to 77.1 per cent during the ten year period under examination. REA cooperatives and the state-owned Grand River Dam Authority expanded their combined share of the Oklahoma market from 7.5 to 14.2 per cent (Table 2-4).

The investor-owned and municipal utilities show expanded relative importance of sales in the residential and commercial classes. The reverse appears to be true of the REA cooperatives, whose industrial sales formed a much more important segment of their market in 1960 than in 1950 (Tables 2-5, 2-6).

Table 2-7 presents a suggestion of the importance of consumption of electricity produced in isolated industrial generating plants. These data apply only to plants reporting to the Federal Power Commission. The apparent share of state consumption arising from generation in these facilities fell from 8.5 per cent to 3.3 per cent during the 1950's.

In Table 2-8, state estimates arrived at in this study are compared with the only two sources of published data on state consumption. Given the diversity of sources used in this study, the total kilowatt-hour consumption figures are remarkably close to those of the Edison Electric Institute and the Federal Power Commission for both years. However, the same degree of correspondence is not evident in the component classes of service. The causes for the rather large discrepancies between the study estimates and the published data for "Residential" and "Other" consumption are not clear. For both years, the Edison Electric Institute "Residential" figures in Table 2-8 were obtained by adding that organization's figures for "Residential" and "Rural" sales. Thus the Institute figure may contain sales which should actually be classed as "Other." Moreover, the quoted Federal Power Commission figure for 1960 "Other" consumption is far too low in light of annual data derived from F.P.C. Form 12 reports.

TABLE 2-1

Estimates of Electricity Sales by Utilities, by County and Class of Service, Oklahoma, 1950, 1960

County and Year	Kilowatt-hours in Thousands				
	Residential	Commercial	Industrial	Other	Total
Adair					
1950	1,982	782	349	218	3,331
1960	7,682	2,340	899	1,170	12,091
Alfalfa					
1950	4,837	3,181	75	508	8,601
1960	9,560	3,304	3,178	1,748	17,790
Atoka					
1950	1,923	996	1,372	333	4,624
1960	6,141	3,622	690	679	11,132
Beaver					
1950	1,524	853	18	78	2,473
1960	6,781	3,274	1,616	1,125	12,796
Beckham					
1950	5,452	4,979	3,926	770	15,127
1960	13,523	11,727	6,428	1,439	33,117
Blaine					
1950	4,748	2,717	1,515	1,333	10,313
1960	10,325	5,319	9,969	2,244	27,857
Bryan					
1950	6,079	5,177	1,946	2,386	15,588
1960	16,284	11,432	2,138	4,199	34,053
Caddo					
1950	6,514	4,633	6,810	1,437	19,394
1960	24,113	11,273	37,310	2,814	75,510
Canadian					
1950	7,776	5,395	9,889	4,925	27,985
1960	19,446	11,548	12,534	6,446	49,974
Carter					
1950	9,411	10,103	24,697	2,935	47,146
1960	33,082	27,445	121,556	9,639	191,722
Cherokee					
1950	2,710	2,698	407	294	6,109
1960	11,048	7,208	5,895	1,501	25,652
Choctaw					
1950	3,749	1,989	1,919	742	8,399
1960	9,154	5,942	4,195	935	20,226

TABLE 2-1 (continued)

Cimarron					
1950	854	912	76	85	1,927
1960	4,623	2,346	500	296	7,765
Cleveland					
1950	12,275	6,846	7,926	11,870	38,917
1960	40,999	19,415	15,309	17,003	92,726
Coal					
1950	1,367	523	1,245	125	3,260
1960	3,170	1,893	378	232	5,673
Comanche					
1950	13,468	8,740	10,094	12,512	44,814
1960	60,505	45,553	17,267	48,810	172,135
Cotton					
1950	2,291	2,814	1,249	232	6,586
1960	6,692	5,059	5,915	799	18,465
Craig					
1950	4,210	2,371	1,701	1,158	9,440
1960	13,495	9,347	1,320	4,102	28,264
Creek					
1950	9,373	8,233	29,670	3,742	51,018
1960	27,059	17,450	54,587	4,741	103,837
Custer					
1950	5,207	3,713	3,532	1,590	14,042
1960	13,627	12,033	5,207	4,228	35,095
Delaware					
1950	2,919	987	337	77	4,320
1960	11,609	4,366	227	351	16,553
Dewey					
1950	2,690	1,091	213	500	4,494
1960	5,382	1,953	297	619	8,251
Ellis					
1950	2,208	1,340	330	646	4,524
1960	4,595	2,519	235	800	8,149
Garfield					
1950	17,820	16,492	62,969	7,187	104,468
1960	49,827	38,489	109,642	22,017	219,975
Garvin					
1950	7,965	6,257	7,324	1,439	22,985
1960	23,278	15,849	37,920	3,721	80,768
Grady					
1950	9,368	4,984	13,543	1,814	29,709
1960	25,606	16,268	42,756	2,943	87,573

TABLE 2-1 (continued)

Grant					
1950	4,539	1,857	350	727	7,473
1960	9,849	3,487	1,710	1,380	16,426
Greer					
1950	3,102	1,048	1,314	1,889	7,353
1960	7,842	3,441	9,414	2,931	23,628
Harmon					
1950	2,437	1,386	653	123	4,599
1960	5,702	3,826	2,021	161	11,710
Harper					
1950	2,218	802	26	77	3,123
1960	6,646	2,049	1,153	418	10,266
Haskell					
1950	1,421	801	2,426	71	4,719
1960	5,217	2,223	857	269	8,566
Hughes					
1950	3,615	3,023	3,543	706	10,887
1960	10,277	8,023	10,978	1,195	30,473
Jackson					
1950	5,251	5,777	450	2,579	14,057
1960	19,421	19,048	2,834	3,537	44,840
Jefferson					
1950	2,837	1,786	449	643	5,715
1960	7,996	5,418	5,908	771	20,093
Johnston					
1950	1,876	963	1,195	208	4,242
1960	5,497	2,365	515	589	8,966
Kay					
1950	19,759	10,620	62,866	7,074	100,319
1960	45,239	30,629	107,851	10,210	193,929
Kingfisher					
1950	3,963	2,652	467	794	7,876
1960	9,465	4,917	739	978	16,099
Kiowa					
1950	6,541	3,537	13,082	615	23,775
1960	13,638	7,324	10,617	1,404	32,983
Latimer					
1950	1,424	644	229	356	2,653
1960	4,231	1,669	39	1,059	6,998
LeFlore					
1950	4,832	2,798	5,987	1,868	15,485
1960	14,869	8,028	6,367	3,271	32,535

TABLE 2-1 (continued)

