

---

# British Columbia Hydro Process Improvements Profile #88

Executive Summary	2
Utility Overview B.C. Hydro 1993 Statistics	3
Utility DSM Overview Utility DSM Overview; B.C. Hydro Current DSM Programs; Annual DSM Expenditure; Annual Energy Savings; Annual Capacity Savings	4
Program Overview	6
Implementation Marketing; Delivery: The Step by Step Process; Measures Installed; Staffing	7
Monitoring and Evaluation	10
Program Savings Project Status to December 1992; Participation; Free Ridership; Savings Overview; Measure Lifetime; Cumulative Energy Savings	12
Cost of Program Total Program Cost; Cost Effectiveness; Cost of Saved Energy; Cost Per Participant, Cost Components; Costs Overview; Case Study: Mechanical Debarker Retrofit	14
Environmental Benefit Statement	16
Lessons Learned / Transferability	18
References	20

# Executive Summary

The Process Improvements program offered by B.C. Hydro Power Smart is administered by Willis Energy Services Limited. It is an excellent model of a program designed to promote and financially support innovation in the pursuit of energy efficiency for large industrial customers. The program has proven that sophisticated retrofits in the industrial sector can be catalyzed and bought at a low cost from a utility perspective.

Process Improvements is based on the engineering expertise of its administrator whose staff provide a wealth of experience related to the program's prime target: the pulp and paper industry. Staff including B.C. Hydro staff, identify opportunities for energy and dollar savings in industries, some of which require utility incentives to shorten customer payback periods. In other cases, this engineering support has resulted in retrofits where customers are not eligible for program incentives yet elect to pursue retrofits on their own due to exceptionally short payback periods of the measures identified. Thus the program effectively pushes the marketplace with incentives, and pulls the marketplace by working with customers to help them identify cost effective retrofit opportunities.

Process Improvements has evolved in a number of ways: Incentive levels have been downwardly adjusted and select technologies have been moved out of the program to B.C. Hydro's more prescriptive programs. In terms of financing, smaller retrofits are generally based upon a set formula while the incentives for larger projects are negotiated on a case-by-case basis, underscoring the basic objective of engaging energy efficiency retrofits at the least cost while remaining sensitive to the needs and financial resources of customers.

To date marketing the program has been focused on B.C. Hydro's 590 largest industrial customers with peak demands of greater than 1 MW. In fact special emphasis has been placed upon the approximately 85 very large "transmission voltage" customers who account for over 90% of the energy sales to the large customer group. The program has served as a powerful customer service for these important customers, helping them retrofit their facilities with gear reducers, synchronous belts, efficient refrigeration equipment, and other retrofit projects such as large mechanical debarkers used in the pulp and paper industries, turbo generators, compressed air equipment, and pulpers. By working closely with these customers, Process Improvements has engaged process changes in industries that will not only save money and reduce power consumption, but which will also support the economic viability of the province of British Columbia.

## **BRITISH COLUMBIA HYDRO Process Improvements**

**Sector:** *Industrial*

**Measures:** *Gear reducers, synchronous belts, refrigeration, and "other" customized site-specific efficiency improvements, mostly related to the pulp and paper industry*

**Mechanism:** *Customer-generated ideas fall into two categories: negotiated incentive approach for large customers, a standard rebate formula for small customers*

**History:** *Process Improvements began in 1990 and continues today*

### **1993 PROGRAM DATA**

*Energy savings:* 1.8 GWh

*Lifecycle energy savings:* 36.0 GWh

*Peak capacity savings:* 4.8 MW

*Cost:* \$900,000

### **CUMULATIVE DATA (1991 - 1993)**

*Energy savings:* 26.3 GWh

*Lifecycle energy savings:* 525 GWh

*Peak capacity savings:* 4.8 MW

*Cost:* \$2,171,000

### **CONVENTIONS**

For the entire 1994 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 U.S. Federal Reserve's foreign exchange rates.

