THE
BONNEVILLE POWER ADMINISTRATION
PROGRAM DESCRIPTION
FOR THE
ALUMINUM SMELTER CONSERVATION/MODERNIZATION PROGRAM

November 1986

Document Prepared by the
Division of Commercial and Industrial Programs
Office of Conservation
Bonneville Power Administration

ACKNOWLEDGEMENT

The Bonneville Power Administration (BPA) is indebted to the volunteer members of the Conservation/Modernization Program Design Team for their joint cooperation and assistance in helping BPA complete the program design. In addition, BPA wishes to express appreciation to those individuals and organizations that provided comments during the public design process.

TABLE OF CONTENTS

CHAPTER		PAGE
	PREFACE	4
1	INTRODUCTION	6
2	BACKGROUND	7
3	PROGRAM OBJECTIVE	9
4	PROGRAM DESCRIPTION	10
	a) Duration	10
	b) Eligibility	10
	c) Budget Level	10
	d) Incentive Level	10
	e) Payment Method	10
	f) Delivery Mechanism	11
	g) Conservation/Modernization	11
	h) Proprietary Information	11
	i) Program Evaluation	11
	j) State and Local Government Participation	11
	k) Linking the DSI Initiatives	12
5	CONTRACT PRINCIPLES	13
6	ENVIRONMENTAL REQUIREMENTS	15

APPENDIX

Appendix A	Documentation of the Final Value Analysis	16

"While the details of BPA's role in this proposed partnership have not yet been developed, each participating company would be expected to raise the capital for the investment. It is perhaps in this area that the State or local governments may be able to participate, if they are able to support industrial development bonds at reduced interest rates. BPA's contribution, whether a rate credit or some form of direct payment, would be predicated on several guiding principles: (a) conservation savings would be returned to BPA when the region needed them, (b) BPA's total power revenues would be enhanced by the modernization program, (c) the total annual costs of the program are constrained to reasonable levels, and (d) payment only for accrued savings would provide assurances that any BPA financial investment will not be lost. Consistent with these principles, it is anticipated that the BPA program would have the effect of purchasing conservation at a very low cost (e.g., 5 mills/kWh or less).

"It is possible that these principles could also lead to BPA support of conservation/modernization for other of the region's industries, particularly those that are energy-intensive. The justification for pursuing this portion within the context of the DSI Options Study does not preclude its extension to other regional industries if the same benefits to the region's ratepayers can be demonstrated by satisfying the principles mentioned above.

"As with the variable rate initiative, there are a number of significant legal, administrative, and technical questions that need to be answered before BPA can positively move forward with a formal proposal. BPA would like to work with its customers and other regional interests in addressing these questions."

PREFACE

The following is an excerpt from the BPA publication titled DSI Options Study* dated June 1985. It served as the charter for designing the program described in this document.

"The Bonneville Power Administration (BPA) and the region's ratepayers would benefit if the inefficient aluminum plants would modernize their facilities. With modern plants, the companies would reduce production costs and become more competitive in the world aluminum market. The plants would then be in a better position to survive economic downturns and operate at higher levels of plant capacity. During this period of regional power surplus, BPA's revenues would therefore be stabilized and possibly enhanced.

"BPA believes that a potential opportunity exists for relatively small levels of BPA support for DSI conservation/modernization to enhance the stability of those loads, and thus BPA's revenues, without harming BPA's other rate classes. Larger BPA contributions, up to payments for all of the modernization costs, could not be supported because BPA's other customers would experience greater costs than the benefits they would receive from the stability of loads in the near term and the return of conservation savings in the long term.

"In order to stimulate aluminum plant modernization investments, BPA is interested in developing a program to join in a partnership with the companies and with State or local governments to provide a financial package that makes plant improvements attractive. The aluminum companies that wish to participate in this "partnership" program would be expected to bear the major share of the responsibility and of the cost for modernizing their plants. For its part, BPA could establish some new mechanism of providing rate credits or direct payments for plant conservation/modernization at participating industrial plants. These rate credits or payments would pay for some portion (e.g., approximately 20 percent) of the cost of modernization.

