Bonneville Power Administration
Energy Smart Design
Profile #37, 1992

Executive Summary

Bonneville Power Administration's Energy Smart Design (ESD) provides design assistance and incentives for installation of energy efficiency measures in new and existing commercial buildings. Perhaps the most exciting aspect of ESD is its dynamic evolution from a somewhat limited program to a comprehensive system for promoting and garnering energy savings. This profile aims to capture the progress made by BPA in adapting program parameters to maximize the effectiveness of ESD.

ESD began in 1988 strictly as a design assistance program. BPA's evaluations identified the need to incorporate financial incentives into the program to increase the uptake of measures identified through design assistance. Therefore, an Optional Services (OS) component was added in 1990 to provide rebates. In October, 1992, a second evolution of the program took place and what BPA calls the "Long Term ESD" program began.

ESD's mechanism for customer participation is simple. A scoping meeting is held to review the project and explore design alternatives. The utility team and client agree on a list of measures to be examined to determine their effectiveness. Measures are analyzed using modelling, or less complex procedures such as manual calculations, or selection from a rebate list or a prescriptive path manual. Note that the client is not required to accept any of the recommended measures.

The range of conservation measures analyzed for any ESD project is a function of the building type and size. It is common to examine alternate HVAC systems, more efficient lighting, the use of more efficient glazings, as well as building shell thermal improvements. In some cases, such as restaurants and laundries, less common measures such as heat recovery systems are analyzed. Eligibility for rebates under OS is determined and the client may proceed with installation of recommended energy conservation measures and receive incentives.

Savings attributable to ESD were quite small in the first years of the program but with the implementation of OS, savings increased significantly. After just two quarters of the fiscal year 1991-92, estimated annual savings nearly doubled to 22.4 GWh. Through March 31, 1992, projects completed under ESD accumulated 37.6 GWh in annual energy savings and 4.29 aMW in annual demand savings.[R#18]

BPA has spent a total of $5.6 million on ESD since the program's inception. Even though OS was not implemented until 1991, the total expenditures on OS incentives, at $2.6 million, has already exceeded BPA expenditures on design assistance services, at $2.4 million. At a 5% discount rate, the cost of saved energy for ESD in the first half of the 1991-92 fiscal year was a very respectable 1.36 ¢/kWh.

Energy Smart Design

Utility:	Bonneville Power Administration
Sector:	Commercial
Measures:	Energy efficient design assistance, incentives.
Mechanism:	Free energy and economic analysis and retrofit recommendations. Cash incentives for installation through Optional Services component.
History:	Started in late 1988.

1992 Program Data

Energy savings:	22.4 GWh
Lifecycle energy savings:	335.6 GWh
Capacity savings:	2.55 aMW
Cost:	$2,348,300

Cumulative Data (1987-1992)

Energy savings:	56 GWh
LIfecycle energy savings:	565 GWh
Capacity savings:	4.29 aMW
Cost:	$5,602,600

Conventions

For the entire 1992 profile series all dollar values have been adjusted to 1990 U.S. dollar levels unless otherwise specified. Inflation and exchange rates were derived from the U.S. Department of Labor's Consumer Price Index and the International Monetary Fund's International Financial Statistics Yearbook: 1991.

The Results Center uses three conventions for presenting program savings. **Annual savings** refer to the annualized value of increments of energy and capacity installed in a given year, or what might be best described as the first full-year effect of the measures installed in a given year. **Cumulative savings** represent the savings in a given year for all measures installed to date. **Lifecycle savings** are calculated by multiplying the annual savings by the assumed average measure lifetime. **Caution:** cumulative and lifecycle savings are theoretical values that usually represent only the technical measure lifetimes and are not adjusted for attrition unless specifically stated.

Utility Overview

The Bonneville Power Administration (BPA) is a U.S. Government owned agency which provides wholesale power to electric utilities. It was created by Congress in 1937 as the marketing agent for power generated at the Bonneville Dam. Since then it has been organized as part of the Department of Energy, and its mission expanded to market power from additional sources in the region, including twenty-nine federal dams, two nuclear plants, and one coal plant. To accomplish this, BPA has designed and built more than 14,000 miles of high-voltage transmission lines. This network has become the backbone of the transmission system for the Northwest over the last forty-seven years.

BPA serves the states of Washington, Oregon, Idaho, and Montana west of the Continental Divide, plus small adjacent portions of California, Nevada, Utah, and Wyoming. The service area covers approximately 300,000 square miles with a population of nearly 9 million people. BPA sells power to 174 wholesale customers made up of:[R#1]

136 — public systems,
12 — investor-owned utilities,
16 — industrial firms, and
10 — federal agencies.

In 1980, under the Pacific Northwest Electric Power Planning and Conservation Act, BPA was assigned the additional responsibility of meeting the future growth in demand for electricity in the region through the acquisition of new generating resources and conservation measures. Through its Office of Energy Resources, BPA develops programs that purchase resources from generators, utilities, and end users of electricity. The resources themselves are obtained through the investment in and use of:

- measures and practices that increase the efficiency with which electricity is generated, transmitted, or used, and

- measures that employ renewable resources to displace consumption of electricity at the point of end use.

BPA FY 1991 STATISTICS

Number of Wholesale Customers	174
Energy Sales	89,173 GWh
Energy Sales Revenue	$1.869 billion
Summer Peak Demand	17,998 MW
Generating Capacity	24,093 MW
Average MW Delivered	10,326 aMW
Average Electric Rates	
Sold by BPA	1.6-2.6 ¢/kWh
Sold by BPA-Supplied Utilities	1.4-7.2 ¢/kWh
Average to All Utility Customers 1990	4.57 ¢/kWh

Because BPA's electricity is mostly hydro, the average megawatt (aMW) capacity stated in the table above is a more important number than the generating capacity. (The full generating capacity of 24,093 MW could be delivered for a short time but could not be sustained.) Based on rainfall data from the last 50 years, BPA estimates that during a worst case rainfall year they would be able to deliver 8,464 aMW.[R#2] The 10,326 aMW delivered in 1991 indicates that BPA sold ~1,862 aMW of nonfirm power that year.

Utility DSM Overview

In order to fulfill the added responsibilities mandated by the Pacific Northwest Electric Power Planning and Conservation Act, it became necessary for BPA to become involved in demand-side management (DSM) programs. In 1982, under the title Energy Resources Program/Project, BPA initiated DSM programs in the residential, commercial, industrial, and agricultural sectors. From 1982 through 1991 BPA spent $1,145 million on a wide range of DSM programs.