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

British Columbia Hydro and Power Authority (referred to as B.C. Hydro in this profile) is a provincial Crown Corporation based in Vancouver, Canada. The third largest electricity utility in Canada, B.C. Hydro provides electric service to over 1.3 million customers in British Columbia, a province just north of the State of Washington along Canada's Pacific coast. Its service area includes over 92% of British Columbia's population with a concentration in the Vancouver area.[R#1]

Between 48,000 and 55,000 GWh of electricity are generated annually, depending upon prevailing water levels, with more than 70% produced by major hydroelectric generation stations on the Columbia and Peace rivers. B.C. Hydro has a service territory covering over 330,000 square miles and provides electricity to customers through an interconnected system of over 32,500 miles of transmission and distribution lines. The utility is proud of its mission statement, "To support the development of British Columbia through the efficient supply of electricity." [R#1]

Although over 85% of B.C. Hydro's customers are residential, residential sales of 15,135 GWh represent only 36% of the electricity B.C. Hydro sold in 1993. What B.C. Hydro calls the "General Distribution" sector (customers with demands of 35 kW and higher, which includes commercial and light manufacturing sectors) makes up roughly 12% of all customers but comprises 37%, 15,550 GWh, of the electricity sales. The remaining customers, called "Transmission Rate" customers (which include large industrial customers), receive power at high voltages and provide their own facilities to transform the energy to usable voltages. Although there are only approximately 85 of these transmission accounts, they make up 23%, 9,669 GWh, of the electricity sold in 1993. The remaining 4% of sales went to other destinations.[R#1,3]

## **B.C. HYDRO 1993 STATISTICS**

<i>Number of Customers</i>	<i>1.36 million</i>
<i>Energy Sales</i>	<i>47,686 GWh</i>
<i>Energy Sales Revenue</i>	<i>\$1.52 Billion</i>
<i>Winter Peak Demand</i>	<i>8,156 MW</i>
<i>Generating Capacity</i>	<i>10,835 MW</i>
<i>Reserve Margin</i>	<i>32.84 %</i>

## **Average Electric Rates**

<i>Residential</i>	<i>4.1 ¢/kWh</i>
<i>General</i>	<i>3.6 ¢/kWh</i>
<i>Transmission</i>	<i>2.2 ¢/kWh</i>

With 5,643 GWh of electricity trade and 3,943 GWh of system line losses, B.C. Hydro generated 51,620 GWh of electricity in 1993. This is an increase of 8% from 1991 and roughly equal to 1992 sales. B.C. Hydro is also experiencing very high growth in customers, with more than 35,000 added last year, the highest number in 10 years. This growth has been more than 20 percent in the past 10 years and is forecast to continue to climb due to an influx of people moving to the area. Also a combination of other factors including the coincidence of abundant rainfall, export markets, and cold weather, have provided unusually high revenues for the past two years.[R#1]

Hydroelectric plants generate 95% of B.C. Hydro's electricity with the remaining 5%, 1,843 GWh, generated from the Burrard natural gas thermal plant. B.C. Hydro predicted in its 1991 Electricity Plan that no new generation facilities would be required until 2005. In that plan, B.C. Hydro committed to make full use of its existing facilities and to fully develop other resource options prior to developing new hydro generation projects. These other resource options include: Power Smart, B.C. Hydro's primary DSM initiative; coordination and purchases; a capacity enhancement program called "Resource Smart;" and private sector generation.[R#3] ■

# Utility DSM Overview

B.C. Hydro began its energy management activities through its Energy Conservation Division in 1975. In 1988 B.C. Hydro created Power Smart to run its demand-side management programs. Power Smart programs began in 1989 and B.C. Hydro's investment in DSM grew to \$35-42 million annually thereafter. From 1989-1993, B.C. Hydro's investment of \$116,349,000 resulted in savings of 1,336 GWh. In 1993 alone the utility's DSM expenditure of over \$39 million represented 2.5% of the utility's \$1.52 billion gross revenues. Since its inception, B.C. Hydro Power Smart has included over 435,000 residential, over 23,800 commercial, and 2,550 industrial participants. [R#5]