"In addition, BPA would like to invite State or local governments to participate financially in whatever ways they can to help the plants modernize (for example, tax benefits). BPA believes this participation is reasonable since the local communities are also major beneficiaries if the plants modernize and remain open. It may be more equitable if some portion of the burden of supporting plant modernization is borne by the local community. This is expecially true since BPA serves only a portion of the region and does not serve some utility service areas in which aluminum plants are located.

"If combined with the BPA rate incentive initiative, this modernization proposal could provide the less efficient plants with the resources and certainty required for proceeding with any necessary modernization investments.

---

* Copies of this document may be obtained from the BPA Public Involvement Office on request.

Chapter 1

INTRODUCTION

The Bonneville Power Administration has developed the Aluminum Smelter Conservation/Modernization (Conservation/Modernization) Program based on the DSI Options Study, Final Report (DSI Options Study), June 1985. The program is intended to help stabilize the aluminum Direct Service Industries' (DSI) loads, and thereby maintain and possibly even enhance BPA's revenues.

Collectively, the aluminum DSIs account for approximately 30 percent of BPA's power system loads and 25 percent of BPA's total power sales revenue when they are operating at capacity levels. An increase in the number of plants worldwide, foreign government subsidies, and changing trends in the use of and demand for aluminum have adversely affected the economic stability of the industry. Several of the older, less efficient, smelters in the region are currently operating well below production capacity levels.

Chapter 2

BACKGROUND

BPA completed the DSI Options Study (Options Study) in June 1985. The purpose of the study was to determine the best course of action BPA could take to preserve the loads and revenues provided by the region's energy-intensive aluminum Direct Service Industries (DSIs). One of three initiatives BPA decided to pursue as a result of the Options Study was the design of the Aluminum Smelter Conservation/Modernization (Con/Mod) Program.

BPA was interested in achieving two program objectives under Con/Mod. The near-term objective was to encourage the aluminum smelters to modernize their facilities, thereby maintaining electric loads on the region's power system and preserving Bonneville's revenue base. The long-term objective was to ensure that the ratepayers investment would be protected by acquiring conservation for the region when it is needed.

BPA designed the program in a public process, with the assistance of a volunteer design team.

In August 1985, BPA held a public meeting in Portland, Oregon, to discuss the Conservation/Modernization Program design. BPA began the public process by inviting additional experts from outside of BPA to provide input into the design of a Conservation/Modernization Program. The Public Power Council, the aluminum industry, the Northwest Conservation Act Coalition, Industrial Customers of Northwest Utilities, the region's State and local governments, and the Inter-Company Pool provided volunteer members to join BPA staff in formulating a design team.

The purpose of establishing the team was to assist BPA in the development of program guidelines. The team worked together from September 1985 to January 1986 to identify and resolve design issues. The goal was to strive for consensus. However, where there were conflicting opinions among the group, BPA had to consider the options presented and decide which offered the greatest benefits to BPA and the region's electric power system.

Design Team Meetings: Meetings with the design team were held regularly from September 1985 through January 1986. A list of issues were identified and discussed by the design team. Issue discussion papers were prepared and presented by BPA staff, the Public Power Council (PPC), the Inter-Company Pool (ICP), the Northwest Conservation Act Coalition (NCAC), Direct Service Industries (DSI), Inc., and State and local governments. BPA considered the ideas and options presented and the various positions stated in the preparation of this proposal.

A technical workgroup, composed of members of the design team, was also established to discuss methods and assumptions involved in determining the value of conservation/modernization energy savings to BPA and the region.

The Final Direct Service Industry Options Environmental Impact Statement (Final EIS), April 1986, considered the environmental effects of offering a Con/Mod program alone or in combination with the Variable Rate. The Final EIS

concluded that the physical environmental impacts expected to result from the Con/Mod program, in addition to the Variable Rate, were minor and would be outweighed by the socioeconomic benefits to the region.

