HISTORY OF THE
AEIC LOAD RESEARCH COMMITTEE
1944 - 1985

PREPARED JUNE, 1985
PREFACE

Early interest in the field of electric loads solidified into the recognition that a thorough knowledge of customers and load behavior is paramount to the financial and operational health of the electric power business. Out of this need, the AEIC Load Research Committee was born.

This History illustrates the early activities of the Committee and the evolution of its subcommittee organizations. Committee functions associated with the development of education programs, the publication of technical reports, and the liaison with other groups are explored chronologically in order to emphasize the ever increasing importance of load research. A few of the Committee's observations and findings are highlighted to demonstrate the breadth and direction of the Committee's load research efforts.

The Committee has long been recognized as a leader able to face the dynamic influences that challenge the electric utility industry.
ACKNOWLEDGEMENTS

The HISTORY OF THE AEIC LOAD RESEARCH COMMITTEE: 1944 - 1985 was researched and authored by Mr. Lawrence J. Vogt of Southern Company Services. Ms. Lois E. Brandenburg of the Detroit Edison Company, Messrs. Raymond C. Williams and William F. Sundermeir of the Philadelphia Electric Company, and Mr. Theodore S. Fetter, the Committee Advisor, reviewed the History for accuracy and clarity. Many hours went into the production of this work which documents both the chronology and the scope of activities of the Load Research Committee. As Committee Chairman, I wish to express my deep appreciation to each of these contributions.

C. B. Grund, Jr. - Chairman
AEIC Load Research Committee
June, 1985
INTRODUCTION

"I conceive of this committee . . . as a body of men who individually and collectively would lead and coordinate the research for facts that will provide a thorough and reliable knowledge of trends in, and the general behavior of, the load characteristics of the more important services rendered by the industry, which is becoming more and more a vital phase of electric utility management. The important information sought . . . requires extensive studies and analyses for an understanding of the major and broad features of load behavior over wide ranges of customers' uses, so necessary in the proper discharge of responsibility of the industry. Such information is needed not only in the proper design of rates, economic studies involving cost to serve, and the establishment of sound sales policies, but is of equal significance in engineering and operating problems dealing with system planning . . ."

These impressions — so prevalent in the changing utility industry of the 1980's — were presented by Mr. Constantine Bary of the Philadelphia Electric Company at the 1944 annual meeting of the AEIC. At the time of that meeting, the newly-established Committee on Load Research, with Bary as the designated chairman, had not yet formally met as a working group. However, prior to the Committee's formation, a Special Committee on Load Studies had been commissioned to investigate and report on electric service load characteristics. This paper traces the development, activities, and accomplishments of the Committee from its earliest stages to the present.

THE SPECIAL COMMITTEE ON LOAD STUDIES

The Special Committee on Load Studies was established in 1938 and remained in existence until 1943. The representatives who participated on the Committee are shown in Table 1. Constantine Bary served as the Chairman throughout the Committee's existence. A report was prepared which addressed six studies, namely:

1. Load trends including trends in sales of electric energy per residential customer; peak day load curves and relative load growths by periods of the day; industrial load growth and hours use of billing demands; and sales of fluorescent lighting;
2. The results of power factor tests on a large number of small commercial light and power customers;
3. The distribution of small commercial customers (3 to 20 KW) by load factors;
4. The sales of principal types of series street lamps and the total lumens represented by these lamps;
5. A statement on the more important coincidence factor studies that were in progress; and
TABLE 1
SPECIAL COMMITTEE ON LOAD STUDIES
1938 - 1943