Lincoln					
1950	3,778	2,788	8,018	1,886	16,470
1960	14,247	14,480	11,790	1,842	42,359
Logan					
1950	5,534	4,548	6,204	5,419	21,705
1960	14,989	9,608	12,018	3,021	39,636
Love					
1950	1,392	1,077	203	115	2,787
1960	4,227	3,547	1,709	317	9,800
McClain					
1950	2,647	1,100	864	543	5,154
1960	10,615	3,948	2,827	934	18,324
McCurtain					
1950	4,062	2,094	902	483	7,541
1960	12,832	6,069	1,158	804	20,863
McIntosh					
1950	2,117	1,293	142	525	4,077
1960	6,024	2,895	1,191	829	10,939
Major					
1950	3,166	1,216	60	569	5,011
1960	6,704	2,219	659	784	10,366
Marshall					
1950	1,905	1,587	231	274	3,997
1960	6,626	5,970	13,660	751	27,007
Mayes					
1950	4,395	2,430	1,629	1,386	9,840
1960	16,861	9,798	221,728	991	249,378
Murray					
1950	2,504	2,293	1,427	739	6,963
1960	7,831	5,069	6,706	1,972	21,578
Muskogee					
1950	15,689	17,329	18,831	8,122	59,971
1960	45,272	34,912	79,985	14,491	174,660
Noble					
1950	3,931	2,640	1,241	627	8,439
1960	10,515	4,679	15,147	1,910	32,251
Nowata					
1950	3,372	1,727	35,164	459	40,722
1960	10,414	5,422	43,248	617	59,701
Okfuskee					
1950	2,541	1,493	702	769	5,505
1960	6,027	2,605	4,250	732	13,614

TABLE 2-1 (continued)

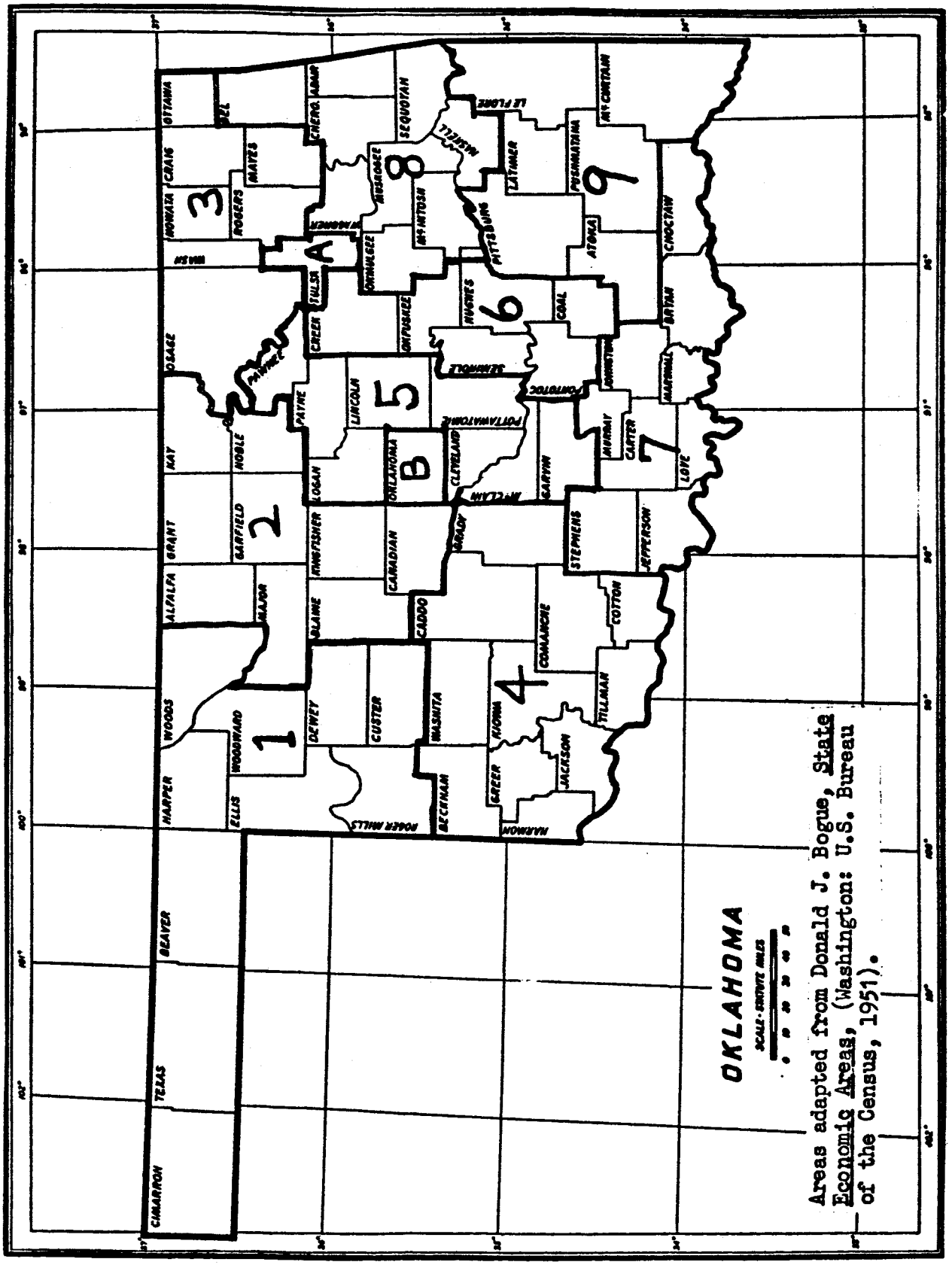
Oklahoma					
1950	114,319	158,610	107,009	83,904	463,842
1960	422,715	440,638	192,116	248,288	1,303,757
Okmulgee					
1950	10,047	6,347	36,204	1,044	53,642
1960	25,642	16,430	64,449	4,138	110,659
Osage					
1950	9,237	4,132	14,427	1,556	29,352
1960	29,722	15,700	97,048	2,409	144,879
Ottawa					
1950	9,974	5,172	108,181	1,629	124,956
1960	24,606	11,264	95,871	4,985	136,726
Pawnee					
1950	3,486	2,159	729	455	6,829
1960	8,082	6,609	15,444	1,744	31,879
Payne					
1950	11,165	11,911	39,659	2,262	64,997
1960	33,066	21,896	88,649	4,460	148,071
Pittsburg					
1950	7,685	5,048	12,472	2,362	27,567
1960	21,585	16,351	8,235	6,033	52,204
Pontotoc					
1950	7,600	8,205	9,202	3,858	28,865
1960	20,163	21,011	89,369	5,663	136,206
Pottawatomie					
1950	10,524	12,062	35,598	4,480	62,664
1960	31,491	23,669	67,138	4,415	126,713
Pushmataha					
1950	1,952	1,090	242	172	3,456
1960	5,918	2,535	190	393	9,036
Roger Mills					
1950	2,014	720	386	156	3,276
1960	3,932	1,480	445	288	6,145
Rogers					
1950	5,578	2,516	10,298	239	18,631
1960	16,399	9,551	1,474	1,501	28,925
Seminole					
1950	6,582	7,881	21,000	6,944	42,407
1960	21,423	14,058	40,497	4,204	80,182
Sequoyah					
1950	2,945	1,760	910	935	6,550
1960	10,985	4,507	8,073	973	24,538

