

CAPITAL BUDGETING BY PUBLIC UTILITIES

Eugene F. Brigham and Richard H. Pettway

October 1973

3-73

CAPITAL BUDGETING BY PUBLIC UTILITIES

Eugene F. Brigham and Richard H. Pettway

October 1973

3-73

Abstract

CAPITAL BUDGETING BY PUBLIC UTILITIES

Eugene F. Brigham and
Richard H. Pettway

This paper reviews the literature on capital budgeting practices of industrial firms, shows how the capital budgeting techniques discussed in the finance literature must be modified before they can be applied to public utilities, and presents the results of a questionnaire survey designed to determine the way public utilities actually make capital budgeting decisions.

CAPITAL BUDGETING BY PUBLIC UTILITIES

Eugene F. Brigham and
Richard H. Pettway

Dr. Brigham is Professor of Finance and Director of the Public Utility Research Center, University of Florida. Dr. Pettway is Associate Professor of Finance, University of Florida.

The theory of capital budgeting has been studied extensively in recent years, and there is also a growing body of literature describing the capital budgeting techniques employed by industrial firms. However, in spite of the importance of the public utilities, virtually no studies relating to these firms' capital budgeting practices have appeared in the financial journals.

Capital investment decisions are based on a number of different inputs. Non-quantifiable considerations, such as the availability of key resources 10 or 15 years in the future, play a major role in most decisions, but academicians and businessmen alike agree that some type of quantitative economic analysis should be employed in capital expenditure analysis. In this paper we review the literature on the capital budgeting techniques used by unregulated firms, show how the traditional capital budgeting techniques have been modified for use by regulated public utilities, and report the results of a survey designed to determine the way public utilities actually make capital budgeting decisions.

I. CAPITAL BUDGETING IN THE UNREGULATED SECTOR

A number of capital budgeting selection criteria have been identified in the finance literature. The four most frequently mentioned are payback, average rate of return (ARR), internal rate of return (IRR), and net present value (NPV). The NPV method is generally regarded as being the "best" in a theoretical sense, with the IRR method a somewhat distant second. Both payback and ARR (which may be defined in several ways) are generally regarded as being distinctly inferior to the two discounted cash flow techniques.

Although the theory of capital budgeting has been extended in very elegant ways in recent years, the basic techniques were specified reasonably well and were widely publicized in the academic literature by the latter part of the 1950's. Once the basic theories were accepted in the academic community, various researchers began to study the question of whether or not business firms actually practiced what the academic community preached. Istvan [8, 9], Pflomn [15], and Soldofsky [16], studied this question in the early 1960's and reported that relatively few firms employed the recommended DCF techniques. The studies by Christy [5], the National Association of Accountants [13], and Terborgh [17], all done in the latter half of the 1960's, indicated an increasing use of DCF methods, but they also showed that the payback and ARR were far more widely used. The most recent studies of national firms, the ones by Klammer [6] and by Abdelsamad [1], showed a continuation of the trend toward DCF; however, 43 percent of the firms in Klammer's study were still using a non-DCF method in 1970.

When the early studies showed that most firms placed a primary reliance on either payback or ARR, two explanations for the non-use, or at least limited use, of DCF were offered: the first hypothesis is that there is simply a learning-and-action lag; the second is that the cost of using a DCF technique

may, in some instances, exceed its benefits. Although neither of these hypotheses has been "proved" by a rigorous empirical study, our own studies suggest that there is some validity to both of them. Accordingly, we think that the use of DCF will increase, but it is most unlikely that any future study will ever find that all investment decisions are made using a DCF cutoff criterion.

II. CAPITAL BUDGETING IN THE UTILITY SECTOR

When we began our project, our first thought was to treat a utility just like any other company. However, it became apparent almost immediately that utility companies take a somewhat different approach to investment decisions--regulation itself has led to a modification of traditional approaches to capital budgeting. To understand the modification, consider Exhibit 1, which presents what might be called the traditional view of the capital budgeting process. Here, the firm takes on projects so long as their rate of return exceeds the cost of capital, and the capital budget for the period in question is I^* . The area under the rate of return schedule, but above the cost of capital schedule, represents what might be called a "producer's surplus." The area labeled "producer's deficit" is rejected. As long as a firm follows this procedure, its shareholders' wealth will be maximized.

According to traditional regulatory theory, this conceptual model is not generally applicable for utility companies. In the regulatory process, a target or allowed rate of return is specified. This return is, either implicitly or explicitly, recognized as being a point (perhaps the midpoint) within a range of rates of return frequently called the "zone of reasonableness." If "good" capital investments cause the actual rate of return to exceed the upper end of this range, then a rate reduction is ordered to drive rates back down to target. Thus, according to traditional regulatory theory,

the existence of the regulatory process will eliminate the "producer's surplus" shown in Exhibit 1. If the surplus is eliminated by regulatory action, this means that projects will have zero NPV's (and IRR's will equal the cost of capital), so the rule of choosing projects so as to maximize NPV does not appear to be operational--at least under the traditional view of regulatory theory.