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. W. Andrews</td>
<td>American Gas and Electric Service Corporation</td>
</tr>
<tr>
<td>W. E. Barbour, Jr.</td>
<td>Boston Edison Company</td>
</tr>
<tr>
<td>C. W. Bary - Chairman</td>
<td>Philadelphia Electric Company</td>
</tr>
<tr>
<td>A. D. Caskey</td>
<td>Public Service of Northern Illinois</td>
</tr>
<tr>
<td>H. A. Enos</td>
<td>American Gas and Electric Service Corporation</td>
</tr>
<tr>
<td>E. J. Fowler</td>
<td>Commonwealth Edison Company</td>
</tr>
<tr>
<td>J. R. Gardner</td>
<td>Central Hudson Gas and Electric Corporation</td>
</tr>
<tr>
<td>R. E. Ginna</td>
<td>Rochester Gas and Electric Corporation</td>
</tr>
<tr>
<td>H. L. Harrington</td>
<td>Niagara Hudson Power Corporation</td>
</tr>
<tr>
<td>L. V. Nelson</td>
<td>Union Electric Company</td>
</tr>
<tr>
<td>E. H. Schmidtman</td>
<td>Wisconsin Electric Power Company</td>
</tr>
<tr>
<td>H. A. Snow</td>
<td>The Detroit Edison Company</td>
</tr>
<tr>
<td>E. T. Steel</td>
<td>Potomac Electric Power Company</td>
</tr>
<tr>
<td>A. H. Sweetnam</td>
<td>Boston Edison Company</td>
</tr>
<tr>
<td>F. M. Terry</td>
<td>Consolidated Edison Company</td>
</tr>
<tr>
<td>C. M. Turner</td>
<td>EBASCO Services</td>
</tr>
<tr>
<td>W. R. Waggoner</td>
<td>Commonwealth and Southern Corporation</td>
</tr>
<tr>
<td>R. R. Hermann - Correspondent Member</td>
<td>Northern States Power Company</td>
</tr>
</tbody>
</table>
(6) The correlation of more important service load characteristics of small commercial customers including the effect of light duty cooking load.

In summarizing its work, the Special Committee pointed out the possibilities of unprecedented changes in customer and system load characteristics and recommended that consistent study and interpretation by utilities be conducted to provide the information needed for intelligent planning for future developments. The Committee concluded that load research is fundamental to the continued welfare of the electric utility industry and that the interchange of load information among companies through a committee will have value.

EARLY ACTIVITIES

The AEIC Load Research Committee held its first organization meeting in April 1944 at which time its fundamental objectives were defined and a tentative program of near term activities was established (realizing, however, that the speed of execution of this program depended upon the time of termination of the war and the progress of industrial reconversion to peacetime activity). By the end of 1944, the Committee had prepared a report on the following subjects:

(1) A study dealing with the review of the work and the principal findings of the former Special Committee on Load Studies. This study was undertaken to bring together in one report the more important aspects of load characteristics (previously studied) so that such information could serve as a useful guide for post war planning and because such a report would be helpful in establishing a continuity of purpose between the past, the present, and the future.

(2) A study of readily available data on air conditioning load characteristics of residential and commercial customers to better understand the effects of this load on the electric utility industry.

(3) A study containing preliminary findings that could throw some light on the probable load characteristics which might be created by certain new appliances and new applications in the domestic field.

In addition, the Committee prepared a special report at the request of the Director of the Power Division, Office of War Utilities of the War Production Board with regard to the effects upon the load and energy requirements of utility systems of the then instituted Government's Order U-9, commonly referred to as the "brown out" order. The report was submitted to the Office of War Utilities in April, 1945.

During the latter part of the 1940's, the Load Research Committee implemented many studies and continued to publish reports for the benefit of the Member companies of AEIC. These reports addressed a wide spectrum of customer groups. For example, a 1946 report provided (a) a review of the effects of World War II on industrial class load
characteristics and the effects of war-time blackouts and government conservation programs during the war, (b) a compilation and analysis of readily available test data on load characteristics of the rural class of service, (c) a description of the methods used by different companies in analyzing their system total load curves by component load curves of various classes of service, and (d) a report on the progress of a study of individual residential customers' demands versus energy consumption.

With the advent of new domestic appliances, the "all-electric" home concept, and the electrification of industry and commerce, the Committee recognized the importance of properly appraising the impact of such load growth on the electric system. The basic feature in the economics of central station service was indicated to be diversity: diversity in the time of use of different appliances of individual customers, diversity between the maximum demands of customers within a given classification, and diversity in the peak loads of the different classes of service. Of paramount importance was the coincidence factor versus load factor relationship. The Committee emphasized the importance of continuously monitoring and evaluating these load characteristics as the working and living habits of the population changed.