PROGRAMS FUNDED BY BPA

RESIDENTIAL

Residential Weatherization Program (Weatherwise)
Residential Construction Demonstration Project
Manufactured Housing Acquisition Program
Washington State Energy Code Program
Oregon State Energy Code Program
Super Good Cents Program
State Technical Assistance Program

COMMERCIAL/INDUSTRIAL/AGRICULTURAL

Northwest Energy Code Program
Commercial Retrofit & End-Use Study
Energy Edge Project
Institutional Buildings Program Follow On

Energy Smart Design Program

Elec. Ideas and The Elec. Ideas Clearinghouse
Lighting Design Lab
Energy $avings Plan
Aluminum Smelter Conservation/Modernization
Sponsor-Designed Program
Irrigated Agriculture Program

OTHERS

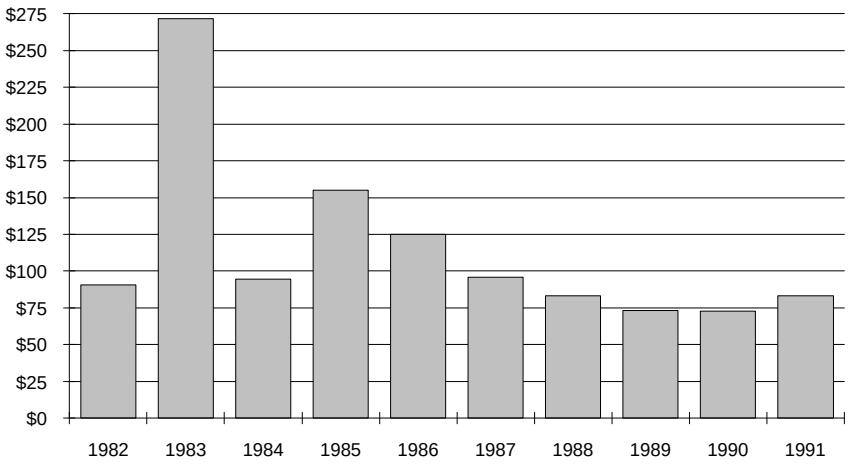
Research and Development
Environmental Oversight
The Partnership Program
Design Wise Program

Utility DSM Overview Table	Annual DSM Expenditure (x1,000,000)	Annual DSM Energy Saving (GWh)	Annual DSM Demand Savings (aMW)
1982	$90.6	266	30.4
1983	$271.6	570	65.1
1984	$94.5	143	16.3
1985	$155.2	159	18.2
1986	$125.1	186	21.2
1987	$95.9	146	16.7
1988	$83.2	425	48.5
1989	$73.1	385	43.9
1990	$72.7	318	36.3
1991	$83.0	101	11.5
Total	$1,145.0	2,699	308.1

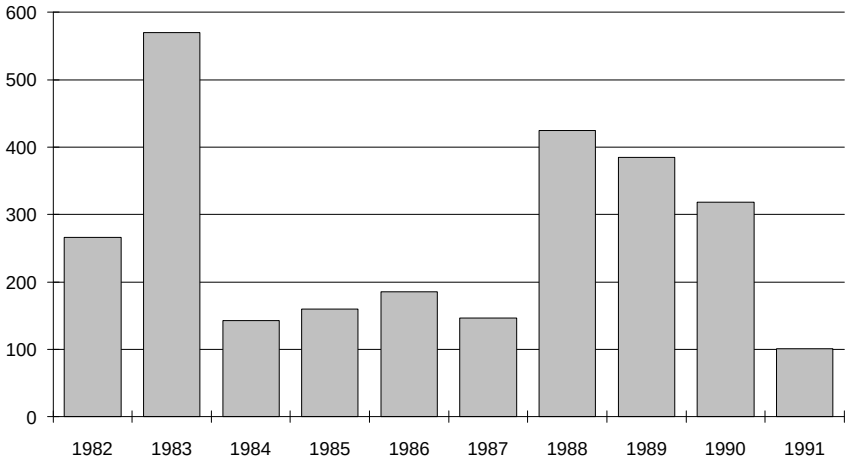
In addition, BPA initiated its Aluminum Smelter Conservation and Modernization (Con/Mod) program in 1988, whose remaining $61.6 million cost will be spread out over a six-year period but whose savings were realized almost immediately. This explains why in 1988, a significant increase in savings was not accompanied by a similar increase in expenditures.[R#4]

BPA's major effort to save energy through conservation programs began in 1982. By 1991, the cumulative effects of these program investments had resulted in over 308 aMW in efficiency gains.[R#4]

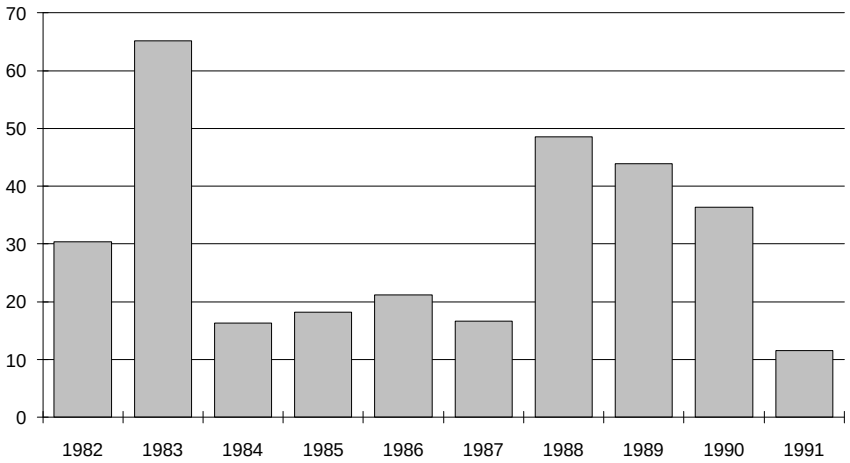
ANNUAL DSM EXPENDITURE ($1,000,000)



ANNUAL ENERGY SAVINGS (GWH)



ANNUAL CAPACITY SAVINGS (aMW)



Program Overview

Bonneville Power Administration's Energy Smart Design (ESD) provides design assistance and incentives for installation of energy efficiency measures in new and existing commercial buildings. Perhaps the most exciting aspect of ESD is its evolution from a somewhat limited program to a comprehensive system for promoting and garnering energy savings. This profile aims to capture the progress made by BPA in adapting program parameters to maximize the effectiveness of ESD.

ESD began in 1988 strictly as a design assistance program. BPA's evaluations identified the need to incorporate financial incentives into the program to increase the uptake of measures identified through design assistance. Therefore, an Optional Services (OS) component was added for a select number of utilities in 1990 to provide rebates. In October, 1992, the Long Term ESD program began, with a modified delivery mechanism and new eligibility parameters.

Originally, customer utilities offered ESD through one of three contracting options with BPA, and only a few larger customer utilities offered incentive payments under Optional Services. Now, there is just one contractual agreement that all utilities enter into with BPA, and the Optional Services component may be included in any contract.

Each utility offers ESD according to its in-house ability to provide design assistance and incentive payment calculations, its technical resources and the types of buildings and customers in its service territory. If the utility does not have in-house resources necessary to implement an ESD program, BPA will contract Alternate Service Providers to provide design assistance and other program services as needed.[R#15]

Also, under Long Term ESD, all new and existing commercial buildings are eligible for design assistance and incentive payments.