TABLE 2-1 (continued)

Stephens					
1950	8,904	9,785	15,135	2,725	36,549
1960	33,689	18,368	84,228	2,992	139,277
Texas					
1950	3,280	4,073	7,394	1,003	15,750
1960	11,753	8,637	16,274	3,143	39,807
Tillman					
1950	5,528	3,189	3,489	1,492	13,698
1960	14,996	5,281	9,381	1,540	31,198
Tulsa					
1950	97,284	42,828	265,764	14,692	420,568
1960	357,662	392,020	457,965	21,717	1,229,364
Wagoner					
1950	1,794	1,493	523	1,166	4,976
1960	12,556	7,935	3,283	2,096	25,870
Washington					
1950	12,410	5,837	33,208	1,685	53,140
1960	42,955	50,576	141,061	4,737	239,329
Washita					
1950	6,041	2,266	1,396	937	10,640
1960	12,634	4,536	3,166	17,684	38,020
Woods					
1950	5,963	3,072	3,981	1,668	14,684
1960	12,287	6,642	963	3,678	23,570
Woodward					
1950	4,248	3,613	779	1,201	9,841
1960	12,397	8,661	2,177	1,942	25,177
State Total					
1950	618,128	493,884	1,089,773	235,147	2,436,932
1960	1,983,337	1,618,997	2,562,543	551,792	6,716,669

Figure 2-1

Census State Economic Areas, Oklahoma



Areas adapted from Donald J. Bogue, State Economic Areas, (Washington: U.S. Bureau of the Census, 1951).

TABLE 2-2

Estimates of Electricity Sales by Utilities, by State Economic Area, and Class of Service, Oklahoma, 1950, 1960
(Refer to Figure 2-1)

State Economic Area and Year	Kilowatt-hours in Thousands				
	Residential	Commercial	Industrial	Other	Total
A (Tulsa Co.)					
1950	97,284	42,828	265,764	14,692	420,568
1960	357,662	392,020	457,965	21,717	1,229,364
B (Okla. Co.)					
1950	114,319	158,610	107,009	83,904	463,842
1960	422,715	440,638	192,116	248,288	1,303,757
Area 1					
1950	30,206	20,189	16,735	7,004	74,134
1960	82,023	49,594	28,867	16,537	177,021
Area 2					
1950	70,539	46,770	139,432	23,744	280,485
1960	170,930	104,591	261,429	47,717	584,667
Area 3					
1950	49,176	24,185	204,608	8,112	286,081
1960	154,452	111,658	601,750	19,342	887,202
Area 4					
1950	65,993	43,353	56,006	24,400	189,752
1960	204,672	133,336	147,109	84,062	569,179
Area 5					
1950	57,374	47,671	106,322	28,354	239,721
1960	176,767	115,474	251,095	37,140	580,476
Area 6					
1950	31,078	29,358	65,362	16,144	141,942
1960	88,119	65,040	200,059	16,767	369,985
Area 7					
1950	38,657	34,760	47,202	10,767	131,386
1960	124,386	85,556	240,615	22,165	472,722
Area 8					
1950	41,624	33,490	60,129	12,452	147,695
1960	136,035	82,816	164,859	25,818	409,528
Area 9					
1950	21,878	12,670	21,204	5,574	61,326
1960	65,576	38,274	16,679	12,239	132,768
State Totals					
1950	618,128	493,884	1,089,773	235,147	2,436,932
1960	1,983,337	1,618,997	2,562,543	551,792	6,716,669

TABLE 2-3

Kilowatt-hour Sales to Final Consumers, Relative Share by State Economic Areas, 1950, 1960
(Refer to Figure 2-1)

State Economic Area	Per cent of Total[a] 1950	1960
A (Tulsa Co.)	17.3	18.3
B (Oklahoma Co.)	19.0	19.4
Area 1	3.0	2.6
2	11.5	8.7
3	11.7	13.2
4	7.8	8.5
5	9.8	8.7
6	5.8	5.5
7	5.4	7.0
8	6.1	6.1
9	2.5	2.0
	100.0	100.0

[a]Details may not add to 100.0 per cent due to rounding.

TABLE 2-4

Kilowatt-hour Sales to Final Consumers
by Major Types of Power-Supplying Agency, Oklahoma, 1950, 1960

	1950		1960	
	Kilowatt-hours (000)	Per cent	Kilowatt-hours (000)	Per cent
Investor-Owned	2,028,941	83.3	5,176,411	77.1
REA Cooperatives	126,775	5.2	612,050	9.1
Government:				
Municipal	224,786	9.2	520,717	7.8
State (GRDA)	56,430	2.3	346,099	5.1
Federal (SWPA)	-	?	61,392	0.9
Total Government	(281,216)	(11.5)	(928,208)	(13.8)
Total Oklahoma	2,436,932	100.0	6,716,669	100.0

TABLE 2-5

Relative Importance of Different Classes of Final Kilowatt-hour Consumption, Major Power-Supplying Agencies, Oklahoma, 1950, 1960

Agency	Per cent of Consumption Class				
	Residential	Commercial	Industrial	Other	Total
Investor-Owned Utilities					
1950	21.6	19.9	48.9	9.6	100.0
1960	28.0	26.2	37.4	8.4	100.0
REA Cooperatives					
1950	78.6	18.3	2.1	1.0	100.0
1960	51.1	17.1	30.4	1.4	100.0
Government:					
Municipalities					
1950	35.8	30.0	21.8	12.4	100.0
1960	42.9	30.0	18.3	8.8	100.0
State (GRDA)					
1950	-	-	80.0	20.0	100.0
1960	-	-	99.6	0.4	100.0
Federal (SWPA)					
1950	-	-	-	-	-
1960	-	-	-	100.0	100.0
Total Government					
1950	21.6	19.9	48.9	9.6	100.0
1960	24.1	16.8	47.4	11.7	100.0
Total Oklahoma					
1950	25.4	20.3	44.7	9.6	100.0
1960	29.5	24.1	38.2	8.2	100.0

TABLE 2-6

Kilowatt-hour Sales to Final Consumers, Per cent by Consumer Class and Major Type of Power-Supplying Agency, Oklahoma, 1950, 1960

Agency	Residential	Commercial	Industrial	Other	Total
			1950		
Investor-Owned Utilities	70.9	81.6	91.1	82.8	83.3
REA Cooperatives	16.1	4.7	0.3	0.5	5.2
Government:					
Municipalities	13.0	13.7	4.5	11.9	9.2
State (GRDA)	0.0	0.0	4.1	4.8	2.3
Federal (SWPA)	0.0	0.0	0.0	0.0	0.0
Total Government	(13.0)	(13.7)	(8.6)	(16.7)	(11.5)
Total Oklahoma	100.0	100.0	100.0	100.0	100.0
			1960		
Investor-Owned Utilities	73.0	83.9	75.6	78.7	77.1
REA Cooperatives	15.8	6.5	7.3	1.6	9.1
Government:					
Municipalities	11.2	9.6	3.7	8.3	7.8
State (GRDA)	0.0	0.0	13.4	0.3	5.1
Federal (SWPA)	0.0	0.0	0.0	11.1	0.9
Total Government	(11.2)	(9.6)	(17.1)	(19.7)	(13.8)
Total Oklahoma	100.0	100.0	100.0	100.0	100.0