Public Utility Investment Decisions in Today's Environment

The preceding theoretical discussion must be modified to conform to the reality of the present situation faced by public utilities. Understanding the state of their financial and regulatory environment also makes our empirical results more meaningful.

Rate of Return Patterns Under Inflation. Exhibit 2-a shows the rate of return pattern facing a typical utility company when (1) inflation is constantly driving costs up, (2) prices, which are set by regulatory action, are increased at discrete intervals, and (3) no regulatory lag is present. As operating costs rise, profits, and consequently the realized rate of return on investment, decline. When the lower control limit is reached, rates are raised, causing the realized rate of return to rise to the target level. However, continued inflation causes the cycle to be repeated, and rates of return are again eroded. The net result of this condition is that the rate of return over a period of time will, on average, fall below the target level.

Exhibit 2-b shows the effects of regulatory lags. At point A the actual rate of return penetrates the lower control limit, prompting the company to ask for a rate hearing, which occurs at point B. At point C an order is issued permitting the company to raise rates, and the rate increase takes effect at point D.

As we have shown it, the actual rate of return does not return to the target level. The cost figures generally used in the point B rate cases are those of the

most recent past year. If inflation continues, then by the time the new rates take effect, the cost figures are outdated--they are too low--hence the calculated utility rates are too low to return the rate of return on investment to the target level.

It would, of course, be possible for regulatory authorities to anticipate price increases--in utility parlance, this is called using a forward test year. Alternatively, the regulatory lag could be shortened by setting the control limits closer to the target rate of return. Such procedures are beginning to be employed by regulatory agencies; the automatic fuel adjustment clause, which permits certain electric utilities to raise prices automatically when fuel costs rise, is an example. However, the past test year is used more frequently than the forward test year, and this has a negative impact on utility profits under inflationary conditions.

A Rising Cost of Capital. Another problem faced by utility companies today is the fact that they have, during the past few years, faced a rising cost of capital. Controversy exists over the actual measurement of the cost of capital, but because of the general increase in interest rates, no one seriously argues that the cost of capital has not risen in recent years. However, because of regulatory lags, the target rate of return has generally been set below the actual cost of capital.

Exhibit 3 illustrates this situation. From T_0 to T_1 , the cost of capital is both stable and equal to the allowed rate of return. At T_1 , the cost of capital begins to rise, and during the interval from T_1 to T_2 the rate of return shortfall widens. At T_2 , a rate case is held, and the allowed rate of return is adjusted upward. However, the continuing increase in the cost of capital causes the cycle to be repeated, and over the entire period the actual rate of return averages less than the cost of capital. Note also that the debt cost used in

the target rate of return is the "embedded" cost, or the average cost of all outstanding debt. If the cost of new debt is above a company's embedded debt cost--as it is for virtually all utilities--then the embedded cost will rise over time even if interest rates in the economy are stable.

Mandatory and Discretionary Investment Decisions

Thus far we have seen that inflation, a rising cost of capital, and regulatory lag have combined to cause a utility's actual rate of return on investment to fall below its target rate of return. We shall show the impact of this rate of return shortfall on the capital budgeting decision, but it is useful to first describe another key feature of utility operations, the fact that utilities are legally required to make the investments needed to provide service upon demand. An unregulated company can, in general, expand or not at its own discretion; a utility company is required to expand to meet whatever service demands are placed upon it by its customers.

Utility companies' capital investments may actually be divided into two categories: mandatory investments and discretionary investments. This breakdown is illustrated in Exhibit 4, where we show the marginal cost of capital schedule and the rate of return schedules for both investment components. As we have drawn it, the mandatory category is substantially larger than the discretionary category; this seems to be in accord with the actual situation.

An example will perhaps illustrate what is involved here. In certain geographic areas a telephone company may have excess switching capacity, permitting it to earn a relatively high rate of return on the investment needed to serve new customers, as its revenues are in excess of its revenue requirements. Profitable investments of this type give rise to the area designated as A. On the other hand, in some other district where existing capacity is fully utilized, to install

a new telephone might require an investment of \$2,000, versus an average plant cost of \$1,000 for each telephone presently in service. The pricing system used in the regulatory process is, in general, based on average costs, not marginal costs, so telephone rates are based upon the \$1,000 investment, not the marginal \$2,000 investment. In the absence of an immediate price increase to take account of the rising average plant cost per telephone in service, growth in the second area necessarily means that the average rate of return on investment will decline. Thus, investment here will correspond to area B in Exhibit 4.

Not all utility investments are in the mandatory category. Companies do have a certain amount of discretion in supplying new types of service, or in making cost-reducing replacement decisions. For example, electric utilities are sometimes able to negotiate special rates for large industrial customers who seek to purchase interruptable power, and it is possible for these utilities to earn a rate of return in excess of their cost of capital on such investments. Similarly, companies may install new and lower-cost generating equipment to replace obsolete equipment, and the returns on such investments might also exceed the cost of capital. Discretionary investments such as these give rise to the "producer's surplus" shown as area C in Exhibit 4.