The Overall Goals of the ESD program are as follows:

- To improve energy efficiency in commercial buildings through free design assistance.
- To effect changes in the region's energy goals by demonstrating the economic benefits of energy efficiency improvements.
- To educate commercial building designers regarding the benefits of including energy-efficient measures in project design.
- To support the use of efficient electric products as a means of promoting prudent electric load growth in the commercial sector.[R#15]

ESD meets these goals through a three-step process. First, ESD analysts meet with project directors and establish a timetable for performing an energy analysis. Next, the analysis is performed and a design analysis report is prepared. The report includes recommended efficiency measures and other information to help the designer make informed energy related decisions. The decision whether to install any of the recommended measures is left to the customer, who is under no obligation to install any energy-efficiency measures. Finally, incentive payments for installation of recommended measures are made available under the Optional Services component of ESD.

Before the introduction of incentive payments under the Optional Services component, the primary means of encouraging implementation of energy efficiency measures was simply the identification of long-term energy-cost savings. Additionally the Energy Smart Design program gives awards to exemplary construction projects. Thus building owners, developers, and designers receive public recognition for the energy-efficiency improvements incorporated into their building design.

One of the unique aspects of ESD, which also makes the program quite complex, is that it is offered to over a hundred utilities. Each utility signs a contractual agreement with BPA to offer ESD, and has differing responsibilities for implementing the program, depending upon the utility's in-house capabilities. Initially, there were three distinct contracting options. Although the Long Term version of ESD dropped the designations of "Option 1, 2, or 3", the concept is still followed.

There were eight Option 1 utilities. These utilities provided the full range of administration and design services available through ESD, including complex hourly simulations of building energy usage, without technical help from Bonneville. Staff at Option 1 utilities are certified to perform hourly simulations of building energy use and to review work performed by subcontractors to the utility.

There were five Option 2 utilities. These utilities usually did not have staff certified in performing hourly simulations, and hired contractors or requested assistance from Bonneville to do the necessary simulations. These utilities were, however, responsible for administering their own ESD program. Thus the distinction between Option 1 and Option 2 utilities was primarily based on the range of modeling services provided by the utility.

The majority (about 80) of the BPA utilities offering ESD fell into the Option 3 category. These utilities refer all requests for design assistance to Bonneville which assigns an Alternate Service Provider (ASP) contracted by BPA to perform the modeling and economic analysis.[R#15]

MARKETING

BPA provides a regional promotion effort for ESD. Each utility that offers ESD does its own local marketing for the program, initially without BPA funding. The Long Term ESD offers limited funding for additional local promotion.

Those implementing the ESD program have found that the most effective means of marketing the program is to make contact with the principals of a new commercial construction project during the design stage, taking advantage of the opportunity to affect the project design. Thus, marketing is targeted to the local building design community, often using contacts from data on participation in other utility programs. Promotional methods are almost exclusively direct mail or phone marketing aimed at individual firms, usually architects and HVAC engineers, with increasing emphasis on developers and commercial building owners.[R#15]

The best sources of information on new projects have been and continue to be word of mouth referrals from architects and engineers familiar with the program, utility staff, State Energy Offices, or Bonneville Power. The use of F.W. Dodge reports on new construction has been helpful, but also problematic in that notification of a building under construction often comes too late in the design process for it to be practical to make design changes.[R#15]

Bonneville has implemented promotional support services including the design of brochures and the inclusion of advertisements in professional magazines.[R#15] These brochures are used primarily by the Option 3 utilities, with the Option 1 & 2 utilities more likely to design their own marketing tools.[R#16]

ESD also has an effective awards component which recognizes exemplary designs and installations. This aspect of the program is built upon the lessons learned from the well-known Energy Edge program, which has gained significant recognition in the Northwest for demonstrations of energy efficiency and their awards.

DELIVERY

Bonneville has offered ESD to all customer utilities within the Pacific Northwest. Utilities sign a contract with BPA and must implement ESD in accordance with the terms stipulated in the contract. BPA's share of incentive payments are passed along to customers by the utility.

Though each utility has a unique approach to implementing its ESD program, the following overall process is common to almost all of the utilities.

DELIVERY: THE STEP BY STEP PROCESS

Those utility customers interested in participating in the program are screened to ensure that their new building or retrofit project is appropriate for the program. The decision usually depends on the phase of construction the building is in and the prospective client's receptivity to change.

A scoping meeting is then held to review the project and develop design alternatives. The utility team and client agree on a list of measures to be examined and the client is asked to sign a contract agreeing to participate in the program (though the client is not required to accept any of the recommended measures) and allowing Bonneville and the participating utility some rights to inspect the finished building. Additionally, the client must agree to cooperate with Bonneville in program evaluation matters.

The range of conservation measures analyzed for any project is usually fairly standard and is a function of the building type and size. It is common to examine alternate HVAC systems (primarily heat pump options), more efficient lighting measures (PL lamps and efficient ballasts), use of more efficient glazing (low E, triple glazing, argon-filled glass), and the addition of more insulation in the shell including roof and floor. In some cases, such as restaurants and laundries, less common measures such as heat recovery systems are analyzed.[R#15]

Energy and economic analyses of alternative energy conserving designs and equipment are completed by utility staff or engineers under contract to the utility or BPA. (Some utilities allow clients to use their own design teams as long as they use the prescribed methods.)

Energy saving analysis is done using an hourly thermal simulation model or a "bin" model, a more generalized simulation. Hourly simulations use a number of different models including DOE2 and Trace, both computer modeling systems. The primary tool for "bin" modeling is ASEAM, a computer based energy bin simulation tool. (Bin analyses are essentially the same as hourly simulations, only comparisons are done using blocks of hours. Use and temperature conditions are input as averages over 4, 8, or 12 hour blocks, rather than as hourly data.)[R#18] As an alternative to modelling, some utilities perform manual calculations, or use spreadsheets or prescriptive paths, and combine these with professional judgement to determine optimal energy-savings scenarios.

The costs analysis is typically based on simple payback using the applicable utility rate schedule. Additional factors typically considered in the cost analysis include incentives available to the client (through the OS component or any other program for which they may be eligible), net present value, and energy escalation rates.[R#15] Measures must be shown to be cost effective based on a lifecycle cost or levelized cost prescribed by Bonneville.[R#18]

A post analysis report (called a Building Design Assistance Report or BDAR) describes the results of the energy and economic analyses, reporting projected costs and estimated energy savings that would be realized if recommended measures were installed. The building designer is then free to accept or reject any of the recommendations in the report prepared by the utility or Alternate Service Contractor.[R#15]

OPTIONAL SERVICES

Starting in 1991, ESD introduced a new program component to ESD called "Optional Services" or "OS". OS provides cash incentives for efficient installations as well as expanded design assistance and post-installation services.