B.C. Hydro's Power Smart initiative had the objective of obtaining a 2,400 GWh load reduction over ten years through the implementation of residential, commercial, and industrial DSM programs. The initiative received much initial success so B.C. Hydro expanded Power Smart's goal to a 5,600 GWh reduction by the year 2010. [R#5]

The initiative was launched with a handful of programs and has included as many as 27 Power Smart programs operating concurrently. One of the major reasons for B.C. Hydro's success is the high level of customer awareness of the Power Smart programs. One of B.C. Hydro's most successful initiatives aimed at increasing customer awareness was "Power Smart Month." The initiative, first conducted in 1990, consisted of a month of energy awareness promotion culminating on "Power Smart Night" when customers were encouraged to turn off all unnecessary lights. When the initiative was repeated on October 21, 1992, B.C. Hydro estimates that its customers saved 251 MWh on Power Smart Night alone.

## BC HYDRO CURRENT DSM PROGRAMS

### Residential

Retail Promotions  
Home Improvements  
Refrigerator Efficiency  
Refrigerator Buy-Back  
Electric to Gas Water Heaters  
Education Program  
New Home Program  
Remote Power Smart Options

### Commercial

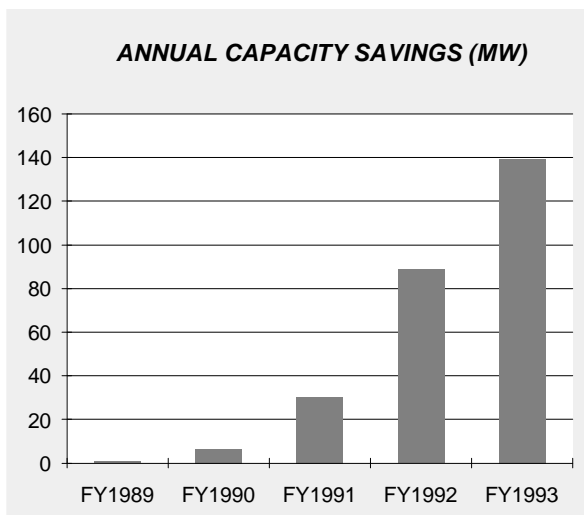
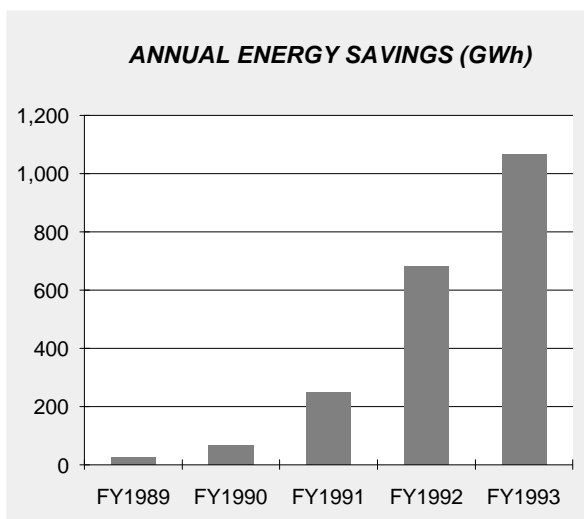
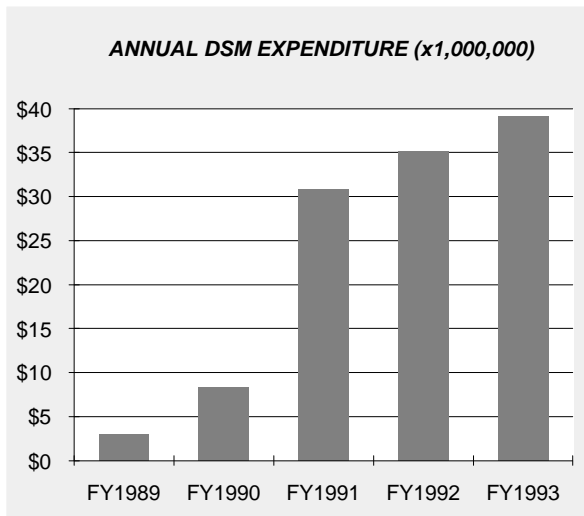
Building Improvements  
New Building Design  
In-House Energy Efficiency  
Natural Choice