If area B exceeds the sum of areas A and C, and if regulatory lags are long, then the existence of mandatory investment requirements will cause an erosion, or attrition, in a utility company's rate of return on investment. In other words, the situation depicted in Exhibit 4 could lead to the pattern of below-target rates of return shown in Exhibit 2.

Combined Effects: Actual Rate of Return Versus Cost of Capital

When inflated operating costs, a rising cost of capital, mandatory investments, and regulatory lags are combined, the net result is a substantial divergence between the cost of capital and the actual rate of return on total investment.

Exhibit 5 illustrates this situation, and the questionnaire results described in a later section suggest strongly that the pattern depicted here is indeed the one facing most utility companies today.

Under the situation depicted in Exhibit 5, incremental investments with high IRR's or NPV's would indeed benefit the companies, and their high incremental profits would not be reduced by regulatory actions. Thus, in today's economic environment, it would seem that the rationale against utilities' use of the NPV method is less valid than under the static conditions assumed in traditional utility theory. Before reaching any conclusions on this matter, however, we must consider the analytic procedures actually used by most utilities in their capital budgeting decisions.

The Public Utilities' Investment Acceptance Criterion

As noted above, under the (unrealistic) assumptions of regulatory theory, the NPV and IRR methods are not appropriate for utilities. Accordingly, the industry developed an alternative DCF procedure for capital budgeting: when choosing among competing projects, they select that project whose future costs, when discounted at the cost of capital, are lowest. Future costs, or revenue requirements as they are frequently called, include the following items: (1) labor, fuel, repair parts, and other operating costs; (2) depreciation; (3) property taxes; (4) income taxes; and (5) a return on the capital invested in the project. The sum of these cost items, all discounted at the current (marginal) cost of new capital, is the present value of revenue requirements.

It is important to note that utility theory assumes that customers' cash payments will actually equal revenue requirements; hence, the annual revenue requirement is really the expected annual cash flow. Also, note that if revenues are exactly equal to revenue requirements, as utility theory assumes they will be, the NPV of any project (or at least the NPV of the total investment required to provide a class of service) will be zero.

The PV of annual cost criterion is actually applied in two separate but related ways. First, as noted above, most utility investment is required or mandatory in the sense that it is necessary to provide service to new or existing customers, and sales revenues are simply disregarded on the grounds that they will be the same regardless of which mutually exclusive project is chosen. In other words, an electric company may project a requirement to generate an additional 10 million kilowatts to meet service demands, then set about deciding how to provide this added capacity. The theoretically optimum method--given the assumed level of demand--is the method that has the lowest present value of future revenue requirements.

The other way the PV of cost criterion is used, and this holds especially when a new type of service not presently offered is being considered, involves (1) calculating the minimum revenue requirements associated with the new service, then (2) conducting some type of demand/regulatory analysis to see if the project will in fact produce revenues equal to its estimated revenue requirements. To illustrate, suppose a telephone company is considering providing data transmission service to a group of business firms. Several switching systems might be used, so they are analyzed to determine the one with the lowest present value of revenue requirements. The company would then attempt to determine whether or not actual revenues, given the proposed price structure, would be sufficient to meet the projected revenue requirements. If projected revenues are sufficient, then the project would be undertaken. If they are not, then the project might be deferred, abandoned, or the company might discuss with the regulatory commission and the prospective users the possibility of setting higher rates for the service.

This type of analysis is really quite similar to the traditional NPV method used in corporate finance, with a company supplying the new service only if the NPV is positive. Note, however, that it is used only for discretionary (cost saving or new product) investments, yet mandatory investments associated with increased output of existing services are far more important for most utility companies.

Before closing this section, we should note two objections utility executives have raised against the NPV method. First, they point out that no explicit revenue projections are required to use the minimum PV of cost method, but revenues are required to calculate the NPV. We suggest that revenue projections are no more difficult for most utilities than they are for most industrial companies, so this objection to NPV seems of questionable validity. Second, they pointed out that utility revenues are generated by a complex system, yet most investment decisions relate to only one part of the system. We would agree that the PV of annual cost method is quite appropriate when deciding which of two replacement transformers is best, and it is known for certain that replacement must occur. However, it seems preferable to us to explicitly consider revenues when analyzing major system additions such as generating plants and high voltage transmission lines. Even if the investment will be undertaken in spite of a negative NPV, the company will at least have data on the project's impact on profitability, and on the rate increases that will be required to restore profitability. It would seem preferable to have this information before the fact rather than to simply proceed on the assumption that rate increases will bring revenues up to revenue requirements.

