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REGULARIZATION OF BUSINESS INVESTMENT IN THE ELECTRIC UTILITY INDUSTRY[1]

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Introduction

THIS PAPER explores the possibilities of regularizing business investment by the electric utility industry. The program for the conference adds, "as means of maintaining high productive employment in a private enterprise economy."

This ultimate goal of "high productive employment" as an incentive for regularization of investment is of less importance in the electric utility industry than in other industries, as data submitted later tend to show. Electric utilities already have achieved a relatively high stability of employment of operating personnel, and the impact of investment on wages and employment in electric utility operations is relatively less significant to the total economy than it is in other industries. Any contribution that electric utilities might make by stabilizing their capital expenditures would be a contribution to employment stability generally, and particularly to employment in the building of plant, or the manufacture of plant and equipment items, needed by electric utilities. These indirect employment effects would bulk larger than the direct effects on the number of employees used in utility operations.

Maintenance of employment in a private enterprise economy is interpreted as limiting our consideration to stabilization policies that are consistent, or not incompatible, with continued private enterprise. In other words, "stability must be operative with something like the present degree of freedom of economic behavior for the individual, the group, and the firm."[2] This puts a major "constraint" on stabilization policies, especially in the electric utility industry. It raises the question in my mind whether the stabilization of govern-

[1] While the opinions expressed in this paper are my own, I should like to acknowledge the assistance of C. K. Drake and D. G. Blair in the preparation of the appendices and the assistance of J. B. Liberman in the preparation of the text.

[2] George L. Bach, "Economic Requisites for Economic Stability," Proceedings of the American Economic Association, 1949, *American Economic Review*, vol. 40, May 1950, p. 156.

ment investment in electric power facilities is intended to be, or should be, excluded from examination.[3]

MEANING OF TERMS

Business investment is defined in the prospectus of this conference as "gross business expenditures on goods and services to be recouped in some future accounting period." In the parlance of the electric utility industry, this means expenditures for new or replacement plant and equipment that can be capitalized in the plant accounts. Such expenditures are usually summarized in a so-called capital or construction budget. Excluded from consideration are expenditures for spare parts, fuel, and various other operating and maintenance materials and supplies that are often used in more than one yearly accounting period. Such materials and supplies and fuel inventories are of appreciable dollar significance in the economy of the individual firm and of the industry (the electric power industry uses about 100 million tons of coal a year now), yet they are excluded from consideration here, because they are not treated as part of the construction budget. In some of the figures and much of the discussion I shall deal chiefly with expenditures for generating plant. These are a large proportion of the total. Expenditures for transmission plant, and to a lesser degree for distribution plant often follow or go along with generating plant additions.

Regularization, in the conference prospectus, "implies a reduction in the traditional cyclical concentration of expenditures in periods of business prosperity." No indication was given in the conference prospectus as to the degree of regularization of business expenditures on which it was desired that authors focus attention, except as this could be inferred from the stated goal of stabilizing employment. That goal seemingly contemplated equalizing capital expenditures in prosperity and depression, at least to the extent that

[3] Emile Despres, A. G. Hart, Milton Friedman, P. A. Samuelson, and D. H. Wallace, "The Problem of Economic Stability," *American Economic Review*, vol. 40, September 1950, p. 523: "Shifts in the timing of construction of some public buildings, river improvements, power facilities, public housing, and the like, would do no harm. The question is therefore raised whether such heavy public works cannot be hurried forward in case of a slump and slowed down in case of a boom, and thus used to temper economic fluctuations. In the past this sector of government expenditure has often behaved perversely, growing in prosperity and shrinking in slump. There would be widespread agreement among economists that the least that should be done is to correct this destabilizing tendency by a closer approach to regularization of government expenditure on heavy public works." (Cf. appendix to this paper, table 10.)

such expenditures contribute to steady employment. At the conference itself discussion ranged from "contracyclical irregularization," through stabilization, down to a policy of merely continuing the placement of new orders for productive facilities and equipment for a period of a few months up to a year after a cyclical downturn occurs, together with completing major commitments that had been made for such construction at the time the business cycle turned down. Had this last, very limited degree of regularization been specified in advance, much of the appraisal in this paper would have been omitted or materially altered, but I understood that an appraisal of policies that would effect a greater degree of stability was desired.

The electric power industry, as customarily thought of, has three main segments. The largest segment consists of investor-owned public utility companies, which serve the general public, directly or indirectly. In addition, some private manufacturing companies own their own electric power generation facilities. These privately owned industrial plants are ordinarily excluded from electric utility industry figures. Finally, there is a growing segment of the industry that consists of government-owned plants and transmission or distribution systems. These now constitute about 20 per cent of the electric power industry supplying the public. Sometimes the available figures relevant to the problem include, and sometimes they exclude, the government-owned part of the industry. Most of the compiled figures exclude industrially owned plants since they ordinarily do not provide appreciable amounts of energy for general public use. Wherever possible, the scope of the electric utility industry figures will be stated. For the most part, however, the relevant figures (except as to capacity and peak loads) are supplied by, and pertain to, only the investor-owned electric utility companies.

Some so-called electric utility companies also render other types of service, such as the provision of gas and steam heat. In most cases, however, relevant figures do not segregate such nonelectric utility operations, so that some data for the electric utility industry, particularly plant investment and income, include data relating to other utility operations, notably gas. According to the latest available Federal Power Commission (FPC) figures, such nonelectric or "other utility operations" contributed less than 10 per cent of operating income of electric utility companies and required somewhat more than 10 per cent of total utility plant.

LIMITATION OF ELECTRIC POWER

Although the writer was asked to analyze problems of regularization in both the electric and gas utility industries, it was deemed feasible to cover only the electric industry in any detail. The rapid expansion of the supplies of natural gas is causing a technological transformation, indeed a revolution, in the gas industry. Year-by-year data for all segments of the gas industry—natural, manufactured, and mixed—are not available for a period long enough to afford any reliable basis for appraising the problems or possibilities of future regularization. Furthermore, consideration of the regularization problems of the gas industry inevitably involves other industries, such as oil, that are highly competitive with gas in the market for space heating. With the recent trends in markets and prices of gas and other fuels, the problems of regularizing investment in the gas industry become too complicated, and the prospects too obscure, to consider it in addition to electric power.

GENERAL APPROACH

The general approach in this paper is partly from the industry point of view and partly from that of an individual utility company. There is no modal type of individual firm in the electric utility industry. Although individual utility companies have many common characteristics, there is nevertheless a great deal of variation among companies in such matters as size; capital structure; types of areas served; proportions of various classes of business; rate of growth; character of management and direction; and the physical, regulatory or legal, and political conditions under which service has to be rendered. It is very unlikely that the officers and directors of a single utility company would follow a regularization program against an opposite trend in the rest of the industry or could do so and still survive. Nevertheless, in appraising the feasibility of such a program the benefits and costs were viewed largely from the standpoint of the management of an individual public utility company, although some clues as to the relative importance of some types of benefits or costs were derived from industry-wide data.[4]

[4] I considered analyzing regularization programs in terms of *pro forma* statements of a sample public utility company assumed to follow this program. The approach was abandoned in view of the gaps in information, the assumptions required, and the question whether the result would be sufficiently representative of the industry. Obviously the regularization problems of an area type, integrated system such as that of the American Gas and Electric Company,

In general, this paper deals with a qualitative analysis, rather than a quantitative appraisal, of the benefits and costs of a regularization program. The size of the task of evaluation and the deficiencies of the available data preclude any other approach.

I shall deal with the subject in the following manner: Most of the relevant tabular and chart material has been concentrated in a statistical appendix with an introductory summary, on the basis of which some comments and generalizations in the text are ventured. These data and the text comments follow this pattern:

1. Description of some basic characteristics of the electric utility industry that affect regularization of plant expenditures
2. Capital budget procedures
3. The extent of irregularity in past plant expenditures, 1925-1950, and the outlook today
4. Chief advantages and disadvantages (benefits, and costs and barriers) of a regularization program
5. Summary

Some Basic Features of Utility Operations

BASIC CHARACTERISTICS OF ELECTRIC UTILITY INDUSTRY AFFECTING REGULARIZATION OF PLANT EXPENDITURES

Sometimes there is a tendency in interindustry economic comparisons to treat electric utilities as if they were like an ordinary goods manufacturer, for example, of automobiles. This has led to some mistaken ideas of how electric utilities can or should be operated. This is particularly true in the kind of problem here being considered. Therefore, it seems important to recall some of the special characteristics of electric utilties that have a bearing upon steadying plant expenditures. At least four are of special importance here:

1. *Regulation.* Electric utility companies are subject to government regulation that in degree and scope is not matched in any other industry, unless it be railroad transportation. Government regulates the affairs of investor-owned electric utilities on all levels—federal, state, and local. Such regulation includes control of prices, profits, security issues and sales, accounting, depreciation, extensions and grade of service, and even, in a very few jurisdictions, plant expenditures and capital budgets. Not all jurisdictions have the

with a service area extending over several states from Michigan to Virginia, are not the same as those of a system like the Consolidated Edison Company of New York, serving a single, concentrated metropolitan area.

same scope of regulatory power or exercise their powers to the same degree. Local governments have generally retired from the utility regulatory field, except as to use of public streets, although there are some areas, such as Ohio, where franchise regulation still plays a prominent role. Also, some subjects are under the control of two or more regulatory agencies at different levels of government.

Recent regulatory policies have produced a reorganization of the industry from the standpoint of management control. In the Public Utility Holding Company Act of 1935, the Congress declared a national policy of limiting holding company control of electric and gas utilities to moderate-sized, regional groups of interconnected utilities that can show justification for continued common control. Of the approximately 300 Class A and B electric utility companies now in existence, only a minority in terms of number, revenues, or assets are now under holding company control, whereas before 1935 a majority had centralized holding company control of financial and major operating policies. The majority of the larger electric utility companies are today directed and managed independently, each by its own board of directors and officers. In addition, there are hundreds of smaller utilities, whether privately, municipally, or cooperatively owned. This split-up of the industry's management organization has an important bearing upon the feasibility of a coordinated national policy of regularizing electric utility plant expenditures.

2. *Legal position as regulated monopoly.* Quite generally now, electric utilities have a practical, if not legal, monopoly of electric utility service to the general public within their service territories. This does not mean that utilities are without competition from alternative sources of energy—oil, gas, coal, etc.—or from customer-owned plants. It merely means that within service territories, to avoid wasteful duplication of investment, there is generally only one investor-owned utility licensed to serve the general public. However, on the horizon or nearer, there is always the potential government-owned or government-sponsored competition (e.g., TVA, BPA (now CPA), SWPA, REA cooperatives).

This privilege of territorial monopoly carries with it correlative duties. These include, of course, submission to government regulation and the duty of serving all applicants for service, without discrimination and upon demand. An electric utility that failed to keep reasonably abreast of public demands for service would risk forfeiture of its franchise.

3. *Service characteristics.* Electric utilities render an instantaneous service that cannot be stored directly in commercial quantities to meet later peak demands. The service is expected to be instantly available on demand of the customer in his premises. Advancing technology has brought the industry's service standards above the minimum requirements of regulatory bodies and has led customers to expect that service will be delivered at home, store, or factory at any time when demanded by the flip of a switch controlled by the customer. Moreover, the quality of that service is expected to permit electric clocks to keep accurate time.

These service characteristics and standards mean that electric utilities have to plan their plant expenditures to have capacity to meet peak loads, the sizes of which are essentially controlled by the users,[5] and to provide a margin of capacity above peak loads sufficient to take care of sudden upsurges of demand, emergencies due to weather or other factors, and errors in forecasting customer behavior.

4. *Large capital requirements.* Electric utilities require large plant investment per dollar of annual revenues. Customarily electric utilities require from $3 or $4 up to $6 or $7 of plant investment for each dollar of annual revenue, depending on whether the plant facilities needed include generating stations and whether these are predominantly steam- or hydro-powered. This means that each dollar of plant investment "turns over" on the average in from three to seven years (instead of a few months to a year, as for most manufacturing or trading corporations). This precludes financing any sizable construction budget out of depreciation accruals and undistributed earnings alone. The need for raising large amounts of new capital makes the maintenance of adequate earnings to cover

[5] Investor-owned electric utilities generally do a considerable amount of promotional work designed to locate new loads in the areas they serve and to stimulate new uses or more intensive uses of electricity by existing customers. To some degree, therefore, an electric utility company can by its own efforts affect its rate of growth and the combined efforts of all companies affect the industry's rate of growth. But the user chooses where to locate and whether to install a new process or to buy a new piece of equipment. The most striking instances in which individual utility companies have shaped their own growth are those where they have induced new industries, such as chemicals and light metals, which require large amounts of power, to locate in certain areas, bringing with them new residential and dependent commercial loads.

In Robert W. Hartley, *America's Capital Requirements: Estimates for 1946-1960*, Twentieth Century Fund, 1950, utility plant is included in the group the demand for which "over any given time would . . . be determined by the prevailing level of economic activity" (p. 7).

interest and pay dividends of prime importance in attracting capital on favorable terms in competition with unregulated industries.

Moreover, this large plant investment on the average has a relatively long life in service. It is not unusual to find in this industry properties with average over-all service lives of from thirty-five to forty years or more. With the importance of technology joined to long-lived plant and a fairly rapid rate of growth, plant obsolescence and inadequacy and the proper location and design of facilities become of unusual significance in the economy of the individual firm.

Finally, it should be remembered that the electric utility industry's large, long-lived plant requires a long planning cycle. It takes at least three years now to build and bring into operation a major new power plant, and the decision to build is itself preceded by many years of system planning.

CAPITAL BUDGET PROCEDURES

A study of the feasibility of a contracyclical or substantial regularization program must take into account the usual capital budgeting procedures of most utility companies. The large plant expenditures per dollar of revenue, regulatory limits on prices and earnings and consequent need to rely heavily on external sources of new capital, the need to keep plant capacity abreast of peak loads, and the length of time necessary between conception and operation (usually two or more years in the case of a new generating plant)—all these combine to make capital budgeting and fiscal planning major and crucial functions of an electric utility company. Most electric utility companies of any appreciable size have a yearly construction budget and also a medium-term budget of three to five years, usually expressed in dollar estimates. Many also have longer-term budgets in the sense of system plans for the physical development of generating and transmission plant at least, facilities that involve looking forward ten or more years. When a generating plant or transmission line is built, such facilities are expected to be used for several decades. Consequently, the location and design of such plant facilities involve decisions with which the utility company must live for a long period of time. Thus forward planning on a long-term basis is no novelty to utility company managements. It is a daily occupation for part of the management personnel. But it is also fraught with unusual hazards.

Though details will vary from company to company, the usual yearly budget procedure is about like this. In the early fall, each operating department of the company is asked to submit its construction budget requests for the following year or years. These are compiled by a budget officer (who may be the treasurer, comptroller, or another official) and reviewed by a budget committee. After conferences or exchange of memoranda, a proposed budget for the year is submitted to executive officers for review and approval.[6] If they agree, with or without revisions, the yearly budget is ordinarily submitted to the board of directors for information or approval. Usually at the same time a longer-term budget for three or five years is submitted for information.

An annual construction budget submitted for directors' information or approval is usually accompanied by a fiscal plan for raising the cash necessary to finance the budget. This financial plan summarizes the *internal* cash resources available for construction purposes, such as depreciation accruals and undistributed earnings; the *external* cash requirements; and suggested means for raising such new capital from outside sources.

It will be apparent that budget making involves a large number of persons and a wide range of supervisory personnel from directors down to department supervisors. Any regularization program would have to be approved by all these levels of management supervision.

Plant Expenditures, 1925-1950, and Future Prospects

In the statistical appendix to this paper I have brought together readily available data on plant expenditures, plant capacity, employment, and wages in the electric utility industry.[7] These statistics pertain to the period 1925-1950, but I have added some estimates for the future in table 29 and some projections to 1970 in table 25 and chart 3. Plant capacity data for 1925-1950 have also been rearranged to illustrate different possible regularization programs (see tables 20-23).

The period 1925-1950 was selected for review to determine the dimensions of several conceivable regularization policies and to

[6] This is usually subdivided into "carry-overs" from the preceding year (because of length of construction period in many cases), minor projects (each less than a certain sum, say, $5,000 or $10,000), and new major projects.

[7] Because of the decision to limit this paper to electric utilities, gas industry data are largely omitted, except where they are customarily combined with electric operating data because of the large number of combination electric and gas companies and the difficulties of separating gas operating data.

afford some basis in experience as an aid in evaluating the benefits, costs, and risks involved.

Consideration of such data warrants the following generalizations and conclusions, in my opinion:

1. Electric (and gas) utilities occupy a minor place in the total economy in terms of participation in national income, corporate sales (gross revenues), gross income, number of employees, and wages (tables 1-4, inclusive).

2. In terms of plant expenditures, as would be expected, electric (and gas) utilities, though still in a minor place, play a larger role (table 8).

3. On the other hand, electric (and gas) utilities are a relatively stable segment of the total economy. Measured by range of fluctuation from the average, electric and gas utilities, in most respects, have about half the range found in other industries. They have therefore already achieved in some measure what is sought by a policy of regularization. Plant expenditures by electric utilities, however, though less irregular than plant expenditures in industry generally, do not show the same degree of relative stability as other phases of their operations. In this respect electric utilities reflect their basic characteristics (tables 8, 10, 14, and 16, especially).

4. Electric utilities and the use of electricity have grown more rapidly than population or industry generally (tables 15, 16, 18, and 19).

5. Technological advance and the expansion of power system interconnections have improved plant use factors and reduced required margins or reserves of capacity, even with such rapid growth (tables 14 and 18).

6. The measurable benefits of a regularization program to electric utilities, judging from past experience, are chiefly in the form of lower over-all plant investments and fixed charges (taxes, interest and return, and depreciation), but the size of these benefits is dependent on how much construction costs fluctuate in sympathy with price changes, whether fixed charges move in sympathy and at a favorable pace with construction costs, and the nature and amount of offsetting costs.

7. Past conditions are not likely to be exactly repeated and thus do not afford convincing criteria of net benefits from a future regularization program.

8. Any future regularization program in the investor-owned electric utility industry must be flexible, easily adaptable to altered rates

of growth, and integrated with usual methods of forecasting and shaping construction budgets. In addition, if such a program were started within the next two or three years, consideration would need to be given to the unusual conditions today. Investor-owned electric utilities now, while in the closing stages of making up plant deficiencies arising from government wartime limitations, are also confronted with greatly stepped-up new capacity requirements arising from defense mobilization activities.