### Industrial

High-Efficiency Motors  
Efficient Fans  
Efficient Pumps  
**Process Improvements**  
New Plant Design  
Employee Involvement (Power Plays)  
Efficient Roadway Lighting  
Efficient Compressors

In 1993 B.C. Hydro operated eight residential DSM programs. These programs included two programs pertaining to refrigerators (see The Results Center Profile #10),

UTILITY DSM OVERVIEW	ANNUAL DSM EXPENDITURE (x1000)	ANNUAL ENERGY SAVINGS (GWh)	ANNUAL CAPACITY SAVINGS (MW)
<b>FY1989</b>	\$2,913	23	0.7
<b>FY1990</b>	\$8,306	68	6.6
<b>FY1991</b>	\$30,832	250	30.3
<b>FY1992</b>	\$35,159	681	88.6
<b>FY1993</b>	\$39,139	1,066	139.5
<b>Total</b>	\$116,349	2088	265.7



one program pertaining to hot water use, an energy audit program, a new home construction program, an education-oriented program, a retail promotions program, and a program aimed specifically at reducing load in those areas not served by main electric transmission lines.

For the FY 1993 (April 1, 1992 - March 31, 1993) Power Smart registered savings of 389 GWh at a B.C. Hydro unit cost of saved energy of 1.04 cents per kilowatt-hour. (These results were calculated by Power Smart.) The residential and industrial sectors accounted for 99 and 90 GWh of savings respectively. With electricity savings of 200 GWh, the commercial sector made the strongest contribution to overall B.C. Hydro Power Smart savings for FY 1993. Recently, the commercial programs were consolidated into two streams, the New Building Design and Building Improvements programs. Under the New Building Design program, savings of nearly 40 GWh were achieved by 480 new buildings. Building Improvements was Power Smart's biggest program in terms of savings, achieving electricity gains of 154 GWh, or fully 40% of the Power Smart total. More than 10,000 improvement projects were carried out.

For industrial customers, B.C. Hydro offers a number of rebate, education, and incentive-based programs including the successful High-Efficiency Motors program discussed in The Results Center Profile #38. Additionally, fans, pumps, and compressors programs are in B.C. Hydro's portfolio of DSM programs.[R#4,5]

Aimed at capturing industrial customers' unique energy savings ideas that fall outside the scope of the other Power Smart industrial programs is the Process Improvements program discussed in this profile. This program is the largest of Power Smart's industrial energy conservation programs and is targeted at all industrial customers who have a peak demand greater than 1 MW and allows for customer-generated ideas to be implemented. ■

# Program Overview

---

Many industrial energy savings opportunities involve processes or custom situations that don't fit within the standard industrial Power Smart product offerings. The Process Improvements program, which has become the largest of Power Smart's industrial energy conservation programs, began as a pilot program in June 1990 and began formal operation in October of that same year. Process Improvements arose out of an interest by Transmission Customer Services to respond to specialized industrial energy savings opportunities. Rather than setting up additional product-based, prescriptive rebate programs, the decision was made to establish a program that responded to customer ideas, complementing existing programs and allowing for customer innovation. In essence, Process Improvements is an avenue for customers and utility staff to explore all types of retrofit projects that have the potential for energy savings.[R#4]

Although the program is open to all industrial users on the B.C. Hydro power grid, marketing for the program has been focussed on the largest industrial customers. In British Columbia, these customers are concentrated in pulp and paper industries, wood products, and mining, a concentration that has shaped the program and specifically the measures installed to capture energy savings.

