# COMPUTER ASSISTED REGULATORY ANALYSIS AND ITS POTENTIAL APPLICATION TO THE COLORADO PUBLIC UTILITIES COMMISSION

prepared by

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# PREFACE

The Colorado Public Utilities Commission, in order to increase its staff's capabilities to perform certain kinds of analyses, requested a legislative appropriation to implement in-house computer analysis. The Joint Budget Committee of the Colorado State Legislature in response called for an explanation of how this capability would be utilized in regulatory analyses. This document was prepared by The National Regulatory Research Institute to assist the Colorado Public Utilities Commission in answering that question.

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# I. INTRODUCTION

In the past several years state public utility commissions have experienced an increased need for information and for information processing. The reasons for this need have grown mainly out of the events of the 1970's: the oil embargo, energy shortages, the slowdown of the national economy, and inflation. The resulting rapid increase in utility costs and therefore, rates, has led to an increased work load on commission staffs. The increased involvement of the public and special interest groups in rate cases has brought to focus the need to quickly and accurately analyze information and apply that information to regulatory issues. The fact that the regulated utilities themselves increasingly use computer analyses for arguing their positions before regulatory bodies means that the public should be no less well equipped in weighing the validity of these representations.

In order to meet these needs a number of state regulatory commission staffs has begun to use computers to assist in performing sophisticated analyses. Although only a few commission staffs have developed such capabilities in all major areas, a number of staffs have developed capability in specific ones. These topics inlcude:

1. rate design
2. cost-of-service
3. utility performance analysis
4. financial analysis
5. fuel usage monitoring and analysis
6. generation planning and load forecasting.

The next section of this report describes some of the programs developed for use in examining these subjects and the use of computer analysis by state regulatory commissions. Section III identifies computer programs which have rate case application that would benefit the Colorado Public Utilities Commission staff. Section IV describes the resources necessary to implement previously developed programs at the Colorado PUC.

As mentioned, the work load of regulatory commission staffs has increased. There is every indication it will continue to do so because of increased public attention to the regulation of energy utilities and the major increase in responsibilities placed on state commissions by the federal government. The passage of the National Energy Act (NEA) in general and the Public Utility Regulatory Policies Act of 1978 (PURPA) in particular will place additional burdens on state regulatory commissions. More powerful analytic capability will be required by each commission to comply fully with many of the requirements of these Acts. For example, PURPA requires each state regulatory commission to investigate and consider specific rate reform standards of various kinds within a three-year period and then report annually for the next ten years on the status of implementation of these reforms. Several of the provisions of PURPA involve fairly complex analyses where a computer capability would be particularly useful. (The specific requirements of PURPA are contained in Appendix A.)*

While it is true that much of this NEA legislation leaves to the states the actual policies to be pursued, the analytical procedures to be followed leading up to those decisions are generally mandatory in nature and backed up with the right of intervention in federal court by the Department of Energy.

In addition, pending before the Colorado State Legislature is a proposal from the Colorado PUC to have electric utilities submit ten-year load and energy forecasts for evaluation. The analyses of these forecasts are to be used by the Commission in its determination and certification of the need for new electric generating capacity. The decisions based on these analyses effect the investment of hundreds of

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*Three other parts of the NEA also add a burden to state commission regulation with new authorities and requirements. These are the National Energy Conservation Policy Act (NECPA), the National Gas Policy Act (NGPA), and the Power Plant and Industrial Fuel Use Act (FUA).

millions of dollars which have sizeable economic impact on the state and its citizens. Numerous scenarios must be analyzed to ensure that all likely events and planning criteria have been met. The alternative is to largely leave these important investment decisions in the hands of the utility companies.

The conclusion here is simply that the Colorado Public Utilities Commission would be in a vastly improved position to carry out all its current and pending responsibilities with the development of computer capability together with appropriate staff skills.

## II. COMPUTER USAGE BY OTHER STATE REGULATORY COMMISSIONS

Several state regulatory commissions have developed and implemented techniques of computerized analysis. Following is a brief discussion of several analysis areas for which computer programs have been developed.

### A. Rate Design

Regulatory commissions are facing a number of controversial issues dealing with the design of utility rate structures. Indeed, issues of rate design are being addressed in the generic rate design case No. 5693 currently before the Colorado Public Utilities Commission. It is not the intent here to discuss the current debate on rate design.* It can be noted, however, that most of the issues in debate can be categorized into two general areas--the purpose of rates and the competing concepts of cost. The first issue treats questions like--should rates reflect cost or should rates be designed to achieve agreed-upon social objectives, eg. income maintenance?; the second considers the problems associated with whether marginal costs, average costs, fully-imbedded costs are best used in valuing utility properties and pricing utility services.