Three public meetings were held in the region in February to receive comment on the draft program proposal. The draft proposal was revised, based on public comment and further analysis by BPA, and published for final public comment in June.

The final comments were considered in completing the Program Description and the Administrator's Decision Document for the Aluminum Smelter Conservation/ Modernization Program.

Chapter 3

PROGRAM OBJECTIVE

BPA is interested in a business-like utility program that will encourage the region's aluminum smelters to increase capital investments in energy efficiency improvements and other plant upgrades. Upgrading production efficiencies at the plants will place them in a better position to compete in the industry. A reduction in the overall cost per pound of aluminum production should improve the likelihood of the plants continuing to operate in the region and possibly at higher production levels.

The DSI Options Study concluded that BPA should undertake the design of a Conservation/ Modernization Program. The program is not intended to be solely a conservation program. It has an important near-term objective that sets it apart from other BPA conservation programs.

1. Near-term objective: To provide an incentive to encourage the region's aluminum companies to modernize their smelters, thereby maintaining BPA revenues and stabilizing loads on the region's electric power system.

2. Long-term objective: To provide additional power to BPA and the region when it is needed.

Accomplishing the near-term objective will also help to keep rates low for other BPA power purchasers. Acquiring conservation in the long term will provide energy savings that might otherwise require expensive new generation facilities.

The purpose of the Conservation/Modernization Program is to stabilize DSI loads and maintain BPA revenues through modernization with an opportunity for conservation through future load reduction.

BPA has defined conservation/modernization as follows:

Modernization: Improvements in efficiency of the production process through facility upgrades or replacements.

Conservation: Reduction in electric power use, obtained through improvements in the efficiency with which electricity is used in the production process.

Chapter 4

PROGRAM DESCRIPTION

The following describes the program features BPA will include in the program based on public comment and the results of further analysis by BPA.

a) Duration. The program will be available to the Northwest aluminum smelters for a 2-year period with an option for the Administrator to extend this period for an additional year.

b) Eligibility. BPA will make the program available to all of the primary aluminum smelters located in the BPA service area that are Direct Service Industries (DSI).

Projects that meet the required conditions of a BPA program announcement will receive funding on a first come, first considered basis, within the annual and total program budget constraints. The smelters will not be required to compete with one another. However, to qualify for a BPA incentive payment, projects must produce measurable electric energy savings.

c) Budget Level. BPA will limit the Conservation/Modernization Program budget level to $76 million in 1985 dollars and make payments over a period of 10-years.

d) Incentive Level. BPA will offer a 5 mill/kWh incentive for energy saved through efficiency improvements at the smelters.

e) Payment Method. BPA will offer a direct payment for a 10-year term. Payments will be made on a quarterly basis.

The smelters will be required to provide verification of pre-modernization and post-modernization production efficiencies. BPA will use this information to determine the efficiency improvement in terms of kWh/lb of aluminum produced. The efficiency improvement will be multiplied by the total pounds of aluminum produced each quarter to determine the energy savings and the amount of payment for that period. See the example provided below.

EXAMPLE:

ACME aluminum plant produces 1 million pounds of aluminum in a quarter. The existing production efficiency is 8 kWh/lb of aluminum produced. The expected new production efficiency, after modernization, is 7 kWh/lb of aluminum produced. The efficiency improvement is, in this case, 1 kWh/lb of aluminum produced. The incentive offered by BPA is 5 mills/kWh of

energy savings. The following formula illustrates the amount BPA would pay to the ACME aluminum company given the information provided above:

$$PL \times EI \times I = QP$$

where,

PL (Production Level) = 1,000,000 lbs of aluminum

EI (Efficiency Improvement) = 1 kWh/lb of aluminum produced

I (Incentive) = 5 mills ($.005)/kWh of energy savings

QP (Quarterly Payment) = $5,000 in 1985 dollars.

f) Delivery Mechanism. BPA will prepare an announcement making the program available to the aluminum companies based on the program features. BPA will require that the aluminum companies provide documentation of energy savings resulting from modernization projects.