At first, only the fourteen Option 1 and 2 utilities were eligible to offer Optional Services. In order to offer the OS program component, these utilities had to submit a workplan that specified how they would implement OS. The workplan was constructed to address BPA-provided Work Plan Guidelines, which specified BPA restrictions on program eligibility, incentive payment amounts, calculation approaches, and reporting requirements. There was also a set of questions regarding program implementation that each utility must answer as part of its workplan.

BPA approved workplans for 14 of the eligible utilities under 13 contracts, (two utilities offered a joint program).[R#17,18] By March 1992, all 14 utilities were offering OS; (Seattle City Light began in early 1991, and Tacoma City Light began in late 1990). In May, 1992, BPA offered incentives to the remaining utilities through the separate Option 3 ESD agreement by which BPA's other utilities offered ESD, and approximately 40 have implemented them.[R#18] OS was available to all utilities under the new Long Term ESD contract.

BPA designed OS with eight components, however the utilities have only been actively implementing three components — Site-Based Payments, Equipment Rebates, and Design Assistance Payments — described in more detail below. Utilities generally use either their state energy code or the Model Conservation Standard as the baseline from which to estimate energy savings from installed measures. Some utilities use the existing conditions or the originally proposed building design as the baseline.

1. Site-based payments are for measures that are identified to be appropriate and cost-effective for a particular site. Most utilities use a prescriptive path for measure identification and incentive payment calculation, although variations exist. For non-prescriptive measures, site-based payments are generally calculated as the minimum of 50% of total measure cost, 100% of the incremental measure cost, or 2.1 cents per lifetime kWh saved. Two utilities calculate non-prescriptive rebates as the minimum of 50% of total measure cost, 70% of the incremental measure cost, or 3.5 ¢/lifetime kWh saved.

2. Equipment Rebates are payments for the cost-effective energy-efficient equipment listed on the utility's rebate list. Each utility developed its own Rebate List, selecting the equipment to be included on the list, as well as the rebate amount to be paid for each measure. Some utilities calculate the rebate amount using the same criteria as they use for determining the Site-Based Payments. Seattle City Light (SCL) and Tacoma City Light (TCL) developed a Rebate List which is also used by several other utilities. Rebates on the SCL/TCL list are based on the minimum of 50% of the total measure cost or 100% of the incremental measure cost.

3. Design Payments are payments to the design team to account for additional time spent incorporating the recommended measures into the building design. The payment amounts are determined based on a percentage (most commonly 15%) of the total measure cost or the incremental cost of the measures. The Tacoma City Light design payment is calculated at 5% of the incentive payment for the project.[R#17]

Additionally, the following services are included in the Optional Services Program, however none are currently being implemented by any of the participating utilities:

SEATTLE CITY LIGHT ESD PROGRAM SAMPLE REBATE AMOUNTS TABLE

Lighting

Electronic ballasts	$15 - $27.50
Fluorescent lamps	$0.75 - $7
Specular reflectors	$24 - $30, or 50% of installed cost
Compact fluorescent lamps and fixtures	$3 - $50
Exit signs	$15 - $50
Fluorescent fixtures	$25 - $95
HID fixtures & retrofits	$50 - $200
Lighting controls	$10 - $50

Heat Pumps

Rebates vary for new construction and renovations, generally calculated as: (efficiency - a) x tons capacity x $b		
	"a" range	"b" range
Water source	3.0 - 3.8	$250
Air to air heat pumps		
at or above 65,000 Btuh	1.0 - 3.0	$250
below 65,000 Btuh	6.35 - 6.8	$73

HVAC

Rebates vary for new construction and renovations, generally calculated as: (proposed efficiency - baseline efficiency) x tons capacity x rebate coefficient		
	baselines	rebate coefficient
Air- or water-cooled water chillers	0.68 - 1.43 kW/ton	$300/ton for each kW/ton below baseline
Air- or water-cooled air conditioners	7.80 - 10.50 EER	$90/ton for each EER above baseline
Programmable thermostats	$50	

Motors

UL listed NEMA B rated motor with specified minimum efficiencies/rpm	$25 - $2,250 or 20% of the purchase price including tax

[R#19]

Building Commissioning – Systematic testing, balancing, and correction of building systems and controls in the operational mode following building construction and occupation, for the purpose of insuring that building systems are operating as designated or intended.

Operations and Maintenance – Services offered over time to insure equipment is operated and maintained as designed for optimum savings.

Account Executive – A utility employee dedicated to working with major accounts, large customers, key developers, etc. to increase their awareness of energy efficiency and promote ESD services.

Peer Matching – Utility staff provide training to employees from other utilities to enhance their effectiveness in offering ESD.

Daylighting – Expanded daylighting incentive and analysis program, including scale modeling, to determine whether daylighting strategies might be effectively employed within a building design. OS requires a workplan and BPA area office approval, neither of which were necessary under the original ESD configuration.[R#17]

MEASURES INSTALLED

ESD performs four functions in its present form: identification of potential energy-efficiency measures appropriate for a new construction, renovation or retrofit project, estimation of potential costs and savings by computer models, recommendations of energy-efficient equipment and designs, and provision of financial incentives for installation of identified measures.

Energy conservation measures are actually installed through the Optional Services component. Measures installed include lighting technologies, high-efficiency heat pumps, high-efficiency electric motors, high-efficiency unitary air conditioning equipment, and high-efficiency electric water chillers. Eligible equipment and rebate amounts vary from utility to utility. For the Equipment Rebate component, 6 utilities use the rebate list developed by Seattle City Light and Tacoma City Light. Rebate amount ranges from the SCL/TCL list are shown in the Sample Rebate Amount Table.

STAFFING REQUIREMENTS

ESD staffing at each utility varies from one person working one-third time on ESD (plus a contractor doing modeling) to one person working full-time on ESD (with up to 5 people working part-time doing modeling.) All utilities interviewed in the process evaluation felt that they could handle more projects with their current staffing levels.[R#16] Approximately 10 FTE at BPA headquarters and area/district offices work on implementing and administering ESD.[R#18]

Monitoring and Evaluation

MONITORING

Each utility participating in any of BPA's DSM programs has to report to BPA at intervals as short as monthly or as long as annually depending upon activity levels and utility needs. BPA representatives review the utilities' plans and programs and accomplishments and approve payments to utilities who then pass through the appropriate amount to the user participants.

Utilities provide hard copy of the program forms to BPA area offices and headquarters where data entry is done. BPA is nearing completion on a system which will allow utilities to electronically transmit this information to BPA.

EVALUATION

BPA has not performed an impact evaluation of the ESD Program, though an evaluation is planned once enough ESD-serviced buildings have been constructed.

Two process evaluations have been completed for the ESD program and an additional evaluation was completed for the Optional Services component which started in 1991. The first ESD process evaluation, covering the first six months of the program, was published in September of 1989, and the second, published in June, 1991, covered the fourteen months after the first evaluation. The goal of the process evaluations is to provide an independent assessment of the effectiveness of the policies, procedures, and overall design of the ESD program.[R#16]

The first process evaluation [R#15] was completed before some of the utilities had fully implemented their ESD programs and while others were still in the beginning stages of development. As such, the evaluation focussed on identifying areas for program improvement. The evaluation was based on interviews with five Option 1 and 2 utilities, participant telephone interviews, and a review of the building design assistance reports that had been completed.