Numerous computer programs which are used to analyze rate structure issues have been developed by state regulatory commissions. The applications addressed by these programs range from the calculation of expected revenues from particular rate structures to complete systems which calculate cost-of-service, design rates, check the rates for the adequacy of revenue recovery, and if necessary, modify the designed rates until revenue is to be recovered. Computer programs are also being used to develop and evaluate rate structures and rate issues such as the impact of lifeline rates, the calculation of marginal costs (both short and long run) and inverted rate structures.

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*See Appendix B for a bibliography on rate design issues, rate experiments and price elasticity.

Several marginal cost models have been developed recently. Most are not fully automated. The Gordian Company's linear programming model is perhaps the most fully automated. Commissioner Charles Cichetti's National Science Foundation sponsored model is readily available on computer tape and has been used by analysts in rate cases. The Ernst and Ernst marginal cost model requires a great deal of computer based statistical analysis, but is not a completely automated model nor generally available. The NERA methodology also relies on hand calculations, although a great deal of background work can be computer based.

An example of a comprehensive system being developed which calculates customer class cost-of-service and design rates is that being developed by the staff of the Texas Public Utility Commission. The staff is developing a model to support the Commission's Generic Rate Design Project and the day-to-day handling of rate cases. The model's primary objective is to provide fast and detailed cost-of-service studies and comparative analyses of different alternatives in rate design; particularly with regard to demand allocation methods, rate-of-return on equity, and price elasticity.

As part of the Federal Energy Administration (FEA) (now Department of Energy, DOE) sponsored rate experiments and demand management demonstration projects* several computer programs capable of estimating revenue and/or customer bills (given load profile data) were developed. These analyses are necessary to implement time-of-day and load management schemes, as well as to forecast revenues under various rate designs.

## B. Cost-of-Service

An integral part of rate design is the determination of costs and the allocation of these costs to customer groups--residential, commercial, or industrial. Without knowledge of these costs, rates cannot be

*See Appendix C for a brief overview of these projects, and a summary of state rate design activities.

designed which, among other things, are equitable and are fairly applied to all service classes. A cost-of-service study translates accounting or economic data into the costs associated with serving customer groups.* The Uniform System of Accounts traditional to regulation does not report cost data in such a manner that a cost-of-service analysis is easily performed.

Operating expenses and capital investment (rate base expenditures) are the cost components which are translated into demand, energy and customer related costs. A number of computer programs have been developed which assist in the preparation of cost-of-service studies. In addition to the Texas PUC, as previously mentioned, the New York PUC and the Ohio PUC have both developed cost-of-service computer programs.

## C. Financial Analysis

Electric utility automated financial analyses and projections have received great attention recently in part due to the development of a computer program called the Regulatory Analysis model (RAm).

This program was developed by a consultant in cooperation with several state regulatory commissions and funded by the National Bureau of Standard's "Experimental Technologies Incentive Program" (ETIP). RAm is a comprehensive financial model that produces projected income statements, balance sheets, sources and uses of funds statements, and special reports under alternative assumptions or projections concerning the course of operating expenses, construction budgets and financial objectives such as return on investment, capital structure, etc. RAm has been used in several recent electric rate cases in Ohio to examine

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*For a detailed discussion of cost-of-service analysis methods see "Electric Utility-Cost Allocation Manual," J. Doran, F. Hoppe, R. Koger and W. Lindsey, National Association of Regulatory Utility Commissioners, Washington, D.C., 1973.

the implications of various policy and accounting treatments such as tax normalization; including construction work in progress in the rate base; and the treatment of accumulated income tax and investment tax credit deferrals. Several states have acquired RAm and are considering its use in rate case analysis.

A financial computer model developed in response to a suggested change in electric utility planning and construction policy is the Empire State Power Resources, Inc. (ESPRI) model developed by the staff of the New York PUC. This model was developed to analyze the proposal made by the seven major New York electric companies to merge their construction planning and financing activities into a single jointly-owned company. Although the model was designed to analyze a specific proposal, it is useful outside the ESPRI context since an analysis of a single company can be made.

A number of other financial models* are available from computer time sharing services and consulting firms.