9. The economic and political conditions and outlook at the end of 1950 differ vastly from 1925 and need realistic appraisal in shaping a feasible regularization program for the future.

These highlights of differences in conditions in 1925 and 1950 need to be kept in mind:

1. In 1925 transmission interconnections had not progressed very far and boiler and turbine equipment was less reliable, which made relatively large capacity margins (30 per cent to 50 per cent) necessary to insure reliability of service. By 1950 electric power systems were largely interconnected and capacity reserves pooled, for emergency purposes at least; and although capacity margins on the average had dropped below 10 per cent in postwar years, construction programs were under way to bring these margins to a safer 12 per cent to 15 per cent.[8]

2. Today utilities operate in a "laboristic" or collective bargaining economy;[9] they face high and probably continuing high taxes relative to tax levels before 1930, but with the huge federal government debt and concern for interest rate levels, costs of capital (exclusive of the effect of income taxes on equity capital) are relatively low compared with 1925 and seem destined to remain at relatively lower levels than a quarter century ago.

3. Investor-owned electric utilities were in a stronger financial position in 1950 than in 1925; they were differently organized, had made greater technological progress, had relatively high load factors

[8] The margins of capacity shown in various tables in the statistical appendix are probably somewhat understated because generating plants frequently have some overload or peaking capability above the name-plate ratings used, combined non-coincident peak loads are usually more than coincident peak loads of individual electric systems, and interconnections and purchased power tend to reduce reserve capacity requirements and make available additional reserves to meet emergencies in a given area. For example, on this practical basis, the reserve margin in 1950 would be 10.5 per cent instead of 7 per cent as shown in table 14.

[9] Sumner H. Slichter, *The American Economy*, Knopf, 1948.

and customer usage, with the latter destined to grow at perhaps even a faster rate.

4. Utility companies in 1950 were subject to more government regulation than in 1925 and they also now have a substantial degree of competition from government-owned and -promoted enterprises. The 1950-1951 political environment, if not hostile or unfriendly, was at least not strikingly sympathetic to investor-owned electric utilities.

5. International political conditions favor a continued high level of economic activity and taxes and of government interest in, and concern for, plant expenditures, and consequently of government control of economic activities. Present economic and political forces seem to have built "cushions" into the economy that will help to moderate future fluctuations in prices, wages, costs, and business activities.

This 1950 environment compared with 1925 suggests that a future regularization program of plant expenditures for investor-owned utilities should have certain basic features if it is to win the votes of corporate directors or regulatory officials. It should be reasonably supported by estimates of benefits in excess of costs or calculated risks. It should be checked against an appropriate growth curve for population and usage, both in each utility system's service area or pool area and for the industry generally. It should be flexible, subject to quick expansion or contraction as against the rigorous requirements of a regularization program, depending on developments in government regulation or competition.

Advantages and Disadvantages of a Regularization Program

"The desirability, from the standpoint of maintaining high and stable employment and national income, of reducing the amplitude of these swings in capital expenditures by private firms is clear. Business leaders have quite generally recognized that they would make an important contribution to economic stability by smoothing out cyclical fluctuation in their capital expenditures, but the practical question for each firm to face is how far it can go in this direction without incurring too much cost and risk."[10]

I believe most utility company executives would agree with this generalization by Professor Dean. Most of them would be eager to make as much of a contribution to general economic well-being by steadying their plant expenditures as is practicable considering the

[10] Joel Dean, *Capital Budgeting*, Columbia University Press, 1951, p. 150.

risks involved and their responsibilities to investors. In a private enterprise system, a regularization program would have to realize benefits above its costs to the individual firm, but forward-looking utility managers would also have an eye for its long-run benefits, realizing that the prosperity of the individual firm is linked with the prosperity and well-being of the communities served.

Widespread adoption of steadier plant expenditures regardless of cyclical ups and downs might bring some important benefits to the electric utility industry. Electric plant expenditures, however, are not a sufficiently large proportion of total capital outlays in the national economy to be the sole, or a very important, balance wheel for stabilizing the entire economy (table 8, col. 10). For the individual utility, a steadier labor market would permit more carefully planned recruitment of new employees, possibly securing higher quality personnel, and would certainly make collective bargaining easier, tending to stabilize wage rates and costs of fringe benefits, in which utilities are in the vanguard among all industries.

Limiting regularization to completion of major commitments on capital outlays or continued placement of new orders for a few months up to a year after business downturn would make relatively minor contributions to "full productive employment," and then chiefly for equipment manufacturers and construction contractors, except where a utility employed its own construction forces.

The other utility gains from general stabilization of the economy merge into the direct benefits a utility company might secure by regularizing its own plant expenditures. Since these benefits often have their associated costs and risks, advantages and disadvantages will be considered together under several headings. In this analysis I have in mind greater degrees of regularization of plant expenditures over the business cycle than the limited degree outlined in the preceding paragraph.

SAVINGS IN CONSTRUCTION COSTS AND FIXED CHARGES

Theoretically, a saving in construction costs could be anticipated by transferring plant expenditures from periods of prosperity and higher prices to periods of depression and lower prices. Such savings would prove illusory, however, if fixed charges (or operation costs) increased in depressions in greater proportion than construction costs were reduced.

The saving from constructing more plant at lower prices may not be in reality so great in the future as it probably would have been in the 1925-1950 period. Not only may the swings in construction costs and materials and equipment prices be less from now on, but also it is uncertain to what extent organized labor in the construction trades will be willing to accept lower wage rates or to work harder or more efficiently when business activity falls off. In any event, this benefit tends to be reduced or eliminated, except as it arises from better work scheduling, by the stabilization of prices and wages promised by a regularization program in the economy as a whole.

Better work scheduling should enable some savings to be realized in construction costs in all three divisions—direct, indirect, and overhead costs—into which such costs are customarily divided in utility accounting. With a more stable demand for their products, equipment and materials manufacturers should be able to quote better prices, especially if standard equipment designs are used (see table 27). An electric utility, without the pressure to meet construction deadlines that has existed since World War II,[11] should be able to plan and schedule construction more efficiently, avoiding bottlenecks in the sequence of equipment installation. Better scheduling, with reasonable cooperation from union officials, should reduce the risks of jurisdictional stoppages, reduce waiting time, reduce overtime labor at premium rates of pay, and generally increase labor productivity and reduce today's stretched-out construction periods. These gains would also bring savings in both indirect costs (uses of tools and equipment, transportation time, stores expense, compensation insurance, etc.) and overhead costs (engineering, interest, taxes and insurance during construction).

Some additional savings might come from better organization for construction. At present, only the larger utility systems can afford to maintain their own construction organizations. A regularization program might open up this opportunity to some medium-size utility companies with resulting economy.

The present feverish construction activity jeopardizes the future realization of these possible construction cost savings. Several million kilowatts of capacity are now being built at high prices and costs that, under a regularization program, might be built at lower costs at some later time.

[11] At the present time, reduced margins of capacity, accelerated load growth, materials shortages, and prolonged periods of construction intensify the need and difficulties of maintaining construction schedules. The penalty for not doing so may be capacity shortages requiring load adjustment or curtailment, or deferment of operating economies.

Whether possible savings in construction costs would be offset by higher fixed charges of taxes, interest, or dividend requirements (depreciation charges will be dealt with later) is a matter for conjecture.

I believe that *tax rates* will not fluctuate as much as formerly.[12] Because of political conditions and the requirements of a "laboristic" economy, *tax burdens* on even the more stable incomes of electric utilities might become onerous in a period of depression, even without much upward revision of tax rates for raising funds to relieve unemployment. Increasing tax burdens combined with falling utility incomes would make the financing of a regularization program more difficult unless some tax relief to encourage regularized plant expenditures was provided.

Such tax relief might take different forms, such as accelerated amortization of forward expenditures for plant (as in the case of defense expenditures now) or deduction from taxable income of both interest and dividend payments on securities issued to finance forward construction. At present tax levels, relief of either kind would be the most welcome form of governmental assistance, provided such relief in needy cases were not translated quickly by regulatory bodies into lower rates not otherwise justifiable. Of the two forms of tax relief, however, the dividend deduction method, even if for a limited period of time (e.g., until the forward construction period is deemed ended), would be preferable to accelerated amortization for a fixed number of years. The latter method, even today, is not being used by some companies entitled to it because they do not anticipate any drop in the tax rate that will assist them in bearing full tax liability when the amortization period ends. But to other companies immediate tax relief would promise enough benefits from construction cost savings under a regularization program to induce them to risk losing those benefits in other ways.

It seems unlikely that the government would permit interest rates to rise as much as they did in the early 1930's. On the contrary, government monetary policy and the reduced demand for capital funds, together with the greater stability of utility bond interest coverage which would make them more attractive to investors, might

[12] If, from 1925 to 1950, utilities had followed program A (table 20) for regularization of building, a major part of any savings would have arisen from the large differences in tax rates in the earlier and later years of that period (table 12). A return to pre-1936 tax levels seems outside the range of probability today.

lower utility interest rates for a year or so after a downturn occurred. Sooner or later, however, judging from very recent experience, some rise in interest rates is likely (table 13). Whether this rise of interest rates and requirements, together with dividend requirements, on the new securities issued to finance regularized plant outlays in a depression would be enough to offset any probable savings in construction costs from a regularization program is debatable. A clear answer to such a question likely to be raised by corporate directors is not apparent from general analysis.

The chief barrier to a regularization program is the probability of higher dividend requirements in a depression. Utilities are already under pressure to regularize dividends so as to make their stock attractive to new investors. Imagine the position of an electric utility experiencing sagging revenues and income, but trying to keep up plant expenditures according to a regularization program and facing the need to pay additional dividends to attract new equity capital under depressed economic conditions! In these circumstances, the savings from continued plant expenditures must be demonstrably great; tax relief from the government must be sufficient and assured for a period of several years; adequate rate or other relief from a regulatory body must be assured and not reversible by a later commission; or funds to finance the construction must have been accumulated in advance expressly for this purpose or must be available for borrowing at not too high cost, before a board of directors of an electric utility would approve such a construction budget, especially if retrenchment were the general order of the day.

In general, therefore, potential tax savings and lower construction costs seem to be the chief net benefits from a thoroughgoing program.

SAVINGS IN OPERATING AND ENGINEERING EXPENSES

Some savings in operating and engineering costs should be realizable from the steadier pace of plant construction.

Four types of operating savings are potentially realizable. These are savings in fuel costs, labor expense, and production costs from base loading of newest units, and savings from more efficient maintenance scheduling.

Savings in fuel costs are apparent from the trends in pounds of coal per kilowatt-hour (table 17) if a regularization program advances installation of more efficient units.

Savings in generating labor expense are possible with advance installation of modern power plants. Properly designed plants can be operated and maintained by labor forces a great deal smaller than those in plants built even as recently as just before World War II.[13] There may be some greater total labor expense from having to man power plants earlier than on customary scheduling, but the expense per kilowatt-hour should be less.

It has long been the practice of electric utilities to operate their newest generating units as base load plants and thus to reap the benefit of their efficiency. This practice would surely continue. To the extent that new units are added ahead of normal load growth, they will be available for these economies.

The summer valleys in the typical electric load curve heretofore have been a boon to electric operating men because they gave time for taking generating and boiler equipment out of service for needed inspection and overhaul. Those valleys are filling up. Many utilities, if they do not have strong interconnections with adjacent systems, are hard-pressed nowadays to find the time to do this needed work. Under a regularization program, capacity margins would tend to be higher in depressions, and maintenance outages might be more economically scheduled to avoid paying premium wage rates for week-end work or overtime. The opposite condition would occur in prosperity when load growth reduced capacity margins to minimum safe operating levels.

With a steadier pace of plant construction, more orderly and careful system planning and engineering work can be arranged by utilities, and perhaps better design engineering work can be done by manufacturers. Orderly scheduling of such work, compared with meeting hurried-up deadlines, permits more alternatives to be explored to find the best answer to engineering and design problems. Because these engineering and design decisions are built into equipment destined to operate for several decades, the long-run potentialities in this area, though intangible, have appreciable significance.

In addition, a regularization program might expand the use of standardized equipment designs by electric utility systems that have a large enough scale of operation and rate of growth to require the successive installations of several duplicate generating units. Such

[13] Compare the latest compilation of steam station costs (by A. E. Knowlton, in *Electrical World*, vol. 136, no. 9, August 27, 1951, p. 108) with previous compilations and Federal Power Commission data, such as those in *Steam-Electric Plant Construction Cost and Annual Production Expenses, 1949*, FPC S-83. From a half man to a man per megawatt is current performance.

standardization of design and specifications permits savings in manufacturers' engineering costs that should be reflected in the price and installed cost of equipment.[14]

TECHNOLOGICAL DEVELOPMENT AND DEPRECIATION

Whether the technological benefits of a regularization program exceed the costs and justify the risks of increased obsolescence is debatable and difficult to appraise. Many intangibles are involved. Evaluation is particularly difficult when conjectures must be made about future inventions and technological progress. My conclusion, after weighing such pros and cons as are sketched herein, is that the promise of net gain is not sufficiently rosy or assured to persuade corporate directors or managers to build plants more than a few years in advance of immediate need.

A regularization program would probably yield some immediate benefits. Earlier installation of larger, more efficient generating units, and less overloading of equipment should bring an earlier realization of fuel savings (see table 17). The industry practice of operating newest equipment at base load would enhance this benefit. There is a gap between an average station heat rate of about 15,500 Btu per net kilowatt-hour (table 17) and the best station heat rate performance of around 9,400 Btu per net kilowatt-hour. To close this gap would be to realize substantial savings in fuel costs.[15] A regularization program would tend to narrow that gap by maintaining construction in times of reduced load growth and having a greater proportion of the total load carried on the more efficient equipment. The declining margin between average and best station heat rate will tend to minimize this effect as time goes on.

On the other hand, the timing of construction under a regularization program and the incentives to use standardized designs work at cross purposes with apparent cycles in technological development. The heart of a real regularization program is to build in advance of need during depressed economic conditions when prices and costs are lowest. At such times incentives for using standard designs of

[14] During and following World War II, some turbine manufacturers offered a standardized unit in certain sizes at a price saving. The cost side of this benefit, however, is perhaps some reduction in operating efficiency, compared with a custom-built machine. See, however, discussion in the next section.

[15] Some idea of the magnitude of such benefits may be gained from the fact that in 1950 more than 216 billion kilowatt-hours were generated in electric company power plants using coal or equivalent fuel at an average cost of $6.03 per ton, which at 13,000 Btu per pound is equivalent to twenty-three cents per million Btu. Edison Electric Institute, *Statistical Bulletin*, 1950, p. 20.

generating units, in order to minimize investment commitments and thereby minimize financing problems, are strongest. The pressure for standardized designs, however, tends to retard introduction of more efficient innovations.[16] The impetus for improved turbine design comes from either the utilities or the competition among manufacturers. The utility pressures are greatest when turbine prices and costs of construction are high and fuel and labor costs are high and rising. Conversely, manufacturers' competition, already keen, might become keener as turbine orders fall off. Nevertheless, from past experience the greatest rates of technological advance seem to have accompanied active demand and rising equipment prices, which have spurred a drive for greater efficiencies to offset higher investment costs by lower operating costs and to economize on use of higher-priced fuel and labor. This is indicated also by the trends in station heat rates derived from table 26, summarized below.[17]

Year of manufacture	*Average Btu per net kilowatt-hours of generation*	INCREMENTAL GAIN *Amount*	*Average per year*
1924	13,700	...	
1928	13,000	700	175
1929	11,800	1,200	1,200
1930	11,700	100	100
1936	11,300	400	66
1937	11,000	300	300
1940	10,750	250	83
1941	10,300	450	450
1949	9,400	900	111

Installing new generating capacity in reverse of this trend does not appear advantageous.

Looking ahead now, the hazards of increased obsolescence as a result of a regularization program loom large from two directions.

[16] This is disputed. See, for example, D. W. R. Morgan, vice-president, Westinghouse Electric Corp., "Central Station Steam Power Generation, Its Past and Prospects," *Westinghouse Engineer*, January 1950, p. 17; but cf. my table 26 and Philip Sporn, "Technological Progress," *Investment Dealers' Digest*, June 4, 1951, sec. 2.

[17] The turbine heat rates from the General Electric Company shown in table 26 were converted into station heat rates by using certain assumptions as to auxiliary power requirements, boiler efficiency, and realization ratios. In making these conversions, I am indebted to Professor Theodore Baumeister of Columbia University. Compare also the curve for heat rates of Westinghouse turbines on chart in Morgan, *op.cit.*, p. 16.

In view of defense mobilization, more high-efficiency capacity is being built today than would have been built otherwise, but the individual units are in some cases less efficient than the ones manufacturers are ready to build, because of the present need to conserve certain critical materials required for turbines with the highest temperatures and efficiencies. Efficiency sacrificed in the design of a power plant is lost for the rest of the plant's useful life. When the defense mobilization period is over, the stepped-up, newly installed capacity will operate at a lower level of efficiency than is now possible and this will be a permanent loss. This industry will then be in a stage when a regularization program would call for forward investments; we shall be within reach of higher levels of efficiency in materials and manufacturing know-how; and we shall have a partly obsolete plant. But the major incentives will be in the direction of tapering off, rather than continuing, investment; managers will recognize that still higher efficiencies will be obtainable later on, when load growth more amply justifies investment.

Another direction from which increased obsolescence hazards threaten is that of the domain of regulatory action. As will be developed later, forward investment under a regularization program increases the chances that regulatory bodies will cut out investment from rate bases, leading to foreshortened service lives, and hence higher depreciation rates and annual charges.

Finally, future prospects of technological advance are so far-reaching as to deter corporate managements from risking too much forward investment in plants of conventional design. One such potentiality is the atomic power plant, being developed thus far under government supervision and financing for national security reasons. Even though an atomic power plant competitive with a conventional fuel-power plant may be a decade or two away, we cannot ignore it when considering adoption of a regularization program.[18] Also, the technology of gas turbines using conventional

[18] See reports of U.S. Atomic Energy Commission, especially *10th Semi-Annual Report*, July 1951, pp. 19-27; Philip Sporn, "Prospects in Industrial Application of Atomic Energy," address to National Coal Association, N.Y., October 7, 1949; Lawrence R. Hafstad, director, Division of Reactor Development, U.S. Atomic Energy Commission, *Reactor Program of the Atomic Energy Commission*, American Petroleum Institute, Los Angeles, 1950; Sam H. Schurr and Jacob Marschak, *Economic Aspects of Atomic Power*, Princeton University Press, 1950; Walter Isard and Vincent Whitney, *Atomic Power, an Economic and Social Analysis*, Blakiston Co., 1952; H. A. Winne, vice-president, engineering policy, General Electric Co., "Atomic Energy's Place in your Plans," address to Electric Utility Executives Conference, June 1950. Cf. Walter Isard

fuels is still in its infancy.[19] Nor has the ultimate in efficiency of steam boilers and turbines using conventional fuels yet been reached, even though incremental progress from here on will probably be relatively small.[20] It is certainly reasonable to expect that steam turbines using conventional fuels with higher pressures than 2,400 psig. and higher temperatures than 1,200° F., and consequently with efficiencies much improved over the lowest turbine heat rates so far attained, will be developed within the next few years.

