

THE ANALYTIC HIERARCHY PROCESS & ELECTRIC UTILITIES:

DESIGNING RATES

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ABSTRACT

The Analytic Hierarchy Process (AHP) can be used as an instrument for making decisions about choosing costing methodologies for ratemaking. An earlier model of the AHP used with Regulators and Power Companies with the goals for ratemaking of (1) Revenue Recovery; (2) Simplicity; (3) Stability; (4) Conservation; and (5) Fairness is extended to include both Residential and Industrial Customers as Actors in the hierarchy. This new hierarchy offers a method of choosing among Short Term Marginal Costs, Long Term Marginal Costs, Accounting Costs that Favor Industries, and Accounting Costs that Favor Residential Customers. Utilizing the author's vicarious intuitions and "Expert Choice" the synthesis of the hierarchy yields a vector of preferences favoring Accounting Costs that Favor Industries slightly over Short Term and Long Term Marginal Costs. To avoid undue discrimination, one might choose Rates based upon either Short Term or Long Term Marginal Costs. A second hierarchy with the same actors and scenarios but with slightly different goals is constructed, tested and synthesized producing the same ranking of final preferences. The Inconsistency Index for the first new hierarchy was .04 and for the second confirmatory new hierarchy, .06.

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Electric utility rates are designed to achieve specific objectives such as industrial growth, affordability for residential consumers, conservation, and economic efficiency. These goals usually conflict with one another demanding a method of reconciliation which produces results that can be realized in actual rate design. We have used the Analytic Hierarchy Process (AHP) to achieve a reconciliation identifying the major goals as: (1) Revenue Requirements; (2) Simplicity of Rates; (3) Stability of Rates; (4) Rates that further Conservation; and (5) Rates that are Fair (Koger, Canada, & Mac Cormac, 1985). A hierarchical questionnaire based upon these goals with appropriate subgoals was circulated to all of the regulators and major companies in the United States. More than 50% responded from each group with both ranking Revenue Recovery as the most important goal and Fairness second.

To design rates that fulfill these goals, however, one must select an appropriate costing methodology. In order to achieve both adequate revenue recovery and fairness, one must design rates that produce sufficient income to allow the company

a fair rate or return and rates that allocate costs "fairly" to the three major class of customers: Residential, Commercial, and Industrial. Rates for each class differ on the basis of the differing demand characteristics. Ratemakers attempt to achieve fairness in allocating costs by designing rates for each class that track costs for each class. But there exist many different costing methodologies depending upon what types of demand are measure: daily peak demand, seasonal peak, hourly peak, etc. And the actual costs for a particular company depend upon its generation capacities. Some companies depend heavily upon nuclear power or fossil fueled plants for their baseload while others depend upon hydroelectric power. If one analyzes a set of generating facilities one can determine which costing methodologies favor which classes of customers (Mac Cormac, 1982, 1986).

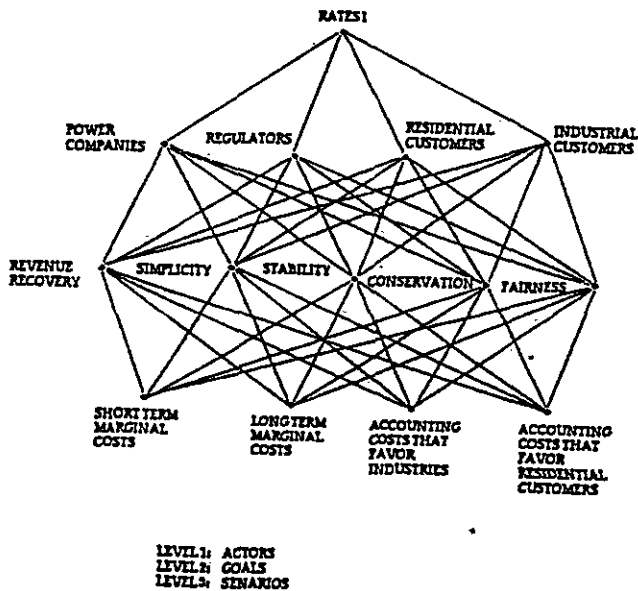
Traditional costing methodologies for electric utilities have been based upon accounting costs. Regulatory bodies filling the role of a surrogate marketplace for a regulated monopoly have attempted to determine costs upon the basis of a past test year of operation. They determine the embedded costs of construction and equipment and the operating costs of generation, transmission and service thereby creating a fictional rate base to which they apply an agreed upon series of rates of return applied to short term and long term debt incurred to cover these costs. Economists have argued vigorously that a more economically efficient methodology would be to employ marginal costing rather than accounting costs. Vigorous debates occur over whether to use marginal or accounting costs and if the former, then what are the short term and long term results. Spot pricing based upon hourly measurements of peak demand and production costs projected to a twenty-four hour cycle has been proposed as one of the best forms of short term marginal costs (Schweppe, Caramanis, Tabors & Bohn, 1989).