By the end of the decade, the Load Research Committee was well established, and its contributions to the industry were widely recognized. As new uses of electric service came about, particularly in a few concentrated localities, the Committee had the opportunity to assemble information, conduct studies, and disseminate reports in advance of large-scale saturation of new appliances and equipment.

After eleven years with the Load Research Committee and its predecessor, the Special Committee on Load Studies, Constantine Bary stepped down as Chairman. In accordance with the practice of the other standing committees of the Association, the principle of an automatic rotation of the chairmanship was adopted. Table 2 lists the Committee members who have served as chairman.

SUBCOMMITTEE ORGANIZATIONS

Because of the numerous and varied research topics in which the Load Research Committee became involved, subcommittees were established. Initially, three general subcommittees were formed, namely:

1. Residential Loads Subcommittee,
2. Rural Loads Subcommittee, and
3. Commercial and Industrial Loads Subcommittee.

These subcommittees provided a means of categorizing research activities by class of customer. In addition, special subcommittees were commissioned to investigate specific types of appliances and equipment or related issues such as load trends, metering, and load characteristics.

Other special subcommittees were implemented to facilitate the documentation and dissemination of research results. In 1951 a special subcommittee published a Manual of Procedures on Load Surveys to assist the load researcher in all aspects of data collection and analysis. In
<table>
<thead>
<tr>
<th>YEARS SERVED</th>
<th>CHAIRMAN</th>
<th>COMPANY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1944-1949</td>
<td>C. W. Bary</td>
<td>Philadelphia Electric Company</td>
</tr>
<tr>
<td>1950-1951</td>
<td>F. M. Terry</td>
<td>Consolidated Edison Company</td>
</tr>
<tr>
<td>1952-1953</td>
<td>C. M. Turner</td>
<td>Cincinnati Gas and Electric Company</td>
</tr>
<tr>
<td>1954-1955</td>
<td>L. V. Nelson</td>
<td>Union Electric Company</td>
</tr>
<tr>
<td>1956-1957</td>
<td>E. H. Schmidtman</td>
<td>Wisconsin Electric Power Company</td>
</tr>
<tr>
<td>1958-1959</td>
<td>B. P. Dahlstrom</td>
<td>Public Service Electric and Gas Company</td>
</tr>
<tr>
<td>1960-1961</td>
<td>H. F. G. Main</td>
<td>Potomac Electric Power Company</td>
</tr>
<tr>
<td>1962-1963</td>
<td>R. C. Fosberg</td>
<td>Hartford Electric Light Company</td>
</tr>
<tr>
<td>1964-1965</td>
<td>E. H. Scott</td>
<td>Detroit Edison Company</td>
</tr>
<tr>
<td>1966-1967</td>
<td>J. W. Hummer</td>
<td>Iowa Power and Light Company</td>
</tr>
<tr>
<td>1968-1969</td>
<td>C. T. Loshing</td>
<td>Cleveland Electric Illuminating Company</td>
</tr>
<tr>
<td>1974-1975</td>
<td>J. A. Leo</td>
<td>Middle South Services</td>
</tr>
<tr>
<td>1976-1977</td>
<td>R. E. Ashburn</td>
<td>Long Island Lighting Company</td>
</tr>
<tr>
<td>1978-1979</td>
<td>S. J. Behrends, Jr.</td>
<td>Carolina Power and Light Company</td>
</tr>
<tr>
<td>1980-1981</td>
<td>G. Clarkson</td>
<td>Public Service Electric and Gas Company</td>
</tr>
<tr>
<td>1982-1983</td>
<td>L. E. Brandenburg</td>
<td>Detroit Edison Company</td>
</tr>
<tr>
<td>1984-1985</td>
<td>C. B. Grund, Jr.</td>
<td>Southern Company Services</td>
</tr>
</tbody>
</table>
1953, a special subcommittee prepared an Index of Reports to cross-reference reports and discussions on all data and information prepared or assembled by the Committee (including the Special Committee on Load Studies). The Steering Subcommittee, which evolved from the Standards for Preparing Reports Subcommittee, made recommendations to expand the scope of data made available in the Committee's Reports.