On balance, there is a real possibility that a thoroughgoing regularization program might mean a long-run technological loss.

FORECASTING ERRORS

A regularization program involves greater hazards in predicting power demands and area load growth. In the system planning by which individual utilities shape their capital budgets, the possibility of forecasting errors looms large. Such forecasting errors may relate either to total power demands or to area load growth. The former is important in determining capacity margins for which construction will be scheduled or system policies of interconnecting with other utilities. The latter type of error is particularly important in guiding forward investment in power plants under a regularization program.

It is customary in system planning to have an area load survey made before deciding upon the location of projected generating capacity. This is done to choose the location that will yield maximum efficiency and economy of generation and reliability of service with the minimum transmission and substation investment. Illustrations abound where marked and rapid shifts in area load growth occur. This is particularly likely on a system where a large, new, heavy-power-using industry locates, and workers and their families, together with satellite service industries and commercial enterprises, locate nearby. In this country—where labor mobility is relatively high; industrial growth is rapid; industrial decentralization is vigor-

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and John B. Lansing, "Comparisons of Power Cost for Atomic and Conventional Steam Stations," *Review of Economics and Statistics*, vol. 31, no. 3, August 1949.

[19] Morgan, *op.cit.*, p. 18, and various publications of the General Electric Co.

[20] G. B. Warren, General Electric Co., "Opportunities for Generating More Power Economically," address to Electric Utilities Executives Conference, June 1950; Morgan *op.cit.*; and C. M. Laffoon, "Evolution and Eventualities of A-C Generation," *Westinghouse Engineer*, January 1950, pp. 20ff.

ous and active, and might become more active as part of an industrial dispersion program to reduce vulnerability to atom bomb attacks; wage rates and transportation rates are rising; and wage differentials and transportation rate structures are changing—fairly rapid shifts or growth in area loads are highly probable.[21] The wrong location or timing in construction of a major power plant might easily cause serious obsolescence or inadequacy, additional transmission and distribution investments and losses, or impairments of service. Study of programs A, B, and C (tables 20-24), and charts 1-3 will show that a forward construction policy might require building plants as much as ten years ahead of load requirements. This is too long a period for a utility to risk construction on a prediction of area load growth even though over-all system plans, on paper or in network analyzer studies, may take a longer look into the future.

INCREASED DIFFICULTIES AND RISKS IN RELATIONS WITH GOVERNMENT

Perhaps the most serious drawbacks to a thoroughgoing regularization program are the problems utility companies face in dealing with regulatory or other government agencies. These may arise when companies seek authority to issue new securities to finance plant construction under a regularization program or to adjust rates to secure enough earnings to attract new capital; they may also arise in handling rate complaint cases or in determining depreciation rates and practices. Other problems and government agencies would be involved if regularization programs were to be induced by government offers of tax relief or other forms of assistance.

1. *Security issues.* Since electric utility companies would ordinarily be unable to finance regularized plant construction budgets only from internal sources or accumulated funds,[22] new security

[21] As an illustration of this variability in area load growth, the Ninth Semi-Annual Electric Power Survey, April 1951, by the Edison Electric Institute shows by regions the actual or forecasted percentage increases of peak loads from the preceding year. These range from a low of 1.8 per cent in region I in 1949 compared with 1948, to a high of 17.3 per cent expected in region V in 1951 compared with 1950. Comparing only highs and lows, six different regions or subregions occupied the high or low position in a five-year period (1950 compared with 1949 omitted on account of regional shifts of certain systems in 1950).

[22] It is conceivable that during boom periods a utility might fund a portion of its depreciation accruals or undistributed earnings to help finance plant expenditures during depression. Such funds as a practical matter would probably not be sufficient to avoid some new security issues in a depression. They

issues would be required. Generally these cannot be issued without the approval of a regulatory body, federal or state, or both. The statutes governing these security certificate applications usually require the regulatory agency to find that the funds to be raised are needed to serve the public and that the types of securities to be issued will result in a reasonably balanced over-all capital structure.

Such requirements in financing a regularization program pose difficulties for both the utility company and the regulatory body. Since the expenditures are to be made in advance of immediate need, the utility in meeting its burden of proof might have to produce evidence of long-run savings in construction and operating costs. To the extent that such evidence rests on forecasts of future load growth, future construction costs, future wages, future taxes, and future costs of capital, it is conjectural at best. A regulatory agency would have to be a firm believer in the worth of a regularization program to give this type of evidence credence in making its findings of the need for the capital funds sought.

The timing of such security issues also raises problems of what will be considered a balanced capitalization. Plant expenditures during depression could probably be financed more cheaply and easily by bond issues, but that is the very time when consumer and regulatory pressure on rate levels and sagging income makes additional fixed obligations inadvisable. In such circumstances a regulatory agency could hardly be blamed for frowning on a bond issue, except in case of dire necessity, and corporate managements would hesitate to increase equity securities at a time when market conditions were most adverse to such securities. Managers might avoid the risk of this impasse by refraining from commitments on regularized plant expenditures until they have secured assurance of regulatory approval of new security issues. If the new securities must be approved and issued before equipment orders are "firmed up," this lengthens the period during which new capital is not earning its way and puts an additional drag on the earnings from existing assets. If commitments are made without this assurance, the pinch on cash might imperil interest and dividends to existing investors. Any material reduction in dividends and in interest coverage would certainly block or handicap new capital issues to finance regu-

also run the risk of disapproval by regulatory bodies and perhaps adverse action on rate levels or on security applications during boom periods. Many utilities would like to regularize maintenance expenditures over a period of years but most utility commissions have frowned upon reserve funds for maintenance.

larized plant expenditures in depression periods, unless even with reduced dividends or coverage of interest the utility's securities still looked more attractive to prospective purchasers than other investment opportunities at the time.[23]

2. *Not used and useful property.* At some times a utility under a regularization program would have plant capacity considerably in excess of current needs.[24] In a rate proceeding, whether on motion of the commission or a complainant or on application by the company (to maintain interest and dividends to existing investors or to increase earnings to attract new capital), a question is likely to arise whether all plant included in the rate base is used or useful. If not so included, forward plant investments, or their equivalent in older property, are rendered nonrevenue-producing, and someone other than the rate payers would have to provide the means of paying fixed charges on the investment.[25] In a private enterprise system, that "someone" is the group of common stockholders unless retrenchments in other directions can be made. If retrenchment fails and common dividends are cut, the officers and directors are likely to have an uncomfortable time at the next stockholders' meeting. Of course, a utility company following a regularization program would presumably seek to justify advance investments in terms of the savings expected by not building later at higher costs. As already stated, however, this is not easily provable.

There are probably only a handful of commissions where a regularization program would receive sympathetic and favorable treatment now. Most commissions seem to look primarily at the past, the present, and the immediate future. They appear to believe that a long look into the future is too speculative for serious considera-

[23] Should dividends have to be substantially maintained in a depression in order to sell common stock for financing regularized capital outlays, the advantage of flexibility in the dividend rate would be lost and with it the inherent risk-bearing character of such securities. Common stock then would become more in the nature of an income debenture. If regulatory agencies reflected this thinking in their findings of necessary rates of return and allowable earnings, the utilities affected might find their credit impaired, the value of existing shareholders' investments considerably pared, and their ability to finance plant outlays in prosperous times appreciably weakened. It is believed that such effects also would not be in the long-run interest of users of electric power.

[24] Compare the capacities shown for 1960 in tables 25 and 29.

[25] One alternative would be to scrap the older investments and charge them off against depreciation reserves. These older plants, however, serve a useful function as "cold" reserve or for emergency use. To scrap them prematurely shortens their service lives and in the long run increases depreciation rates and costs.

tion. Claims for including property held for future use in rate bases are regarded skeptically. Thus a utility company having on its books a considerable investment of this kind and with a substantial margin of capacity runs a grave risk of having its rate base and allowable earnings cut back because of not used and useful property, or property in unreasonable amount held for future use or too remote future use. Since these excesses will arise in periods of depression when regulatory bodies are particularly sensitive to demands for rate reductions, the regulatory problem will be magnified. Moreover, there is no assurance that a subsequent commission will not reverse an earlier ruling.

If it be said that federal regulation would eliminate this rate-base risk—an assumption for which there is no present factual basis—many persons would probably say that "the cure is worse than the disease." It is by no means clear that federal regulatory agencies would view this rate-base problem any differently than many state commissions; in fact, today they would probably be stricter. Of course, if utilities generally, both government-owned and investor-owned, followed a regularization program and if regulatory personnel were educated in this program, this risk might be moderated; but, in view of the political pressures bearing on commissions, there is no assurance that the risk can be removed. The surest way for a utility company to protect itself against this risk is to deviate from a strict regularization program by placing a limit of, say, 25 per cent or 30 per cent on the margin of capacity above load that will be built into any system.

3. *Rate levels.* At times a utility might need higher rate levels to support regularized investment for future use and to permit outside financing of the construction. This would precipitate not only the rate-base problem just mentioned but also rate of return and cost allocation problems. It might also distort one company's rates compared with those of its neighbors (unless all those in a power pool followed the same regularization program). This is a frequent source of rate complaint, in which the utility must sustain the burden of proving its rates reasonable in a sometimes long and expensive proceeding. Were commissions to accept rate increases in a depression in order to support a regularization policy, they would have to abandon the contrary theory that rate decreases in depressions would help stimulate recovery.

One basic rate problem involved, as most commissions look at such matters, is whether present users may fairly be asked to pay in their rates to support investment intended primarily to benefit future users. Unless a utility could successfully establish that present rate payers would benefit on later reversal of the cycle by receiving lower rates or avoiding still higher ones, its application for a rate increase to support the regularization program might well be turned down. Without adequate earnings to attract new capital, the new capital will cost more or the utility will be forced to abandon regularization.

4. *Federal regulation.* Possible extension of federal jurisdiction over management's planning and capital budgeting is a very real risk facing electric utilities embarking on a regularization program. Federal supervision might seem an easy way to introduce regularized budgeting on a widespread basis. It might also seem a way to correct the divergent attitudes of state regulatory bodies, which otherwise might confuse the whole scheme. Finally, federal jurisdiction might be asserted to secure a national uniformity of policy or as a means of coordinating the regularization policies of holding company systems and independent operating utilities (including municipals and cooperatives, as well as federal projects, one might add).

The tenor of federal regulation in recent years has not been one to induce investor-owned utilities to accept federal jurisdiction, expanded to include budgeting, without resistance. I believe that the municipally- or state-owned systems would also be unhappy over, or resistant to, federal supervision. Only a few jurisdictions now have power to review utility capital budgets or pass upon plant expenditures before they are made. Usually budget making and construction are deemed to be inherently managerial functions. Even where control has been exercised in this area, commissions have been loath to substitute their judgment for that of the managers or directors.

In any event, the displacement of state control of utilities by centralized federal regulation is by no means clearly in the public interest. The relations of utility companies to their customers and to the communities served are essentially of local interest. Our existing regulatory structure has been built on the premise that these local relations can be better regulated by state agencies, which are closer to, more familiar with, and more sensitive to, local needs and desires. Until this scheme of regulation is shown to have failed to serve the public interest, there is every reason to preserve it and strengthen it where necessary. To scrap this going scheme of regulation and go to centralized federal control, as a means of securing a more widespread and uniform regularization program with a doubtful net gain, seems a dubious public policy.

5. *Government subsidies or ownership.* This analysis leads to the distinct possibility, if not probability, that some form of government subsidy or ownership would be deemed necessary to make a regularization program effective, if that program did not commend itself as a voluntary business policy to directors and officers of investor-owned electric utility companies. Government subsidies seem to be a logical conclusion if a regularization program does not clearly generate net savings in fixed charges or if regulatory agencies do not alter their thinking and their policies to make the program feasible without such support.

Government subsidies might take a number of forms or combinations of them. Since some subsidies take a form that is incompatible with "maintenance of the private enterprise system," I have assumed they fall outside the scope of this conference and therefore I do not discuss them in detail here, but merely point out why they would not recommend themselves to corporate directors or managers.

One form of government assistance to encourage steady plant expenditures—allowing certain deductions from taxable income—is discussed elsewhere (pp. 154-155). It is the one most compatible with a private enterprise system. It offers no inducement for government-owned projects, not subject to or assuming taxes, to regularize their plant expenditures. But it does involve rate reduction risks that make it unfeasible unless managers can be sure that regulatory bodies will be sympathetic or that future changes of tax laws will not rescind the allowable deductions.

Another form of subsidy is the direct advance of government funds to finance forward construction. Depending on how rapidly government advances are repayable, the level of interest costs, and whether property financed by a government advance can be included in a rate base, this might save for utility corporations some part of their costs of capital and most of their costs of financing. As a practical matter, however, it is unlikely that electric utility companies would seek such advances, for they would expect the government to insist on a voice in managing affairs affecting such advances.

Still another form of government subsidy might be direct government ownership and financing of the facilities advanced in the construction schedule. Advocates might justify this expenditure of public funds, under the general welfare clause of the Constitution, as a stabilization measure and also as a means of spreading more rapidly the benefits of wider use of electricity and thus improving standards of living and productivity.[26] Direct government building might be accompanied by government operation or by leasing to utility companies for operation, with or without an option to buy from the government in the future when the load catches up.[27] Such an arrangement resembles mixed ownership schemes in some European countries.

One difficulty in a regularization program that deserves mention is today's widely dispersed direction and management of the electric utility industry. Earlier I noted that, as a result of administration of the Public Utility Holding Company Act of 1935, business policies of electric utility companies are now set by a great number of independent boards of directors. Upon entering a period of depression, the bent of most corporate directors is for retrenchment and conserving cash rather than spending cash for new plant not immediately needed. That is the thinking also of most of their business associates outside the directors' room. This attitude of mind is a great obstacle to a corporate officer seeking board approval of a construction budget involving contracyclical plant expenditures, especially if external sources of new capital funds must be tapped.[28]

[26] There is a suggestion of this in Council of Economic Advisers, *Annual Economic Review*, January 1950, pp. 112ff.

[27] Were the government to embark on a national policy of regularization with power to build power plants and turn them over to utility companies for operation under lease-purchase arrangements or to review utility plans for plant construction, and utility companies did not accept tendered leases or submit construction budgets for review, the industry would run the risk of sharing the experience of some other industries, like steel, where government officials sought to participate in system planning functions and industry officials had different views of what was needed or feasible. Such a policy would appear to most corporate directors as a step toward nationalization, unless the lease-purchase arrangements were ironclad concerning the right of full private operation and acquisition.

[28] This resembles the "increased risks of inadequate liquidity" referred to in Dean, *op.cit.*, p. 159. I do not discuss Professor Dean's "reduction in present worth" factor (pp. 155-157) because it seems to me more applicable to an unregulated enterprise than to a regulated electric utility with limited earning power.

Also I omit discussion of such factors as incentives under a regularization program and the kind of price system useful to guide economic behavior in a private enterprise system, since these are phases more appropriately discussed by others.

I also omit discussion of the economic policy aspects of a regularization program intended to diminish the practice of capital formation by internal financing at the sole discretion of inside boards of directors and to increase resort to new capital markets as a proving ground for plant expenditure programs. Investor-owned utilities already meet these standards.

Summary

Is a program of regularizing plant expenditures of electric utilities feasible?

My answer to this question is in three parts:

1. A *thoroughgoing* regularization program for electric utility plant expenditures is not practically feasible *unless*:

a. There is a simultaneous, substantial reduction in cyclical fluctuations in nonutility industries;

b. There is a net saving in average annual capital costs big enough to prevent rate rises or, alternatively, regulatory policies of rate-making and securities control are adjusted;

c. Tax policies are adjusted;

d. Government adopts a regularization program for its own electric plant construction;

e. Separate, independent utility companies or systems, certainly those pooling their capacity and reserves in a so-called "power pool," can be effectively coordinated or persuaded to adopt a common policy; and

f. Keeping up construction in a serious depression is the only way to minimize the risks of progressive socialization of the industry, were the government to try to do the construction work itself.

If these conditions are not or cannot be substantially met, the risks or the odds that the costs may exceed measurable benefits are too great to warrant a comprehensive regularization policy, either voluntarily adopted or government-enforced or -subsidized.

2. An immediate *limited* regularization program is feasible for an individual company or system, along with others in the same power pool, willing to take a forward-looking attitude and actively to promote and secure regulatory acceptance of the policy. The limits are of two kinds: type of plant and scale of construction.

a. *Type of plant.* For individual system policy, a regularization program should be limited to general plant and to generating and associated transmission plant. Plans for general plant, such as service, commercial and office buildings, can be made and placed on a shelf for use in depression periods. Generating and transmission plant may be standardized to some extent without undue sacrifice, but in a feasible regularization program there need to be maximum and minimum limits within which regularization should be confined.

b. *Scale of construction.* In my judgment a regularized program of generating plant construction should be held between a lower

limit of 10 to 12 per cent margin of capability above load and an upper limit of 25 to 30 per cent. Such limits are applicable to the average, area type power system with substantial interconnections with adjacent systems. Though subject to change as conditions change, these limits are placed now with realization of the difficulties of evaluating benefits and costs of regularization and in the light of accelerated growth of load and capacity now forecast and scheduled through 1954 (chart 3 and table 25), the unevenness of annual rates of change (table 14), and the length of periods of construction of power plants. When the upper limit of the zone—25 or 30 per cent—is reached or forecast, the construction program should be pared down; when the lower limit of about 10 to 12 per cent is reached or forecast, the construction program should be stepped up.

The foregoing limited regularization program is, of course, predicated on a continuance of present methods of load and capacity forecasting. The present prospects are that after 1954, generating plant construction between these limits should be pitched to a 5 per cent industry growth curve (with appropriate modification for individual system growth different from the industry average), unless defense mobilization continues at about the same pace as now or unless a "hot war" or other similar stimulant of power demand spurs a more rapid rate of growth.