## D. Utility Performance Analysis

Recent increased concern about utility productivity has led to computer programs which are used to investigate utility company performance. As part of the ETIP project a method utilizing regression analysis on FPC accounts was developed to identify and highlight certain performance aspects of utility operations. This computer program is called the Performance Evaluation model (PEm). This type of program is coupled with the FPC Regulatory Information System (now the DOE Respondent Information System) (RIS) will provide analysts with a machine readable and terminal-accessible electric utility data base. The RIS data base may well spur development of more generalized automated performance analysis techniques.

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*For example, the Electric Utility Corporate Model offered by General Electric and the AUTOPLAN program offered by the McDonald Douglas Time sharing service MCAUTO.

## E. Fuel Usage Monitoring and Analysis

A large portion of the rise in consumer utility bills has resulted from the rapid increase in fuel prices. For the most part, these costs have been passed through to the consumer through the operation of fuel adjustment clauses. A number of state commissions are currently implementing computerized monitoring systems (including fuel monitoring) which analyze the calculations performed by the utilities as to the charges passed through to the consumer. They are also used to "red-flag" situations which appear to be abnormal. Some, such as the Virginia State Corporation Commission, are also implementing computer models which project fuel usage for a test period in order to normalize monthly fuel charges to consumers.

Fuel usage and expense simulation models have been developed because of the importance of fuel costs in the revenue requirement and capacity optimization decisions of utilities. These models can be used to estimate the savings associated with improved power plant productivity programs to reduce heat rates, forced outages, maintenance time, etc. They have helped to successfully address questions related to the cost of "excess capacity" by estimating foregone fuel savings associated with bring a generating unit on-line at various dates. Some work has been done recently to estimate the fuel costs associated with installing scrubbers and the resulting changes in heat rate, unit availability, and station power requirements.

## F. Generation Planning and Load Forecasting

Computer based models are widely used in the areas of load forecasting and power generation planning. The need for additional generating capacity is reviewed by some form of a power siting authority in most states. These hearings are often filled with debates over various econometric techniques to forecast loads and capacity optimization routines to meet forecasted load. Several states have developed independent load forecasting capability.

In addition to the load forecasting models several states (Ohio PUC, Florida PSC) have acquired and experimented with capacity planning models. The Wein Automated System Planning Model (WASP) developed at Oak Ridge National Laboratory is perhaps the best known and most accessible capacity planning model. WASP has been introduced in some evidentiary hearings but its complexity and data requirements make it somewhat difficult to use.

Another federally developed code, CONCEPT (Construction Cost Estimation), is a preliminary effort to develop detailed cost budgeting and cost management techniques for power plant construction expenditures.

## G. Summary Table of Computer Usage by State Regulatory Commissions, 1978

The following summary table lists for each state regulatory commission its usage of computer analysis and application areas. As can be seen from the table, 25 of 44 states are using or are beginning to use computer analyses. These states are developing in-house capabilities in order to develop computer programs for specific applications, in order to modify existing programs for their particular needs and in order to develop and maintain the data bases specific to their state and which are necessary to operate the programs.

SUMMARY TABLE OF COMPUTER USAGE BY TOPIC BY STATE REGULATORY COMMISSION, 1978

| STATE REGULATORY COMMISSIONS | EDP SECTION OR STAFF | PURCHASE OUTSIDE SERVICES | RATE DESIGN | COST OF SERVICE | FINANCIAL ANALYSIS | FORECASTING PLANNING | RATE OF RETURN | DEPRECIATION ANALYSIS |
|---|---|---|---|---|---|---|---|---|
| Alabama | No | No | | | | | | |
| Alaska | Data Not Available | | | | | | | |
| Arizona | Yes | Yes° | | | | | | |
| Arkansas | Yes | Yes$^{X}$ | | X | X$^{+}$ | X | X | |
| California | Yes | Yes$^{*}$ | X | | X | | X | X |
| Colorado | No | Yes | | | | | | |
| Connecticut | Yes | Yes$^{\circ X}$ | X | | X | | X | |
| Delaware | No | No | | | | | | |
| Florida | Yes | Yes$^{X}$ | X | | X | X | X | X |
| Georgia | No | No | | | | | | |
| Hawaii | Data Not Available | | | | | | | |
| Idaho | No | No | | | | | | |
| Illinois | Yes | Yes° | X$^{+}$ | | X | | X$^{+}$ | X$^{+}$ |
| Indiana | No | No | | | | | | |
| Iowa | Yes | Yes$^{\square X}$ | X | X$^{+}$ | | | X | |
| Kansas | No | No | | | | | | |
| Kentucky | S | Yes$^{\circ \square}$ | | | | | | |
| Louisiana | No | No | | | | | | |
| Maine | No | No | | | | | | |
| Maryland | No | Yes$^{X}$ | | | | | | X |
| Massachusetts | Yes | No | | | | | | |
| Michigan | Yes | Yes$^{\circ X *}$ | X | | X | X | | X |
| Minnesota | No | No | | | | | | |
| Mississippi | No | No | | | | | | |
| Missouri | Yes | Yes$^{\circ *}$ | X | | X | | X | X |