g) Conservation/Modernization. BPA will verify that energy efficiency improvements are operating effectively over the entire performance period. BPA also will reduce the companies' Contract Demand to ensure conservation is acquired based on the reduction in required power that results from energy efficiency improvements at the plants. Contract Demand reductions will be implemented as the smelters complete their projects, or on June 30, 1991, whichever occurs first.

h) Proprietary Information. BPA will work together with the aluminum companies to establish requirements for protecting proprietary information.

i) Program Evaluation. BPA will evaluate the Conservation/Modernization Program on an ongoing basis. If evaluation results suggest that programmatic features should be modified or added to increase benefits or decrease costs for BPA and the region, BPA will reserve the right to make changes in the program.

Modifications to the program could involve changes in the payment method, proposal evaluation criteria, or other programmatic features. Any changes subsequent to program implementation will not affect contracts already in place, unless mutually agreed to by the parties.

The following features were discussed during the program design process, but were not adopted in the final program design.

j) State and Local Government Participation. BPA had proposed to provide an additional 1 mill/kWh incentive to match an equal amount provided by State or local governments who are direct economic beneficiaries of the operating plants. In response to public comment, BPA decided to eliminate the State and local government matching fund feature from the program. However, BPA feels that the mechanisms currently in place and further planned actions by State and local governments in support of the smelters will be a key determinant in the success of this program.

k) Linking The DSI Initiatives. BPA decided not to require participation in the Variable Rate as a condition for participation in the Conservation/Modernization program. The Variable Rate was discussed in the DSI Options Study and adopted by BPA in June 1986.

Chapter 5

CONTRACT PRINCIPLES

The following are contract principles developed by BPA to clarify basic conditions to be included in Con/Mod Contracts with the aluminum smelters:

a. Contract Expiration Date

Con/Mod contracts will expire June 30, 2001, when the DSI power sales agreement expires.

b. Project Completion Deadline

To provide 10 years of payments, BPA will need to know the extent of the efficiency improvements completed 10 years prior to the 2001 contract expiration date.

The aluminum smelters must verify the level of energy efficiency achieved at each potline as projects are completed, or by June 30, 1991, whichever occurs first. If a smelter chooses to implement a project in several stages, it will not receive payments for additional efficiency improvements achieved after June 30, 1991.

c. Full-Payment for 10-Years of Energy Savings

One of the program features stated that BPA would provide each participating smelter the opportunity to receive payments for energy savings achieved by completed projects over a 10-year period.

Projects that are staged-in do not achieve full energy savings potential until they are completed. This means that quarterly payments made by BPA during the staging-in period are actually fractions of the payments made each quarter after the projects are completed.

BPA will provide the equivalent of 10 full-years of payments for energy savings from projects completed by June 30, 1991.

d. Timing of a Contract Demand Reduction

Contract Demand reductions will be executed as the projects are completed at the smelters, or by June 30, 1991, whichever occurs first.

e. Determining Efficiency Improvements

Aluminum is created by an energy-intensive electrochemical reaction in basic raw materials contained in a "potcell." Many of these potcells are placed in rows called "potlines." Each smelter houses several potlines. Some of the potlines operate continually, while others are "swing-lines" that operate according to the fluctuating world price of aluminum.

In addition, the aluminum production process is not static. That is, the smelters continue to improve the process through experience and experimentation. To determine the effects of energy efficiency improvements, it is necessary to establish a baseline efficiency (kWhs/lb aluminum produced) for both pre-and post-modernization periods.

For the reasons stated above, BPA will measure baseline efficiencies on a potline-specific basis, rather than for a whole smelter. Furthermore, the time-frame for establishing base periods will be the first six months of calendar year 1986. However, if a potline did not operate in the first six months of 1986, Bonneville will accept the most recent six-months operating history to establish the baseline efficiency for that potline. Post-modernization baseline efficiencies will be determined as projects are completed, or by June 30, 1991, whichever occurs first.

f. Efficiency Improvements That Qualify for Bonneville Payment

The aluminum companies are primarily concerned with efficiency improvements at the potlines. That is where the bulk of the energy saving opportunities exist. However, there may be some ancillary equipment (i.e., lights, HVAC, etc.) upgrades that would enhance overall plant efficiency. The expected energy savings from ancillary equipment upgrades account for less than 5 percent of the overall achievable savings from smelter sites.