Even such a limited regularization program will not be easy to sell to boards of directors or to regulatory bodies. But within what seem to me practicable limits it is a forward-looking program, and by its vigorous execution investor-owned electric utilities could make some significant contribution to general economic stability and the general welfare.

3. At the beginning of this paper, reference was made to an even more limited concept of regularization. This might involve carrying out major commitments already made when a downturn of business appears, and continuing to place new orders for plant outlays for some limited period after the downturn appears.

In 1930 the electric power industry, responding to an appeal by President Hoover, voluntarily placed in effect in substantial measure a limited regularization policy of this kind. As tables 6, 7, 8, and 10 make very clear, construction expenditures by electric utility companies were greater in 1930 than in 1929, in contradistinction to the drop (table 8) in gross private investment, new construction, and producers' durable equipment. In 1931 electric utility expenditures dropped, but only to approximately 67 per cent of the 1929 level, whereas gross private domestic investment, new construction, and investment in producers' durable equipment, 1931, were only 34 per cent, 46 per cent, and 49 per cent of their respective 1929 levels.

Lacking readily available information on the placing of new orders for electrical equipment following the stock market collapse in 1929, I can only assume that though placements of new orders probably did not continue at the same pace as in 1928 and 1929, expenditures on which major commitments had been made at the turn of the cycle were evidently continued, as the above data indicate.

The result of this policy of utilities, as shown in table 14, was to add in 1930 over 500,000 more kilowatts of generating capacity than were added in 1929, thus increasing the margin of capacity above load from an already large proportion of 55 per cent of load in 1929 to 64 per cent in 1930.

When these excess margins of capacity seemed destined to increase further as industrial load (table 16) declined at an accelerated rate, it was only prudent to cease placing new orders. The electric utilities would have faced even more serious financial predicaments than actually occurred, if new orders for generating equipment had continued to be placed. As can be seen from table 11, the stability of nonindustrial use, particularly in homes, saved the industry from an even more drastic drop in earnings than actually occurred.

Comparing this experience with the short, sharp recession of 1937-1938, dollar expenditures by electric utilities in 1938 showed a relatively small decline compared with industry generally (table 8), although the kilowatt capacity and margin of capacity above load continued to increase (table 14). In fact, electric plant expenditures as a proportion of gross private domestic investment trebled in 1932 over 1931 and 1930 and were six times the proportion in 1929 (table 8). In 1938, private electric plant expenditures as a proportion of gross private investment increased by 50 per cent or more over the proportions in 1937 and 1936.

For most utilities this limited regularization policy would probably be found more feasible and acceptable than that recommended in section 2 of the answer at the beginning of this summary. Indeed, part of it would be made effective almost automatically. This limited regularization policy, even to the extent of continuing some new orders for several months up to a year after the business cycle turned down, would probably be regarded as feasible wherever margins of capacity above load at the time of the business downturn were like those now existing (on the order of 7 to 10 or 12 per cent), where margins were unlikely to go above 30 per cent, and as long as the economy is in a better position than formerly to cushion the severity of any business decline.

But I believe that more than this limited regularization policy is practicable for electric utilities. Within a 10 per cent to 30 per cent margin of capability above load, with careful analysis and vigorous execution, regularizing plant outlays could be shown to be feasible to boards of directors and to make some significant contribution to the general welfare.

Statistical Appendix

Tables 1 to 29 of this appendix assemble some of the readily available data deemed relevant to an analysis of regularization of electric plant investment and to an evaluation of some of the potentialities of such a policy. Charts 1 to 5 show some growth trends. Data were obtained largely from published sources, as noted in the tables. They pertain mostly to the period 1925-1950, although in tables 22 and 25 and chart 3, some projections into the future are shown. The section of this paper entitled "Plant Expenditures, 1925-1950, and Future Prospects" summarizes certain high lights gleaned from these tables. Here we give a few more particulars.

The tables indicate:

1. The importance and relative stability of electric and gas operations in the total economy (tables 1-4);
2. Available data on past electric plant expenditures and construction cost trends (tables 5-10);
3. Electric utility income, depreciation, taxes, capital costs and yields (tables 11-13);
4. Plant capacities, peak loads, capacity margins, and growth (tables 14-19);
5. Trends in generating plant efficiencies and prices (tables 17, 26 and 27);
6. Comparison of hypothetical regularization programs, 1925-1950 (tables 20-23); and
7. Comparison of future growth trends and estimates of future growth (tables 25, 29).

A few comments on the tables and the shortcomings of the data seem appropriate, if only to serve as a guide for discriminating use.

In a few tables the amplitude of fluctuation is indicated by computing the ratio of the high minus the low to the average. This method is borrowed from Professor Dean.[29]

Variations are found among the several estimates of plant expenditures by electric utilities (table 5). Such variations between industry- and government-compiled data are most striking from 1935 to 1943 and may be due to differences in scope of the industry or whether only nonmilitary expenditures were included.

Certain comparative deficiencies of Edison Electric Institute (EEI) data for the present purpose should be noted. Published EEI statistics on electric plant expenditures include expenditures by municipal plants and cooperatives, but they do not include federal government expenditures on power facilities, whether in multiple-purpose projects or not. Nor will plant expenditure data tally with the data on plant capacity and peak loads. The latter reflect all enterprises contributing to the public supply, including municipals, cooperatives, and federal power projects like TVA. EEI data (table 11) are only for investor-owned companies as of the end of 1950. Any attempt to compare such data with those for government-owned enterprises is handicapped by the fact that accounting for costs and income by government and cooperative enterprise is not on a comparable basis with that by investor-owned utilities.

Capacity margins shown in various tables beginning with table 14 tend to be understated.[30]

The electric power industry is growing rapidly and vigorously. This is indicated by growth of per capita capacity, peak load, generation, and sales (tables 18, 19). For the future, remember the large margins of error shown by some population forecasters.[31]

As a test check of how certain types of regularization programs would have worked out in the past, and as an aid in evaluation, programs A, B, and C were set up and analyzed. For study purposes the following periods were chosen:

1926-1930, relatively stable construction costs
1931-1933, reduced construction costs
1934-1940, rising construction costs

[29] Dean, *op.cit.*, p. 156.

[30] See EEI, *Statistical Bulletin*, 1950, p. 15, and notes to table 5, p. 20.

[31] Joseph S. Davis, *The Population Upsurge in the United States*, War-Peace Pamphlet no. 12, Food Research Institute, Stanford University, 1949; Harold F. Dorn, "Pitfalls in Population Forecasts and Projections," Frank W. Notestein, "The Population of the World in the Year 2000," and Joseph S. Davis, "Population and Resources," *Journal of the American Statistical Association*, September 1950, pp. 311, 335, 346.

1941-1945, higher costs under wartime conditions
1946-1950, sharply rising construction costs

The actual additions of generating capacity and the test programs were put on a comparable basis, costwise, by using a schedule of yearly construction costs per kilowatt on a judgment basis. These unit costs were applied to actual and programed yearly additions to get a general idea of potential savings in construction costs from using one program or another. Applying these unit investment costs to the same amount of capacity additions (47 million kilowatts), in order to compare the investment costs of the different construction schedules, gave the following comparison:

Actual	$6,529.7 million
Program A	5,839.9
" B	6,345.0
" C	6,486.0

Breakdown of the estimated investments in the construction periods noted above showed that program A (an equal amount of building each year) would have saved the most investment but probably would have created the greatest regulatory risk because of excess capacity margins. Program C seemed the most flexible and realistic.

The difference in the capacity situation and outlook now and in 1925 makes any regularization program distilled from 1925-1950 experience of little use for the future. Even studies in the recent past of future capital requirements seem obsolete today.[32] Recognizing the hazards in forecasting future developments, various estimates for 1960 nevertheless are assembled in table 25.

[32] The Twentieth Century Fund study of future capital requirements was tied to a population estimate for 1950 of 144.6 millions. The U.S. census showed 151.1 millions.

TABLE 1

RELATIVE IMPORTANCE AND STABILITY OF INVESTOR-OWNED ELECTRIC AND GAS UTILITIES IN THE TOTAL ECONOMY, AS INDICATED BY NATIONAL INCOME 1929-1949

(population and dollar figures in millions)

	NATIONAL INCOME					NATIONAL INCOME PER CAPITA		ELECTRIC AND GAS AS PERCENTAGE OF ALL INDUSTRIES
	Current dollars		*1926 dollars*[a]		ESTIMATED POPULATION	*1926 dollars*[a]		
	All industries	*Electric and gas*	*All industries*	*Electric and gas*		*All industries*	*Electric and gas*	
1929	$ 87,355	$1,640	$ 91,663	$1,720	121.8	$ 753	$14	1.9
1930	75,003	1,606	86,809	1,858	123.1	705	15	2.1
1931	58,873	1,562	80,648	2,139	124.0	650	17	2.7
1932	41,690	1,404	64,336	2,167	124.8	516	17	3.4
1933	39,584	1,237	60,067	1,877	125.6	478	15	3.1
1934	48,613	1,359	64,904	1,814	126.4	513	14	2.8
1935	56,789	1,405	70,986	1,756	127.3	558	14	2.5
1936	64,719	1,522	80,098	1,884	128.1	625	15	2.4
1937	73,627	1,662	85,315	1,926	128.8	662	15	2.3
1938	67,375	1,639	85,719	2,085	129.8	660	16	2.4
1939	72,532	1,716	94,075	2,226	130.9	719	17	2.4
1940	81,347	1,860	103,495	2,366	132.0	784	18	2.3
1941	103,834	2,002	118,939	2,293	133.2	893	17	1.9
1942	137,119	2,113	138,784	2,139	134.7	1,030	16	1.5
1943	169,686	2,178	164,584	2,112	136.5	1,206	15	1.3
1944	183,838	2,167	176,767	2,084	138.1	1,280	15	1.2
1945	182,691	2,240	172,676	2,117	139.6	1,237	15	1.2
1946	180,286	2,569	148,874	2,121	141.2	1,054	15	1.4
1947	198,688	2,748	130,630	1,807	144.0	907	13	1.4
1948	223,466	3,079	135,352	1,865	146.6	923	13	1.4
1949	216,831	3,485	139,891	2,248	149.2	938	15	1.6
High-low difference	$183,882	$2,248	$116,700	$ 646		$ 802	$ 5	
Average	$112,569	$1,961	$109,267	$2,029		$ 814	$15	
Ratio	1.63	1.15	1.07	0.32		0.99	0.33	

[a] Reflects use of Dept. of Labor wholesale price index (composite).

Sources: Dept. of Commerce, *Survey of Current Business*, July 1947 and July 1950 National Income Supplements. Population from Bureau of the Census, *Current Population Reports*, August 17, 1950, series P-25, no. 44; and Dept. of Commerce, *Statistical Abstract of the United States, 1949*. "Electric and Gas" refers to investor-owned companies.

TABLE 2

RELATIVE IMPORTANCE AND STABILITY OF INVESTOR-OWNED ELECTRIC AND GAS UTILITIES IN THE TOTAL ECONOMY, AS INDICATED BY CORPORATE SALES 1929-1949

(population and dollar figures in millions)

	CORPORATE SALES					CORPORATE SALES PER CAPITA		
	Current dollars		*1926 dollars*[a]		ESTIMATED POPULATION	*1926 dollars*[a]		ELECTRIC AND GAS AS PERCENTAGE OF ALL INDUSTRIES
	All industries[b]	*Electric and gas*	*All industries*[b]	*Electric and gas*		*All industries*[b]	*Electric and gas*	
1929	$138,640	$2,851	$145,477	$2,991	121.8	$1,194	$25	2.1
1930	118,294	3,136	136,914	3,629	123.1	1,112	29	2.7
1931	92,365	3,129	126,527	4,286	124.0	1,020	35	3.4
1932	69,185	2,873	106,767	4,433	124.8	856	36	4.2
1933	73,027	2,770	110,815	4,203	125.6	882	33	3.8
1934	89,553	2,947	119,563	3,934	126.4	946	31	3.3
1935	101,953	3,111	127,441	3,888	127.3	1,001	31	3.1
1936	119,462	3,283	147,849	4,063	128.1	1,154	32	2.7
1937	128,884	3,458	149,344	4,006	128.8	1,160	31	2.7
1938	108,551	3,360	138,106	4,274	129.8	1,064	33	3.1
1939	120,789	3,505	156,665	4,546	130.9	1,197	35	2.9
1940	135,248	3,708	172,071	4,717	132.0	1,304	36	2.7
1941	176,181	4,007	201,811	4,589	133.2	1,515	34	2.3
1942	202,777	4,132	205,240	4,182	134.7	1,524	31	2.0
1943	233,435	4,368	226,416	4,236	136.5	1,659	31	1.9
1944	246,737	4,687	237,247	4,506	138.1	1,718	33	1.9
1945	239,512	4,818	226,382	4,553	139.6	1,622	33	2.0
1946	270,898	5,058	223,698	4,176	141.2	1,584	30	1.9
1947	347,801	5,676	228,666	3,731	144.0	1,588	26	1.6
1948	381,300	6,295	230,951	3,812	146.6	1,575	26	1.7
1949	359,678	6,748	232,050	4,353	149.2	1,555	29	1.9
High-low difference	$312,115	$3,978	$130,480	$1,726		$ 862	$11	
Average	$178,775	$3,996	$173,810	$4,148		$1,297	$31	
Ratio	1.75	0.99	0.75	0.42		0.66	0.35	

[a] Reflects use of Dept. of Labor wholesale price index (composite).
[b] Excludes industrial division of finance, insurance, and real estate.
Sources: Same as those for table 1.

TABLE 3

RELATIVE IMPORTANCE AND STABILITY OF ELECTRIC AND GAS UTILITIES IN THE TOTAL ECONOMY, AS INDICATED BY CORPORATE PROFITS AND DIVIDEND PAYMENTS, 1929-1949
(dollar figures in millions)

	Corporate profits						*Net corporate dividend payments*		
	BEFORE FEDERAL AND STATE INCOME AND EXCESS PROFITS TAXES			AFTER FEDERAL AND STATE INCOME AND EXCESS PROFITS TAXES					
		Electric and gas			*Electric and gas*			*Electric and gas*	
	All industries		*Percentage of all industries*	*All industries*		*Percentage of all industries*	*All industries*		*Percentage of all industries*
1929	$ 9,818	$ 565	5.8	$ 8,420	$495	5.9	$5,823	$449	7.7
1930	3,303	436	11.5	2,455	370	15.1	5,500	601	10.9
1931	−783	350	..	−1,283	293	..	4,098	526	12.8
1932	−3,042	295	..	−3,424	232	..	2,574	471	18.3
1933	162	251	154.9	−362	196	..	2,066	333	16.1
1934	1,723	387	22.5	977	316	32.3	2,596	411	15.8
1935	3,224	366	11.4	2,259	300	13.3	2,872	428	14.9
1936	5,684	436	7.6	4,273	355	8.3	4,557	446	9.8
1937	6,197	543	8.8	4,685	441	9.4	4,693	485	10.3
1938	3,329	494	14.8	2,289	395	17.3	3,195	459	14.4
1939	6,467	578	8.9	5,005	465	9.3	3,796	483	12.7
1940	9,325	708	7.6	6,447	526	8.2	4,049	483	11.9
1941	17,232	832	4.8	9,386	528	5.6	4,465	472	10.6
1942	21,098	904	4.3	9,433	491	5.2	4,297	386	9.0
1943	25,052	991	4.0	10,646	524	4.9	4,493	400	8.9
1944	24,333	956	3.9	10,808	503	4.7	4,680	421	9.0
1945	19,717	955	4.8	8,502	492	5.8	4,699	414	8.8
1946	23,464	1,150	4.9	13,881	714	5.1	5,808	470	8.1
1947	30,489	1,087	3.6	18,549	669	3.6	6,561	510	7.8
1948	33,880	1,115	3.3	20,911	679	3.2	7,467	509	6.8
1949	27,625	1,268	4.6	17,024	766	4.5	7,821	576	7.4
High-low difference	$36,922	$1,017		$24,335	$570		$5,755	$268	
Average	$12,776	$ 698		$ 7,185	$464		$4,577	$464	
Ratio	2.89	1.46		3.39	1.23		1.26	0.58	

Source: Dept. of Commerce, *Survey of Current Business,* July 1947 and July 1950 National Income Supplements.

TABLE 4
RELATIVE IMPORTANCE AND STABILITY OF ELECTRIC AND GAS UTILITIES IN TOTAL ECONOMY, AS INDICATED BY EMPLOYMENT AND WAGES
1929-1949

	NUMBER OF FULL-TIME EMPLOYEES				WAGES AND SALARIES		WAGES AND SALARIES AS PERCENTAGE OF CORPORATE SALES	
			Per million dollars of corporate sales					
	All industries (THOUSANDS)	*Electric and gas* (THOUSANDS)	*All industries*	*Electric and gas*	*All industries* (MILLIONS)	*Electric and gas* (MILLIONS)	*All industries*	*Electric and gas*
1929	35,295	465	255	163	$ 50,165	$ 739	36	26
1930	33,245	473	281	151	45,894	758	39	24
1931	30,107	437	326	140	38,886	699	42	22
1932	26,661	384	385	134	30,284	592	44	21
1933	27,100	371	371	134	28,825	539	39	19
1934	30,230	386	338	131	33,520	583	37	20
1935	31,651	392	310	126	36,508	623	36	20
1936	34,824	418	292	127	41,754	675	35	21
1937	36,187	437	281	126	45,948	745	36	22
1938	34,582	423	319	126	42,812	740	39	22
1939	36,038	423	298	121	45,745	747	38	21
1940	37,981	443	281	119	49,587	795	37	21
1941	42,556	454	242	113	61,708	849	35	21
1942	47,630	422	235	102	81,887	861	40	21
1943	53,782	373	230	85	105,647	852	45	20
1944	55,154	353	224	75	116,924	871	47	19
1945	53,315	359	223	75	117,673	932	49	19
1946	46,962	429	173	85	111,227	1,157	41	23
1947	46,977	470	135	83	122,059	1,407	35	25
1948	47,836	506	125	80	134,357	1,631	35	26
1949	47,767	521	130	77	134,172	1,759	37	26
High-low difference	28,493	168	260	88	$105,532	$1,220		
Average	39,804	426	260	113	$ 70,266	$ 884		
Ratio	0.72	0.39	1.00	0.78	1.50	1.38		

Source: Same as that for table 3.