B. C. Hydro has over 22,000 industrial customers who use roughly 17,000 GWh of utility-generated electricity each year. While the target market for the program has been the 590 largest of these customers who collectively consume 85% of that energy, and who individually have peak power demands greater than 1 MW, a special emphasis has been placed upon the approximately 85 very large

"Transmission Voltage" customers who account for over 90% of the energy sales to the large customer group. [R#5]

In terms of measures installed the Process Improvements program has promoted four basic categories of technologies: gear reducers, synchronous belts, refrigeration, and "other" retrofit projects. "Other" projects include a wide variety of technology retrofits related to the pulp and paper industry such as replacing hydraulic with large mechanical debarkers, rewinding turbo generators, and installing automatic computer control systems.

Retrofit projects that meet the program's eligibility criteria may be offered incentives in order to make them more attractive for customers. For gear reducer and synchronous belt projects there were established incentive amounts, but for other projects the size of the incentive has been based on the unique circumstances of the energy savings measure. The goal is for B.C. Hydro to offer an incentive which is just enough to motivate the customer to implement an electrical energy savings measure that would otherwise not have been initiated.

When the program was launched, one of its goals was to achieve savings of 27 GWh over its first 20 months. In addition for 1993-1995 the program's goals were to attain incremental energy savings of 68.3, 72.0, and 51.1 GWh/yr, respectively. Other goals of the program are to provide energy savings to B.C. Hydro at the lowest possible cost and to operate within the Power Smart goals which are to provide a cost-effective supply of electricity, to enhance customer service, to reduce environmental impact by delaying the need for new generation facilities, and to stimulate the demand and supply of B.C. products. ■

## MARKETING

Marketing Process Improvements has involved a series of strategies. While the program's primary target is the 590 large industrial customers served by B.C. Hydro, the program's marketing efforts have placed special emphasis on the approximately 85 "Transmission Voltage" industrial customers. The targeting strategy for the program relies primarily on personal contact to disseminate information. Distribution Customer Services representatives and Transmission Customer Services representatives use Process Improvements as a very important part of their Power Smart "tool box" in their visits with customers.

Marketing the program is essentially a two-way street: Customer Service representatives verbally describe the program, as well as all other relevant Power Smart programs, to customers during the course of their routine visits. Inversely, when customers have innovative ideas about how to save energy in their facilities, Process Improvements serves as a means of supporting these customer-generated innovations with both engineering support and financial incentives. This has allowed B.C. Hydro staff to switch from selling rebate products to discussing and encouraging customers' ideas.

Process Improvements serves as a "door opener," the basis for initiating calls, and a means for building relationships. As one representative said, "It's hard to get their attention when electricity is only 1-2% of costs; this is the only program that gets 'em fired up. This program allows the customer to run the gamut of energy conservation and to thus create significant savings in energy bills." To support both customer and staff-generated energy efficiency ideas, program-funded research continues to help identify energy-efficient opportunities and to develop in-house expertise in specific technologies and equipment. [R#6]

Other ways that the program is marketed include periodic mailings about all Power Smart product offerings and customer seminars and workshops.

Because of B.C. Hydro's resource situation the utility does not currently need the large levels of savings that this program could produce. Therefore Process Improvements is not being marketed aggressively. Instead B.C. Hydro's intent is to build the foundation for a solid program which will be in a position to be ramped up quickly when the utility has a more immediate need for conservation re-

sources. Given this strategy the current personal marketing approach has proven appropriate and cost-effective. [R#6]


## DELIVERY: THE STEP BY STEP PROCESS

Willis Energy Services Limited was the original designer of Process Improvements and is now responsible for the program's implementation. Its staff perform all functions associated with the day-to-day management of the program, tracking its results, and suggesting continual refinements to enhance its effectiveness. Jon Hessen of Willis Energy Services is the Program Manager.