\+ Planned
S Starting One
o State Data Center Service
□ Through Consultants
x University Data Center Services
* Private Firm

Source: Fall 1978 visits of NRRI staff to State Commissions

SUMMARY TABLE (Continued)

| STATE REGULATORY COMMISSIONS | EDP SECTION OR STAFF | PURCHASE OUTSIDE SERVICES | RATE DESIGN | COST OF SERVICE | FINANCIAL ANALYSIS | FORECASTING PLANNING | RATE OF RETURN | DEPRECIATION ANALYSIS |
|---|---|---|---|---|---|---|---|---|
| Montana | No | Yes$^{x}$ | | | | | | |
| Nebraska | Data Not Available | | | | | | | |
| Nevada | Yes | Yes | X | | | | | |
| New Hampshire | No | No | | | | | | |
| New Jersey | No | No | | | | | | |
| New Mexico | Data Not Available | | | | | | | |
| New York | Yes | Yes$^{*}$ | X | X | X | X | X | X |
| North Carolina | Yes | Yes$^{\circ}$ | X | X | X | X | | X |
| North Dakota | Yes | Yes$^{\circ}$ | | | | | | |
| Ohio | Yes | Yes$^{\circ x *}$ | X | X | X | | X | X |
| Oklahoma | No | No | | | | | | |
| Oregon | Yes | Yes$^{\circ *}$ | | | X | | X | X |
| Pennsylvania | Yes | Yes$^{\circ}$ | X$^{+}$ | | X | X$^{+}$ | X | X |
| Rhode Island | No | No | | | | | | |
| South Carolina | Yes | Yes$^{x}$ | | | X | X | X | |
| South Dakota | Yes | No | | | | | | |
| Tennessee | No | Yes$^{x}$ | | | X | | | |
| Texas | Yes | Yes$^{*}$ | X | X | X | X | X | X |
| Utah | No | Yes$^{\square}$ | | | | | | |
| Vermont | Yes | Yes$^{\circ}$ | | | | X | | |
| Virginia | Yes | Yes$^{\circ *}$ | | | X | | X | |
| Washington | Yes | Yes$^{\circ}$ | | | | | | |
| West Virginia | No | No | | | | | | |
| Wisconsin | Data Not Available | | | | | | | |
| Wyoming | No | No | | | | | | |

\+ Planned
S Starting One
$\circ$ State Data Center Services
$\square$ Through Consultants
x University Data Center Services
* Private Firm

Source: Fall 1978 visits of NRRI Staff to State Commissions

Notes to Summary Table of
Computer Usage By Topic By State Regulatory Commission, 1978

Arizona - An EDP section has been established and application areas are being determined.

Colorado - Computer services are provided by the Revenue Department for docketing purposes.

Maryland - Utilizes a depreciation data set on the University of Maryland computer system.

Massachusetts - Has staff which can utilize computers.

Montana - Uses services of a university data center. Staff does not directly utilize ADP.

North Dakota - Application area is facility siting.

South Dakota - The respondent to the survey said that there are staff members responsible for EDP but that no outside services were purchased.

Tennessee - Computer services are purchased from Vanderbelt University in the financial analysis area.

Washington - Application areas are case status reporting and transportation enforcement.

## III. COMPUTER ANALYSIS AND THE COLORADO PUBLIC UTILITIES COMMISSION

Before discussing the potential for computer analysis at the Colorado Public Utilities Commission, it is appropriate to review the rate case processing procedure of the Commission. At the outset, it should be recalled that by statute, a time limitation of 240 days exists to process a rate case. Briefly, rate case processing proceeds as follows:

1. The Utility files an advice letter with the Commission to, say, increase rates.
2. The Commission has thirty days to either suspend the rate increase and set a hearing or allow the increase to go into effect.
3. If a hearing is set the commission, its staff, and parties to the case, then have approximately 240 days to:

    (a) investigate the filing,
    (b) prepare and submit testimony,
    (c) hold hearings,
    (d) issue a decision,
    (e) allow for filing of judicial appeals.

The main issue in each rate case frequently is the determination of the utilities' required revenue. The investigation into the revenue aspects of the case by staff takes approximately 100-130 days. Following that the hearing takes two to four weeks. Subject to the findings of the hearing, an order is issued as to the allowed revenue for the utility. At this point, the staff performs a cost-of-service study and designs rates.