TABLE 5

COMPARISON OF ESTIMATES OF CONSTRUCTION EXPENDITURES BY ELECTRIC AND GAS UTILITIES, 1920-1950 (millions)

	TWENTIETH CENTURY FUND (FOR ELECTRIC COMPANIES)			Edison Electric Institute (for electric companies)[a]	DEWHURST AND SEC		
	Total (1)	*Plant* (2)	*Equipment* (3)	(4)	*Electric* (5)	*Gas* (6)	*Total* (7)
1920	$475	$285	$190		$437	$117	$ 554
1921	310	185	125		276	88	364
1922	439	260	179		395	178	573
1923	794	470	324		723	168	891
1924	908	540	368		827	255	1,082
1925	846	465	381	$ 846	766	217	983
1926	766	426	340	766	704	312	1,016
1927	779	429	350	779	722	322	1,044
1928	756	420	336	756	679	265	944
1929	811	445	366	811	774	232	1,006
1930	872	435	437	872	835	221	1,056
1931	542	270	272	542	538	145	683
1932	281	140	141	281	257	84	341
1933	164	80	84	164	113	44	157
1934	175	85	90	175	126	53	179
1935	237	122	115	237	190	60	250
1936	373	150	223	373	300	90	390
1937	554	220	334	554	470	97	567
1938	505	265	240	505	400	78	478
1939	507	300	207	507	350	73	423
1940	640	310	330	640	490	83	573
1941	698	305	393	698	590	92	682
1942	522	250	272	522	460	118	578
1943	306	166	140	306			540
1944	291	161	130	291			490
1945	444	244	200	444			630
1946				850			1,040
1947				1,598			1,900
1948				2,357			2,680
1949				2,844			3,140
1950				2,621			3,170

[a] Includes investor-owned electric utilities, municipal plants, and rural cooperatives.

Sources: Cols. 1-3 from Robert W. Hartley, *America's Capital Requirements: Estimates for 1946-1960*, Twentieth Century Fund, 1950; col. 4 from Edison Electric Institute, *Statistical Bulletin*, 1950; cols. 5-7, through 1942, from J. F. Dewhurst and associates, *America's Needs and Resources*, Twentieth Century Fund, 1947, pp. 756-757; thereafter, from Securities and Exchange Commission Statistical Series, Release No. 998.

TABLE 6
CONSTRUCTION EXPENDITURES BY ELECTRIC UTILITY COMPANIES
1925-1950
(millions)

	INCLUDING MUNICIPALS AND RURAL COOPERATIVES[a]					
	Total	*Production*	*Transmission*	*Distribution*	*General*	*Total excluding municipals and rural cooperatives*[a]
1925	$ 846.0	$ 281.0	$173.3	$ 297.7	$ 94.0	$ 761.4
1926	766.4	285.3	173.5	214.8	92.8	689.8
1927	779.4	230.3	161.8	302.0	85.3	701.5
1928	755.9	239.0	177.6	268.4	70.9	680.3
1929	810.7	260.4	156.3	320.0	74.0	729.6
1930	871.6	294.0	138.3	354.6	84.7	784.4
1931	541.9	160.6	90.9	239.4	51.0	487.7
1932	281.2	53.0	51.0	157.2	20.0	253.1
1933	164.0	24.7	25.6	102.9	10.8	147.6
1934	175.2	21.1	34.2	106.8	13.1	157.7
1935	237.1	37.8	35.3	146.7	17.3	213.4
1936	372.5	46.8	45.1	256.6	24.0	335.2
1937	553.7	126.8	78.6	312.0	36.3	500.0
1938	505.2	149.8	51.0	272.9	31.5	434.0
1939	506.5	94.5	57.8	320.1	34.1	387.0
1940	640.4	207.0	79.1	320.5	33.8	536.0
1941	697.9	237.9	98.0	315.0	47.0	590.0
1942	522.2	228.0	88.0	191.2	15.0	456.0
1943	305.9	156.9	44.2	97.7	7.1	275.0
1944	291.3	97.0	50.0	135.3	9.0	262.0
1945	443.8	120.8	71.0	235.0	17.0	350.0
1946	850.0	212.0	115.0	482.0	41.0	650.0
1947	1,597.5	492.0	214.0	819.0	72.5	1,235.0
1948	2,357.0	905.0	300.0	1,075.0	77.0	1,830.0
1949	2,843.5	1,249.0	310.0	1,200.0	84.5	2,191.0
1950	2,621.0	1,089.0	305.0	1,127.0	100.0	2,050.0
Total	$21,337.8	$7,299.7	$3,124.6	$9,669.8	$1,243.7	$17,687.7

[a] Does not include large government power projects.

Sources: Municipal and rural data from staff of Edison Electric Institute; other data from EEI, *Statistical Bulletin*, 1950.

TABLE 7
EXPENDITURES FOR NEW PLANT AND EQUIPMENT
BY U.S. BUSINESS, 1929-1951
(dollar figures in millions)

	TOTAL EXPENDITURES BY ALL INDUSTRIES	ELECTRIC AND GAS		RAILROADS		MANUFACTURING	
		Amount	*Percentage of total*	*Amount*	*Percentage of total*	*Amount*	*Percentage of total*
1929	$ 9,165	$1,006	11.0	$ 840	9.2		
1930	7,610	1,056	13.9	865	11.4		
1931	4,712	683	14.5	360	7.6		
1932	2,608	341	13.1	164	6.3		
1933	2,137	157	7.3	101	4.7		
1934	3,080	179	5.8	218	7.1		
1935	3,740	250	6.7	166	4.4	$ 1,796	48.0
1936	5,076	390	7.7	306	6.0	2,452	48.3
1937	6,732	567	8.4	525	7.8	3,332	49.5
1938	4,520	478	10.6	238	5.3	1,832	40.5
1939	5,200	480	9.2	280	5.4	1,930	37.1
1940	6,492	540	8.3	440	6.8	2,580	39.7
1941	8,190	710	8.7	560	6.8	3,400	41.5
1942	6,110	680	11.1	540	8.8	2,760	45.2
1943	4,530	540	11.9	460	10.2	2,250	49.7
1944	5,210	490	9.4	580	11.1	2,390	45.9
1945	6,630	630	9.5	550	8.3	3,210	48.4
1946	12,040	1,040	8.6	570	4.7	5,910	49.1
1947	16,180	1,900	11.7	910	5.6	7,460	46.1
1948	19,230	2,680	13.9	1,320	6.9	8,340	43.4
1949	18,120	3,140	17.3	1,350	7.5	7,250	40.0
1950	18,560	3,170	17.1	1,140	6.1	8,220	44.3
1951[a]	23,910	3,540	14.8	1,520	6.4	11,920	49.9

[a] Estimated.

Sources: For 1929-1940, electric and gas data from J. F. Dewhurst and associates, *America's Needs and Resources,* Twentieth Century Fund, 1947; other data from Dept. of Commerce letter to E. W. Morehouse, July 13, 1951. For 1941-1951, all data from Securities and Exchange Commission, Statistical Series, Release No. 998.

TABLE 8

COMPARISON OF GROSS PRIVATE DOMESTIC INVESTMENT IN NEW CONSTRUCTION AND IN PRODUCERS' DURABLE EQUIPMENT WITH ELECTRIC UTILITY PLANT EXPENDITURES, 1929-1950
(dollar figures in millions)

	Gross private domestic investment (1)	New construction (2)	Producers' durable equipment (3)	ELECTRIC EXPENDITURES Total (4)	Private (5)	Ratios (per cent) Cols. 4 ÷ 1 (6)	Cols. 5 ÷ 1 (7)	Cols. 4 ÷ 3 (8)	Cols. 5 ÷ 3 (9)	Cols. 5 ÷ (2+3) (10)
1929	$15,824	$ 7,824	$ 6,438	$ 811	$ 730	5.13	4.61	12.60	11.34	5.12
1930	10,209	5,566	4,926	872	784	8.54	7.68	17.70	15.92	7.47
1931	5,362	3,561	3,162	542	488	10.11	9.10	17.14	15.43	7.26
1932	886	1,668	1,781	281	253	31.72	28.56	15.78	14.21	7.34
1933	1,306	1,142	1,783	164	148	12.56	11.33	9.20	8.30	5.06
1934	2,807	1,420	2,531	175	158	6.23	5.63	6.91	6.24	4.00
1935	6,146	1,890	3,351	237	213	3.86	3.47	7.07	6.36	4.06
1936	8,318	2,783	4,531	372	335	4.47	4.03	8.21	7.39	4.58
1937	11,440	3,687	5,444	554	500	4.84	4.37	10.18	9.18	5.48
1938	6,311	3,309	3,975	505	434	8.00	6.88	12.70	10.92	5.96
1939	9,917	4,899	4,577	506	387	5.10	3.90	11.06	8.46	4.08
1940	13,949	5,566	6,108	640	536	4.59	3.84	10.48	8.78	4.59
1941	18,334	6,784	7,676	698	590	3.81	3.22	9.09	7.69	4.08
1942	10,873	3,951	4,857	522	456	4.80	4.19	10.75	9.39	5.18
1943	5,709	2,549	4,082	306	275	5.36	4.82	7.50	6.74	4.15
1944	7,714	2,817	5,706	291	262	3.77	3.40	5.10	4.59	3.07
1945	10,733	3,934	7,545	444	350	4.14	3.26	5.88	4.64	3.05
1946	28,726	10,291	12,328	850	650	2.96	2.26	6.89	5.27	2.87
1947	30,187	13,904	17,080	1,597	1,235	5.29	4.09	9.35	7.23	3.99
1948	43,124	17,716	19,893	2,357	1,830	5.47	4.24	11.85	9.20	4.87
1949	33,028	17,268	19,473	2,843	2,191	8.61	6.63	14.60	11.25	5.96
1950	60,200[a]	22,900[a]	26,100[a]	2,621	2,050	4.35	3.41	10.04	7.85	4.18
High-low difference	$59,314	$21,758	$24,319	$2,679	$2,043					
Average	$15,505	$ 6,610	$ 7,879	$ 827	$ 675					
Ratio	3.83	3.29	3.09	3.24	3.03					

[a] Preliminary.

Sources: Cols. 1-3 from Dept. of Commerce, *Survey of Current Business*, Supplements; cols. 4-5, from Edison Electric Institute, *Statistical Bulletin*, 1950. See also table 6, above.

TABLE 9
COMPARISON OF CONSTRUCTION COST INDEXES
1925-1950

	HANDY-WHITMAN INDEX (1911:100)		HANDY-WHITMAN INDEX Converted to 1940:100			BUREAU OF FOREIGN AND DOMESTIC COMMERCE (1940:100)	
	Production plant (1)	Transmission and distribution (2)	Production plant (3)	Transmission and distribution (4)	General plant (5)	Construction and resource improvements (6)	Machinery and equipment (7)
1925	217	193	82	92	112	102	108
1926	218	190	83	91	109	102	104
1927	216	184	82	88	108	102	101
1928	216	188	82	90	107	102	101
1929	226	201	86	96	109	104	105
1930	223	184	85	88	104	100	96
1931	216	184	82	88	95	91	88
1932	196	171	75	81	87	79	84
1933	200	173	76	82	91	85	83
1934	224	187	85	89	99	92	91
1935	226	187	86	89	95	88	90
1936	230	193	87	92	94	90	91
1937	249	214	95	102	101	98	100
1938	257	209	98	99	100	97	100
1939	260	209	99	99	100	97	99
1940	263	210	100	100	100	100	100
1941	277	218	105	104	107	109	104
1942	286	229	109	109	113	126	108
1943	286	228	109	108	114	132	108
1944	286	236	109	112	118	130	108
1945	293	243	111	116	121	134	109
1946	342	265	130	126	136		
1947	384	320	146	152	157		
1948	440	345	167	164	178		
1949	458	353	174	168	183		
1950	469	367	178	175	192		

Sources: Cols. 1-5 based on index of electric utility costs compiled by Whitman, Requardt and Associates; combination of North Atlantic and North Central divisions. Cols. 6-7 from Robert W. Hartley, *America's Capital Requirements: Estimates for 1946-1960*, Twentieth Century Fund, 1950.

TABLE 10
CONSTRUCTION EXPENDITURES BY ELECTRIC UTILITIES IN CURRENT AND CONSTANT (1940) DOLLARS, 1925-1950
(millions)

	IN CURRENT DOLLARS, EXCLUDING MUNICIPALS AND RURAL COOPERATIVES[a]				IN CONSTANT (1940) DOLLARS, EXCLUDING MUNICIPALS AND RURAL COOPERATIVES				MUNICIPALS AND RURAL COOPERATIVES	
	Total expenditures (1)	*Production* (2)	*Transmission and distribution* (3)	*General* (4)	*Total expenditures* (5)	*Production* (6)	*Transmission and distribution* (7)	*General* (8)	*Current dollars* (9)	*Constant dollars* (10)
1925	$ 761.4	$ 281.0	$386.4	$ 94.0	$ 846.6	$342.7	$420.0	$83.9	$ 84.6	$ 92.0
1926	689.8	285.3	311.7	92.8	771.3	343.7	342.5	85.1	76.6	84.2
1927	701.5	230.3	385.9	85.3	798.4	280.9	438.5	79.0	77.9	88.5
1928	680.3	239.0	370.4	70.9	769.4	291.5	411.6	66.3	75.6	84.0
1929	729.6	260.4	395.2	74.0	782.4	302.8	411.7	67.9	81.1	84.5
1930	784.4	294.0	405.7	84.7	888.3	345.9	461.0	81.4	87.2	99.1
1931	487.7	160.6	276.1	51.0	563.4	195.9	313.8	53.7	54.2	61.6
1932	253.1	53.0	180.1	20.0	316.0	70.7	222.3	23.0	28.1	34.7
1933	147.6	24.7	112.1	10.8	181.1	32.5	136.7	11.9	16.4	20.0
1934	157.7	21.1	123.5	13.1	176.8	24.8	138.8	13.2	17.5	19.7
1935	213.4	37.8	158.3	17.3	240.1	44.0	177.9	18.2	23.7	26.6
1936	335.2	46.8	264.4	24.0	366.7	53.8	287.4	25.5	37.3	40.5
1937	500.0	126.8	336.9	36.3	499.7	133.5	330.3	35.9	53.7	52.6
1938	434.0	149.8	252.7	31.5	439.7	152.9	255.3	31.5	71.2	71.9
1939	387.0	94.5	258.4	34.1	390.6	95.5	261.0	34.1	119.5	120.7
1940	536.0	207.0	295.2	33.8	536.0	207.0	295.2	33.8	104.4	104.4
1941	590.0	237.9	305.1	47.0	563.9	226.6	293.4	43.9	107.9	103.8
1942	456.0	228.0	213.0	15.0	417.9	209.2	195.4	13.3	66.2	60.7
1943	275.0	156.9	111.0	7.1	252.9	143.9	102.8	6.2	30.9	28.6
1944	262.0	97.0	156.0	9.0	235.9	89.0	139.3	7.6	29.3	26.2
1945	350.0	120.8	212.2	17.0	305.7	108.8	182.9	14.0	93.8	80.9
1946	650.0	212.0	397.0	41.0	508.3	163.1	315.1	30.1	200.0	158.7
1947	1,235.0	492.0	670.5	72.5	824.3	337.0	441.1	46.2	362.5	238.5
1948	1,830.0	905.0	848.0	77.0	1,102.3	541.9	517.1	43.3	527.0	321.3
1949	2,191.0	1,249.0	857.5	84.5	1,274.4	717.8	510.4	46.2	652.5	388.4
1950	2,050.0	1,089.0	861.0	100.0	1,155.9	611.8	492.0	52.1	571.0	326.3

TABLE 10 (concl.)

	In current dollars, excluding municipals and rural cooperatives[a]				In constant (1940) dollars, excluding municipals and rural cooperatives				Municipals and rural cooperatives	
	Total expenditures (1)	*Production* (2)	*Transmission and distribution* (3)	*General* (4)	*Total expenditures* (5)	*Production* (6)	*Transmission and distribution* (7)	*General* (8)	*Current dollars* (9)	*Constant dollars* (10)
Total	$17,687.7	$7,299.7[a]	$9,144.3[a]	$1,243.7	$15,208.0	$6,067.2	$8,093.5	$1,047.3	$3,650.1[a]	$2,818.4
High-low difference	$2,043.4	$1,227.9	$750.0	$ 92.9	$1,097.6	$693.0	$414.3	$78.9	$636.1	$368.7
Average	$ 680.3	$ 280.8	$351.7	$ 47.8	$ 584.9	$233.4	$311.3	$40.3	$140.4	$108.4
Ratio	3.00	4.37	2.13	1.94	1.88	2.97	1.33	1.96	4.53	3.40

[a] The Edison Electric Institute had no breakdown of municipal and rural cooperative expenditures by class of plant. However, since the bulk of such expenditures are for transmission and distribution plant, the totals were deducted from this category. This, it is estimated, results in an understatement of transmission and distribution and an overstatement of production plant by approximately $200 million. (See table 6.)

Sources: Cols. 1-4, 9, and 10 from Edison Electric Institute, *Statistical Bulletin*, 1950; cols. 5-8 based on Handy-Whitman index converted to 1940 prices (see table 9).

TABLE 11

ESTIMATED INCOME STATEMENT OF INVESTOR-OWNED ELECTRIC UTILITIES, ADJUSTED FOR 1926-1950 TO COVER COMPANIES OPERATING DECEMBER 31, 1950

(millions)

	Operating revenue	*Deductions*				*Income*					
						Operating					
		Operating expense	*Depreciation*	*Taxes*	*Total*	*Electric*	*Other depts.*	*Other*	*Gross*	*Deductions from*	*Net*
1926	$1,415	$ 609	$121	$133	$ 863	$552	$75	$50	$ 677	$277	$400
1927	1,567	653	130	147	930	637	79	54	770	298	472
1928	1,689	670	145	167	982	707	83	59	849	323	526
1929	1,817	709	153	175	1,037	780	85	64	929	344	585
1930	1,894	723	156	190	1,069	825	86	68	979	383	596
1931	1,874	694	160	195	1,049	825	86	68	979	388	591
1932	1,713	618	161	201	980	733	85	61	879	373	506
1933	1,640	600	166	212	978	662	80	36	778	374	404
1934	1,710	635	177	239	1,051	659	70	33	762	371	391
1935	1,785	669	184	251	1,104	681	75	34	790	370	420
1936	1,911	721	197	281	1,199	712	75	32	819	359	460
1937	2,031	781	216	308	1,305	726	51	62	839	330	509
1938	2,018	762	226	323	1,311	707	50	63	820	335	485
1939	2,148	798	249	352	1,399	749	58	66	873	334	539
1940	2,277	863	260	404	1,527	750	62	77	889	332	557
1941	2,467	947	279	520	1,746	721	55	73	849	312	537
1942	2,609	1,002	291	628	1,921	688	62	66	816	317	499
1943	2,816	1,127	307	680	2,114	702	66	66	834	322	512
1944	2,955	1,225	319	677	2,221	734	63	62	859	342	517
1945	3,012	1,259	322	652	2,233	779	66	60	905	360	545
1946	3,127	1,385	324	639	2,348	779	62	68	909	258	651
1947	3,480	1,701	339	664	2,704	776	51	74	901	245	656
1948	3,886	2,019	364	712	3,095	791	46	72	909	243	666
1949	4,113	2,030	389	794	3,213	900	61	71	1,032	267	765
1950	4,497	2,152	439	940	3,531	966	71	76	1,113	281	832

Source: Edison Electric Institute, *Statistical Bulletin*, 1950.