The subcommittee structure shown in Table 3 was simplified in 1959 by consolidation into five groups:

1. Residential and Rural Loads Subcommittee,
2. Commercial and Industrial Loads Subcommittee,
3. Specific Loads Subcommittee,
4. General Topics Subcommittee, and
5. Steering Subcommittee.

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**TABLE 3**

**SUBCOMMITTEE ORGANIZATIONS PRIOR TO 1959**

**GENERAL SUBCOMMITTEES**

- Residential Loads
- Rural Loads
- Commercial and Industrial Loads

**SPECIAL SUBCOMMITTEES**

- Air Conditioning Loads
- Customer Load Classification
- Electric House Heating
- Index of Reports
- Load Research Economics
- Load Trends
- Manual of Procedures For Load Surveys
- Metering Equipment
- Methods of Load Projection
- Power Factor
- Residential Lighting and Appliances
  (formerly Small Household Appliances)
- Small Nonmanufacturing and Manufacturing Customers
- Standards For Preparing Reports
- Steering
- Television Loads
- Water Heating Loads
The changes were intended to (a) lighten the burden on the subcommittee chairmen, (b) more evenly distribute work among the subcommittee members, and (c) permit more time of the full Committee to be devoted to creative discussion and consideration of the economic impact of load characteristics on the operation of a utility.

Because of an increasing involvement in company load projections by the Load Research Committee members, a Load Forecasting Subcommittee was established in 1970. This subcommittee set three goals: to analyze and summarize the experiences of the companies represented by the Committee, to become more familiar with the activities of other committees with an interest in load forecasting, and to analyze the effect of changing load characteristics and increasing appliance saturations and other load applications on customer class sales and system loads.

Another reorganization of the subcommittee structure was approved in 1977. The new organization consisted of:

1. Class Load Studies Subcommittee,
2. Specific Loads Subcommittee,
3. Elements of Load Subcommittee,
4. General Topics Subcommittee, and
5. Steering Subcommittee.

In 1979, the General Topics Subcommittee was renamed the Load Research Methods Subcommittee. Also, the Elements of Load Subcommittee was replaced by a new subcommittee on Load Research Planning.

The most recent reorganization of the subcommittee structure is shown in Figure 1. The subcommittee responsibilities are listed below.

Steering - Composed of Chairman, Vice Chairman, and past Chairmen of the Committee responsible for planning, organization, procedure, and membership of the Committee and its Subcommittees.

Agenda - Composed of Vice Chairman of the Committee and the Subcommittee Chairmen from Applications and Liaison, Methods and Planning, and Reports and Publications.

Applications and Liaison - Responsible for planning and organizing Committee-sponsored seminars, regional conferences, and workshops, as well as, providing for liaison with governmental and industry groups whose interests and proposals affect utility load research.

Methods and Planning - Responsible for investigating and proposing new techniques, methods of analysis, and applications of load research that address foreseeable national and industry problems including joint research, EPRI proposals, software design, meter requirements, and reporting standards.

Reports and Publications - Responsible for collecting, evaluating, editing, abstracting, and otherwise preparing for printing the annual reports of the committee as well as volumes resulting from the proceedings of workshops, seminars, and the output of other working committees.
FIGURE 1
CURRENT COMMITTEE ORGANIZATION

APPLICATIOMS AND LIAISON SUBCOMMITTEE

METHODS AND PLANNING SUBCOMMITTEE

REPORTS AND PUBLICATIONS SUBCOMMITTEE

STEERING SUBCOMMITTEE

CHAIRMAN

VICE CHAIRMAN

AGENDA SUBCOMMITTEE
EDUCATION PROGRAMS

In an effort to encourage company participation in load research projects and to provide a medium for the exchange of information, the Committee has initiated and sponsored various programs which have benefits for the industry as a whole. These programs, which are not restricted to AEIC member companies, consist of a national seminar, a national workshop, and regional conferences.