The issues associated with determining cost-of-service and designing rates are of course extremely important to company and customers. The staff, in a relatively short period of time, must determine the costs associated with providing service to each customer class. In making

that determination, issues associated with the cross subsidy among service classes and the impact of the rate increase on individual classes must be addressed. The cost-of-service analysis is time consuming and complicated because of the large number of calculations required and the fact that approximately thirty procedures for allocating shared costs to customer class are recognized.

The capabilities of the Colorado PUC staff to perform a timely in-depth analysis and determination of customer class cost-of-service would be greatly enhanced if the staff had in-house computer analysis capabilities. Having this capability would ultimately benefit the utility consumers of the state of Colorado and make this aspect of state government service more efficient and effective.

Computerized analysis would be of assistance in other aspects of a rate case. Conceptually, a rate case is a straightforward process. The revenue requirement of the utility is determined. This revenue requirement is allocated to the customer service classes. Rates are designed to recover the revenue assigned to each class. For all this to be done, expenses such as operating and maintenance, taxes, depreciation, etc., are determined for a historical test year, the value of utility plant (the rate base) is determined, and a fair rate of return to apply to that rate base is calculated. From these values the revenue requirement is determined. Each of these steps is markedly aided by use of computer analysis. Without addressing these individual issues specifically, the point here is that as the pressure on staff to perform more in-depth analyses grows, the need to utilize computer analysis will also grow.

## IV. IMPLEMENTING COMPUTER ANALYSIS IN COLORADO

Because in some sense regulation does not vary drastically from one state to another, programs developed at other state commissions can be transferred to and utilized by the Colorado Public Utilities Commission's staff. This benefits the Colorado Commission in that sizeable savings in the costs associated with program development can be realized. However, the need for in-house computer staff and computer capability still exists. Personnel are needed with the capabilities to analyze programs received from other commission and to modify those programs to meet the specific needs of the staff. In addition personnel at the Colorado Commission must maintain the programs and develop the data necessary to operate the programs for the Colorado utilities under its jurisdiction

Data development and computerization of these data in the long run can be very beneficial to the Colorado Commission in carrying out its regulatory responsibilities. Data, treated as a resource, allow regulators to make accurate and timely decisions. The DOE Respondent Information System mentioned earlier offers electric utility data to state commissions. To best utilize and assess these data, computer analysis capability is needed.

In order to implement in an orderly and cost effective manner a capability for in-house computer analysis a system analyst would need to be hired. This person would have experience in system development, computer program evaluation, hardware and time-sharing service evaluation, and program user training. Regulatory experience would also be desirable.

Once hired, this person would evaluate computer time-sharing services available in the Denver area. This evaluation should not only address the cost of computer time but the support services offered. Utilizing the services of a reputable computer time-sharing service will facilitate the development of in-house computer capability and also will be cost effective.

The systems analyst, working closely with other commission staff and the time-sharing service representative, would determine which computer programs to request from other state commissions. Key to this determination is the application of the program to Colorado regulatory analysis and the problems associated with making the program operational at the computer time-sharing service.

As discussed above, determining cost-of-service is a likely candidate for initial computerization. Programs which perform cost-of-service studies can be obtained from the New York PSC, the Ohio PUC, the Texas PSC and The National Regulatory Research Institute. The cost associated with obtaining any of these programs is, in general, the cost of making a copy, which is only $50-100. As application areas are defined, programs can be obtained to assist the analyses performed by staff in those areas.

In summary, even though the development costs of a number of computer programs have been born by Commissions other than Colorado, the Colorado staff still requires in-house computer capability to implement these programs, maintain them and develop the data bases required to operate the programs.

## V. CONCLUSION

The Colorado Public Utilities Commission needs in-house computer analysis capabilities. Implementation of this capability can be realized at a relatively low cost. To implement this, a system analyst and access to a computer time-sharing service are necessary. The analyst would interface with the rate case processing staff and a time-sharing service to evaluate and implement previously developed computer programs which would assist staff in case processing. Since numerous programs have been developed by other commissions and are available at a relatively low cost, acquiring the program will save the Colorado Public Utilities Commission significant amounts of development money as well as relieve the staff of having to "re-invent the wheel." Low cost implementation support is also available from The National Regulatory Research Institute (NRRI). Computer program procurement assistance is available from the NARUC Staff Subcommittee on Computers and NRRI.