TABLE 12

COMPARISON OF DEPRECIATION AND TAX ACCRUALS, 1926-1950, OF INVESTOR-OWNED ELECTRIC UTILITIES OPERATING DECEMBER 31, 1950

	Depreciation			*State and local taxes*			*Federal taxes*			*Total taxes*		
		PERCENTAGE OF:			PERCENTAGE OF:			PERCENTAGE OF:			PERCENTAGE OF:	
	Amount (millions)	*Total operating revenue*	*Utility plant*	*Amount (millions)*	*Total operating revenue*	*Utility plant*	*Amount (millions)*	*Total operating revenue*	*Utility plant*	*Amount (millions)*	*Total operating revenue*	*Utility plant*
1926	$121	8.6								$133	9.4	
1927	130	8.3								147	9.4	
1928	145	8.6								167	9.9	
1929	153	8.4								175	9.6	
1930	156	8.2								190	10.0	
1931	160	8.5								195	10.4	
1932	161	9.4								201	11.7	
1933	166	10.1								212	12.9	
1934	177	10.4								239	14.0	
1935	184	10.3								251	14.1	
1936	197	10.3								281	14.7	
1937	216	10.6	1.6	$207	10.2	1.5	$101	5.0	0.7	308	15.2	2.2
1938	226	11.2	1.6	212	10.5	1.5	111	5.5	0.8	323	16.0	2.3
1939	249	11.6	1.8	212	9.9	1.5	140	6.5	1.0	352	16.4	2.5
1940	260	11.4	1.8	214	9.4	1.5	190	8.3	1.3	404	17.7	2.8
1941	279	11.3	1.9	226	9.2	1.5	294	11.9	2.0	520	21.1	3.5
1942	291	11.2	2.0	231	8.9	1.6	397	15.2	2.7	628	24.1	4.2
1943	307	10.9	2.1	232	8.2	1.6	448	15.9	3.0	680	24.1	4.6
1944	319	10.8	2.2	235	8.0	1.6	442	14.9	3.0	677	22.9	4.6
1945	322	10.7	2.2	241	8.0	1.7	411	13.7	2.8	652	21.6	4.5
1946	324	10.4	2.2	264	8.4	1.8	375	12.0	2.5	639	20.4	4.3
1947	339	9.7	2.1	290	8.3	1.8	374	10.8	2.3	664	19.1	4.1
1948	364	9.4	2.0	321	8.3	1.8	391	10.0	2.2	712	18.3	4.0
1949	389	9.5	2.0	352	8.6	1.8	442	10.7	2.3	794	19.3	4.0
1950	439	9.8	2.0	390	8.7	1.8	558	12.4	2.6	948	21.1	4.4

Source: Edison Electric Institute, *Statistical Bulletin*, 1950. Segregation of taxes and utility plant data not available prior to 1937.

TABLE 13

COMPARISON OF YIELDS ON PUBLIC UTILITY MORTGAGE BONDS, PREFERRED STOCKS, AND COMMON STOCKS

1925-1950

(per cent, except for last column)

	MORTGAGE BONDS		PREFERRED	COMMON STOCK		
	A	*Baa*	STOCK	*Earnings*	*Dividend*	*Ratio: Earnings ÷ Dividend*
1925	5.42	5.91	6.85	n.a.	n.a.	
1926	5.17	5.67	6.77	n.a.	n.a.	
1927	5.02	5.46	6.09	n.a.	n.a.	
1928	4.95	5.33	5.80	n.a.	n.a.	
1929	5.22	5.76	6.11	3.81	2.10	1.81
1930	5.06	5.88	6.08	4.26	3.45	1.23
1931	5.12	6.90	5.21	5.44	5.20	1.05
1932	6.46	8.78	6.90	6.32	7.53	0.84
1933	6.32	9.38	n.a.	4.54	5.81	0.78
1934	5.55	7.49	n.a.	4.38	5.86	0.74
1935	4.61	5.56	4.57	5.66	5.11	1.11
1936	4.08	4.67	4.66	4.99	3.66	1.36
1937	3.98	5.09	4.66	6.23	5.40	1.15
1938	3.90	5.26	4.88	5.85	6.27	0.93
1939	3.52	4.50	4.75	6.50	5.31	1.22
1940	3.24	4.05	4.49	7.06	5.99	1.18
1941	3.07	3.84	4.61	8.76	8.02	1.09
1942	3.09	3.73	4.84	10.84	9.75	1.11
1943	2.99	3.58	4.48	8.21	6.84	1.20
1944	2.97	3.52	4.20	8.37	6.28	1.33
1945	2.87	3.39	4.02	6.54	4.99	1.31
1946	2.71	3.03	3.63	6.43	4.22	1.52
1947	2.78	3.08	4.08	7.33	5.30	1.38
1948	3.02	3.36	4.60	8.12	5.85	1.39
1949	2.90	3.28	4.39	8.32	5.86	1.42
1950	2.79	3.18	4.23	8.39	5.66	1.48

n.a.: Not available.
Source: Moody's *Public Utilities*, Special Features Section.

TABLE 14

CAPACITY, COMBINED PEAK LOAD, AND MARGIN OF CAPACITY OF ALL ELECTRIC LIGHT AND POWER INSTALLATIONS CONTRIBUTING TO THE PUBLIC SUPPLY, AS OF DECEMBER 31, 1925-1950

	CAPACITY			COMBINED PEAK LOAD			MARGIN OF CAPACITY			
		Increase over previous year			*Increase over previous year*			*Increase over previous year*		*Margin of capacity as percentage*
	(THOUSANDS OF KILOWATTS)		*(per cent)*	(THOUSANDS OF KILOWATTS)		*(per cent)*	(THOUSANDS OF KILOWATTS)		*(per cent)*	
1925	21,472	....	..	14,150	....	..	7,322	....	..	52
1926	23,386	1,914	8.9	15,600	1,450	10.2	7,786	464	6.3	50
1927	25,079	1,693	7.2	16,500	900	5.8	8,579	793	10.2	52
1928	27,805	2,726	10.9	18,050	1,550	9.4	9,755	1,176	13.7	54
1929	29,839	2,034	7.3	19,200	1,150	6.4	10,639	884	9.1	55
1930	32,384	2,545	8.5	19,700	500	2.6	12,684	2,045	19.2	64
1931	33,698	1,314	4.1	19,125	—575	—2.9	14,573	1,889	14.9	76
1932	34,387	689	2.0	18,225	—900	—4.7	16,162	1,589	10.9	89
1933	34,587	200	0.6	18,375	150	0.8	16,212	50	0.3	88
1934	34,119	—468	—1.4	19,200	825	4.5	14,919	—1,293	—8.0	78
1935	34,436	317	0.9	21,000	1,800	9.4	13,436	—1,483	—9.9	64
1936	35,082	646	1.9	23,900	2,900	13.8	11,182	—2,254	—16.8	47
1937	35,620	538	1.5	24,700	800	3.3	10,920	—262	—2.3	44
1938	37,492	1,872	5.3	25,350	650	2.6	12,142	1,222	11.2	48
1939	38,863	1,371	3.7	28,700	3,350	13.2	10,163	—1,979	—16.3	35
1940	39,927	1,064	2.7	30,800	2,100	7.3	9,127	—1,036	—10.2	30
1941	42,405	2,478	6.2	34,650	3,850	12.5	7,755	—1,372	—15.0	22
1942	45,053	2,648	6.2	35,850	1,200	3.5	9,203	1,448	18.7	26
1943	47,951	2,898	6.4	40,100	4,250	11.9	7,851	—1,352	—14.7	20
1944	49,189	1,238	2.6	40,650	550	1.4	8,539	688	8.8	21
1945	50,111	922	1.9	39,550	—1,100	—2.7	10,561	2,022	23.7	27
1946	50,317	206	0.4	45,000	5,450	13.8	5,317	—5,244	—49.7	12
1947	52,322	2,005	4.0	49,550	4,550	10.1	2,772	—2,545	—47.9	6
1948	56,560	4,238	8.1	53,750	4,200	8.5	2,810	38	1.4	5
1949	63,100	6,540	11.6	56,500	2,750	5.1	6,600	3,790	134.9	12
1950	68,501	5,401	8.6	64,300	7,800	13.8	4,201	—2,399	—36.3	7

Source: Edison Electric Institute, *Statistical Bulletin*, 1950.

TABLE 15

CAPACITY, COMBINED PEAK LOAD, AND GENERATION OF ALL ELECTRIC LIGHT AND POWER INSTALLATIONS CONTRIBUTING TO THE PUBLIC SUPPLY, AS OF DECEMBER 31, 1925-1950

	ESTIMATED POPULATION (*millions*)	CAPACITY		COMBINED PEAK LOAD		GENERATION	
		Total kilowatts (thousands)	*Kilowatts per capita*	*Total kilowatts (thousands)*	*Kilowatts per capita*	*Total kilowatt-hours (millions)*	*Kilowatt-hours per capita*
1925	115.8	21,472	0.185	14,150	0.122	61,451	531
1926	117.4	23,386	0.199	15,600	0.133	69,353	591
1927	119.0	25,079	0.211	16,500	0.139	75,418	634
1928	120.5	27,805	0.231	18,050	0.150	82,794	687
1929	121.8	29,839	0.245	19,200	0.158	92,180	757
1930	123.1	32,384	0.263	19,700	0.160	91,112	740
1931	124.0	33,698	0.272	19,125	0.154	87,350	704
1932	124.8	34,387	0.276	18,225	0.146	79,393	636
1933	125.6	34,587	0.275	18,375	0.146	81,740	651
1934	126.4	34,119	0.270	19,200	0.152	87,258	690
1935	127.3	34,436	0.271	21,000	0.165	95,287	749
1936	128.1	35,082	0.274	23,900	0.187	109,316	853
1937	128.8	35,620	0.277	24,700	0.192	118,913	923
1938	129.8	37,492	0.289	25,350	0.195	113,812	877
1939	130.9	38,863	0.297	28,700	0.219	127,642	975
1940	132.0	39,927	0.302	30,800	0.233	141,837	1,075
1941	133.2	42,405	0.318	34,650	0.260	164,788	1,237
1942	134.7	45,053	0.334	35,850	0.266	185,979	1,381
1943	136.5	47,951	0.351	40,100	0.294	217,758	1,595
1944	138.1	49,189	0.356	40,650	0.294	228,189	1,652
1945	139.6	50,111	0.359	39,550	0.283	222,486	1,594
1946	141.2	50,317	0.356	45,000	0.319	223,178	1,581
1947	144.0	52,322	0.363	49,550	0.344	255,739	1,776
1948	146.6	56,560	0.386	53,750	0.367	282,698	1,928
1949	149.2	63,100	0.423	56,560	0.379	291,032	1,951
1950	151.1	68,501	0.453	64,300	0.425	328,998	2,177

Sources: Population from Bureau of the Census, *Current Population Reports*, series P-25, no. 44, and Dept. of Commerce, *Statistical Abstract*; other data from Edison Electric Institute, *Statistical Bulletin*, 1950.

TABLE 16

COMPARISON OF INDUSTRIAL PRODUCTION AND AMOUNT OF ELECTRICITY GENERATED BY ALL PLANTS CONTRIBUTING TO THE PUBLIC SUPPLY 1925-1950

	FRB INDEX OF INDUSTRIAL PRODUCTION (1935-1939:100)			TOTAL GENERATION OF ELECTRICITY			INDUSTRIAL SALES OF ELECTRICITY		
		Increase over previous year			*Increase over previous year*			*Increase over previous year*	
	Combined index (1)	*(no. of points)* (2)	*(per cent)* (3)	(MILLIONS OF KILOWATT-HOURS) (4)	(5)	*(per cent)* (6)	(MILLIONS OF KILOWATT-HOURS) (7)	(8)	*(per cent)* (9)
1925	90			61,451					
1926	96	6	6.6	69,353	7,902	12.8	31,993		
1927	95	−1	−1.0	75,418	6,065	8.7	34,539	2,546	8.0
1928	99	4	4.2	82,794	7,376	9.8	37,715	3,176	9.2
1929	110	11	11.1	92,180	9,386	11.3	42,971	5,256	13.9
1930	91	−19	−17.3	91,112	−1,068	−1.2	40,148	−2,823	−6.6
1931	75	−16	−17.6	87,350	−3,762	−4.1	36,937	−3,211	−8.0
1932	58	−17	−22.7	79,393	−7,957	−9.1	30,964	−5,973	−16.2
1933	69	11	19.0	81,740	2,347	3.0	33,857	2,893	9.3
1934	75	6	8.7	87,258	5,518	6.8	36,944	3,087	9.1
1935	87	12	16.0	95,287	8,029	9.2	40,865	3,921	10.6
1936	103	16	18.4	109,316	14,029	14.7	48,655	7,790	19.1
1937	113	10	9.7	118,913	9,597	8.8	51,359	2,704	5.6
1938	89	−24	−21.2	113,812	−5,101	−4.3	43,140	−8,219	−16.0
1939	109	20	22.5	127,641	13,829	12.2	51,108	7,968	18.5
1940	125	16	14.7	141,837	14,196	11.1	59,556	8,448	16.5
1941	162	37	29.6	164,788	22,951	16.2	76,061	16,505	27.7
1942	199	37	22.8	185,979	21,191	12.9	88,378	12,317	16.2
1943	239	40	20.1	217,758	31,779	17.1	106,657	18,279	20.7
1944	235	−4	−1.7	228,189	10,431	4.8	115,187	8,530	8.0
1945	203	−32	−13.6	222,486	−5,703	−2.5	107,490	−7,697	−6.7
1946	170	−33	−16.3	223,178	692	0.3	98,885	−8,605	−8.0
1947	187	17	10.0	255,739	32,561	14.6	113,523	14,638	14.8
1948	192	5	2.7	282,698	26,959	10.5	124,088	10,565	9.3
1949	176	−16	−8.3	291,100	8,402	3.0	120,766	−3,322	−2.7
1950	200	24	13.6	328,998	37,898	13.0	139,065	18,299	15.2

Sources: Cols. 1-3 from *Federal Reserve Bulletin*, June 1951; cols. 4-9 from Edison Electric Institute, *Statistical Bulletin*, 1950.

TABLE 17

CONSUMPTION OF FUEL AND HEAT PER KILOWATT-HOUR GENERATED BY ALL ELECTRIC UTILITIES CONTRIBUTING TO THE PUBLIC SUPPLY 1925-1950

	Pounds of coal per kilowatt-hour generated (1)	*Btu per kilowatt-hour generated* (2)
1925	2.00	26,000
1926	1.90	25,000
1927	1.82	23,700
1928	1.73	22,500
1929	1.66	21,600
1930	1.60	20,800
1931	1.52	19,800
1932	1.49	19,400
1933	1.46	19,000
1934	1.45	18,800
1935	1.44	18,700
1936	1.44	18,700
1937	1.44	18,700
1938	1.40	18,200
1939	1.38	17,900
1940	1.34	17,400
1941	1.34	17,400
1942	1.30	16,900
1943	1.30	16,900
1944	1.29	16,800
1945	1.30	16,900
1946	1.29	16,800
1947	1.31	17,000
1948	1.30	16,900
1949	1.24	16,100
1950[a]	1.19	15,500

[a] Preliminary.

Sources: Col. 1 from Edison Electric Institute, *Statistical Bulletin*, 1950; conversion to Btu in col. 2 based on assumed average heat value of 13,000 Btu per pound of coal.

TABLE 18

GENERATION, SALES, AND CAPACITY OF ALL ELECTRIC LIGHT AND POWER INSTALLATIONS IN THE U.S., 1920-1950

		SALES		GENERATION	
	Population (millions)	*Total kilowatt-hours (millions)*	*Kilowatt-hours per capita*	*Total kilowatt-hours (millions)*	*Kilowatt-hours per capita*
1920	106.5			39,405	370
1921	108.5			37,180	343
1922	110.1			43,632	396
1923	112.0			51,222	457
1924	114.1			54,662	479
1925	115.8			61,451	531
1926	117.4	56,089	478	69,353	591
1927	119.0	61,251	515	75,418	634
1928	120.5	66,988	556	82,794	687
1929	121.8	75,294	618	92,180	757
1930	123.1	74,906	608	91,112	740
1931	124.0	71,902	580	87,350	704
1932	124.8	63,711	511	79,393	636
1933	125.6	65,916	525	81,740	651
1934	126.4	71,082	562	87,258	690
1935	127.3	77,596	610	95,287	749
1936	128.1	90,044	703	109,316	853
1937	128.8	99,359	771	118,913	923
1938	129.8	93,731	722	113,812	877
1939	130.9	105,768	808	127,642	975
1940	132.0	118,643	899	141,837	1,075
1941	133.2	140,060	1,052	164,788	1,237
1942	134.7	159,407	1,183	185,979	1,381
1943	136.5	185,889	1,361	217,758	1,595
1944	138.1	198,160	1,435	228,189	1,652
1945	139.6	193,558	1,387	222,486	1,594
1946	141.2	190,794	1,351	223,178	1,581
1947	144.0	217,581	1,511	255,739	1,776
1948	146.6	240,740	1,642	282,698	1,928
1949	149.2	248,542	1,666	291,032	1,951
1950	151.1	280,539	1,890	328,998	2,177

TABLE 18 (concluded)

	CAPACITY			PERCENTAGE INCREASE OVER PRECEDING YEAR PER CAPITA	
	Total kilowatts (thousands)	*Kilowatts per capita*	*Kilowatt-hours generated per kilowatt of capacity*	*Generation*	*Capacity*
1920	12,714	0.119	3,099		
1921	13,519	0.125	2,750	−7.3	5.0
1922	14,192	0.129	3,074	15.5	3.2
1923	15,643	0.140	3,274	15.4	8.5
1924	17,681	0.155	3,092	4.8	10.7
1925	21,472	0.185	2,862	10.9	19.4
1926	23,386	0.199	2,966	11.3	7.6
1927	25,079	0.211	3,007	7.3	6.0
1928	27,805	0.231	2,978	8.4	9.5
1929	29,839	0.245	3,089	10.2	6.1
1930	32,384	0.263	2,813	−2.2	7.3
1931	33,698	0.272	2,592	−4.9	3.4
1932	34,387	0.276	2,309	−9.7	1.5
1933	34,587	0.275	2,363	2.4	−.4
1934	34,119	0.270	2,557	6.0	−1.8
1935	34,436	0.271	2,767	8.6	0.4
1936	35,082	0.274	3,116	13.9	1.1
1937	35,620	0.277	3,338	8.2	1.1
1938	37,492	0.289	3,036	−5.0	4.3
1939	38,863	0.297	3,284	11.2	2.8
1940	39,927	0.302	3,552	10.3	1.7
1941	42,405	0.318	3,886	15.1	5.3
1942	45,053	0.334	4,128	11.6	5.0
1943	47,951	0.351	4,541	15.5	5.1
1944	49,189	0.356	4,639	3.6	1.4
1945	50,111	0.359	4,439	−3.5	0.8
1946	50,317	0.356	4,435	−0.8	−0.8
1947	52,322	0.363	4,888	12.3	2.0
1948	56,560	0.386	4,998	8.6	6.3
1949	63,100	0.423	4,644	1.2	8.8
1950	68,501	0.453	4,800	11.2	7.6

Sources: Same as for table 15.