The discovery that the cost of electricity cannot be determined in a precise, unequivocal and objective manner does not mean that costs, however measured, should not be a primary factor in judging the fairness of distribution. The methodological variability of the cost factor does mean that objective cost-based rates do not exist except as a myth. As soon as one admits that different "costs" can be ascertained for the same production, transmission and consumption of electricity in a single utility company, one must also ask the question of why a particular method adopted for measuring costs was selected. Such a decision can only be justified by reconciling the different objectives for rates exercised by various parties interested in rates. For the purpose of this study I shall limit my list of actors to: (1) Producers of Electrical Power [Power Companies]; (2) Regulators; (3) Residential Customers; and (4) Industrial Customers. I have omitted consideration of the Commercial Class of Customers since they have been less of a political force in shaping rate structures. Most of the battles over the issues of fairness have occurred between the Residential and Industrial classes of Customers.

Four very general types of costing methodologies have been chosen for consideration: (1) Short Term Marginal Costs; (2) Long Term Marginal Costs; (3) Accounting Costs that Favor Industries; and (4) Accounting Costs that favor Residential Customers. "Short Term Marginal Costs" represent various types of spot pricing while by "Long Term Marginal Costs", I mean a marginal costing methodology that employs a mechanism for reconciling revenue. Marginal costing applied to electric utilities will produce both excesses and deficiencies of revenue in the short term since capital costs are non-linear: one can generate additional electricity up to the capacity of the existing equipment but beyond that capacity one must invest in a massive way to produce any additional units. The Peak and Average costing methodology is an example of an Accounting costs that Favors Industries: while Average and Excess favors Residential Customers (Mac Cormac, 1984).

Figure 1 represents a hierarchy designed to select a costing methodology acceptable to competing actors concerned with rates all of whom possess the common objectives but with differing preferential weights of: (1) Revenue Recovery; (2) Simplicity; (3) Stability; (4) Conservation; and (5) Fairness. By "Fairness" I do not

Figure 1 Costing for ratemaking.



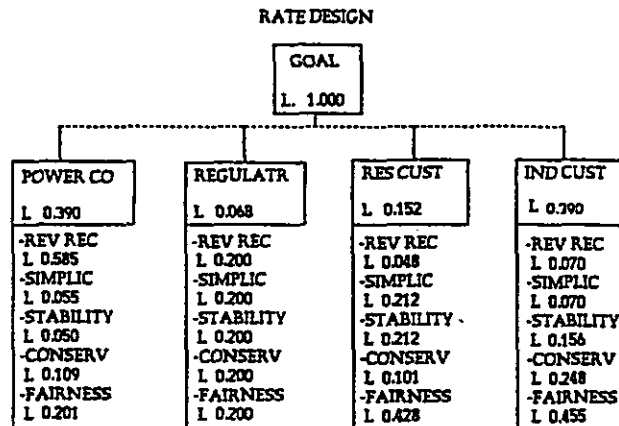
assume the existence of an objective, unequivocal costing methodology that will assign the proper shares of costs to various customer classes. Rather, I understand "Fairness" to mean the avoidance of undue discrimination and the construction of rates based upon the choice of a costing methodology that reconciles through the AHP goals for ratemaking of different interest groups (I have expanded upon the AHP as an arbiter of fairness as a moral value elsewhere (Mac Cormac, 1983, 1984, 1987).

Unlike our earlier study (Koger, Canada, & Mac Cormac, 1985), the hierarchy presented in Figure 1 has not been used with actual ratemakers. To test its feasibility, however, the author made pairwise comparisons adopting the points of view of the various actors. In the initial pairwise comparison of the actors with their concern for rates, the following vector of priorities resulted: Power Companies, .390; Regulators, .068; Residential Customers, .152; and Industrial Customers, .390. One might be surprised at the low value of the importance of rates received by ratemakers. Relative to the generators of electricity, the Power Companies whose very survival depends upon rates high enough to produce adequate revenue recovery, and relative to industrial customers whose competitive edge in the world marketplace may depend upon keeping the costs of electricity low, Regulators have a less intense interest. Even relative to Residential Customers, Regulators hold a more disinterested position. Thus, the vectorial preferences do express the interest of the different actors with respect to rates.