Most of the recommendations that grew out of that first evaluation were implemented in 1990 and 1991. Bonneville stepped up its promotional support and developed a prescriptive path compliance method. However, the major change that came out of the first process evaluation was the addition of the Optional Services component of ESD.

The most critical finding of the first process evaluation was that long payback periods precluded implementation of many identified energy conservation measures. The Optional Services component of ESD, introduced in 1991, is aimed at reducing the payback period for recommended measures and thus encourages their implementation.

Program administrative procedures and BPA marketing support were analyzed from the utility perspective, and found to be somewhat inadequate. With development of the prescriptive path for small buildings, and improvement of utility modelling capabilities, most of the administrative complaints have been resolved. Additionally, BPA stepped up promotional support, providing promised marketing materials to utilities and placing advertisements in professional magazines.

The ESD training process was investigated from the utility perspective, finding that the training could be more effective if it was geared toward different skill levels. One way Bonneville acted upon this recommendation was by including the Peer Matching component in the OS program. Through Peer Matching, utility staff would share their expertise with less experienced utilities, however no utility has taken advantage of this component. Nonetheless, there is a great deal of peer matching being accomplished via telephone calls, visits, and sharing of program materials and lessons learned.

Responding to the process evaluation findings, Bonneville offered shorter, more in-depth training sessions in 1990 which received positive feedback. Even with these improvements, the 1991 process evaluation recommended that targeted training should be more actively pursued. Additional training opportunities are coordinated and funded through the Regional Education and Training Committee (RETAC).

The second process evaluation [R#16] built upon the results of the first evaluation, providing a more in-depth review of the ESD Program. Data for the second process evaluation were gathered from interviews with Option 1-3 utilities, Alternate Service Providers, clients, program drop-outs, and non-participants.

The second evaluation had 6 goals:

1) Revisit the issues identified in the first process evaluation; 2) Evaluate the effectiveness of the ASPs; 3) Evaluate the program from the perspective of Option 3 utilities; 4) Assess the long-term impacts of the program; 5) Determine how marketing changes could influence non-participants; and 6) Investigate other technical issues.

In meeting these objectives, the second process evaluation generated five recommendations. First, marketing ESD as a money-saving program, rather than an energy-saving program, is likely to be more effective in influencing non-participants. Second, marketing efforts should be aimed at trade allies such as architects and engineers who tend to be aware of new construction and renovation plans early in the design process. Third, the responsibility for screening projects assigned to ASPs should be established in order to avoid wasted time and effort on projects that are not viable. Fourth, follow-up with customers after they receive their Building Design Assistance Report should be conducted by either ASPs, BPA, or the Option 3 utilities, in order to increase the likelihood that recommended measures are installed. Finally, the evaluation recommended that BPA closely track the implementation of recommended measures, since the evaluation found that customers were still not installing some measures due to the long payback periods.

Bonneville also commissioned a process evaluation of its Optional Services component. The evaluation was based on staff interviews from participating utilities, a non-participating utility, and Bonneville Area Offices. Utilities appreciated the fact that Bonneville listened to their concerns that design assistance alone might not lead to installation. In fact many utilities considered ESD a failure prior to the implementation of incentives as there was little or no interest or participation in ESD, and the buildings that were participating in the design process were not installing recommended measures.[R#17]

The Optional Services Program created dramatically higher levels of interest and participation in ESD. Only one of the utilities that had been offering OS for more than two months did not report an increase in recommended measures that were installed. That exception was a utility that had, through unique marketing, already achieved a fairly high participation and implementation rate prior to the availability of incentives.[R#17]

One potential shortcoming of Optional Services is that there may not be enough conservation opportunities in new construction to meet BPA's aggressive conservation goals. As a result, several utilities suggested that the emphasis of the OS program be shifted more toward retrofits of equipment in existing buildings. This has now been incorporated into the Long Term ESD.

DATA QUALITY

Costs and savings data presented in the next two sections were provided by BPA. The savings figures are based on the building design analyses conducted in conjunction with the program. BPA tracks the number of recommended measures installed to determine an estimate of the actual savings realized by the program. All BPA costs and savings are shown for fiscal years, with the costs and savings incurred prior to the introduction of OS in fiscal year 1990-91 being lumped together under the heading 1987 - 1990 in the tables. The 1991 figures represent a full fiscal year, (October 1, 1990 to September 30, 1991). The 1992 figures are for 2 quarters of the 1991-92 fiscal year (October 1, 1991 to March 31, 1992).

Seattle City Light data on costs and participation are presented to illustrate the costs incurred by the utilities in implementing the program. Savings data from the SCL program were not available. Similarly, data provided by Tacoma City Light (TCL) are presented for the years 1990 and 1991 to illustrate participating utilities' activities in ESD.

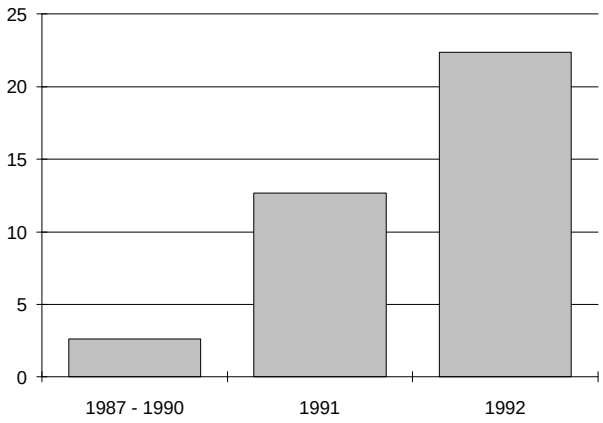
Program Savings

Savings Overview Table	Annual Energy Savings (MWh)	Cumulative Energy Savings (MWh)	Lifecycle Energy Savings (MWh)	Annual Capacity Savings (aMW)	Cumulative Capacity Savings (aMW)
1987 - 1990	2,605	2,605	39,075	0.295	0.295
1991	12,667	15,272	190,001	1.445	1.740
1992	22,373	37,645	335,598	2.550	4.290
Total	37,645	55,522	564,674	4.290	

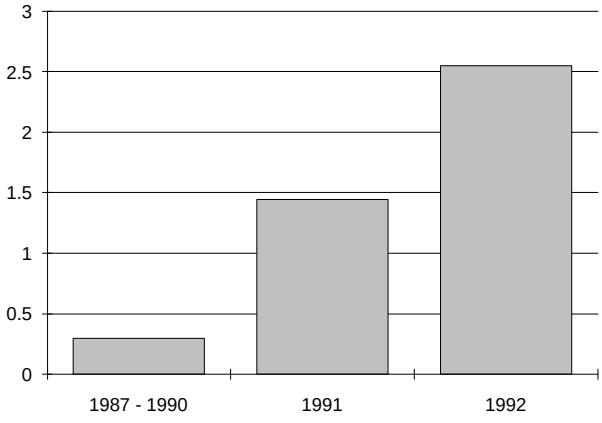
[R#18]