It is further concluded that the Colorado PUC staff needs computer assisted regulatory analysis not only for rate case processing but also in order to respond to legislative requirements such as those imposed on it by the Public Utility Regulatory Policies Act.* Finally, if the Colorado PUC receives legislative authority to evaluate load forecasts and the generation requirements of Colorado electric utilities, the need for computerized analysis will become imperative.

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*It should be remembered that counterpart federal legislation applying to gas utilities is yet to come but may be imminent, adding one more set of state commission requirements.

Appendix A

# RATE REFORM STANDARDS AND IMPLICATIONS FOR AUTOMATED ANALYSIS IN THE PUBLIC UTILITY REGULATORY POLICIES ACT OF 1978 (PURPA)

The recently passed Public Utility Regulatory Policies Act of 1978 (PURPA) requires state regulatory commissions to investigate and consider a number of rate reform standards within three years and then report annually for the next ten years on the status of these reforms.

The rate making standards* suggest specific areas for future and current evolution in automated analysis: these standards include:

1. Cost-of-Service. "Rates charged by any electric utility for providing electric service to each class of electric consumers shall be designed, to maximum extent practicable, to reflect the costs of providing service to such class. . . "

2. Declining Block Rates. This rate practice, once the foundation of the industry, is discouraged by the Act unless the utility and state commission determine that a utility's cost-of-service justifies a cheaper rate for larger amounts of electricity usage.

3. Time-of-Day Rates. "The rates charged by any electric utility for providing electric service to each class of electric consumers shall be on a time-of-day basis which reflects the costs of providing electric service to such classes of electric consumers at different times of the day unless such rates are not cost-effective, with respect to such class. . ."

4. Seasonal Rates. "The rates charged by an electric utility for providing electric service to each class of electric consumers shall be on a seasonal basis which reflects the costs of providing service to such class of consumers at different seasons of the year to the extent that such costs vary seasonally for such utility."

5. Interruptible Rates. "Each electric utility shall offer each industrial and commercial electric consumer an interruptible rate which reflects the cost of providing interruptible service. . ."

6. Load Management Techniques. Each electric utility shall utilize load management when: (1) it is determined to be cost effective; (2) it will be reliable; and (3) it will provide useful energy or capacity management advantages to the utility.

In addition to these rate standards, each commission would be required to evaluate standards that are "not directly related to rate structure of an electric utility, but rather relate to other practices of electric

*Taken from Public Law 45-617 the "Public Utility Regulatory Policies Act of 1978," November 9, 1978 92 STAT. 3117

utilities related to terms and conditions of electric service that may indirectly affect the rate structure..." According to the legislative language of the bill, these standards include:

1. Master Metering. "To the extent determine appropriate..., master metering of electric service in the case of new buildings shall be prohibited or restricted to the extent necessary to carry out ..." the purpose of the bill.

2. Automatic Adjustment Clause. "No electric utility may increase any rate pursuant to an automatic adjustment clause..." unless the state regulatory commission has recently reviewed the clause and has determined that the clause is not contributing to a utility's revenue.

3. Information to Consumers. Each utility is required annually to provide a "clear and concise" explanation of the applicable rate to each of its consumers.

4. Termination of Electric Service. This provision requests utilities to add the following to termination of service rules: (1) "no electric service to an electric consumer may be terminated unless reasonable prior notice (including notice of rights and remedies) is given to such consumer and such consumer has a reasonable opportunity to dispute the reasons for such termination and (2) ...termination of service would be especially dangerous to health as determined by the state regulatory authority..."

5. Advertising. Utilities are prohibited from "promotional" and "political" advertising but are asked to advertise conservation and time-of-use and other energy-efficient practices.

The automated analyses capabilities required to make reasonable judgements on these issues currently exist. The problem will be to integrate existing models into a cohesive framework, develop more useful capacity optimization models, and refine demand forecast models to incorporate the effects of time-of-use rates. However, compliance with the Act, especially within the two to three year time period will be a formidable task for any state commission.

Further analytical requirements implicit in PURPA are illustrated in the requirements of Sections 115 and 116.

Section 115: "Special Rules For Standards" of the Act contains directions to commissions on how they should determine whether proposed time-of-day rate structures are cost effective:

> "...a time-of-day rate...shall be determined to be cost effective with respect to each such class if the long run benefits of such rate to the electric utility and its electric consumers...are likely to exceed the metering costs and other costs associated with the use of such rates."