TABLE 2-7

Electricity Generated at Private Plants Filing Reports with the Federal Power Commission, by County, Oklahoma, 1950, 1960

County	Kilowatt-hours (000) 1950	1960
Beaver	1,242	-
Beckham	-	15,697
Blaine	3	5
Canadian	5,607	4,601
Creek	-	2,314
Garvin	-	20,372
Grady	1,466	4,499
Kay	67,845	118,565
Kiowa	350	-
Lincoln	-	700
McCurtain	10,479	7,834
Major	-	4,900
Marshall	-	5,200
Oklahoma	16,976	10,677
Okmulgee	6,618	2,850
Osage	4,015	2,233
Pawnee	1,850	2,346
Pontotoc	48,960	-
Pottawatomie	1,994	-
Seminole	13,723	7,240
Stephens	-	19,127
Tillman	1,756	-
Washington	43,372	-
Location n.a.	582	-
Totals	226,838	229,160

Source: Federal Power Commission, unpublished reports and special tabulation.

TABLE 2-8

Comparison of Study Estimates of Oklahoma Electricity Sales by Utilities and Estimates of Edison Electric Institute and Federal Power Commission, by Class of Service, 1950, 1960

	Residential	Commercial	Industrial	Other	Total
	Kilowatt-hours in Thousands				
1950					
Edison Electric Institute	635,073	462,455	987,607	207,282	2,292,417
Federal Power Commission	663,243	502,860	1,079,612	224,117	2,470,432
Study estimate	618,128	493,884	1,089,773	235,147	2,436,932
1960					
Edison Electric Institute	2,234,000	1,616,000	2,574,000	463,000	6,887,000
Federal Power Commission	2,334,392	1,571,870	2,559,283	370,080	6,835,625
Study estimate	1,983,337	1,618,997	2,562,543	551,792	6,716,669
	Percentage excess over study estimate				
1950					
Edison Electric Institute	+ 2.7	-6.4	-9.4	-11.9	-5.9
Federal Power Commission	+ 7.3	+1.8	-0.9	- 4.4	+1.4
1960					
Edison Electric Institute	+12.6	-0.2	+0.5	-16.1	+2.5
Federal Power Commission	+17.8	-2.9	-0.1	-44.8	+1.8

Source: Edison Electric Institute, Statistical Yearbook of the Electric Utility Industry, 1950, 1960.
Federal Power Commission, Electric Power Statistics, monthly issues, 1950, 1960.

PART III

ELECTRICITY USE AND STANDARDS OF LIVING

This study was predicated on the assumption that electricity consumption data provide useful insights into processes of economic growth and levels of economic activity. Although no detailed analytic work has been undertaken using the data developed in this study, it is interesting to observe rather clear-cut relationships between electricity use and indicators of economic activity. This relationship will be examined first for the world as a whole and then for the Oklahoma economy.

Electricity and the World Economy

The most striking evidence of the relation of electricity use to economic development can be obtained from statistical publications of the United Nations. In Table 3-1 and Figure 3-1, 1958 total output per capita (gross domestic product at factor cost) is compared with electricity generation per capita for the United Nation's seven major world geographic regions. It is obvious that world standards of living vary directly with the production of electricity. A slight exception to the regular decline in per capita output and electricity production occurs in the case of the Soviet Union. Unfortunately, Russian output figures are not available from the United Nations and must be estimated from another source.

Electricity and the Oklahoma Economy

Data prepared in this study for the state of Oklahoma indicate a general repetition of the world pattern. Estimates of county electricity use by class of consumption ("residential," "commercial," "industrial" and

TABLE 3-1

Per Capita Gross Domestic Product and Electricity Consumption, by Major World Geographic Regions, 1958

United Nations Region	(1) Per Capita Gross Domestic Product (dollars)	(2) Total Electricity Use (millions of Kwh)	(3) Population (millions)	(2) ÷ (3) = (4) Kwh Per Capita
Africa	115	33,700	245	137
North America[a]	1,780	839,900	257	3,268
South America	322	44,300	137	323
Asia	107	118,995	938	127
Europe	815	470,651	306	1,538
Oceania	1,013	28,200	16	1,763
U.S.S.R.	982	235,351	207	1,137
Total	472	1,908,100	2,893	660

[a]Includes Central America.

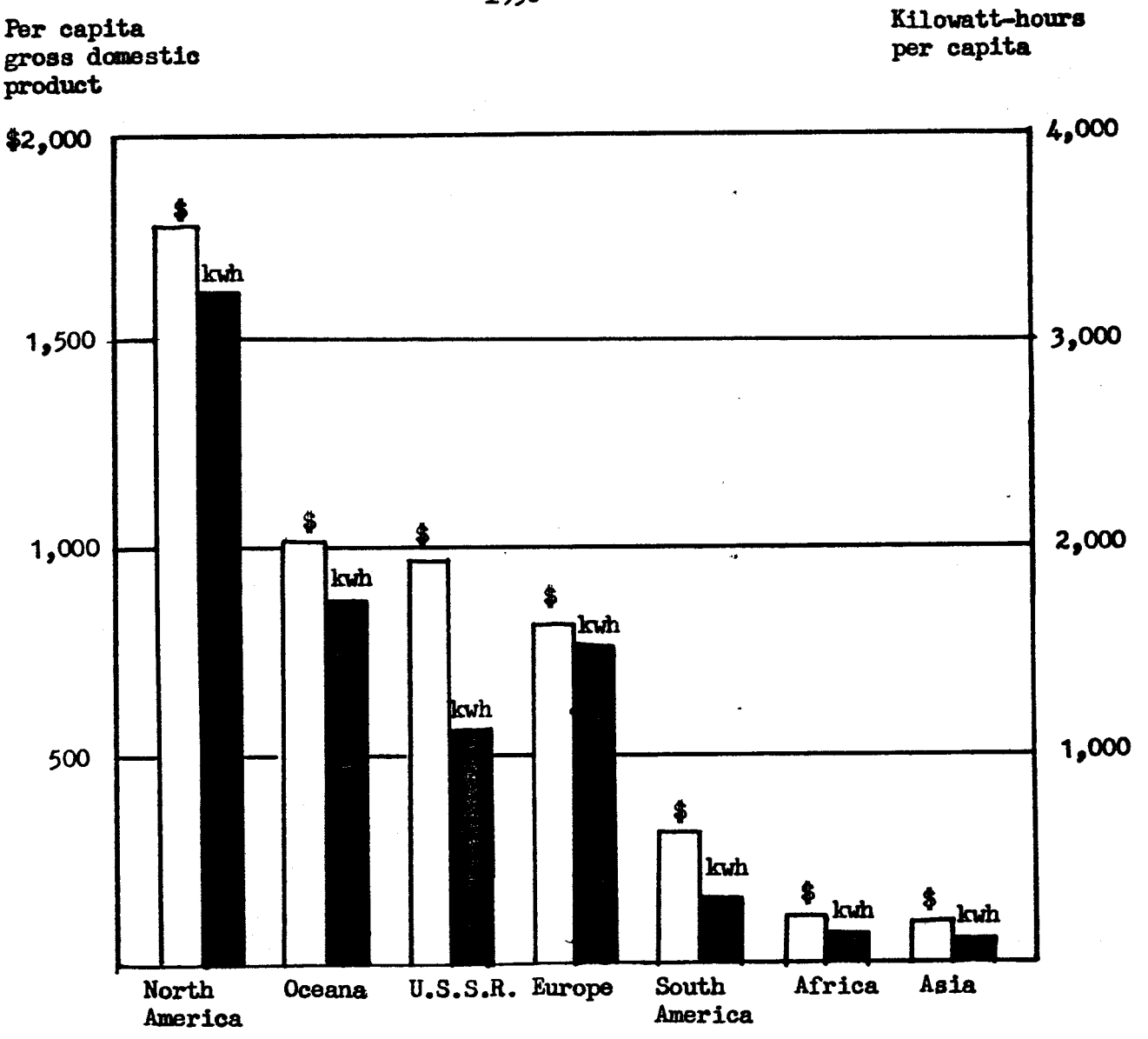
Source: Column (1) except U.S.S.R.:
United Nations, Department of Economic and Social Affairs, Yearbook of National Accounts Statistics, 1963, (New York: United Nations, 1964), pp. 321-26.