Using "Expert Choice" as a means of both making pairwise comparisons and computing vectors of preferences, the following Local vector of preferences for goals for ratemaking resulted for each of the four actors.

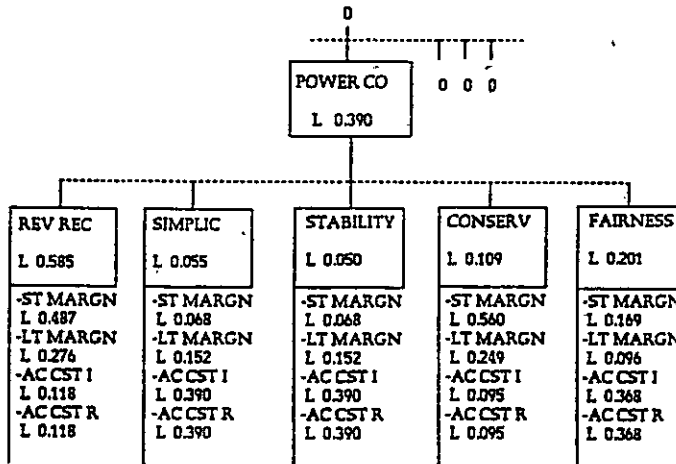
We see in Figure 2. (based upon the author's test choices) that the Power Companies are concerned primarily with Revenue Recovery, .585, and secondly with Fairness, .201

Figure 2 Local goals for ratemaking.



~.201. Regulators express equal preferences for all five goals while both Residential and Industrial Customers express the most concern for Fairness. Both classes prefer rates based upon Fairness defined as an avoidance of undue discrimination and a rational allocation of the distribution of costs.

Figure 3: Local power company priorities for costing methodologies.

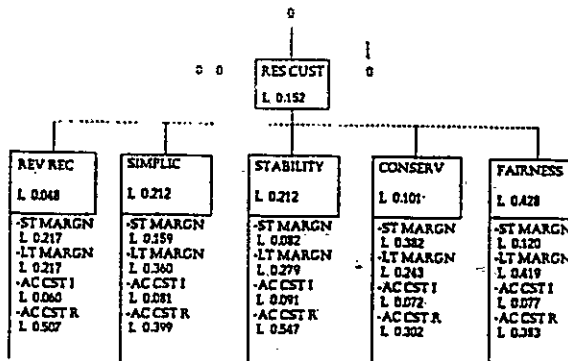


With respect to Revenue Recovery, Power Companies prefer both Short Term and Long Term Marginal Costing Methodologies. They probably prefer Short Term Marginal Costs like Spot Pricing more than Long Term Marginal Costs because Spot Prices yield a greater economic efficiency while Long Term Marginal Costs move in the direction of accounting costs through devices like revenue reconciliation required by Regulators. Power Companies believe that they can maximize their profits and serve their customers best by pursuing economic efficiency. Similarly, Short Term Marginal Costs maximize Conservation in the minds of Power Company managers. They choose Accounting Costs that Favor Industries and Accounting Costs that Favor Residential Customers as equally allocating costs fairly. This may sound strange to choose costing methodologies that favor anyone as "fair" but wise Regulators know that no one method exists as absolutely fair and objective and that marginal costing methodologies may be economically efficient but almost impossible to decide what class they advantage or disadvantage. Marginal rates may seem impartial but short term rates fulfill their own goal of economic efficiency rather than that of Fairness. Regulators know that if they consciously choose costing methodologies that advantage industrial customers, they are consciously following a path of economic development hoping that in the long run, it will also advantage residential customers through additional jobs and income. If they choose costing methodologies that favor residential customers, they know that if industrial

customers suffer too much, again in the long run, residential customers may lose jobs and income. Hence, both Accounting Costs that Favor Industries and Accounting Costs that Favor Residential Customers are explicitly recognized as involving conscious decisions that involve Fairness. These same costing methodologies are recognized as producing greater simplicity and stability of rates than either short or long term marginal costing methodologies.