TABLE 19

AVERAGE ANNUAL GROWTH IN CAPACITY, COMBINED PEAK LOAD, AND GENERATION OF ELECTRIC UTILITIES, 1925-1950

	1925	*1950*	*Average annual increase (per cent)*
Population	115,800,000	151,100,000	1.1
Capacity	*Kilowatts*		
Total	21,472,000	68,501,000	4.8
Per capita	0.185	0.453	3.6
Combined Peak Load	*Kilowatts*		
Total	14,150,000	64,300,000	6.3
Per capita	0.122	0.425	5.1
Generation	*Kilowatt-hours*		
Total	61,451,000,000	328,998,000,000	6.9
Per capita	531	2,177	5.8

Sources: Same as for table 15. Annual growth rates interpolated from twenty-five-year compound interest tables.

TABLE 20
REGULARIZATION OF CAPACITY ADDITIONS, 1925-1950
PROGRAM A

	Regularized capacity[a] *(thousands of kilowatts)*	*Actual peak load (thousands of kilowatts)*	MARGIN OF CAPACITY *(thousands of kilowatts)*	*(per cent)*
1925	21,472	14,150	7,322	52
1926	23,353	15,600	7,753	50
1927	25,234	16,500	8,734	53
1928	27,115	18,050	9,065	50
1929	28,996	19,200	9,796	51
1930	30,877	19,700	11,177	57
1931	32,758	19,125	13,633	71
1932	34,639	18,225	16,414	90
1933	36,520	18,375	18,145	99
1934	38,401	19,200	19,201	100
1935	40,282	21,000	19,282	92
1936	42,163	23,900	18,263	76
1937	44,044	24,700	19,344	78
1938	45,925	25,350	20,575	81
1939	47,806	28,700	19,106	67
1940	49,687	30,800	18,887	61
1941	51,568	34,650	16,918	49
1942	53,449	35,850	17,599	49
1943	55,330	40,100	15,230	38
1944	57,211	40,650	16,561	41
1945	59,092	39,550	19,542	49
1946	60,973	45,000	15,973	35
1947	62,855	49,550	13,305	27
1948	64,737	53,750	10,987	20
1949	66,619	56,500	10,119	18
1950	68,501	64,300	4,201	7

[a] Based on even distribution of annual capacity increases between 1925 and 1950 (See table 15.)

Source: Basic data from Edison Electric Institute, *Statistical Bulletin*, 1950.

TABLE 21
REGULARIZATION OF CAPACITY ADDITIONS, 1925-1950
PROGRAM B

	Capacity adjusted to assumed safe margin (col. 3) (thousands of kilowatts) (1)	*Adjusted peak load*[a] *(thousands of kilowatts)* (2)	MARGIN OF CAPACITY *(thousands of kilowatts)* (3)	*(per cent)* (4)
1925	18,395	14,150	4,245	30
1926	19,499	14,999	4,500	30
1927	20,669	15,899	4,770	30
1928	21,066	16,853	4,213	25
1929	22,330	17,864	4,466	25
1930	23,670	18,936	4,734	25
1931	25,090	20,072	5,018	25
1932	26,595	21,276	5,319	25
1933	28,191	22,553	5,638	25
1934	28,687	23,906	4,781	20
1935	30,408	25,340	5,068	20
1936	32,232	26,860	5,372	20
1937	34,166	28,472	5,694	20
1938	36,216	30,180	6,036	20
1939	38,389	31,991	6,398	20
1940	40,692	33,910	6,782	20
1941	43,134	35,945	7,189	20
1942	43,817	38,102	5,715	15
1943	46,446	40,388	6,058	15
1944	49,233	42,811	6,422	15
1945	52,187	45,380	6,807	15
1946	55,318	48,103	7,215	15
1947	58,637	50,989	7,648	15
1948	62,155	54,048	8,107	15
1949	65,885	57,291	8,594	15
1950	69,837	60,728	9,109	15

[a] Using 1925 actual peak load as a base and assuming an annual 6 per cent increase. (See table 15.)
Source: Basic data from Edison Electric Institute, *Statistical Bulletin*, 1950.

TABLE 22
REGULARIZATION OF CAPACITY ADDITIONS, 1925-1950
PROGRAM C

	Capacity adjusted to assumed safe margin (col. 3) (thousands of kilowatts)	*Adjusted peak load*[a] *(thousands of kilowatts)*	MARGIN OF CAPACITY	
			(thousands of kilowatts)	*(per cent)*
	(1)	*(2)*	*(3)*	*(4)*
1925	18,395	14,150	4,245	30
1926	20,279	14,999	5,280	35
1927	21,450	15,899	5,551	35
1928	22,562	16,853	5,709	34
1929	24,000	17,864	6,136	34
1930	24,625	18,936	5,689	30
1931	25,090	20,072	5,018	25
1932	26,595	21,276	5,319	25
1933	28,191	22,553	5,638	25
1934	28,687	23,906	4,781	20
1935	30,408	25,340	5,068	20
1936	32,232	26,860	5,372	20
1937	34,166	28,472	5,694	20
1938	36,216	30,180	6,036	20
1939	38,389	31,991	6,398	20
1940	40,692	33,910	6,782	20
1941	43,134	35,945	7,189	20
1942	43,817	38,102	5,715	15
1943	46,446	40,388	6,058	15
1944	47,684	42,811	4,873	11
1945	48,606	45,380	3,226	7
1946	51,046	48,103	2,943	6
1947	54,365	50,989	3,376	7
1948	58,603	54,048	4,555	8
1949	65,143	57,291	7,852	14
1950	69,837	60,728	9,109	15

[a] Using 1925 actual peak load as a base and assuming an annual 6 per cent increase. (See table 15.)

Source: Basic data from Edison Electric Institute, *Statistical Bulletin*, 1950. (See table 15, above.)

TABLE 23

COMPARISON OF REGULARIZATION PROGRAMS A, B, AND C[a] WITH ACTUAL CAPACITY AND MARGINS, 1925-1950

	Actual capacity, year end (table 15) (thousands of kilowatts)	Regularization Program A: Capacity (thousands of kilowatts)	Regularization Program A: Increase over actual (thousands of kilowatts)	Regularization Program A: Margin over actual peak load (table 20) (per cent)	Regularization Program B: Capacity (thousands of kilowatts)	Regularization Program B: Increase over actual (thousands of kilowatts)	Regularization Program B: Margin over adjusted peak load (table 21) (per cent)	Regularization Program C: Capacity (thousands of kilowatts)	Regularization Program C: Increase over actual (thousands of kilowatts)	Regularization Program C: Margin over adjusted peak load (table 22) (per cent)
1925	21,472	21,472	....	52	18,395	–3,077	30	18,395	–3,077	30
1926	23,386	23,353	–33	50	19,499	–3,887	30	20,279	–3,107	35
1927	25,079	25,234	155	53	20,669	–4,410	30	21,450	–3,629	35
1928	27,805	27,115	–690	50	21,066	–6,739	25	22,562	–5,243	34
1929	29,839	28,996	–843	51	22,330	–7,509	25	24,000	–5,839	34
1930	32,384	30,877	–1,507	57	23,670	–8,714	25	24,625	–7,759	30
1931	33,698	32,758	–940	71	25,090	–8,608	25	25,090	–8,608	25
1932	34,387	34,639	252	90	26,595	–7,792	25	26,595	–7,792	25
1933	34,587	36,520	1,933	99	28,191	–6,396	25	28,191	–6,396	25
1934	34,119	38,401	4,282	100	28,687	–5,432	20	28,687	–5,432	20
1935	34,436	40,282	5,846	92	30,408	–4,028	20	30,408	–4,028	20
1936	35,082	42,163	7,081	76	32,232	–2,850	20	32,232	–2,850	20
1937	35,620	44,044	8,424	78	34,166	–1,454	20	34,166	–1,454	20
1938	37,492	45,925	8,433	81	36,216	–1,276	20	36,216	–1,276	20
1939	38,863	47,806	8,943	67	38,389	–474	20	38,389	–474	20
1940	39,927	49,687	9,760	61	40,692	765	20	40,692	765	20
1941	42,405	51,568	9,163	49	43,134	729	20	43,134	729	20
1942	45,053	53,449	8,396	49	43,817	–1,236	15	43,817	–1,236	15
1943	47,951	55,330	7,379	38	46,446	–1,505	15	46,446	–1,505	15
1944	49,189	57,211	8,022	41	49,233	44	15	47,684	–1,505	11
1945	50,111	59,092	8,981	49	52,187	2,076	15	48,606	–1,505	7
1946	50,317	60,973	10,656	35	55,318	5,001	15	51,046	729	6
1947	52,322	62,855	10,533	27	58,637	6,315	15	54,365	2,043	7
1948	56,560	64,737	8,177	20	62,155	5,595	15	58,603	2,043	8
1949	63,100	66,619	3,519	18	65,885	2,785	15	65,143	2,043	14
1950	68,501	68,501	....	7	69,837	1,336	15	69,837	1,336	15

[a] Program A is based on an even distribution of capacity increases throughout the twenty-five-year period; program B, on an annual 6 per cent increase in peak load and safe capacity margin, as indicated; program C, on an annual 6 per cent increase in peak load and adjusted capacity to provide a reasonable margin above actual load, 1925-1930, and to limit wartime additions.

Source: Basic data from Edison Electric Institute, *Statistical Bulletin*, 1950. (See table 15, above.)

Table 24

Summary of Margins of Capacity over Peak Load, 1925-1950

	Actual capacity	Regularized capacity: Program A[a]	Regularized capacity: Program B[a]	Regularized capacity: Program C[a]	Actual peak load	Margins of capacity over actual peak load: Actual (thousands of kilowatts)	Actual (per cent)	Program A (thousands of kilowatts)	Program A (per cent)	Program B (thousands of kilowatts)	Program B (per cent)	Program C (thousands of kilowatts)	Program C (per cent)
	(thousands of kilowatts)												
1925	21,472	21,472	18,395	18,395	14,150	7,322	52	7,322	52	4,245	30	4,245	30
1926	23,386	23,353	19,499	20,279	15,600	7,786	50	7,753	50	3,899	25	4,679	30
1927	25,079	25,234	20,669	21,450	16,500	8,579	52	8,734	53	4,169	25	4,950	30
1928	27,805	27,115	21,066	22,562	18,050	9,755	54	9,065	50	3,016	17	4,512	25
1929	29,839	28,996	22,330	24,000	19,200	10,639	55	9,796	51	3,130	16	4,800	25
1930	32,384	30,877	23,670	24,625	19,700	12,684	64	11,177	57	3,970	20	4,925	25
1931	33,698	32,758	25,090	25,090	19,125	14,573	76	13,633	71	5,965	31	5,965	31
1932	34,387	34,639	26,595	26,595	18,225	16,162	89	16,414	90	8,370	46	8,370	46
1933	34,587	36,520	28,191	28,191	18,375	16,212	88	18,145	99	9,816	53	9,816	53
1934	34,119	38,401	28,687	28,687	19,200	14,919	78	19,201	100	9,487	49	9,487	49
1935	34,436	40,282	30,408	30,408	21,000	13,436	64	19,282	92	9,408	45	9,408	45
1936	35,082	42,163	32,232	32,232	23,900	11,182	47	18,263	76	8,332	35	8,332	35
1937	35,620	44,044	34,166	34,166	24,700	10,920	44	19,344	78	9,466	38	9,466	38
1938	37,492	45,925	36,216	36,216	25,350	12,142	48	20,575	81	10,866	43	10,866	43
1939	38,863	47,806	38,389	38,389	28,700	10,163	35	19,106	67	9,689	34	9,689	34
1940	39,927	49,687	40,692	40,692	30,800	9,127	30	18,887	61	9,892	32	9,892	32
1941	42,405	51,568	43,134	43,134	34,650	7,755	22	16,918	49	8,484	24	8,484	24
1942	45,053	53,449	43,817	43,817	35,850	9,203	26	17,599	49	7,967	22	7,967	22
1943	47,951	55,330	46,446	46,446	40,100	7,851	20	15,230	38	6,346	16	6,346	16
1944	49,189	57,211	49,233	47,684	40,650	8,539	21	16,561	41	8,583	21	7,034	17
1945	50,111	59,092	52,187	48,606	39,550	10,561	27	19,542	49	12,637	32	9,056	23
1946	50,317	60,973	55,318	51,046	45,000	5,317	12	15,973	35	10,318	23	6,046	13
1947	52,322	62,855	58,637	54,365	49,550	2,772	6	13,305	27	9,087	18	4,815	10
1948	56,560	64,737	62,155	58,603	53,750	2,810	5	10,987	20	8,405	16	4,853	9
1949	63,100	66,619	65,885	65,143	56,500	6,600	12	10,119	18	9,385	17	8,643	15
1950	68,501	68,501	69,837	69,837	64,300	4,201	7	4,201	7	5,537	9	5,537	9

[a] See note a to table 23.

Source: Basic data from Edison Electric Institute, *Statistical Bulletin*, 1950. (See table 18, above.)

TABLE 25

ESTIMATES OF PEAK LOADS AND CAPACITIES BASED ON VARIOUS RATES OF GROWTH, 1950-1970

	Estimated peak load 6 per cent growth[a]	Estimated capacity, 15 per cent above peak load	ESTIMATED CAPACITY[b]			ESTIMATED CAPACITY[c]		
			6 per cent annual growth	Margin of capacity		5 per cent annual growth	Margin of capacity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(THOUSANDS OF KILOWATTS)		(THOUSANDS OF KILOWATTS)		(per cent)	(THOUSANDS OF KILOWATTS)		(per cent)
1950	64,300[d]	73,945	68,501[d]	4,201	6.5	68,501[d]	4,201	6.5
1951	68,158	78,382	75,557	7,399	10.9	75,557	7,399	10.9
1952	72,247	83,084	85,379	13,132	18.2	85,379	13,132	18.2
1953	76,582	88,069	96,137	19,555	25.5	96,137	19,555	25.5
1954	81,177	93,354	104,600	23,423	28.9	104.600	23,423	28.9
1955	86,048	98,955	110,876	24,828	28.9	109,830	23,782	27.6
1956	91,211	104,893	117,528	26,317	28.9	115,322	24,111	26.4
1957	96,684	111,187	124,580	27,896	28.9	121,088	24,404	25.2
1958	102,485	117,858	132,055	29,570	28.9	127,142	24,657	24.0
1959	108,634	124,929	139,978	31,344	28.9	133,499	24,865	22.9
1960	115,152	132,425	148,377	33,225	28.9	140,174	25,022	21.7
1961	122,061	140,370	157,280	35,219	28.9	147,183	25,122	20.6
1962	129,385	148,793	166,717	37,332	28.9	154,542	25,157	19.4
1963	137,148	157,720	176,720	39,572	28.9	162,269	25,121	18.3
1964	145,377	167,184	187,323	41,946	28.9	170,382	25,005	17.2
1965	154,100	177,215	198,562	44,462	28.9	178,901	24,801	16.1
1966	163,346	187,848	210,476	47,130	28.9	187,846	24,500	15.0
1967	173,147	199,119	223,105	49,958	28.9	197,238	24,091	13.9
1968	183,536	211,066	236,491	52,955	28.9	207,100	23,564	12.8
1969	194,548	223,730	250,680	56,132	28.9	217,455	22,907	11.8
1970	206,220	237,153	265,720	59,500	28.9	228,328	22,108	10.7

[a] Based on 6 per cent annual increase from 1950.

[b] Capacity based on EEI estimates to 1954; thereafter on 6 per cent annual increase. Margin represents excess over peak load shown in col. 1.

[c] Capacity based on EEI estimates to 1954; thereafter on 5 per cent annual increase. Margin represents excess over peak load shown in col. 1.

[d] Actual data.

Sources: Basic data from Edison Electric Institute, *Statistical Bulletin*, 1950, and Report of EEI Electric Power Survey Committee, April 1951. All plants contributing to public supply covered.

TABLE 26
DESIGN EFFICIENCY OF TURBINES USED IN GENERATION OF ELECTRICITY
1924-1949

	Minimum turbine heat rate (Btu per kilowatt-hour)	*Size of unit (kilowatt)*	*Type of unit (compound)*	STEAM CONDITIONS *(psig)*	*(F.)*
1924	10,300	60,000	Cross	550	725/725
1928	9,960	55,000	Tandem	650	725/725
1929	9,235	55,000	Vertical	1,250	750/750
1930	9,170	50,000	Vertical	1,200	750/750
1936	9,000	110,000	Vertical	1,200	900
1937	8,700	150,000	Tandem	1,200	825/825
1940	8,620	100,000	Cross	1,250	950
1941	8,270	76,500	Cross	2,300	940/900
1949	7,920	125,000	Cross	2,000	1,050/1,000

Source: Letter from General Electric Co. to E. W. Morehouse, July 25, 1951.