Columns (2) and (3):
United Nations, Department of Economic and Social Affairs, Statistical Yearbook, 1963, (New York: United Nations, 1964), pp. 337-45, and pp. 23-43.

Column (1), U.S.S.R. figure estimated from Abram Bergson, The Real Income of Soviet Russia Since 1928, (Cambridge: Harvard University Press, 1961), p. 295.

Figure 3-1

Per Capita Gross Domestic Product and Electricity Consumption, by Major World Geographic Regions, 1958



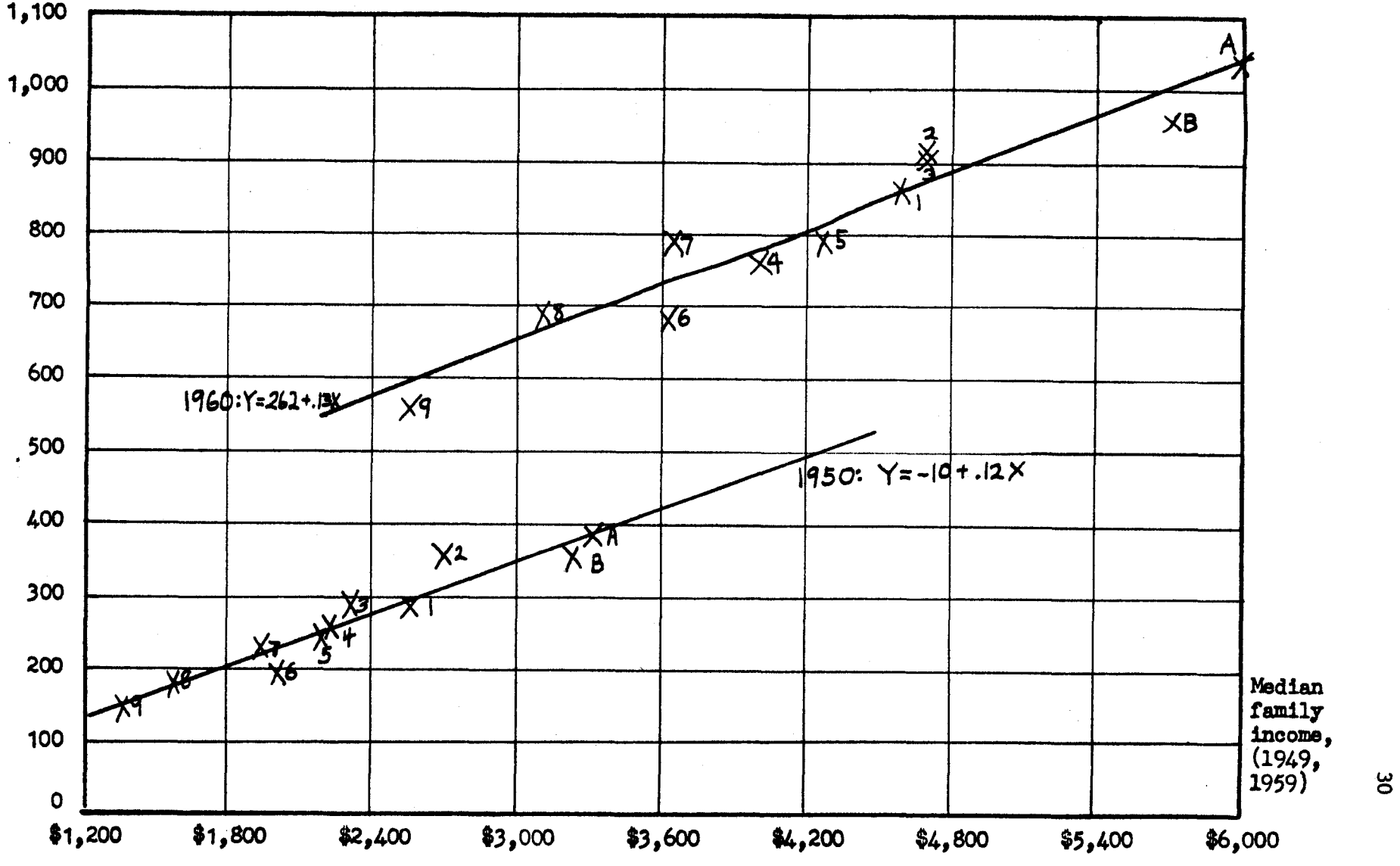
Source: See Table 3-1

and "other") were developed for 1950 and 1960. These data were then aggregated for the state's eleven Census State Economic Areas. The areas, described in Figure 2-1, are relatively homogeneous with respect to economic and social characteristics. The electricity consumption figures for each area were then divided by appropriate area population figures to arrive at per capita consumption. These per capita figures were then compared with area median family income data. Median family income may be taken as a representative measure of the standard of living of the inhabitants of an area. Census median family income figures are available only for the years preceding the decennial censuses. Geographic patterns do not change rapidly enough to greatly reduce the effectiveness of comparing 1949 and 1959 income data with 1950 and 1960 electricity use. It is quite clear that within Oklahoma, standards of living are directly related to the level of per capita electricity consumption. This is most apparent when median family income is compared with residential kilowatt-hour consumption per capita. In Figure 3-2, regression lines for 1950 and 1960 indicate a tendency for annual residential consumption per capita to rise at the rate of 12 to 13 kilowatt-hours per $100 increase in median family income.