The Con/Mod program is designed to pay for all verified electric energy savings that result from upgrades at the smelters. Therefore, any efficiency upgrades which save electric energy should be considered eligible for payment.

g. Smelter Performance Monitoring

BPA will monitor plant performance over a 10-year period to ensure that efficiency improvements are maintained through the term of the Contract. Continuous performance monitoring will require that BPA monitor production performance at each smelter to ensure that changes at the facilities achieve and sustain the energy efficiency improvements.

h. Protection Procedures for Proprietary Information

Each aluminum company has an established policy regarding proprietary information. Some of the companies take a more liberal position regarding the confidentiality of their operations than do others. The primary concern focuses on baseline efficiencies and newly developed technologies.

BPA will not disseminate proprietary information related to baseline efficiencies or specific facility upgrades at the smelters, other than brief generic project descriptions. All data required to verify energy savings will be maintained at the smelter-sites. BPA will reserve the right to inspect that data as needed to provide payment and/or to conduct financial audits.

Chapter 6

ENVIRONMENTAL REQUIREMENTS

The National Environmental Policy Act (NEPA) requires that BPA assess the environmental impacts of all conservation programs prior to a decision to make them available to the region.

The environmental and socioeconomic impacts of the aluminum smelter conservation/modernization program were addressed in the Final Direct Service Industry Options Environmental Impact Statement (Final EIS), April 1986, and the Administrator's Record of Decision (ROD) for the Aluminum Smelter Conservation/Modernization Program, November 1986.*

The Final EIS and the ROD found no need for mitigation of environmental impacts of the program. Furthermore, the Final EIS and the ROD also addressed cumulative impacts of the conservation/modernization program with the Variable Rate for aluminum smelters. The impacts predicted to occur in that case are similar in nature and degree to those predicted to occur with the conservation/modernization program alone.

BPA has never been involved in monitoring emissions from aluminum smelters. BPA is not expert in these sophisticated technologies and cannot expect to successfully duplicate or establish procedures that match or exceed the quality of monitoring provided by existing regulatory agencies. Therefore, BPA must rely on the findings of other public agencies authorized and required to monitor the smelters. To do otherwise would be ineffective duplication.

---

* Copies of the Final EIS and the ROD may be obtained from the BPA Public Involvement Office on request.

APPENDIX A

DOCUMENTATION OF THE FINAL VALUE ANALYSIS

USING THE DECISION ANALYSIS MODEL

I. Introduction

This section describes and documents that analysis for the conservation/modernization program which was carried out using the Decision Analysis Model (DAM). This model was originally designed for BPA's Option Study, an assessment of the impacts of various policy options directed towards the Direct Service Industries. The purpose for using the DAM in the present analysis was to reexamine the findings of the Options Study, in which incentive payments for conservation/modernization of 3-5 mills per kWh saved were found to have benefits to aluminum DSI's without harming other customers. The results of this analysis generally verify and support this conclusion.

II. Modeling

A. General

For purposes of this documentation, only a brief overview of the Decision Analysis Model is provided. For a more detailed description, refer to the DSI Options Study - Final Report, parts 1 and 2, June 1985 and Appendix B of the Draft EIS Direct Service Industry Options, January 1986. The Decision Analysis Model links together four basic components of the region's power supply system: load forecasting, power system operation and capacity expansion, rates and finances, and employment. Each of these areas have traditionally been modeled separately and in greater detail than in the DAM. The strength of the DAM is in its ability to integrate these diverse areas and thereby provide a reasonable method for assessing the relative merits of alternative policy options across a broad spectrum of impacts. As stated in the Options Study, the results of the DAM should be interpreted with some caution. It was not designed nor intended to be as accurate as the traditional more detailed specialized models available. Rather its design attempted to achieve a compromise of precision with broad scope and flexibility.