TABLE 27
PRICES OF STEAM GENERATOR UNITS WITH CAPACITY OF MORE THAN 7,500 KILOWATTS MANUFACTURED BY GENERAL ELECTRIC COMPANY, 1929-1950

	Price index (1940:100)		*Price index (1940:100)*
1929	73.0	1940	100.0
1930	70.1	1941	100.7
1931	74.5	1942	100.7
1932	75.9	1943	100.7
1933	80.3	1944	95.9
1934	89.1	1945	97.8
1935	96.4	1946	118.7
1936	96.4	1947	143.3
1937	105.1	1948	146.7
1938	106.6	1949	160.7
1939	102.9	1950	164.0

Source: Same as for table 26.

TABLE 28

CAPACITY AND PRICES OF TURBINE GENERATORS PRODUCED BY WESTINGHOUSE ELECTRIC CORPORATION, 1925-1950

	Capacity		Capacity
1925	437.50	1938	487.50
1926	500.00	1939	122.50
1927	287.50	1940	365.00
1928	850.00	1941	537.50
1929	587.50	1942	791.00
1930	745.00	1943	410.00
1931	170.00	1944	230.00
1932	95.00	1945	325.00
1933	80.00	1946	510.00
1934	260.00	1947	1,397.00
1935	70.00	1948	1,990.00
1936	112.50	1949	1,879.75
1937	387.50	1950	1,881.00

	PRICE IN DOLLARS PER KILOWATT OF TURBINE GENERATOR UNITS[a] FOR RATING AND CAPABILITY OF:		
	20,000–25,000 kilowatts	*40,000–50,000 kilowatts*	*60,000–75,000 kilowatts*
1925	12.45	9.65	8.55
1930	13.10	10.15	8.95
1935	17.50	13.20	11.70
1940	16.30	14.10	12.10
1946	21.50	18.60	16.00
1947	23.60	20.40	17.60
1948	26.00	22.50	19.35
1950	29.00	24.80	21.30

[a] Based on 850 psig–900°F. steam conditions, and for 1935-1950 prices are also based on the use of 3,600-rpm turbines and hydrogen-cooled generators.

Source: Letter from Westinghouse Electric Corp. to E. W. Morehouse, August 14, 1951.

TABLE 29

COMPARISON OF VARIOUS FORECASTS OF ELECTRIC GENERATING CAPACITY, KILOWATT-HOUR GENERATION, AND ANNUAL RATES OF GROWTH 1949-1960

Source of estimate	Estimated capacity in 1960: Total (millions of kilowatts)	Estimated capacity in 1960: Per capita[a] (kilowatts)	Estimated generation in 1960: Total (billions of kilowatt-hours)	Estimated generation in 1960: Per capita[a] (kilowatt-hours)	Average annual compounded rate of growth — Capacity: Kilowatts (per cent)	Capacity: Per capita[a] (per cent)	Generation: Kilowatt-hours (per cent)	Generation: Per capita[a] (per cent)
1. DeLuccia (FPC)	115.0	0.712	525.0	3,251	5.7	5.0	5.5	4.8
2. Lang (GE) Low	123.0	0.760	540.0	3,340	6.3	5.5	5.8	5.0
High	139.0	0.860	605.0	3,750	7.5	6.7	6.8	6.2
3. Hooper (W)	...	...	532.0	3,300	...	...	5.6	4.9
4. Ebasco Low	96.0	0.590	...	...	4.0	3.1	...	...
High	104.0	0.640	...	...	4.7	4.0	...	...
5. Tegen (GPU)	112.0	0.693	500.0	3,100	5.5	4.7	5.0	4.3
6. Morehouse (GPU) 1	125-129	0.757-0.782	550.0	3,300	6.2-6.5	5.4-5.6	5.4	4.1
2[b]	123.7	0.750	526.0	3,200	6.0	5.2	4.9	3.8

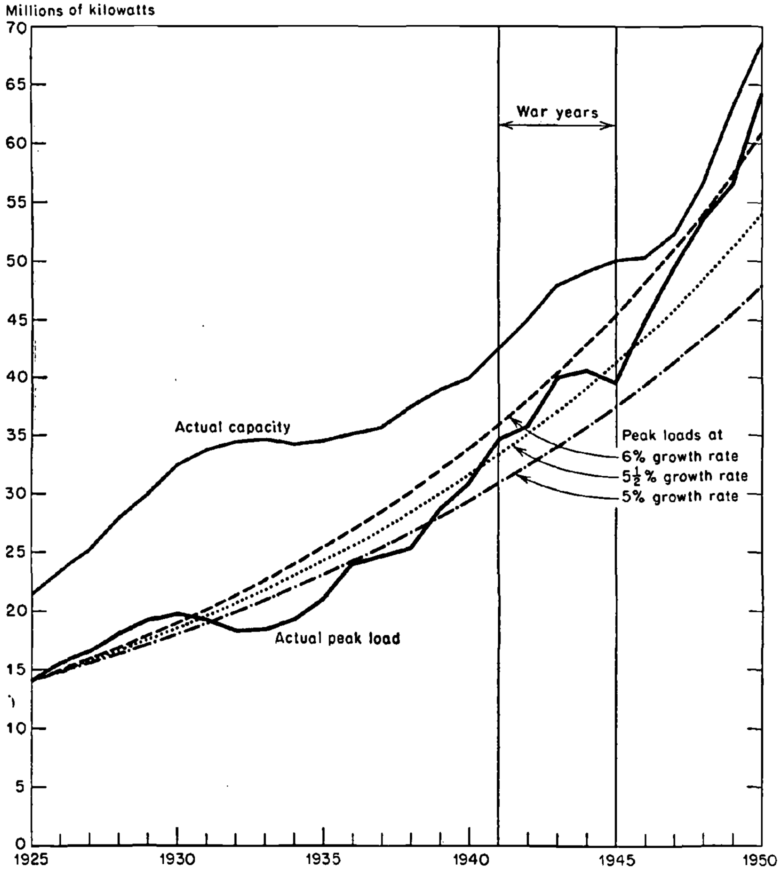
[a] Population estimate of 165 million for 1960 used for calculations except in case of Tegen, who used 161.5 million. The 165-million estimate compares with others for 1960 as follows: Robert W. Hartley, 155.1 million; J. S. Davis, 162-172 million; Warren S. Thompson, Scripps Foundation, telegram to E. W. Morehouse, June 1950, 164-168 million.

[b] Estimate for 1950-1960 based on millions of industrial kilowatt-hours per point of Federal Reserve Board Index of Industrial Production trended at 3 per cent increase per year to 269 in 1960, as compared with 200 in 1950. Growth factor of 3 per cent derived from Report of Council of Economic Advisers, January 1950, pertaining to gross national product or productivity per man-hour. However, the FRB index for 1950 reflected approximately 3 per cent compounded annual rate of growth since 1929.

Sources: (1) E. Robert deLuccia, chief, Bureau of Power, Federal Power Commission, "Power Supply and Requirements in the United States," address at Midwest Power Conference, Chicago, April 19, 1949. (2) Chester H. Lang, vice-president, General Electric Co., address at Electric Utilities Executive Conference, Henderson Harbor, N.Y., June 1950; reproduced by A. F. Tegen, president, General Public Utilities Corp., in "The Future of the Electric Utilities from the Viewpoint of Management," Life Officers Investment Seminar, American Life Convention, in association with University of Chicago School of Business, held at Beloit College, Beloit, Wis., June 23, 1950. (3) D. C. Hooper, manager, Market Planning Dept., Westinghouse Electric Corp., "The Electrical Industry in 1959," *Investment Dealer's Digest*, June 5, 1950. (4) Ebasco Services, Inc.; reproduced by A. F. Tegen for seminar at Beloit, Wis. referred to in source 2. (5) A. F. Tegen, addresses at Beloit, Wis. seminar referred to in source 2, and at Investment Banking Seminar, Wharton School of Finance and Commerce, University of Pennsylvania, June 1951. (6) E. W. Morehouse, vice-president, General Public Utilities Corp., unpublished estimates.

Chart 1

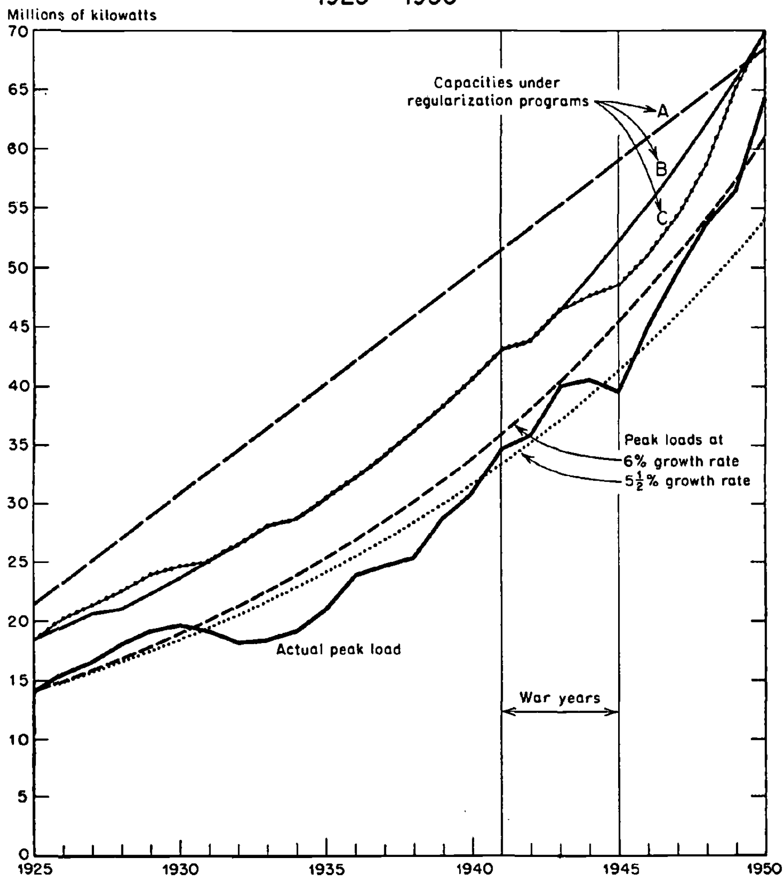
Combined (Non-coincident) Peak Loads and Capacity of Electric Utilities Compared with Peak Loads at Various Annual Rates of Growth 1925 – 1950



Note: Actual capacity as reported by the Federal Power Commission.
Actual peak loads as estimated by Edison Electric Institute.

Chart 2

Trend of Combined Peak Loads of Electric Utilities Actual and at 5½% and 6% Growth Rates Compared with Capacities under Regularization Programs A, B, and C 1925 – 1950



Note: Actual peak loads obtained from E. E. I. 1950 *Statistical Bulletin.*

Chart 3

Estimated Combined Peak Loads and Capacities of Electric Utilities, Using Various Rates of Growth 1950 – 1970

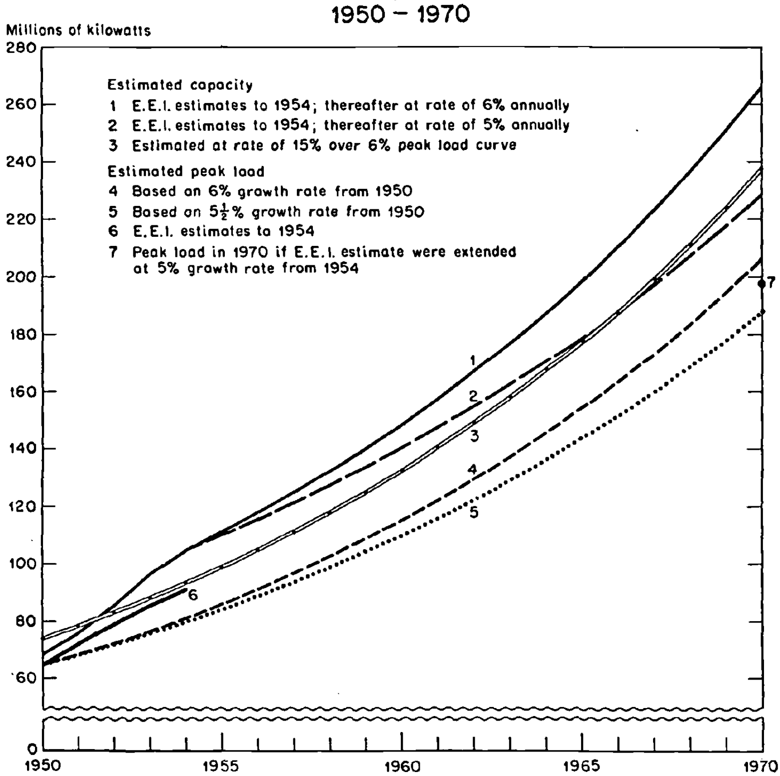
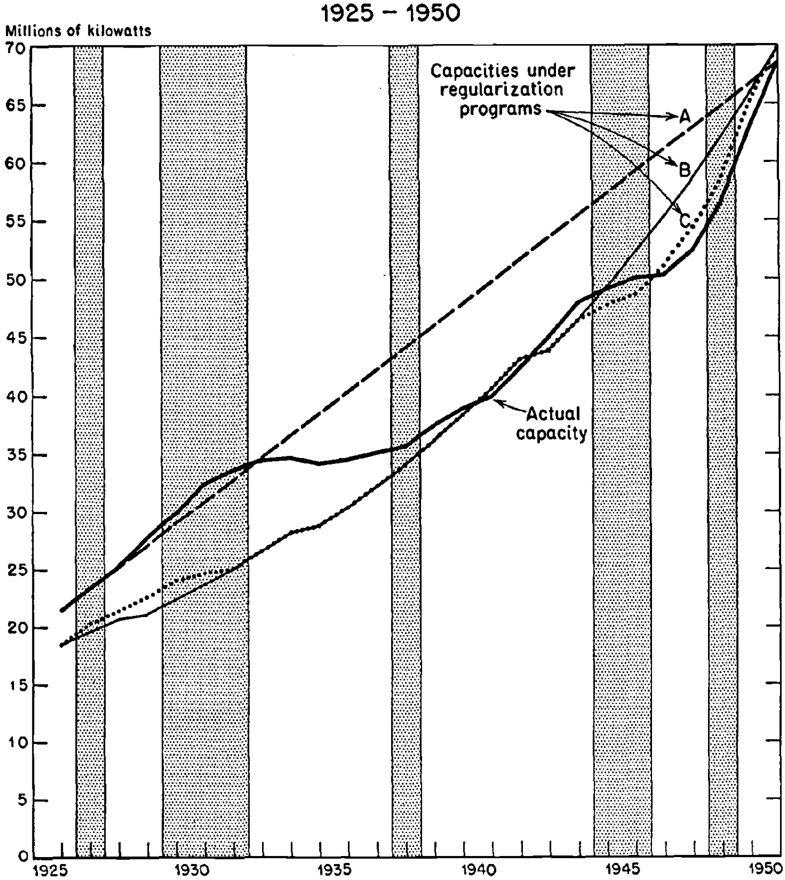


Chart 4

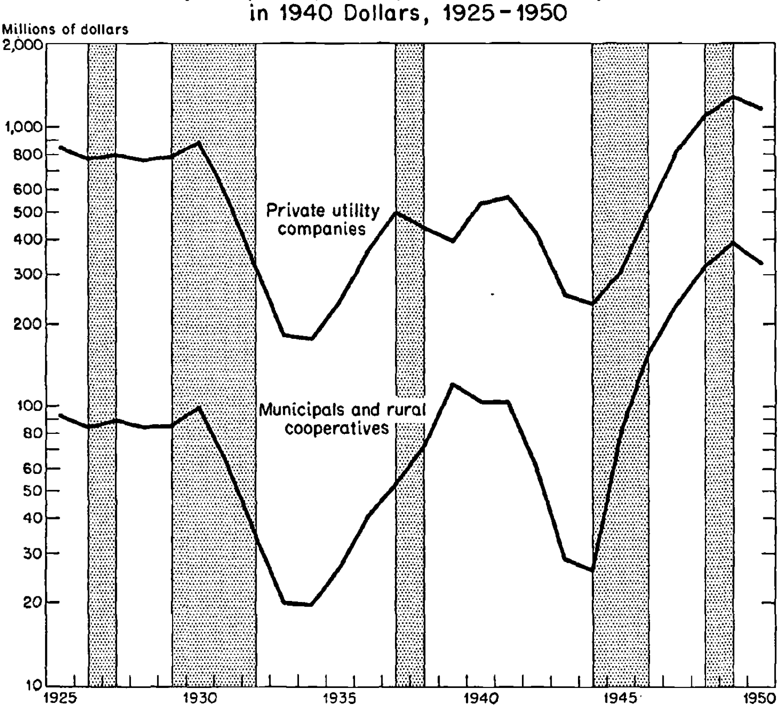
Trend of Actual Combined Capacity of Electric Utilities Compared with Estimated Capacities under Regularization Programs A, B, and C 1925 – 1950



Note: Shaded areas represent periods of general business contraction, based on NBER reference cycles.

Chart 5

Trend of Actual Construction Expenditures by Private Electric Utility Companies, Municipals and Rural Cooperatives in 1940 Dollars, 1925-1950



Note: Shaded areas represent periods of general business contraction, based on NBER reference cycles.

Ratio scale

COMMENT

BERT G. HICKMAN, National Bureau of Economic Research

Several business representatives commented on the importance of competitive investment and stressed the notion that such investment cannot be delayed. They implied, I think, that such investment is not subject to regularization. I do not think the conclusion is justified. If one is thinking of introducing an innovation before competitors can do so, then the current phase of the cycle should not be of overriding importance. If firms think in terms of a long investment horizon, a period of depressed business and low costs would be an excellent time to introduce new projects. A longer investment horizon might be induced by a public policy that prevented severe contractions. Unless it is argued that the technological possibilities for new innovations are developed only during expansions, there is no reason why new innovations should not be introduced during contractions so long as a long period of decline in demand is not anticipated. These remarks apply particularly to going concerns. Perhaps ventures by new firms must wait for an immediately favorable market. However, the concept of regularization by the firm implies, I think, a going concern, and especially so if hope is vested in large firms. If investment involves the duplication of a prior innovation by a competitor, this competitive behavior could promote regularization if only we could persuade the Schumpeterian entrepreneur to invest early in the downswing.