Although the positive relationship between median family income and per capita electricity use is less strong for industrial and commercial consumption, it is nevertheless still positive. Table 3-2 presents coefficients of rank correlation relating median family income and electricity consumption for 1950 and 1960 on the basis of figures for the state's eleven economic areas. On an *a priori* basis, it would appear that median family income should be more closely related to commercial consumption than to

Figure 3-2

Residential Electricity Consumption Compared with Median Family Income, by State Economic Areas, Oklahoma, 1949-50 and 1959-60



industrial consumption. Large regional concentrations of industrial power use would be expected to cause irregularities in the relationship. The 1960 data are consistent with this assumption because of the high coefficient of rank correlation for commercial use, and the low coefficient for industrial use. The pattern for 1950, however, shows a higher coefficient for industrial than for commercial use. This peculiarity is as yet unexplained.

TABLE 3-2

Coefficients of Rank Correlation, Kwh Consumption Per Capita and Median Family Income, State Economic Areas, Oklahoma[a]

	1950	1960
Residential	.97	.97
Commercial	.42	.81
Industrial	.56	.15
Total	.73	.69

[a]Median family income data for 1949 and 1959, electricity consumption for 1950 and 1960.

PART IV

DESCRIPTION OF PROCEDURES

A wide variety of procedures were used to develop the county kilowatt-hour data. Detailed descriptions of these procedures are presented for each of the major power supplying agencies. The potential user of the statistics presented in Part II should read this material carefully. Particular note should be taken of several instances in which a priori assumptions about consumption patterns were necessary in order to allocate greater-than-county totals to individual counties.

Public Service Company of Oklahoma

Public Service Company serves areas in northeastern, southeastern, and southwestern Oklahoma. Its sales to final consumers take place entirely within the State of Oklahoma. Kilowatt-hour sales to final consumers rose from 830 million in 1950 to 2,271 million in 1960.

The firm's internal accounts reported kilowatt-hour sales and revenues printed out from data processing equipment. Data were broken down spatially according to individual municipalities and vicinities surrounding individual municipalities. This permitted easy county identification of kilowatt-hour consumption patterns. Individual municipality and vicinity data were reported according to particular rate classes. To place these into the system of consumer classes used in this study, it was necessary to add the kilowatt-hour figures for the rate classes in each consumer class for every municipality and vicinity. This was a considerable task for larger communities, since the differentiation of consumers was quite extensive and involved about 70 classes. Many small communities, however, had consumption

in few rate classes. Staff of Public Service Company facilitated the compiling of class totals by permitting the investigators to use adding machines at the firm's Tulsa offices.

Oklahoma Gas & Electric Company

Oklahoma Gas & Electric Company is the state's largest single electric power supplying organization. Its principal service area is in the central part of the state extending northward to the Kansas border, southward to the Texas border and eastward into western Arkansas. Its Oklahoma sales to final consumers were 1.1 billion kilowatt-hours in 1950 and 2.8 billion kilowatt-hours in 1960.

Like Public Service Company, the firm's internal accounts permitted the identification of consumption by consumer class for service within municipalities. Non-urban sales were treated differently and were rather difficult to place within county boundaries. Variations in accounting practice between 1950 and 1960 caused further complications.

Six divisions composed of a total of twenty-one districts are basic to OG&E's internal geographic breakdown of statistics. Only eight districts lie wholly within single counties; three more appear to be virtually single county districts. Fortunately, one of these three, the Oklahoma City District, accounts for slightly over one-third of the firm's kilowatt-hour sales. In no case are the boundaries of a district congruous with the boundaries of a county.

In 1960, data for non-urban consumption were reported by districts and in 1950 they were reported by divisions. In both years data were broken down by consumer class. Moreover, OG&E utilized a separate consumer class category called "Oil Field Industrial" encompassing all sales related to the

petroleum industry. In some instances this was reported on a division basis and in others by district. Even when consumption in this category occurred within a municipality, it was not reported as such, but rather was included as a separate component in district or division figures. It was necessary to utilize a number of ad hoc techniques to handle non-urban and oil field consumption. The following sections describe in detail the processes used to arrive at the county-by-county consumption data for OG&E.

1960 Allocation

An internal account book containing monthly kilowatt-hour sales for the various municipalities and geographic areas was used to get 1960 consumption figures broken down by consumer class. Since annual totals had not been calculated in the book, it was necessary to rearrange the data and add up the components. This required some 18,000 entries and a substantial amount of adding and checking to assure accuracy. The task was facilitated by rounding all kilowatt-hour figures to the nearest thousand. Some slight adjustments were made to assure that for each municipality and other category the sum of the kilowatt-hours for the four consumption classes added to the appropriate annual total figure. However, rounding and balancing later proved to be the source of a minor discrepancy between the aggregate firm totals and calculated totals in the "other" and "industrial" classes.[1]

"Oil Field Industrial" accounted for 20 per cent and non-urban consumption accounted for another 10 per cent of OG&E's total 1960 kilowatt-hour sales to final consumers. Discussion with officials of the firm indicated

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1 The discrepancy was prorated among all the counties in the OG&E territory. In no case did the prorating change a component by more than 1,000 kilowatt-hours.

no feasible technique for pinpointing exactly the county location of all of this consumption. Non-urban residential kilowatt-hours for each district were prorated among counties on the basis of the pattern of urban residential consumption. This technique appeared reasonable on the basis of the assumption that concentration of rural residential consumption was greatest in areas surrounding concentration of urban population. Other classes of consumption were allocated on the basis of interviews with various OG&E staff who were particularly familiar with certain divisions. In several instances it was discovered that one petroleum refinery accounted for a very substantial share of a district's oil field consumption.

After final allocations of these data were worked up, the information was examined by OG&E staff to see whether the data appeared accurate. It is the investigator's opinion that the 1960 allocation of oil field and non-urban kilowatt-hour consumption would compare favorably with the actual data--if such were available.

1950 Allocation

Data for 1950 were developed after work was completed on 1960. Similar problems of allocating oil field and non-urban consumption appeared. Whereas these data were generally available for 1960 on a district basis, they were available only on a division basis for 1950. Two further problems hampered the OG&E allocation for 1950. First, the firm had recently been in the process of destroying records which had outlived their usefulness. This meant that some information which might have been of help simply did not exist. Second, the passage of thirteen years meant that personal discussion with company staff was an unsatisfactory technique of estimating percentage allocation of these classes. The relative magnitude of these allocation problems

was considerably greater than in 1960, with oil field consumption accounting for about 25 per cent and non-urban about 14 per cent of total sales to final consumers.