III. THE QUESTIONNAIRE RESULTS

At the outset of our project, we planned to replicate the type of survey that others had done, but to sample regulated utilities rather than unregulated industrial companies. It soon became apparent that a simple replication would not be appropriate. For the reasons discussed in the preceding sections, public utilities are subject

to a somewhat different set of forces than industrial companies, and in recognition of this fact, we developed a new questionnaire, designed to provide answers to the following set of questions:

1. What project selection techniques do utility companies use when choosing among alternative investments?
2. How do utility companies account for risk differentials among projects?
3. Do public utilities conduct post-audits to check actual performance against predicted results?
4. Do utilities experience periods of capital rationing, and, if so, how do they handle this problem?
5. What do utility companies consider to be the most difficult problems encountered in the capital budgeting process?
6. What is the average embedded (or historical) cost of capital, and how does it compare to the current (or marginal) cost of capital?
7. What capital costs, embedded or current, are used as the hurdle or discount rate in the utilities' capital budgeting process?
8. What is the allowed, or target, rate of return, and how does this rate compare to the actual realized rate of return for the current year?
9. Is dividend policy influenced by either capital requirements (investment opportunities) or by conditions in the capital markets?

The Sample Companies

Originally, we hoped to obtain information on the various types of public utilities--electric, gas, telephone, and water. However, during the questionnaire development stage, it became apparent that different questionnaires would be needed for firms in different industries, so we decided to concentrate on the electric companies. We selected as our sample the 116 electric utilities listed on the Compustat public utility tapes; these companies account for 99.5 percent of privately-owned electric company assets. The questionnaires were sent to the chief financial officer of each company, and 53, or 46 percent of the sample, completed and returned our questionnaire. We compared the responding and nonresponding

firms with respect to size and location, and we found no significant differences between the responding and nonresponding groups. The questionnaires were completed in the fall of 1972, and the data reflect conditions existent at that time.

Project Selection Criteria

To determine the selection criteria used by electric companies, we asked the following question: "What investment selection technique or techniques does your company use when choosing among alternative projects? If more than one standard is used, please indicate the approximate percentage of the total dollar volume of investment that is evaluated by each method." The responses are given in Exhibit 6.

Several comments should be made about the results shown in the table. First, most individual companies actually indicated that they use only methods 1, 2, and 5. Second, 94 percent, or 50 out of 53 of the companies, use the DCF method (minimum PV of revenue requirements) to analyze at least some of their capital projects. This contrasts with Klammer's finding that only 57 percent of the Fortune 500 industrial companies used a DCF method. Thus, it seems clear that the electric utility industry makes a more extensive use of time-adjusted selection criteria as recommended in the academic literature.

As we indicated earlier, discretionary investments are generally accepted only if the utility thinks revenue requirements will actually be realized. In other words, the company would determine the least-cost method of providing a discretionary service, then go ahead with the project only if it thinks that actual revenues will equal or exceed revenue requirements. If expected revenues equal revenue requirements, then the traditional expected NPV will equal zero, while if expected revenues exceed revenue requirements, $NPV > 0$. Thus, to the extent that discretionary investments are handled in this manner, utilities do, in effect, use the NPV method.

Exhibit 6. Project Selection Methods Employed
by Electric Utilities, 1972

	<u>Percent of total dollar volume of capital expendi- tures evaluated by method in a typical year*</u>
1. "Urgency": Capital expenditures required to restore service after a system breakdown	4.1%
2. No formal analysis is made; instead, the judgment of the decision maker is relied upon	17.8
3. Pick project with lowest total "first costs" (i.e., the lowest initial costs)	7.4
4. Pick project with the lowest present value (PV) of initial cost	1.7
5. Pick project with the lowest PV of annual costs (i.e., lowest discounted value of future revenue requirements). Generally, revenue requirements equals the expected first cost of the project multiplied by an annual cost percentage which consists of expected cost of money, property and income taxes, depreciation, and maintenance costs.**	<u>69.0</u>
	<u>100.0%</u>

*The percentages given here are unweighted averages of the individual questionnaire responses.

**Companies that use the equated or level annual charge method are included in this group.

We should comment on the use of the "urgency" criterion, and also on projects selected on the basis of judgment rather than formal analysis. Most respondents indicated that at least some projects are accepted on the basis of urgency, and our discussions with utility executives lead us to conclude that the urgency criterion is eminently reasonable. When service is out and people are without lights and refrigeration, it makes more sense to take immediate action to restore service than to follow normal capital budgeting procedures. Similarly, almost all the companies indicated that some projects are accepted without formal analysis, relying instead upon the judgment of the on-the-spot decision maker. A typical example of this type of investment is the worn out transformer, which the engineer decides to replace with whatever new transformer he believes, from his experience, to be the best for the specific job. As with the urgency criterion, our discussions with utility executives convinced us the nonuse of formal capital budgeting procedures for this set of projects does not necessarily imply inefficient or unsophisticated management. Rather, it suggests a conscious comparison of the costs of following formal capital budgeting procedures versus the benefits that would be gained by using these formal procedures.