Clearly, evaluation of long run benefits requires implementation of automated analysis techniques. One of the primary long run benefits of time-of-day rates and load management techniques are foregone capital and operating costs associated with deferring capacity additions and increased utilization of efficient base load units. Improved engineering/economic utility simulation models will be required to estimate the benefits of reduced load growth. Current capacity optimization models should be refined so that they are more useful in policy analysis. Models of the capacity deferral or acceleration decision should be developed. These models will have to be applied to the specific situation of each state.

Section 116: "Reports Respecting Standards" requires state authorities:

> "Not later that 1 year after the date of the enactment of this Act and annually thereafter for 10 years, each State regulatory ...shall report to the Secretary (DOE) ... its consideration of the standards... Such report shall include a summary of the determinations made and actions taken with respect to each such standard on a utility-by-utility basis."

Congress intends that each state continuously review its progress and reevaluate its decisions on an annual basis. This will require the implementation of monitoring and evaluation programs.

A monitoring program would not only be useful for complying with the annual reporting requirements and managing an implementation program but should be designed to mesh with demand forecasting models so that results of early attempts to implement rates can be evaluated in the long run context required by the Act.

Although this is a brief overview of PURPA it is clear that this Act places an increased need for state regulatory commissions to perform complex analyses--many requiring computer capabilities.

Appendix B

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# PRICE ELASTICITY

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Appendix C

# AN OVERVIEW OF FEDERAL ENERGY ADMINISTRATION RATE AND DEMAND MANAGEMENT EXPERIMENTS STATE ACTIVITIES IN RATE REFORM

## SURVEY OF FEDERAL AND STATE RATE DESIGN PROJECTS

### FEA/DOE Rate Demonstration Projects*

The Electric Utility Rate Demonstration program was established to fulfill three main objectives: (1) to demonstrate to utilities and to utility regulators the viability and customer acceptance of innovative electric rates; (2) to gather empirical data as to the impacts of such rates on consumers and consumption patterns; and (3) to transfer these results to an analysis of national data.

A total of sixteen were initiated by D.O.E.; seven in 1975 and nine in 1976. Four have been completed to date with the balance to be concluded in the next three years. The demonstrations focused on a wide range of rate design and load management alternatives, with the primary emphasis on time of day rates. Other alternatives investigated included flat rates, lifeline rates, inverted rates and demand rates. Load management techniques under investigation included direct and indirect measures. Among these were time switches, load limiting devices, remote control systems, demand controllers and peak load warning devices.

The demonstrations involved experimentation in structured environments with suitable control groups and consideration of non-electricity price variables such as weather and regional characteristics. Following is a brief description of each experiment and the key subject matter involved.

(1) Vermont - Public Service Board and Green Mountain Power Co. This study involves experimentation with inverted demand off-peak, three-part tariffs, peak Kw demand and interruptible rates. There was voluntary participation by residential customers with the objectives of testing customer acceptance and response to the various rate forms and the potential impact upon utility revenues and load shapes. Also tested were hydronic heat storage devices and a ripple control system for load management.

(2) Connecticut - Public Utilities Commission and Connecticut Light and Power Co. The rate form tested in this experiment was a three-part time of day rate. Residential participation was voluntary. The

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* Information contained in this section was excerted from "Electric Utility Rate Demonstration Program - Fact Sheet," Department of Energy, ERA - Regulatory Institution Office, November 1977. A more detailed report on these experiments will be available early in 1979.

objectives were to test customer response to time of day rates and to determine deferral and cost savings potential. Incentives were provided to invest in load control devices.

(3) New Jersey - State Energy Office and Jersey Central Power and Light. The rate form tested consisted of two-part time of day rates with different peak, off-peak and seasonal ratios. There was mandatory participation of residential customers with a further test of a bi-directional load management system. The object was to test the economic feasibility of load management system and customer response to time of day rates.

(4) Ohio - Public Utilities Commission with Dayton Power and Light Co., Toledo Edison Co. and Buckeye Power Co. Two-part time of day rates which varied seasonally were tested. Residential participation was voluntary. Tests of radio controlled water heating, HVAC loads, and heat storage were conducted. The objectives were to investigate customer consumption patterns, the feasibility of supervised load control, the cost impact of heat storage and the development of a computer program to determine the incremental costs of producing electricity.

(5) Arkansas - Public Service Commission and Arkansas Power and Light Co. The rate structure tested consisted of three-part time of day rates with different peak, off-peak and seasonal ratios. Residential, commercial and industrial participation was mandatory. The major objectives were analyses of elasticities of demand under cost based rates and determination of the medium term implications of demand charges on utility operating and capital costs.