Load Research Seminar - The seminar was designed for companies desiring to begin a load research program and to train entry-level personnel in the fundamentals of load research. A poll of AEIC member companies indicated such an overwhelming interest in such a program that three regional seminars were initially scheduled. The first seminar was held in New Orleans in December 1973, the second in Newark in January 1974, and the third in Denver in February 1974. Seminars have been conducted annually since that time. In 1979, two seminars were held in order to meet the needs of the industry in dealing with the federal filing requirements of the Public Utility Regulatory Policy Act (PURPA). To date, over 750 people have attended representing investor-owned utilities, REA cooperatives, public power organizations and state and federal regulatory agencies.

Load Research Workshop - While the seminar served well as an introduction and overview of load research, a forum was needed to address topical interests in detail. To meet this need, a workshop was held in Philadelphia in September, 1977 to address the subject of sampling techniques. Starting in 1979, a workshop has been held each year to thoroughly explore a single topic selected by the Load Research Committee. These subsequent workshops have dealt with such topics as weather normalization of sales and demands, transferability of load data, and the application of load research to commercial marketing issues. Workshop participants prepare either a paper on the selected topic or a written critique of one of the papers. The papers and critiques are discussed at the workshop and published as a separate report of the Committee.

Load Research Conferences - To further promote the education of load research personnel and encourage the interchange of load research concepts, practices, and information among utilities having common interests, the idea of a regional conference was suggested. A trial conference was held in Atlanta in August of 1981. Papers on various topics were presented and participation was astounding. A second southeast conference scheduled in 1982 was joined by a northeast conference in Hartford. In 1983, the midwest conference was initiated in Chicago. These three regional conferences have continued on an annual basis with overwhelming support by the industry.

In addition to the Committee-sponsored programs, the AEIC Load Research Committee supports the annual EEI Rate Fundamentals Course by providing a load research instructor.
REPRESENTATIONS AND PUBLICATIONS

Over the years, the Load Research Committee has conducted numerous investigations of both end-use and customer class loads including load relationships, such as coincidence factor versus load factor. At its meetings, the Committee reviews and analyzes data and information submitted by the Subcommittees. The Committee as a body selects the material to be included with its annual report to the Association. While reports on customer and class load characteristics remain the backbone of the Committee annual reports, more emphasis has recently been placed on merit papers which explore new methods of investigation, analysis, and application of load research results.

Other documents of industry value have been published as well. For example, the previously mentioned Manual of Procedures on Load Surveys (1951) provides a detailed description of field test procedures and equipment, data interpretation and analysis, and specifications for testing specific utilization applications. In 1956, a special subcommittee distributed a paper on the value of load research in an effort to promote member companies to increase their use of research information as an aid to problem solving.

In 1964 the first volume of a series entitled "Applied Statistics in Load Research" was released. The second volume was printed the following year while the third and final volume of the series was released in 1974. This series was developed because the Committee felt the need to make a statistical evaluation of some of the procedures and methods utilized in testing and in the application of data. It was also desired to conduct an investigation of alternative and new methods of approach.

The proceedings of the workshop series have been printed in report form. These publications cover the following topics:

1. Development of Residential Class Load Curves,
2. Development of General Service Class Load Curves,
3. Weather Normalization of Demand and Energy Use Data,
4. Methods Used to Develop Current or Future Load Patterns Based on Historic or Borrowed Data,
5. Applications of Load Research Data, and

Most recently, the Committee prepared an Annual Directory of Load Research Projects, 1983-1984. The Directory includes load research study summaries submitted by AEIC member companies which address the major customer classes and several end-use groups. The summaries contain information concerning the design of the sample, the data collection hardware utilized, and other pertinent facts about the study.

Initially, Committee reports and other printed documents were issued exclusively to AEIC member companies. In 1954 the Executive Committee of the Association endorsed a recommendation by the Load Research Committee to make its reports available to nonmember companies as well. As a result, a new channel was opened for the Committee to better serve the needs of the industry.
LIAISON WITH OTHER GROUPS

Since its beginning in 1944, the Load Research Committee has been recognized as a leader in the field. This leadership has expanded over time, and today the Committee continues to work closely with many industry organizations and groups who are associated in some fashion with load research.