Since the oil field industrial consumption represented the largest single unallocated part of OG&E's 1950 kilowatt-hour sales, an attempt was made to locate specifically as much of this component as possible. Staff in the firm's main office contacted each division headquarters to obtain assistance in determining the distribution of this sales category. Cooperation was obtained from each division, and it appeared that the figures and estimates were reasonably accurate. For one division, Shawnee, it was necessary to visit the division office where two months of oil field industrial data were taken directly from a 1950 ledger book[2] and used to allocate total division oil field sales.

The remaining non-urban consumption was allocated using the technique applied to 1960 non-urban residential consumption. Urban county totals for the four consumption classes for 1950 were developed for each division. Division non-urban consumption for each class was then allocated according to the county pattern of urban kilowatt-hours for that class. Such an allocation left room for wide error--especially in the case of large-scale industrial and public users. Nevertheless, the urban consumption patterns appeared to be the only available technique which had some reasonable *a priori* basis. Economic activity using electricity tends to be concentrated in complexes whose centers are urban areas defined legally by city limits. The complex itself frequently extends beyond city limits.

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2 This ledger book was discovered by chance; it should have been eliminated as part of the firm's record destruction program.

Summary

The greater relative magnitude of data reported only on a division basis for 1950 necessarily meant that less confidence could be placed in the 1950 county allocation than in the 1960 allocation. Even for 1950, however, the accurate determination of the distribution of oil field industrial sales and the virtually total correspondence of the Oklahoma City district with Oklahoma County reduced greatly the margin of error.

The use of the wide range of ad hoc techniques described above is obviously undesirable as a technique for generating a continuing series of data. Throughout much of the work there appeared to be no basis at all for utility firms such as OG&E to identify any of their kilowatt-hour sales on a county basis. Almost at the conclusion of the study one important piece of information developed regarding the county identification of basic OG&E customer accounts. When the investigators traveled to the Shawnee district office to allocate 1950 oil field industrial sales, they noticed that each customer's ledger sheet showed a county location. It was discovered that this identification was necessary to determine the annual intangible property tax on accounts receivable paid on a county basis. While this, strictly speaking, related to revenues rather than physical quantities, the ledger sheets also contained the results of meter reading.

The county identification of individual ledger cards raises a question as to whether there might be a more orderly technique for determining county location of OG&E kilowatt-hour sales. Since the customer ledgers are used to determine monthly statements, no annual totals are developed. Adding up twelve months of figures for all customers would not be feasible. However the allocation of annual totals on the basis of a few months' individual

customer kilowatt-hours might work well. January and July appear to be adequate for allocating oil field industrial sales, for seasonal elements are not very important in determining activity in this sector. Other classes of consumption, save residential, could be allocated on the basis of an average for the months at the end of each quarter. Number of non-urban consumers in these classes would not prove prohibitive. For the large number of rural residential consumers, annual average district kilowatt-hours per customer might be prorated on the basis of the January (or January and July) accounts receivable for that class.

Municipal Utilities

Summary sheets on kilowatt-hour sales by municipal utilities were obtained from the Federal Power Commission regional office at Fort Worth. These sheets had been developed from copies of Federal Power Commission Form No. 12 filled out by the utilities. All municipal utilities in the state file these reports, although those selling less than five million kilowatt-hours file only every five years. There were sixty-nine municipal systems in Oklahoma in 1950 and seventy in 1960. The municipal systems accounted for 9.2 per cent of Oklahoma consumption in 1950 and 7.8 per cent in 1960.

The major limitation of data on consumption of electricity from municipal systems probably results from unmetered service to municipal agencies. Stanley Self, in his excellent survey of Oklahoma municipal utilities, estimated that about 12 per cent of electric energy output of municipalities was free service.[3] Though some portion of this does appear in the Federal

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3 Stanley Allen Self, Municipal Electric Utility Systems in Oklahoma, unpublished Ph.D. dissertation, University of Oklahoma, 1958, p. 260.

Power Commission energy reports, it is possible that the cities are less careful about accounting for all kilowatt-hours going to final consumption than are the other power-distributing agencies.

Rural Electric Cooperatives

Every county in Oklahoma is served by one or more rural electric cooperatives. From 1950 to 1960, these organizations' share of state final consumption kilowatt-hour sales rose from 5.2 to 9.2 per cent. Particularly marked was the cooperatives' growing participation in the state's industrial electricity market, where their kilowatt-hour share grew from .2 per cent to 7.3 per cent. The twenty-six Rural Electrification Administration financed cooperatives participating in the Oklahoma Association of Electric Cooperatives accounted for over 98 per cent of the state's cooperative business in both years. There was a fringe of about ten organizations operating either independent of the Rural Electrification Administration, or having their primary business in other states.

Coverage

Biennial reports of the Oklahoma Tax Commission contain lists of all organizations paying the state's annual rural electric cooperative license fee. The Annual Statistical Reports of the Rural Electrification Administration also list rural electric cooperatives on a state-by-state basis. These reports, however, cover only cooperatives borrowing from the Rural Electrification Administration, and also do not indicate cooperatives selling power in more than one state.

Table 4-1 presents the Oklahoma Tax Commission's list of cooperatives applicable to 1950 and 1960. As Table 4-1 indicates, the questionnaire method relied upon in this study did not develop county kilowatt-hour data

TABLE 4-1

Rural Electric Cooperatives Serving Final Consumers,[a]
Number of Customers and Questionnaires Returned,
Oklahoma, Fiscal Years, 1951, 1961

	Number of Customers		Questionnaire
	1950	1960	Returned
Alfalfa Electric Cooperative, Inc.	3,248	3,136	X
Arkansas Valley Elec. Coop. Arkansas	652	1,028	X
Caddo Electric Cooperative	5,534	7,204	X
Canadian Valley Elec. Coop. Inc.	3,672	6,012	X
Central Rural Electric Cooperative	3,437	4,694	X
Choctaw Electric Cooperative, Inc.	3,703	6,646	X
Cimarron Electric Cooperative	5,256	5,040	X
Consumers Cooperative Elec. Co.	32	34	
Cookson Hill's Elec. Coop. Inc.	1,661	4,701	X
Cotton Electric Co-Operative	6,391	7,127	X
East Central Oklahoma Elec. Coop. Inc.	4,567	7,554	X
Ft. Cobb Elec. Refrig. Coop.	324	--	
Greenbelt Elec. Coop. Inc. Texas	304	228	X
Harmon Electric Assn. Inc.	2,609	2,275	X
Indian Electric Cooperative, Inc.	3,774	6,759	X
Kay Electric Cooperative	3,672	3,732	X
Kiamichi Elec. Coop. Inc.	3,473	5,248	X
Kiwash Elec. Coop. Inc.	4,296	3,735	X
Lake Region Elec. Coop. Inc.	8	5,739	X
Northeast Oklahoma Elec. Coop. Inc.	4,859	9,731	X
Northfork Elec. Coop. Inc.	3,591	3,034	X
Northwestern Electric Coop. Inc.	3,894	5,251	X
Oil Field Cooperative Elec. Co.	23	132	
Oklahoma Electric Cooperative	3,845	4,993	X
Ozarks Rural Elec. Coop. Corp. Arkansas	1,934	3,910	X
Panhandle Empire Electric Coop. Inc.	--	--	
People's Electric Cooperative	5,659	7,133	X
Red River Valley Rural Elec. Assn.	2,450	3,540	X
Rich Mountain Elec. Coop. Inc. Arkansas	126	190	
Rita Blanca Elec. Coop. Inc.	--	22	X
Rural Electric Cooperative, Inc.	2,553	3,831	X
Sooner Electric Power Coop. Inc.	--	5	
Southeastern Elec. Coop.of Durant, Oklahoma	3,248	4,424	X
Southwest Arkansas Elec. Coop. Corporation	28	70	
Southwest Rural Elec. Assn. Inc.	2,769	3,065	X
Southwestern Elec. Coop. Inc. New Mexico	3	6	
Tri-County Electric Cooperative, Inc.	2,128	3,710	X
Verdigris Valley Elec. Coop. Inc.	2,852	5,823	X
Total	96,575	139,762	