NOTE: FY 1992 savings for all the charts and tables in this section are for the period October, 1 1991 to March 31, 1992

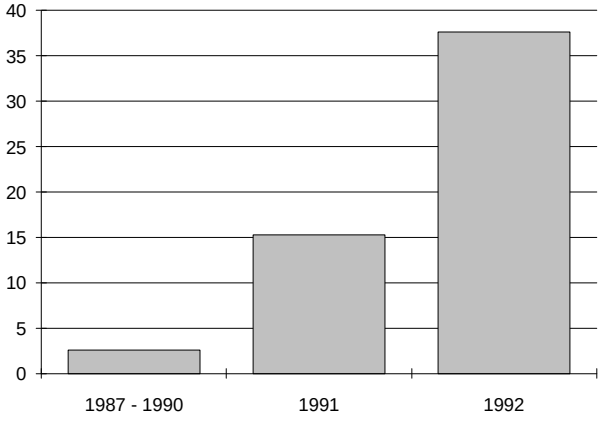
ANNUAL ENERGY SAVINGS (GWH)



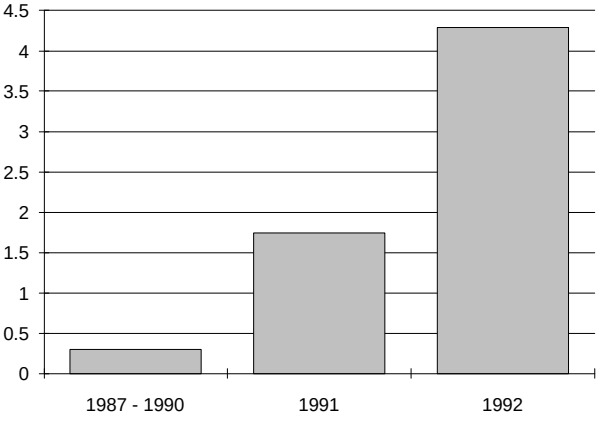
ANNUAL CAPACITY SAVINGS (aMW)



CUMULATIVE ENERGY SAVINGS (GWH)



CUMULATIVE CAPACITY SAVINGS (aMW)



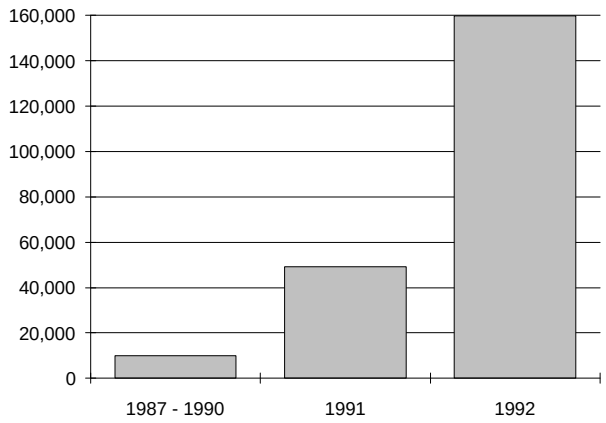
Savings attributable to ESD were quite small in the first years of the program. With the introduction of OS in 1991, savings increased significantly. After just two quarters of the fiscal year 1991-92, the estimated annual savings have almost doubled from 1990-91, to 22.4 GWh. Program managers at BPA anticipate that total annual energy savings for projects completed during the 1991-92 fiscal year could reach 44 GWh, with 5.1 aMW in demand savings. Through March 31, 1992, projects completed under ESD have accumulated 37.6 GWh in annual energy savings, 564.7 GWH in lifecycle energy savings, and 4.29 aMW in demand savings.[R#18]

Tacoma City Light (TCL) has reported annual savings totalling 3.2 GWh from projects completed during 1990 and 1991 through ESD. Seattle City Light (SCL) savings data were not available.

PARTICIPATION RATES

Since the program began in 1988, 660 projects have received design assistance services through ESD. Of these, 369 have actually implemented some or all of the energy conservation measures recommended by the ESD Building Design Analysis Report. In the first two quarters of fiscal year 1991-92, 140 projects received design assistance, 131 of which implemented some of the recommended measures. This rate of uptake is significantly better than in the first years of the program, when only about half of the projects actually installed recommended measures. Program managers at BPA estimate that more than 500 projects will have received design assistance and install recommended measures in fiscal year 1991-92.[R#18]

SAVINGS PER PARTICIPANT (KWH)



ESD Overall Participation Table	Design Participants Projects Completed	Projects Completed that Generated Energy Savings	Annual Energy Savings per Project Completed (kWh)
1987 - 1990	262	130	9,943
1991	258	108	49,096
1992	140	131	159,809
Total	660	369	

[R#18]

TCL provided design assistance and incentives for 65 projects in 1990 and 1991.[R#21] SCL has provided design assistance to 41 projects between 1989 and 1991, with design assistance and incentives through OS going to 75 projects in 1991.[R#20]

SCL Participation Table	SCL Design Participants Projects Completed	SCL Rebate or Incentive Program (OS) Projects Completed
1989	2	N/A
1990	7	N/A
1991	32	75
Total	41	75

[R#23]

MEASURE LIFETIME

Lifetimes of measures installed through ESD vary from 2 to 30 years. TCL uses an average lifetime of 14 years in its evaluations.[R#21] Seattle City Light uses lifetimes derived from BPA recommendations for most measures, with ASHRAE standards used for HVAC system service lives. The following are recommended service lives for the SCL ESD program.[R#19]

Building Envelope	7 to 24 years
Lighting	2 to 20 years
HVAC	10 to 30 years
Controls	10 to 20 years
Motors	10 to 18 years
Domestic Hot Water	10 to 15 years
Refrigeration	3 to 15 years

In calculating lifecycle savings and cost of saved energy, The Results Center used 15 years as the average lifetime of the measures installed.