Adjustments for Risk

If all projects under consideration are not equally risky, then this fact should be taken into account in the capital budgeting process. The two procedures most commonly recommended in the finance literature are (1) the use of risk-adjusted discount rates and (2) the use of certainty equivalents to deflate risky cash flows. Exhibit 7 shows what utility companies actually do. First, no respondent indicated that his company used certainty equivalents, and only about 15 percent of the companies use the risk-adjusted discount rate technique. Thus, 85 percent of the utility companies apparently do not use either of the formal risk adjustment mechanisms recommended in the academic literature.

Exhibit 7. Procedures Used to Account for Differing Degrees of Project Risk

	<u>Primary Method Used**</u>	<u>Secondary Method Used (if any indicated)**</u>
1. Raise the cost of capital used in calculating revenue requirements for riskier projects	4.4%	10.4%
2. Adjust downward the expected life if the project is more risky than normal	11.0	8.4
3. No formal differentiation is recognized	42.3	--
4. Use "sensitivity analysis" (i.e., formally consider what will happen to costs and revenues under alternative conditions, and use this information in a judgmental manner to reach a decision as to the best alternative)	<u>42.3</u>	<u>12.4</u>
	<u>100.0%</u>	<u>32.5%*</u>

*Only 32.5% of the responding companies indicated that they used two methods to account for risk differentials.

**The percentages given here are unweighted averages of the individual questionnaire responses.

This is not to say, however, that most utility companies indicated that they gave no formal recognition to risk differentials; 58 percent of the companies did acknowledge risk in some manner. The two most commonly used procedures are (1) a type of sensitivity analysis designed to determine what will happen to cost and revenues under alternative conditions, and then to use this information in a judgmental manner when reaching a decision about investment alternatives, and (2) an arbitrary downward adjustment in the expected life of a particular project if it is deemed to be more risky than normal.

Although it is clear that the electric utility industry does not follow academic suggestions about how to handle risk to a very large degree, it is interesting to note that the utilities do formally analyze risk to a greater extent than do the Fortune 500 industrial companies. Klammer found that only 40 percent of the industrial firms surveyed explicitly analyze risk versus 58 percent of the utility companies.

Post-Audits of Investment Projects

The academic literature suggests that an important part of the capital budgeting process is the post-audit procedure, wherein actual results are compared with projected results. Post-audits are supposed to lead to better capital budgeting in the future (1) by uncovering any serious weaknesses or systematic biases in the input generation process and (2) by stimulating decision makers to be more careful in input generation simply because they know their estimates will be checked later.

Exhibit 8 shows the percentage of the electric companies that conduct post-audits. The table is divided into two sections, one for residential and commercial investments, the other for industrial investments. The primary reason for this breakdown is that industrial service is frequently in the discretionary category, and some utility executives feel that post-audits are more applicable for investments of this type. The table also recognizes the fact that post-audits can be made for

Exhibit 8. Post-Audits of Investment Projects

	Percentage of Respondents that Conduct Post-Audits	
	<u>Residential and Commercial Investments</u>	<u>Industrial Service Investments</u>
1. Post-audit of initial outlay costs	60.9%	63.0%
2. Post-audit of operating costs	30.2%	38.6%
3. Post-audit of operating revenues	25.6%	35.7%

construction costs, operating costs, and operating revenues.

It is somewhat surprising to note that only a little over 60 percent of the utilities conduct post-audits of their initial capital expenditures. This compares with Klammer's finding that 88 percent of the largest industrial firms employed post-audits of construction costs. We are not sure why this differential exists, but one explanation given by a utility company executive for his own company's lack of interest in construction cost post-audits for all projects relates to the very long construction periods sometimes involved. This executive pointed out that today it takes an average of 14 years to plan and build a nuclear plant, and that with such a long time frame, the initial cost estimates are simply not relevant. The early estimates are available and could be looked up and analyzed, but why bother? This executive also suggested that a considerable amount of utility investment is done under fixed cost contracts, and post-audits are obviously not useful in these instances.

Exhibit 8 also shows that utilities generally do not conduct post-audits of either operating costs or operating revenues, although a noticeably larger percentage of industrial as opposed to commercial/residential projects are subjected to post-audits. The principal reason for the companies' infrequent use of operating cost/revenue post-audits is, apparently, that since most of their investments are in the mandatory category, they simply must be made regardless of either the operating cost of the project or the revenues it produces.

Capital Rationing

We were interested in learning whether or not electric utilities have experienced capital rationing, and, if they have, how they reacted to it. As indicated in the top section of Exhibit 9, 40 percent of the companies have been subject to capital rationing. When asked what action would be taken under conditions of capital rationing, the respondents replied as indicated in the lower section

Exhibit 9. Capital Rationing in the Electric
Utility Industry

	<u>Have had Capital Rationing</u>
I. Percentage of respondents that have experienced capital rationing during the past 5 years*	40%
II. Procedures for dealing with Capital rationing	<u>Percentage of respondents that indicated their firm would take the action noted</u>
1. Apply for a rate increase	89%
2. Eliminate or postpone those projects that are least likely to meet revenue requirements	75%
3. Lease fixed assets	55%
4. Make less capital intensive investments (i.e., accept the alternative with the lower first cost or initial outlay, even though it might have a shorter estimated service life, or higher operating cost per dollar of revenues.)	45%

*A period of capital rationing is defined as a period when the firm could not obtain sufficient funds at or below its allowed rate of return to make all its identified and justifiable investments.

of the table. Eighty-nine percent of the firms indicated that they would apply for a rate increase; if a rate increase was granted, then their higher earning power would presumably enable them to obtain the capital necessary for making all "identified and justifiable" investments.