[a]Kamo Electric Cooperative, Inc., and Western Electric Cooperative excluded because they are power wholesalers.

Source: Oklahoma Tax Commission, Biennial Report, 1950-52, pp. 271-72; 1960-62, pp. 289-90.

for every cooperative in the state. Nevertheless, coverage in terms of total kilowatt-hours is probably very close to 100 per cent for both years. Cooperatives from which no kilowatt-hour data was obtained accounted for .6 per cent of total cooperative customers in 1950 and .2 per cent in 1960. Moreover, in neither year did any of the unincluded cooperatives list customers in the Tax Commission's "other-consumers" category which encompasses all customers except domestic and commercial.

Identification of County Consumption Patterns

County outlines were superimposed upon a map showing the territories served by the twenty-six organizations participating in the Oklahoma Association of Rural Electric Cooperatives. In no case did the area served by a given cooperative correspond to county boundaries. The investigators experimented with alternative procedures of county allocation in the offices of the Central Rural Electric Cooperative at Stillwater. Ultimately, it proved necessary to rely upon allocations obtained from mailed questionnaires.

Experimentation at Central Rural Electric Cooperative.--The cooperative maintained an alphabetical listing of all customers showing their 1960 annual kilowatt-hour consumption. Each customer had an account number which identified his county (as well as township and section) location. A 5 per cent sample, choosing every twentieth customer, was obtained for the "Residential Service Farm and Nonfarm" class. Some form of sampling procedure was necessary because there were 4,217 customers in this class. The sample accounted for 97 per cent of the total kilowatt-hour sales for that class. The county location of every customer in the sample was determined and the cooperative's annual total sales for that class was allocated to counties on the basis of the sample results. The systematic sampling technique probably provided an

accurate allocation because the universe was relatively homogeneous.

Since the sampling technique was time-consuming, a simpler and less costly method of county allocation of residential consumption was tested against the sample allocation. It appeared that the only piece of data on the cooperatives' activities reported on a county basis was miles of power line. This reporting is required by state law and is used as a basis for turning the revenues from the 2 per cent tax on cooperatives sales over to county governments and school districts. Allocation of total residential kilowatt-hours on the basis of the county pattern of the cooperative's powerline mileage gave results differing widely from those of the sample. In addition, staff at Central advised that the relation between miles of power line and kilowatt-hours sold was very indirect. Thus this allocation technique was rejected.

Central's data on kilowatt-hour sales for the "Large Power" (industrial) class of customer was readily available in a separate tabulation. Since there were only 58 consumers in this class, it was not necessary to take a sample. Consumption by these consumers accounted for almost half of Central's 1960 total kilowatt-hour sales.

The entire universe of 350 customers for the "Small Power" (commercial) class was also obtained, although this entailed sorting them out of the general customer alphabetical file. Two sampling techniques to allocate commercial kilowatt-hours to counties were tested against the universe allocation. Both a systematic sample like that used for residential customers, and a random sample using a random number table gave results differing greatly from that of the universe.

It thus appeared that the great diversity in size of annual kilowatt-hour consumption for individual customers in both commercial and industrial

classes blocked the use of statistical sampling techniques to get county allocations. The much greater degree of homogeneity among residential customers indicated that systematic sampling would be adequate. It must be noted, however, that such an inference regarding residential consumption was not tested against actual county distribution figures for the universe.

One of the investigators spent almost a week engaged in these experiments with Central's data. It was determined that any procedures using the cooperatives' accounting records were beyond the time and resources available to the investigators.

Questionnaire Method.--The only practical way to get some estimate of county allocation of rural electric cooperative sales was to use a mailed questionnaire. Each cooperative's questionnaire was tailor-made so that it included 1950 and 1960 Federal Power Commission Form No. 12 kilowatt-hour data for the four consumption classes, together with a listing of the counties included in the cooperative's territory. Managers were asked to provide rough estimates of the per cent of the kilowatt-hours for each consumption class that went to each listed county. Although this allocation procedure lacked precision, it appeared not unreasonable to assume that cooperative managers had a fairly good idea of how their business was distributed geographically.

Response to the questionnaire was excellent. All twenty-six of the cooperatives participating in the Oklahoma Association of Electric Cooperatives replied. Mr. Czar Langston, General Manager of that organization urged members to cooperate in filling out the questionnaires. Two Arkansas cooperatives and two in Texas marketing power in Oklahoma also replied. The coverage permitted by returns from the questionnaire was close to 100 per cent of total state cooperative sales (Table 4-1).

Miscellaneous

Data from four other power-supplying agencies were of some importance. The Southwestern Public Service Company, the Empire District Electric Company, and the Grand River Dam Authority supplied detailed breakdowns of their Oklahoma sales. Consultation with the staff of the Southwestern Power Administration indicated the desirability of using data from that agency's "Power Marketing Report" for 1960.

PART V

CONCLUSION

This report shows that it is possible to arrive at annual county-by-county estimates of electricity consumption by class of customer and that such data can serve as useful indicators of levels of economic activity. However, it is also clear that compiling electricity consumption data for county units is an extremely complex and time consuming task--a task which would have been considerably more difficult if applied to a state with more than two major investor-owned utilities. Moreover, the necessity of making untested assumptions in order to allocate some blocks of consumption to the county level reduces confidence in the data. Thus the most appropriate use of the data in this report is for aggregations of counties such as the Census State Economic Areas. Individual county figures should be quoted only with careful qualification.

It is the investigator's opinion that compilation of electricity consumption on an expanded scale on a county-by-county basis at this time is not economically feasible. However, the development and rapid dissemination of such data for broader geographic areas could be achieved with a minimum of effort. The spreading use of the Standard Industrial Classification for purposes of classifying customers may mean that much more information about short-run economic change can be obtained from utility data. Should the state of Oklahoma ever establish some sort of an economic data office, it would be desirable to work closely with appropriate officials of the state's utilities to establish regional reports.