In 1956 the Committee collaborated with Middle West Service Company under the sponsorship of the General Electric Company in conducting a nation-wide survey of residential lighting. Twenty-two companies tested 131 homes. Consolidated Edison Company provided staff support for analyzing data and preparing reports.

In the early 1960's the Committee noted that data and reports which it received, originated predominantly in the eastern half of the United States. To increase contributions from the western sections of the country, utilities in the west serving at least 150,000 electric customers were invited to attend the 1963 fall conference in Phoenix. The effort was successful as data from the far west became available to the Committee, thus rounding out its representation on a national basis.

In 1966, the Load Research Committee and the EEI Rate Committee formed a joint task force to study the kilowatt-hour consumption of various residential appliances under differing conditions. The study was intended to be conducted on a national basis and in a manner similar to the residential lighting survey mentioned above.

The Committee's efforts to search for new ideas resulted in correspondence with the Electricity Council in England. A British expert from the Council attended a meeting of the Committee in Virginia in 1969. He addressed a topic which was quite familiar to the British and other European countries but was somewhat new in the United States: signal-controlled load shedding.

The Committee's research activities included involvement in electric vehicle studies in the early 1970's. The Committee proposed the use of standard load research techniques in conjunction with an Electric Energy Association testing of the Battronic electric delivery van. The Committee had three members on the Electric Vehicle Council in order to assess the impacts of this technology on the electric system.

In 1975, a NARUC resolution called upon EEI and EPRI to conduct a joint study on all aspects of peak load pricing. Three members of the Load Research Committee participated on a drafting committee since field experiments might be required. These representatives developed a standard procedure for testing time-of-day rates in field experiments. By 1977, approximately two-thirds of the Committee membership were involved in work relating to the NARUC-initiated studies.

A major study effort of heat pumps was planned in 1976 through a partnership of EPRI, Westinghouse, and the Load Research Committee. EPRI identified national and regional interests and priorities, thereby supplying direction for the study and secured funding of the required
metering equipment. Westinghouse standardized equipment applications to ensure consistent data gathering and served as coordinator with centralized data processing and analysis support. The AEIC member companies concentrated on the particular applications within their diverse service areas and contributed expert knowledge and experience in the conduct of load research investigations.

At the close of the 1970's, the Load Research Committee was aggressively active with other groups. For example, the Committee assisted the Department of Commerce in its compilation of abstracts of major load research studies that had been conducted throughout the country. The EEI/EPRI Rate Design Study considered load research to be of significant importance, and members of the Committee provided input and critique in support of the study efforts. Three members of the Committee served as consultants to the DOE-sponsored effort by Argonne National Laboratories to produce the comprehensive Load Research Manual.

In addition to the Committee efforts, as individuals, members have contributed their expertise and experience at the national level. They have served in leadership roles in the Rate Design Study, the EEI Rate Advisory Council, and the Utility Regulatory Analysis Program. Committee members have provided contacts and staff work on various aspects of congressional energy-related legislation.

Today, the Load Research Committee maintains strong working relationships with allies who are active in research, such as the Western States Load Research Group. Also, the Committee and EPRI have defined their roles in load research to ensure a strong, effective, and continuing interface between the two groups.

**OBSERVATIONS AND FINDINGS**

In the over 40 years of its organization, the Load Research Committee has investigated virtually all types of loads, including changes in the saturation of such loads and their economic impacts on the electric system. Load statistics have been determined by test and by calculation for individual appliances and equipment, end-use groups of loads, customer classes, and the system as a whole. Some studies have been implemented on an on-going basis in order to verify previous findings and/or monitor variations in load behavior.

Many socio-economic factors have affected the evolution of system load: inflation-driven rate increases, national energy conservation efforts, changes in customer working/living habits, and changes in the load mix. In light of such factors, the Committee attempts to rationalize the load trends which occur. In some instances, the Committee has reached a conclusion as to the type(s) of load growth which should be sought for the economic benefit of the utility. The following observations and findings represent a select few of the Committee's "revelations" concerning various end-use loads and load relationships. The year in which each conclusion or statement was proclaimed is indicated to provide perspective on the forward looking aspects of load research.
Heat Pump - The potential magnitude of this load is great as evidenced by the fact that if only 5% of the residential customers throughout the country were to be equipped with this device, an addition to the country's peak loads of around 7,000,000 KW would be obtained (1947) ... the importance of the heat pump in assisting in solving the energy crisis can be highlighted by some preliminary analysis of results from tests on electric furnaces which indicated a 4.6 KWH per degree-day usage, as compared to an equivalent size heat pump which indicated a 3.5 KWH per degree day usage -- a gain in efficiency of nearly 24% (1975).