One of the model's unique characteristics is its ability to handle the probabilistic nature of major variables which are inherently uncertain. These include regional load growth, availability of water for the operation of the hydrosystem and the market price of aluminum. When the model is set to run in its probabilistic mode (which was the basis for this analysis), a random draw is made for each of these variables in each run. Such a set of random values comprise one "game." Typically, a probabilistic run comprises 50 games. The results for all games are averaged together to find the expected value of the results.

The DAM produces a number of different outputs, including electric load, aluminum industry production levels, power, rates, and a variety of others. However, the simple overall measure of relative impacts of alternative options is "customer benefits." For the aluminum customers this represents the present value of the discounted net cash flow resulting from the operation of the region's 10 smelters according to the production levels determined by the model described below. For the other customers, the net benefits refer to the present value of the cost of electric energy. Thus the DAM compares policy options by measuring the relative net benefits to aluminum and other customers resulting from implementation of the policy options, including the No Action policy option.

A number of improvements were made to the aluminum industry production forecasting portion of the DAM between the draft and final conservation/modernization proposal. In the version of the model used for the draft proposal the Variable Rate was not incorporated into the long-term capacity planning logic, but only in the short-run operations portion of the model. Coding changes to the model now incorporate the Variable Rate in both the long-term and the short-term routine. In addition, the Variable Rate logic has been revised to incorporate more detailed aspects of the Variable Rate design which were not modeled earlier. These include the seasonal lower rate limit and the proposed adjustment to the pivot points based on the rolling average of historical aluminum prices. The pivot point adjustment requires a user specified lower bound for the pivot points, the number of years the pivots are initially fixed, and the number of years over which the rolling average aluminum price is calculated.

B. Industry

The aluminum industry portion of the DAM models both the shortrun (operational) and long-term (capacity) planning decisions of the region's 10 aluminum smelters. The logic employed in both the shortrun and longrun portions of the model is based on previous industry modeling (e.g., Aluminum Smelter Model) and traditional approaches to capital investment analysis (i.e., discounted net cash flow). Reliance was placed on past studies and analysis for the development of input parameters, most importantly production costs and aluminum prices. In the longrun portion of the model, current total costs of aluminum production (both fixed and variable) for each smelter are compared to a longrun expected aluminum price (all costs and prices in constant 1985 dollars). If the present value of the expected longrun price exceeds the present value of the total costs of production over a 10-year planning period, the smelter is assumed to remain in operation.

The model next tests whether an investment in either of two levels of modernization (conservation/modernization) would increase the profitability of operations over the long term. The model selects the specified levels of investment that would make the smelter more profitable (by lowering production costs of power and labor). In this way the model chooses the most profitable level of investment. Under some circumstances, if a plant does not find it profitable over the long-term to make any investment in modernization, the model assumes that the plant will close permanently. The results are fed into the resource planning and rate-setting components of the DAM model.

The power rates that are determined in the rates module of the DAM are used in the short-term operating decision components of the load forecasting model. Short-term operating level decisions are made quarterly within the model, for each smelter, and are aggregated to annual values. In this case, short-term marginal costs are compared to forecasted quarterly aluminum prices to determine short-term profitability. Production increases to full capacity if a smelter is profitable, and operating rates are reduced to the equivalent of one potline if it is not profitable. (This particular assumption is based on empirical observation of minimum operating levels during the past 5 years.)

Production levels directly determine electric load requirements through the power efficiency estimate for each smelter (in kWh/lb). Loads are apportioned by type (i.e., firm, nonfirm, and top quartile) and revenues to BPA from these load levels are also determined.