(6) Arizona - Solar Research Commission and Arizona Public Service Co. Rates investigated consisted of three-part time of day rates with multiple peak and off-peak ratios. Participation was voluntary for residential customers. A number of load control devices and off-peak HVAC systems were also tested. The objectives were to assess the socio-economic implications of time of day rates and load management systems.

(7) Los Angeles - The city and the Department of Water and Power. A number of rate designs were tested including lifeline, seasonal, flat and two-part with multiple peak/off-peak ratios and varying peak periods. Participation was residential and voluntary. The objectives were to assess customer response to various rates and to assess the impact on utility operation of time varying rates.

(8) Wisconsin - Public Service Commission and the Wisconsin Public Service Corporation. Rate designs tested were seasonal, flat, time of day and demand rates. Residential participation was mandatory. Measures of price, demand elasticities and customer comprehension of price signals were the major objectives.

(9) Michigan - Public Service Commission and Detroit Edison. The focus of the study was energy management resulting from two-part time of day rates already in use. Industrial customers participated in a voluntary manner. The emphasis was on saving energy at system peak with some monetary incentive to invest in load control devices.

(10) New York - Public Service Commission and Consolidated Edison. This study focused upon institutional and legal aspects of load management opportunities; the impact of load management; the impact of time varying rates on the customer and utility system; and the cost effectiveness of various load management strategies. Residential and commercial participation was both voluntary and mandatory.

(11) California - Energy Resources Conservation and Development Commission and Public Utilities Commission with Pacific Gas and Electric Co., San Diego Gas and Electric Co., Southern California Edison and Sacramento Municipal Utility District. This rate demonstration project consisted of time of day rates coupled with various pricing periods, demand charges and load management tariff provisions. Also interruptible rates and special off-peak rate incentives were tested. Industrial, commercial and residential participation was both voluntary and mandatory with the objectives of assessing the actual impact, cost and system implications of shifting all large customers to time of day rates. The costs and benefits of extending time of day rates to residential and low demand customers were also considered.

(12) Puerto Rico - Commonwealth and the Water Resource Authority. The Turvey marginal cost approach to time of day rates was used with residential customers. Participation was voluntary with the objectives of measuring consumption changes and estimating utility and customer savings from the implementation of time of day rates.

(13) North Carolina - Utilities Commission and Carolina Power and Light, and Blue Ridge Electric Membership Corp. This experiment consisted of three-part, time of day rates and demand rates with seasonal variations. Residential participation was mandatory. Project objectives included evaluating the system load curves; the costs and benefits of time of day rates; and customer attitudes and responses to alternative peak load rates.

(14) Edmond, Oklahoma - Edmond Municipal Electric Co. The municipal electric company tested seasonal, time of day and flat rates on residential customers. Mandatory participation was required with the objectives of measuring changes in usage patterns; customer acceptance; and revenue changes under the test rates. Also, the feasibility of system wide implementation was analyzed.

(15) Washington - State Energy Office and Seattle City Light, Clark County PUD, and Puget Sound Power and Light. Inverted rates were tested on residential, commercial and industrial customers. Participation was voluntary. Cash rebates to public housing residents who conserved were used as a feedback to customers for conservation. The major objectives were controlled evaluation of rate increases; analysis of relationships between income and energy use; and implementation of cost effective means of providing feedback to customers who conserved energy.

(16) Rhode Island - Public Utilities Commission and Blackstone Valley Electric Company. Three-part time of day rates were implemented with mandatory participation of residential customers and super

markets. Objectives were to measure consumer response and whether resulting load management benefits warrant costs incurred.

State Activities in Rate Reform

To provide further information on state activities in the area of rate reform the results of a recent survey conducted by the Electricity Consumers Resource Council (ELCON)* will serve as an update. The ELCON study found that:

(1) in 28 states commission policy was to discourage declining block rates;

(2) in 41 states commission approved seasonally varying rates;

(3) generic hearings investigating general rate structure design had been held in 24 states including:

Arizona, California, Colorado, Connecticut, District of Columbia, Florida, Hawaii, Illinois, Iowa, Maine, Maryland, Massachusetts, New Hampshire, New Mexico, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas, Utah, Washington and Wisconsin;

(4) commissions in 26 states had approved time of day rates on experimental or permanent basis, in at least one class of customers;

(5) utilities in 14 states measured marginal or incremental costs for each customer class;

(6) in five states, commissions required utilities to measure the marginal or incremental cost of service by customer class.

Nearly every state has implemented some form of rate reform and, throughout the country, states are participating in analyses of rate structure reforms.

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* State Electricity Update: January-February 1978, by Electricity Consumers Resource Council, Washington, D.C.