Television - The use of television increases a customer's total consumption; however, the net increase is less than the energy use of the television itself due apparently to decreased radio and lighting use coincident with use of the television. Television has not materially changed the load curve shape or load factor of the residential class (1950) ... the average weekday and the Saturday load patterns are quite similar and show that, during the day, the use is higher in summer than in winter, but the evening use is higher during the winter. The average summer Sunday use is not too different from weekday use, but the Easter and Palm Sunday patterns show the effect of the interest in broadcasts in religious services and of programs related to these holidays. Television use is substantially off-peak for most systems, but significant changes in programming may change these characteristics (1960) ... the results of a color television test indicated the average annual use was 600 KWH, but there was a strong seasonal pattern. Daily use ranged from 1.40 KWH per day in July to 1.83 KWH per day in January. The average rating was 286 watts. The annual KWH divided by the wattage rating indicates an average annual viewing time of 2,097 hours or 40.3 hours per week (1974).

Ranges and Water Heaters - Electric range pre-war and post-war energy consumptions are approximately the same, while post-war diversified demand per range is less than pre-war demand; therefore, load factor increased indicating a change in living and working habits (1947) ... as far as these two major appliances are concerned, the best economic results for the utility are obtained from both ranges and water heaters (a) when they constitute a part of the total residential load, (b) when water heaters are operated on a controlled basis, and (c) when the ultimate market saturation of these appliances approximates the ratio of two ranges to one off-peak water heater (1948) ... residential customers with electric water heaters use about half of their energy in the water heater -- regardless of the amount of total energy consumption, except electric space heating customers (1968).

Air Conditioning - Commercial air conditioning group coincidence factors are relatively high while load factors are relatively low (on the order of 15%). As a result of correlations developed, it appears that 85% of the variation of KWH use is attributable to the effect of temperature with the remaining 15% due principally to the variations in relative humidity (1951) ... residential air conditioning is one load which varies between particular areas and for which generalizations must be carefully avoided. However, it is apparent that the hours use of demand for central units is greater than for window units. Promotion should be directed to the central units; however, each company should evaluate its own area before accepting this conclusion (1967).
Space Heating - With electric heat, the coincidence factor in a winter month will be close to 100%, whether the monthly load factor is 10% or 60%. Temperature is the controlling element with respect to coincidence factor (1953). Residential electric heat reaches its peak at 8:00 a.m., giving considerable diversity from normal peaks on either production facilities or distribution systems. It also has a high load factor in comparison with other residential loads. While variations in outdoor temperature undoubtedly affect the shape of the load curve, it is highly probable that the sharp rise in demand between 6:00 - 8:00 a.m. is largely caused by customers who raised their thermostat settings when they arose in the morning. The companion to this increase in demand is the reduction occurring between 10:00 p.m. and midnight when these same customers lowered their thermostat settings upon retiring in the evening. Educating heating customers to operate their systems at a constant thermostat setting throughout the entire day and night has been found advantageous by gas distributors and would be equally so for electric companies that serve appreciable amounts of electric home heating (1956). The ratio of maximum diversified demand to rated capacity is lower for resistance heating systems than for the air-to-air heat pump with supplemental resistance heating elements. This is undoubtedly due to the fact that heat pumps are normally operated from a single thermostat, whereas residential heating systems operate from several thermostats which builds up a diversity within the heating system (1958).

Heat Storage - Facts show that, from over-all economic considerations, it should be cheaper to shave peaks by providing heat storage in conjunction with electric heating systems at the utilization level of electricity supply than to accomplish its equivalent by providing production, transmission, and distribution facilities on an electric utility system. Savings in electricity cost-to-serve range from $160 to $250 a year per unit, and certainly the first cost of heat storage systems need not exceed $300 to $500 per installation (1959).