Seventy-five percent of the companies indicated that they would, if rate increases were not granted, eliminate or postpone those projects that would be least likely to meet revenue requirements, and over half the companies indicated that they would lease rather than purchase fixed assets. The willingness to lease was somewhat surprising, but apparently utility companies that are strapped for capital are increasingly resorting to leasing arrangements. The fourth alternative mentioned was to make less capital intensive investments, even in situations where the present value of future revenue requirements would be reduced by taking a more capital intensive project.

Perceived Problem Areas in Capital Budgeting

We were interested in learning what the utility companies consider to be the most difficult aspects of capital budgeting; the responses we received are shown in Exhibit 10. Far and away the most serious problem in the eyes of utility executives is obtaining permission from environmental protection agencies and/or the Atomic Energy Commission to build new generating plants. No other factor was considered to be a serious problem by even half as many respondents.

The remainder of Exhibit 10 surprised us somewhat. We expected the companies to have trouble estimating annual costs and revenues, and also the cost of capital, but obviously they do not consider these estimates to be serious problems. In retrospect, it is easy to see why this is so. First, the cost of capital for utility companies is, rightly or wrongly, determined in rate cases, so the executives involved in capital budgeting do have a specified cost of capital to work with. Second, the capital budgeting techniques used by most utility companies

Exhibit 10. Perceived Problem Areas in
Capital Budgeting

Percent of Respondents Stating
that the Indicated Factor is:

	<u>A Very Serious Problem</u>	<u>A Fairly Serious Problem</u>	<u>Not at all Serious</u>
1. Obtaining regulatory approval for new plants from environmental protection agencies and/or AEC	75	17	8
2. Specification of first cost or capital requirements of a new investment	35	43	22
3. Estimation of the cost and availability of the input factors (i.e., fuel, labor)	34	47	19
4. Estimation of the project's economic life giving regard to both demand factors and obsolescence of the investment due to new technology	32	42	26
5. Estimation of when the plant will be placed in service	30	45	25
6. Making investments that should be profitable, given demand and technology factors, but that are not allowed to earn their expected return by regulatory authorities	23	43	34
7. Making sure all reasonable alternatives have been considered	23	43	34
8. Specification of the effects of inflation on annual costs in general	21	55	24
9. Estimation of annual operating cost of the project	21	51	28
10. Predicting the needs of the franchise area in advance	19	50	31
11. Estimation of annual revenue attributed to the project	19	33	48
12. Specification of a "cost of money" or cost of capital	19	25	58
13. Estimation of project life from a wear/tear standpoint	2	44	54

tend to surpress revenue estimates; revenue shortfalls are supposed to be made up by rate increases. And third, the companies frequently assume that, once a project is in operation, the regulatory process will provide sufficient revenues to cover operating costs.

It is also interesting to examine the second column in the table, the one headed "A Fairly Serious Problem." Many items not considered to be "very serious" are considered, nevertheless, to be "fairly serious"; for example, estimating the annual operating costs of a project, response 9 in Exhibit 10, is not generally considered to be a very serious problem, but it is considered to be a fairly serious one.

In general, one might conclude from the responses shown in Exhibit 10 that the utility companies seem to have a fairly good grasp of those aspects of capital budgeting that are emphasized most heavily in the academic literature.

Cost of Capital, Allowed Rates of Return, and Realized Rates of Return

We were interested in learning something about the companies' cost of capital, allowed rates of return, and actual rates of return on investment, and our results dealing with these items are shown in Exhibit 11. The average after-tax current cost of capital, 9.3 percent, is well above the indicated embedded cost of capital, 8.0 percent; this differential is, presumably, caused by the fact that the embedded cost of debt for most companies is well below the current rate of interest on long-term bonds.

It is also interesting to note that the average allowed rate of return as prescribed by regulatory authorities, 7.6 percent, is below the indicated 8.0 percent average embedded cost of capital. There are a large number of rate cases in process across the country today, and allowed rates of return will presumably be increased somewhat. All of this suggests that the situation illustrated in Exhibit 5 above actually does exist.