Cost of the Program

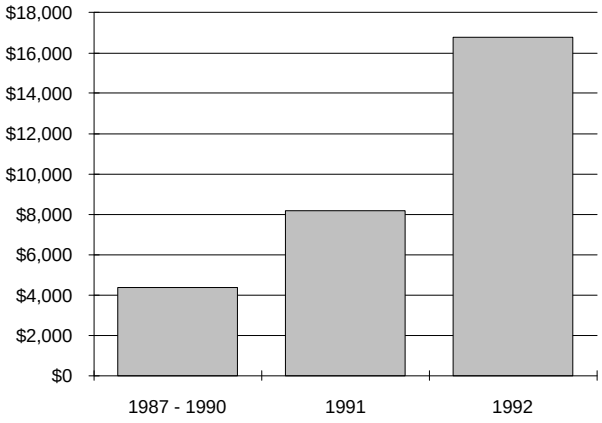
Costs Overview Table	Design Assistance Service (x1000)	BPA Administrative Costs (x1000)	Additional Administrative Costs for OS Projects (x1000)	BPA Incentive Costs for OS Measures (x1000)	Total BPA Cost (x1000)	Cost per Completed Project
1987 - 1990	$956.6	$187.3	$0.0	$0.0	$1,143.9	$4,365.9
1991	$1,096.9	$190.9	$36.7	$785.9	$2,110.4	$8,180.0
1992	$367.5	$85.2	$65.1	$1,830.6	$2,348.3	$16,773.6
Total	$2,421.0	$463.3	$101.8	$2,616.5	$5,602.6	

[R#18]

NOTE: FY 1992 costs for all the charts and tables in this section are for the period October 1, 1991 through March 31, 1992

TOTAL BPA PROGRAM COST (x1,000)

COST PER PARTICIPANT



SCL Cost Overview Table	SCL Administrative Costs (x1000)	SCL Incentive Payments for Completed Projects (x1000)	Total SCL Contri-bution (x1000)	BPA Contri-butions (x1000)	Total (SCL & BPA) Program Cost (x1000)	Cost per Completed Project (x1000)
1988	$21.1	$0.0	$21.1	$0.0	$21.1	N/A
1989	$62.6	$8.6	$71.2	$36.4	$107.5	$53,773.56
1990	$190.1	$107.4	$297.6	$131.3	$428.9	$61,268.57
1991	$541.3	$1,183.9	$1,725.2	$1,392.2	$3,117.5	$29,135.35
Total	$815.2	$1,299.9	$2,115.1	$1,559.9	$3,675.1	

[R#20]

As shown in the Cost Overview Table, BPA has spent a total of $5.6 million on ESD since the program's inception, including administrative and startup costs, and incentive costs. Even though OS was not implemented until 1991, the total expenditures on OS incentives at $2.6 million has already exceeded BPA expenditures on design assistance services, at $2.4 million.[R#18]

In 1991, Tacoma City Light spent $0.06 million on incentives and $0.35 million on operating costs, with the BPA incentive contribution of $0.34 million.[R#21] Seattle City Light (SCL), has spent a total of $2.1 million on the program between 1988 and 1991. BPA contributions have totalled $1.6 million. SCL costs in 1991 totalled $1.7 million, $1.2 million in incentives and $0.5 million in operating costs, with BPA contributions of $1.4 million.[R#20]

COST EFFECTIVENESS

The cost of saved energy, as calculated by The Results Center, became very attractive for this program after OS was implemented. At a 5% discount rate, the cost of saved energy was 4.23 ¢/kWh before the introduction of OS, dropping to 1.61 ¢/kWh in fiscal year 1991-92, and 1.01 ¢/kWh in the first half of the 1991-92 fiscal year.

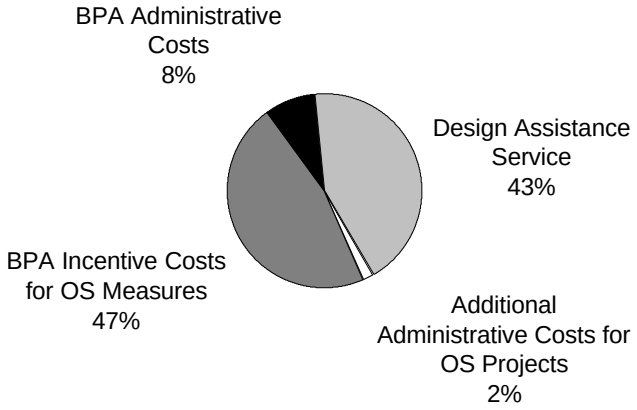
COST PER PARTICIPANT

BPA's cost per completed project increased significantly with the introduction of OS in 1991, however, the savings generated by the program have certainly offset the additional costs. Before OS, the program cost about $4,400 per completed project; in the first half of the 1991-92 fiscal year, the cost was $16,800 per completed project.

The total cost per completed project at TCL (including TCL operating cost, incentive payments, and BPA contribution) was about $12,250 in 1991. The comparable cost per completed project at SCL in 1991 was $29,100.

COST COMPONENTS

About 47% of the total BPA expenditures on ESD were for incentive payments under OS. These payments, which started in 1991, primarily take the form of reimbursements to utilities. In the first half of fiscal year 1991-92, OS incentive payments were almost 78% of the total program expenditures. Design assistance payments represent 43% of the program expenditures since the program began, and have fallen to 16% of the 1991-92 costs. Administrative costs for the program totalled about 6% in 1991-92, decreasing from the overall program average of 10%.



Cost of Saved Energy Table (¢/kWh)	Discount Rates						
	3%	4%	5%	6%	7%	8%	9%
1987-1990	3.68	3.95	4.23	4.52	4.82	5.13	5.45
1991	1.40	1.50	1.61	1.72	1.83	1.95	2.07
1992	0.88	0.94	1.01	1.08	1.15	1.23	1.30

Environmental Benefit Statement

Marginal Power Plant	Heat Rate BTU/kWh	% Sulfur in Fuel	CO2 (lbs)	SO2 (lbs)	NOx (lbs)	TSP* (lbs)
Coal	**Uncontrolled Emissions**					
A	9,400	2.50%	119,705,000	2,840,000	574,000	57,000
B	10,000	1.20%	127,644,000	1,099,000	371,000	275,000
	Controlled Emissions					
A	9,400	2.50%	119,705,000	284,000	574,000	5,000
B	10,000	1.20%	127,644,000	110,000	371,000	18,000
C	10,000		127,644,000	733,000	366,000	18,000
	Atmospheric Fluidized Bed Combustion					
A	10,000	1.10%	127,644,000	336,000	183,000	92,000
B	9,400	2.50%	119,705,000	284,000	230,000	17,000
	Integrated Gasification Combined Cycle					
A	10,000	0.45%	127,644,000	226,000	37,000	92,000
B	9,010		114,819,000	82,000	28,000	6,000
Gas	**Steam**					
A	10,400		69,624,000	0	159,000	0
B	9,224		60,463,000	0	379,000	18,000
	Combined Cycle					
1. Existing	9,000		60,463,000	0	232,000	0
2. NSPS*	9,000		60,463,000	0	110,000	0
3. BACT*	9,000		60,463,000	0	15,000	0
Oil	**Steam--#6 Oil**					
A	9,840	2.00%	100,772,000	1,527,000	180,000	171,000
B	10,400	2.20%	106,879,000	1,515,000	227,000	110,000
C	10,400	1.00%	106,879,000	216,000	182,000	57,000
D	10,400	0.50%	106,879,000	635,000	227,000	35,000
	Combustion Turbine					
#2 Diesel	13,600	0.30%	133,752,000	266,000	413,000	23,000
Refuse Derived Fuel						
Conventional	15,000	0.20%	158,792,000	409,000	539,000	120,000

Avoided Emissions Based on 55,521,589 kWh Saved (1987-1992)

In addition to the traditional costs and benefits there are several hidden environmental costs of electricity use that are incurred when one considers the whole system of electrical generation from the mine-mouth to the wall outlet. These costs, which to date have been considered externalities, are real and have profound long term effects and are borne by society as a whole. Some environmental costs are beginning to be factored into utility resource planning. Because energy efficiency programs present the opportunity for utilities to avoid environmental damages, environmental considerations can be considered a benefit in addition to the direct dollar savings to customers from reduced electricity use.