III. Major Assumptions

A. Modernization Programs

Assumed levels of efficiency improvement associated with modernization for each smelter are taken from a study conducted for BPA by an independent aluminum industry consultant [e.g., Energy Conservation Potential in Smelter Modernization in the PNW, Resource Strategies (RSI), Inc., May 1985]. This report identified as cost effective a program of modernizing the region's smelters to state of the art status. This program would cost about $330 million and would achieve approximately an 11 percent improvement in energy efficiency, resulting in about 340 MW of power being conserved. The RSI report stated that, by itself, smelter modernization will not be enough to solve the regional industry's basic economic problems. However, according to RSI, as part of a package along with other cost reductions and variable power rate, smelter modernization makes sense in a surplus power situation.

B. Conservation/Modernization Credit Levels

The DSI Options Study concluded that a payment of 3-5 mill per kWh saved was the appropriate level of payment for conservation/modernization. In the draft analysis, to reexamine the results of the Options Study, payments of 3, 5, as well as 10 mills per kWh saved were generally used. However, in the final conservation/modernization analysis payments of 4 through 9 mills per kWh saved were used. Some sensitivity runs using alternative levels were also made.

C. Base Case (No Action)

In the draft conservation/modernization analysis the assumption was made that the No Action option, against which proposed options are measured, would include the continuation of the Incentive Rate to the DSI's. In the final conservation/modernization analysis this was changed to reflect the proposed Variable Rate. The Variable Rate is modeled identifically in each of the alternative options as it is under the No Action. This represents an improvement over similar analysis in the Options Study, which assumed the No Action assumption in the base case option, but not under the conservation/modernization payment options.

D. Aluminum Prices and Production Costs

The analysis in the Options Study assumed a longrun price of .75$/lb. This price is presumed to reflect the average price in 1985 dollars, which will be required to induce the development of new smelting capacity. In the time since the Options Study, industry forecasters have generally reduced their expectation for future prices. In the draft conservation/modernization analysis a .70$/lb. longrun price was used, but in the present analysis the expected price was further reduced to .65$/lb. In the model this price is combined with a random component (with a standard deviation of .06$/lb/) to reflect future technological as well as market price used in the long-run capacity decisionmaking portion of the DAM. This price is combined in the model with short-term (essentially current) prices to derive the short-term expected quarterly prices for use in the short-term operational decisionmaking portion of the DAM.

The aluminum smelting production costs used in the model are essentially derived from two studies on regional smelter production costs conducted by independent industry analysts for BPA. These are: (1) Primary Aluminum Production Costs in the PNW, John Moberly Associates, July 1984; and (2) Alumina Costs and Supply Arrangements in the PNW, Resource Strategies, Inc., May 1985. These reports, as well as BPA's own estimates and analyses, are the basis for all the production costs used in the DAM. These cost estimates also reflect extensive public review and input regarding the cost parameters, which occured during the technical review sessions help by BPA as part of the Options Study. For a more detailed examination of the production costs, refer to the BPA document Variable Industrial Power Rate Design Study, December 1985. New alumina, labor and "other" costs were used in this study for the Arco plant. This reflects the different costs facing the new management and owners of this plant.

E. Resource Strategies

The DAM makes a number of assumptions regarding the power supply system's operation and expansion. These assumptions relate to water conditions, intertie size, SW market sales, future investor-owned utility deficits placed on BPA, the future of WNP 1 and 3, etc. The assumptions regarding these variables, while implicit in the analysis of conservation/modernization by virtue of their inclusion in the DAM , did not play a direct role in the sensitivity analysis of alternative credit levels. Generally these resource assumptions are the same as were used in the draft 1986 Resource Strategy, BPA, November 1985.