Refrigerators - A study developed a meaningful energy use statistic of 0.36 KWH per cubic foot per day for refrigerator-freezers which could apply to nationwide projections of energy consumption. In other words, based on these tests, this major residential load device increases its energy use in direct proportion to its rated size (1972).

Residential Load - The cumulative effect of load can be illustrated by starting with lighting and small appliances which operate at an annual load factor of less than 40% which is improved by adding a refrigerator but then reduced by adding a range. Annual load factor is increased by adding a dryer and reaches its maximum when a water heater is included. Space heating by means of a heat pump adds substantially to annual energy use but tends to reduce the load factor for the group. House heating by resistance panels requires more energy than a heat pump, and its greater contribution to the group demand is reflected by a reduction of the load factor, which is improved by the addition of cooling load (1957).
Coincidence Factor vs Load Factor - The relationship was first demonstrated in 1937. The shape of the original empirical curve was rationalized and verified from mathematical considerations. In the range of 40% - 70% monthly load factor for an individual customer, the group coincidence factor is relatively unaffected by an increase in the individual customer's monthly load factor (1947) ... Between 30% - 70% load factor, there is little change in coincidence factor (82% - 86%) which represents a "Zone of Opportunity" whereby additional use of electric service can be sold to customers within this range with a minimum requirement for new generation and transmission facilities (1953) ... A coincidence factor versus load factor curve was developed for separate summer and winter months. The average curves are not very far apart and summer observations are more widely dispersed (1962) ... An increase in the level of coincidence factors between 40% - 75% is attributed to the effect of the gradual reduction of working hours, which with an accompanying decrease in the length of the period of high load probability, should result in somewhat higher average levels of coincidence factors (1963) ... results of the present study indicate a lower coincidence factor in summer months for similar load factors as compared with the 1962-1963 study. The comparison of winter months shows the same general trend but conforms more readily to past patterns. It should be noted that, as compared to prior studies, the 1938-1939 period showed little or no rate activity; the 1951-1952 period was during a time of greater rate activity and industrial expansion due to the Korean War; the 1962-1963 period was one of promotional ratemaking; and the 1974-1975 period was one of volatile rate activity coupled with an industrial recession (1976).

Energy Use vs Demand Use - While average energy use has increased significantly, a major change in group maximum demands took place in the pre-war to post-war era (1950) ... distribution planning has profited from a conforming analysis of the energy use versus demand use relationship of residential customers. Several utilities have developed formulas for estimating transformer peaks from billing information. The result has been better utilization of transformer capacity at a substantial savings (1964).

Metering - The industry, in cooperation with manufacturers, has developed new meters and new techniques leading to automation in load research. These developments should in the near future bring about new economies in load research and greatly speed up the process of tabulating results. The efforts have led to the design and manufacture of digital-type load survey recorders, utilizing continuous tapes, which will permit full automation in processing. As a companion to the load survey recorders, translators have been developed which transfer demand data by time to punch cards. The present equipment is now undergoing some design changes and is being field tested by a number of companies (1959).

These examples illustrate the dynamic nature of both the individual and aggregate loads which the Committee has investigated in the past and will continue to study in the future. As the posture of the system changes, the Committee implements and maintains the load research
necessary for utility management to make prudent decisions about marketing programs, engineering applications, system planning, and other essential functions of the electric utility industry.

SUMMARY

The AEIC Load Research Committee has been in existence since 1944. Prior to the establishment of the Committee, a special committee on Load Studies (created in 1938) concluded that load research was essential in securing the necessary facts and knowledge fundamental to the continued welfare of the electric utility industry. To this end, the Load Research Committee has (a) conducted numerous studies of loads and load trends, (b) developed load research educational programs, (c) published reports and other documents, and (d) attained strong working relationships with other groups associated with load research. Recognized as a leader in the industry, the Load Research Committee looks forward to the challenges yet to be faced as a result of the ever-changing physical and economic conditions which exert such a powerful influence upon the electric power business.

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