The environmental benefits of energy efficiency programs can include avoided pollution of the air, the land, and the water. Because of immediate concerns about urban air quality, acid deposition, and global warming, the first step in calculating the environmental benefit of a particular DSM program focuses on avoided air pollution. Within this domain we have limited our presentation to the emission of carbon dioxide, sulfur dioxide, nitrous oxides, and particulates. (Dollar values for environmental benefits are not presented given the variety of values currently being used in various states.)

HOW TO USE THE TABLE

1. The purpose of the previous page is to allow any user of this profile to apply BPA's level of avoided emissions saved through its Energy Smart Design program to a particular situation. Simply move down the left-hand column to your marginal power plant type, and then read across the page to determine the values for avoided emissions that you will accrue should you implement this DSM program. Note that several generic power plants (labelled A, B, C,...) are presented which reflect differences in heat rate and fuel sulfur content.

2. All of the values for avoided emissions presented in both tables includes a 10% credit for DSM savings to reflect the avoided transmission and distribution losses associated with supply-side resources.

3. Various forms of power generation create specific pollutants. Coal-fired generation, for example, creates bottom ash (a solid waste issue) and methane, while garbage-burning plants release toxic airborne emissions including dioxin and furans and solid wastes which contain an array of heavy metals. We recommend that when calculating the environmental benefit for a particular program that credit is taken for the air pollutants listed below, plus air pollutants unique to a form of marginal generation, plus key land and water pollutants for a particular form of marginal power generation.

4. All the values presented represent approximations and were drawn largely from "The Environmental Costs of Electricity" (Ottinger et al, Oceana Publications, 1990). The coefficients used in the formulas that determine the values in the tables presented are drawn from a variety of government and independent sources.

*** Acronyms used in the table**

TSP = Total Suspended Particulates
NSPS = New Source Performance Standards
BACT = Best Available Control Technology

LESSONS LEARNED

Most of the major lessons learned through the implementation of ESD are embodied throughout this profile as BPA and its customer utilities have been highly responsive to modifying the program to increase its effectiveness. The primary changes implemented were the introduction of the OS component and the evolution to what BPA calls the Long Term ESD. This has been a function of an effective evaluation feedback loop.

Through the first process evaluation, BPA determined that the first cost of installing energy conservation measures was often the most important consideration in whether an identified measure would be included in the final design. Additionally, it was found that the awards program had only a secondary effect on the decision process, that is, in instances where the costs and savings of implementing a measure indicated a marginal payback, owners and designers might decide to include the measure if they knew that they would receive an award.

After the second process evaluation, there was consensus that by reducing the payback period of recommended measures to two years or less, the number of measures installed would significantly increase. Thus, OS was developed, and has so far proven popular and effective in the utilities in which it has been implemented.

Influencing the installation of energy conservation measures was just one of the ESD objectives. Even before the introduction of OS, ESD had been successful in meeting many of its stated goals. In particular, the educational element of ESD has had far reaching effects. Utility staff interviewed for the second process evaluation indicated that awareness of the program among building designers and developers had increased, and that incidences of repeat participation were increasing. Most of those interviewed for the first process evaluation indicated that a primary success of the program had been that it allowed designers to consider energy conservation options that might not otherwise have been included in the design process. The flexibility of the program was noted as a strong point in that the designers did not feel compelled to act upon the ESD recommendations. Building designers who learned of certain conservation options through initial participation in ESD were thus likely to include such ideas in future projects.

Now with the continued commitment to the program through Long Term ESD, BPA will continue its success in introducing building designers to energy-efficiency ideas and in promoting the relationship among the utilities and the design community. In this sense, ESD is carrying BPA closer toward increased standards of energy-efficiency in the Pacific Northwest.

TRANSFERABILITY

The manner in which responsibility for ESD program administration, marketing, and implementation are divided among BPA and its member utilities makes the program valuable for certain applications. For instance, this configuration might best be suited to European utilities, where the existence of a central entity providing administrative support to several smaller utilities is more common. The program could also be successfully implemented independently by a single utility.

References

1. BPA, "Fiscal Year 1991 Generation and Sales Statistics"

2. Ralph Stein, Chief of Loading Research Section, BPA, personal communication, August 1992.

3. Patricia Tawney, E$P Principles Manager, BPA, personal communication, July 1992.

4. BPA, "Conservation Resource Energy Data: 1992 Draft".

5. Wayne Lehman, Public Utilities Assistant, BPA, personal communication, August 1992.

6. Bonneville Power Administration, "Principles for the Energy $avings Plan," Revised April 1992.

7. Annie Sincavage, E$P Data Systems Manager, BPA, personal communication, July 1992.

8. Janelle Schmidt, Economist, BPA, personal communication, July 1992.

9. Bonneville Power Administration, "1992 Resource Program: 10 Year Plan, Draft II," May 1992.

10. Allan Ingram, Mechanical Engineer, BPA, personal communication July-August 1992.

11. Ken Canon, Executive Director, Industrial Customers of Northwest Utilities, personal communication July-August 1992.

12. Mike Rose, Public Utilities Specialist, BPA, personal communication, July 1992.

13. John Harrison, "Head Start for Salmon Recovery," Northwest Energy News, Volume 11, No. 4, July/ August 1992.

14. Ken Satre, Energy Utilization Engineer, Snohomish County Public Utility District, personal communications, July 1992.

15. James A. Heidell and Karen M. Lorberau, "Energy Smart Design Program Second Process Evaluation Final Report," Synergic Resources Corporation, September 19, 1989.

16. William Gavelis, "Energy Smart Design Program Second Process Evaluation Final Report", Synergic Resources Corporation, June 1991.

17. Ronald Moe, William Gavelis, Lisa A. Skumatz, and Cabell Breckinridge, "Evaluation of Energy Smart Design Optional Services Program Final Report", November 1991.

18. Jim Dowty, Energy Smart Design Program, BPA Program Manager, personal communication, November 1992.

19. Seattle City Lights, ESD informational and promotional materials, 1992.

20. Caroline Yee-Joy Dethloff, Energy Planning Supervisor, Commercial/Industrial Section, Seattle City Light, personal communication, November 1992.

21. Tacoma Public Utilities Energy Conservation Office, "1991 Annual Report", 1992.

22. Brian Coates, Energy Research and Evaluation Analyst, Seattle City Light, personal communication, December 1992.

23. Dennis Pearson, Evaluation Unit, Seattle City Light, personal communication, December 1992.

24. Frank Godwin, personal communication, December 1992.