F. Required Rate of Return

The Required Rate of Return (RROR) in the DAM functions as a real (net of inflation) discount rate in the long-term capacity planning decisionmaking module. As such an increase in the RROR reduces the present value of future benefits of modernization or capacity changes in the calculation of discounted net cash flow. Similarly a decrease in the RROR has the opposite effect, increasing the present value of future cash flows. In the Options Study analysis a RROR of 15 percent was used. At this RROR level, however, together with the assumed production costs, market prices, and costs of modernization, nearly all of the potential (Level 1) modernization was occuring in the DAM

without any credit level. The Options Study report identified this result as intuitively unreasonable, because it was felt implausible that, absent a conservation/modernization program and variable power rate, most or all of the smelters would make major modernization investments, given regional power rate and supply uncertainties as well as the poor financial condition of some of the aluminum companies. The way the Option Study analysis dealt with this problem was to "hardwire" the DAM to prevent modernization without conservation/modernization payment. The current analysis attempts to deal with the same problem by increasing the RROR to 20 percent. The higher RROR is consistent with an assumption that firms would use a higher discount rate when evaluating potential investments in a situation characterized by a high degree of uncertainty. Under this assumption approximately 15 percent of the potential (Level 1) modernization occurs without conservation/modernization.

G. Time Horizon

The DAM is designed to run to the year 2015, although this can be varied. The customer benefits and other impact categories in the current analysis are assessed over this 30-year time period, although the conservation/modernization program itself is only assumed to last 10 years (i.e., 1986 to 1996). One alternative time period was wherein the impacts were assessed only out to the year 2001.

IV. Results

A. Base Case

Results of the analysis are presented in terms of "customer benefits," and in units of millions of dollars, discounted to a net present value using a three percent real rate over 30 years. (Note that the discount rate used for comparing benefits between customer groups is significantly lower than the rate assumed to be used by the aluminum industry for long-term decisionmaking with respect to regional smelters.) For each scenario tested, comparative benefits are presented for aluminum customers, other customers, and total customer benefits. Benefits for each conservation/modernization payment option of 4 through 9 mills per kWh saved are compared to the No Action level of benefits, which in the present analysis was the proposed Variable Rate. Both total benefits for each option and benefits calculated as difference from the No Action option are presented. Considerable caution should be used in interpreting the absolute level of customer benefits under either No Action or alternative options. These levels are only approximations and serve primarily as reference points in order to compare relative changes between options.

In the base case set of options total customer benefits are increased relative to no Action as conservation/modernization payment levels are increased up through 9 mills. While aluminum customers experience a consistent increase in their benefits as payments increases, other customer benefits increase by a small amount only at 5 mills. There appears to be a nonlinear relationship between benefits to other customers and modernization payments because at a 4 mill payment as well as at 6 through 9 mills other customers are hurt by the payments to the aluminum customers. Statistical tests were performed to test the difference in means of net benefits and firm loads across options, which indicated that there was a significant difference at a 56 percent significance level.

B. Contract Expiration in 2001

This scenario assumed that follow-on contracts with the aluminum customers would not be offered. The net benefits for aluminum and other customers in the No Action option under this scenario would be significantly less than if the follow-on contracts had been offered. Again as conservation/modernization payments increase, benefits increase to aluminum customers, though by a lesser amount, and decrease to other customers. The overall benefits are decreased if the current contract with the aluminum customers is not renewed in 2001.

C. Targeted Programs

This scenario tests the effect of allowing all of the higher cost plants except for Alcoa Wenatchee, Kaiser Tacoma, and Reynolds Longview, to participate in the Conservation/Modernization Program. The results indicate that both the aluminum industry and other customers would benefit relative to the base case, since the excluded plants were modernizing without payments. Conservation/modernization payments of 4, 6, and 8 mills would increase the benefits to the aluminum customers, and slightly to the other customers at only 4 and 8 mills. The impacts to other customers are small and do not appear to be practically significant.

V. Conclusions

The major conclusion seems to be that the region benefits overall by a Conservation/Modernization Program. The results of this analysis indicate that the aluminum industry would benefit greatly from the program and any adverse economic effects to other customers would be minimal.

In addition, the DAM analysis indicated that the benefits to other customers and the aluminum industry would increase if the Conservation/Modernization Program was targeted only at the less efficient, higher cost plants. However, a targeted program was considered and rejected because Bonneville did not want to advantage one aluminum smelter over another by restricting participation in a Conservation/Modernization Program.