Exhibit 11. Cost of Capital, Allowed Rates of Return, and Realized Rates of Return, Electric Companies, 1972*

1. Average After-Tax Current (or Marginal) Cost of Capital	9.3%
2. Average After-Tax Embedded Cost of Capital	8.0%
3. Allowed, or Target, Rate of Return as Prescribed by Regulatory Agencies	7.6%
4. Current Actual Rate of Return on Investment	7.2%

*The cost of equity capital is defined as the rate of return on book equity that was authorized if a rate case was recently concluded, or the rate of return most likely to be allowed if a rate case were to be decided now. The problems encountered when attempting to measure the cost of equity are well known, and it is possible that Commission-determined costs of capital are seriously over- or understated. We have simply avoided this issue by accepting the Commission's estimates.

It should be noted that the figures given are returns on book equity, which may be different from investors' required rates of return on market values. For a discussion of this point, see the discussion of A. A. Robichek in the 1971 AT&T rate case (FCC Docket No. 19129) or E. F. Brigham in the 1972 Comsat rate case (FCC Docket No. 16070).

Also, it should be noted that different companies employ different rate base valuation methods (i.e., original cost vs. "fair value"), and different rates of return on these different rate bases are appropriate. Such differences were considered in the study upon which Exhibit 11 is based.

Source: Eugene F. Brigham and Richard H. Pettway, "Capital Budgeting in the Public Utility Sector," University of Florida, Public Utility Research Center, Working Paper No. 3-73, October 1973.

The last item shown in Exhibit 11, the current rate of return on investment, is substantially lower than either the allowed rate of return or the cost of capital. Thus, the situations shown in both Exhibits 2 and 5 seem to exist today.

The Cost of Capital Used as the "Hurdle Rate"

We asked the companies to indicate which cost of capital, the embedded cost or the current (or marginal) cost, was used in the capital budgeting process. The overwhelming majority of the companies used either the current cost of capital or a figure very close to the current cost; no company used the embedded cost of capital when analyzing new investments. This practice is consistent with the corporate finance literature.

Dividend Policy

At least some of the writings in finance suggest that companies should alter their dividend payout policies as changes occur in either investment opportunities or in capital market conditions. To determine whether or not utility companies do adjust their dividend policies, we put the question to them, and we received the answers shown in Exhibit 12. According to the respondents, only about one-third of the utility companies' dividend policies are adjusted in response to changing investment opportunities or capital market conditions.

One thing was very clear from comments attached to the questionnaire--the utility company executives very definitely think that the market price of their stock is influenced by dividend policy. Quite a few respondents made note of the fact that Potomac Electric Power Company, in a well-known case, took exactly the action suggested in our questionnaire, and, apparently as a result of this action, the price of the stock dropped precipitously. Academicians might argue that the stock price declined because of other factors, but it would be hard to convince

Exhibit 12. Adjustments to Dividend Policy in Response to Investment Opportunities and Capital Market Conditions

The following question was asked:

It has been suggested that utility companies' dividend policies may be affected by capital investment opportunities or requirements and by capital market conditions (i.e., the state of stock and bond markets). For example, in a period of high investment demand and tight money, companies might not increase dividends if earnings increased, thus reducing the payout ratio, or they might even cut dividends in order to conserve capital. Recognizing that it might take several years to effect such a change, do you think that your own company's dividend policy would be affected by:

	<u>Percent Responding:</u>	
	<u>Yes</u>	<u>No</u>
a. Changes in capital expenditure opportunities or requirements?	34%	66%
b. Capital market conditions?	40%	60%

a number of utility company executives that this was the case.

IV. SUMMARY AND CONCLUSION

In this paper we have reviewed the literature on capital budgeting practices of unregulated industrial firms, showed how the capital budgeting techniques discussed in the finance literature have been modified by public utilities, and presented the results of a questionnaire survey designed to determine the way public utilities actually make capital budgeting decisions.

According to published studies, the use of DCF selection criteria by unregulated firms has increased markedly since the early 1960's, and by 1970, 57 percent of the Fortune 500 industrial companies used some type of DCF technique to choose among capital investment projects. Larger, more capital intensive firms tend to use DCF techniques most frequently, and there is also a tendency for DCF techniques to be applied more frequently when cash flow estimates are subject to less uncertainty.

Unregulated firms are supposed to seek projects that have an internal rate of return that exceeds the cost of capital, or net present values greater than zero--these criteria will maximize stockholders' wealth. Under regulatory theory, however, revenues are supposed to be adjusted, through the ratemaking process, so that the average project's IRR is always equal to the cost of capital and its NPV equal to zero. The "standard" capital budgeting selection criteria are not used by utilities, but these companies have developed their own criteria: select among sets of mutually exclusive projects the one that minimizes the present value of revenue requirements.

Under inflation, the established pattern of rate regulation has not worked out like utility theory assumes, and as a result, the utility companies have been placed in a difficult position. On the one hand, they are supposed to make whatever investment is necessary to meet service demands, yet rising costs, coupled

with prices that rise only with a lag, have caused rates of return to erode. Thus, many utilities are placed in a position where they must accept projects whose internal rates of return are less than their cost of capital.

We surveyed the publicly-owned electric companies about their capital budgeting methodology, and reached the following conclusions.