If one performs the same analysis for Residential Customers we might expect that in every case these actors prefer Accounting Costs that Favor Residential Customers. Yet Figure 4 shows that Residential Customers recognize that with respect to Conservation, Short Term Marginal Costs are preferred to Accounting Costs that Favor Residential Customers. With respect to Conservation, Short Term Marginal Costs are preferred, .382, slightly over Accounting Costs that favor Residential Customers, .302. And with respect to Fairness, Long Term Marginal costs are preferred by Residential Customers, .419, over Accounting Costs that Favor Residential Customers, .383. Residential Customers believe that Accounting Costs which Favor Industrial Customers are unfair but they also recognize that with respect to Conservation and Fairness, Accounting Costs that Favor Residential Customers are not as desirable as Short Term Marginal Costs for Conservation and Long Term Marginal Costs for Fairness.

Figure 4 Local residential customer priorities for costing methodologies.

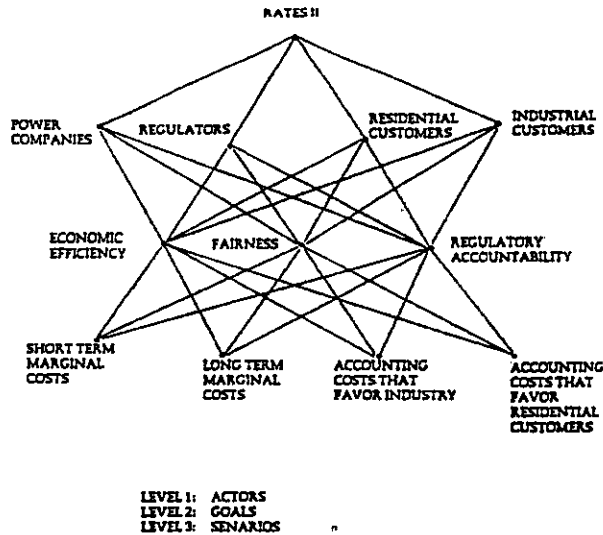


A synthesis of all of the preferences expressed in the hierarchy of Figure 1 yields the vector of preferences as follows: Accounting Costs that Favor Industries, .317; Short Term Marginal Costs, .255; Long Term Marginal Costs, .248; and Accounting Costs that Favor Residential Customers, .181. The overall Inconsistency Index for this synthesis is .04. This scenario suggests that Rates based upon Costing Methodologies

that Favor Industries fulfill more of the Goals for Ratemaking of the various actors slightly more than Rates based upon either Short Term or Long Term Marginal Costs. The values of preference for all three are close enough, however, that one might use any one to achieve the goals that we have established for ratemaking. The hierarchy does suggest that Rates based upon Costing Methodologies that favor Residential Customers should not be employed. Why? Probably because such Rates may lead to economic stagnation thereby frustrating the various goals for ratemaking. If Rates based upon Costing Methodologies that Favor Industries disadvantage Residential Customers to the point of undue discrimination, then our notion of Fairness will be violated and the values of the hierarchy will change thereby changing the ultimate choice of a costing methodology. To avoid such a possibility, the ratemaker might be tempted to choose either Short Term or Long Term Marginal costs, especially since they are so close in value to the choice of Accounting Costs that favor Industries.

Since no one hierarchy uniquely captures fully the goals of decision-makers, I constructed a similar hierarchy for ratemaking but with more general but overlapping goals for ratemaking. In Figure 5, I chose the same actors and scenarios but included (1) Economic Efficiency; (2) Fairness; and (3) Regulatory Accountability as my goals for ratemaking. Again, I used "Expert Choice" to express vicariously preferences of the goals that I thought Power Companies, Regulators, Residential Customers, and Industrial Customers would make.

Figure 5 A second hierarchy for costing for ratemaking.



Much to my surprise and delight, the synthesis of this hierarchy yielded the following results: Accounting Costs that Favor Industries, .370; Short Term Marginal Costs, .253; Long Term Marginal Costs, .230; and Accounting Costs that Favor Residential Customers, .148. The overall Inconsistency Index for this hierarchy is .06, slightly more than the .04 Inconsistency Index of the first hierarchy. But the preferences follow the same order and are close in value. What does this tell us? The second hierarchy adds weight to my belief that the first hierarchy which was partially used by Power Companies and Regulators (Koger, Canada, & Mac Cormac, 1985) can serve as a legitimate instrument in the choice of costing methodologies

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