1. Utility companies use a DCF selection criterion (minimum PV of revenue requirements) to a greater extent than do the Fortune 500 industrials. This differential usage probably results from the fact that the utilities are large and capital intensive, make very long-term investments, and can estimate cash flows better than firms more subject to competitive pressures.
2. Utilities seem to recognize risk differentials among projects to at least as great an extent as do industrial companies, but since these differences cannot generally be quantified, they influence project selection in a judgmental manner, not through a formal technique such as certainty equivalents or risk-adjusted discount rates.
3. Utility companies do not employ post-audits of investment projects to as large an extent as do industrial firms.
4. Capital rationing is becoming a problem for utilities. Their first reaction is to seek rate increases which will enable them to raise additional funds, but if rate increases are not forthcoming, then projects will be eliminated or postponed, assets will be leased, or less capital intensive alternatives will be accepted.
5. Utility companies do not generally consider input estimates to be a very serious problem. Interestingly, they overwhelmingly consider obtaining approval for new generating plants from environmental protection agencies or the AEC to be the single most difficult aspect of capital budgeting.
6. The current cost of capital exceeds the embedded cost, and this cost exceeds both the allowed and realized rates of return. This situation has given rise to a large number of pending rate cases.
7. When utilities use the discounted cash flow techniques, they use the marginal cost of capital as a hurdle rate.
8. The majority of the companies indicated that their dividend policy is not influenced by capital needs or by capital market conditions, at least not in the short run.

Overall, the electric companies seem to be operating largely in a manner that, while different because of their regulatory environment, is generally consistent with the types of capital budgeting techniques recommended in the academic literature. However, we do feel that public utilities should at least consider employing the NPV method rather than the PV of annual cost method for both discretionary and mandatory system expansion investments. While difficulties would certainly be encountered in making these calculations, the NPV method would provide valuable data on the explicit impact of expansion on both profitability and revenue requirements.

REFERENCES

1. Abdelsamad, Moustafa, A Guide to Capital Expenditure Analysis (New York: AMACOM, American Management Association, 1973).
2. Averch, H., and L. Johnson, "Behavior of the Firm Under Regulatory Constraint," American Economic Review, December 1962.
3. Baily, Elizabeth E., and John C. Malone, "Resource Allocation and the Regulated Firm," Bell Journal, Spring 1970.
4. Baumol, W., and A. Klevorick, "Input Choices and Rate-of-Return Regulation: An Overview of the Discussion," Bell Journal, Autumn 1970.
5. Christy, George A., Capital Budgeting--Current Practices and Their Efficiency (Eugene: Bureau of Business & Economic Research, University of Oregon, 1966).
6. Corey, Gordon R., "The Averch and Johnson Proposition: A Critical Analysis," Bell Journal, Spring 1971, pp. 358-373.
7. Haynes, W. Warren and Martin B. Solomon, Jr., "A Misplaced Emphasis in Capital Budgeting," The Quarterly Review of Economics & Business, Vol. II, No. 1, February 1972, pp. 39-46.
8. Istvan, Donald F., Capital Expenditure Decisions: How They are Made in Large Corporations (Bloomington: Bureau of Business Research, Indiana University, 1961).
9. Istvan, Donald F., "The Economic Evaluation of Capital Expenditures," The Journal of Business (1961).
10. Kafoglis, M., "Output of the Restrained Firm," American Economic Review, September 1969.
11. Klammer, Thomas P., "Empirical Evidence of the Adoption of Sophisticated Capital Budgeting Techniques," Journal of Business, Vol. 45, No. 3, July 1972, pp. 387-397.
12. Lerner, Eugene M., and Alfred Rappaport, "Limit DCF in Capital Budgeting," Harvard Business Review, XLVI (September-October, 1968), pp. 133-139.
13. National Association of Accountants, Financial Analysis to Guide Capital Expenditure Decisions, Reserach Report 43 (New York: National Association of Accountants, 1967).
14. Nolan, Terry J., and A. Frederick Banda, "An Empirical Study of the Capital Investment Decision Making Process in Selected Ohio Companies in 1971--Part I," Akron Business and Economic Review, Spring 1972, Vol. 3, No. 1, pp. 10-16; Part II, Akron Business and Economic Review, June 1972.
15. Pflomn, Norman P., "Managing Capital Expenditures," Studies in Business Policy, 107 (New York: The National Industrial Conference Board, 1963).

16. Soldofsky, Robert M., "Capital Budgeting Practices in Small Manufacturing Companies," Studies in the Factor Markets for Small Business Firms (Ames: Iowa State University, 1963).
17. Terborgh, George, Business Investment Management, a MAPI Study and Manual (Washington, D.C.: Machinery and Allied Products Institute and Council for Technological Advancement, 1967).
18. Zajac, E. E., "A Geometric Treatment of Averch-Johnson's Behavior of the Firm Model," American Economic Review, March 1970.

CAPITAL BUDGETING BY PUBLIC UTILITIES

Eugene F. Brigham and Richard H. Pettway

October 1973

3-73