**Initial customer contact is made:** Initial and ongoing contact with prospective participants is made by B.C. Hydro's Transmission Customer Services (TCS) representatives who maintain contact with B.C. Hydro's Transmission Voltage industrial customers, or Distribution Customer Services (DCS) representatives servicing the 22,000 smaller Distribution Voltage industrial customers. These two B.C. Hydro groups are responsible for all contacts with the customers and clearly explain the flexibility of the program to them. [R#4]

**Customers then submit applications to B.C. Hydro:** The prospective customer fills out an application which the Program Manager reviews to determine if it is a technically viable Power Smart project. The energy savings estimates received vary in sophistication, from calculations as simple as comparing equipment nameplate information, to complex engineering studies complete with computer models of facilities and processes.

As part of the application customers are asked to identify non-energy benefits that might be gained from their project, such as reduced maintenance or improved product quality. This information is used to establish actual project payback periods. Customers are also required to submit plans for measuring the actual energy savings should their application be accepted and the retrofit implemented. B.C. Hydro will assist the customer to make sure that he has the right ideas, knows the technologies, and understands the analyses. [R#4]

**Technical reviews are conducted:** All projects receive a technical review which is conducted by Willis Energy Services. If a project involves a technology in which Willis Energy Services and B.C. Hydro do not have adequate expertise, then an outside consultant may be 

## Implementation (continued)

---

contracted to perform the technical review. The objective of the technical review is to confirm the estimated energy savings for a project and to verify the feasibility of the project. It reduces the risk to B.C. Hydro of the projected energy savings not being attained.[R#4]

**The customer incentive is determined:** Throughout this process, customer contact is maintained by the B.C. Hydro TCS and DCS representatives. For small retrofit projects the Program Manager is able to determine and approve incentive payments. For larger projects, the Program Manager works in conjunction with B.C. Hydro's Manager of Industrial Operations to decide if and what amount of an incentive is warranted. If it is determined that an incentive is warranted, the incentive amount is calculated and then offered to the customer via the customer service representative.

**The retrofits are completed by the customer:** The customer is then responsible for installing the energy conservation measure(s). He signs a Program Agreement that says that the measure will be in place and operational for at least three years. The Program Agreement also gives B.C. Hydro the right to conduct post installation monitoring at the customer's facility. The customer must finance the installation and arrange either to do the retrofit in-house or contract out the work.

**Retrofits are verified prior to customer payment:** B.C. Hydro's customer services representatives check invoices and visit the site to confirm that the measures have been properly installed before the incentive is paid by the utility. It can take as little as a few months to years from the time of initial contact with the customer until the project is completed.

### INCENTIVES

Process Improvements uses a three-tiered system for determining incentive levels.

1) For small projects where annual savings are expected to be less than 200 MWh/yr, a standard formula based on ¢/kWh saved is used for calculating rebates. B.C. Hydro paid customers the lesser amount of either a 15¢ (Canadian)/first year kWh savings, or an amount calculated to buy-down a customer's payback to two years. (In FY 1991 the kWh incentive was reduced to 10¢ (Canadian)/first year kWh savings.)[R#13]

2) For larger projects, generally over \$50,000 (Canadian) in project cost, the incentive is determined through a negotiation process which takes into account the unique circumstances of the project and the customer involved. After a complete and documented analysis of savings and costs is finished, discussions between the customer, customer representatives, and B.C. Hydro staff are conducted to determine the amount of incentive. The program's objective is to pay out the lowest amount necessary to get the project implemented. As a model for the maximum amount allowable in this negotiation, 5¢ (Canadian) per first year kWh saved or buying down the customer's payback to two years, whichever is less, is the basis for determining the incentives for large projects.[R#4]

This negotiation process enables B.C. Hydro to attain kWh savings at a lower average cost than standardized rebates would allow. It is also a useful instrument for identifying and screening out some free riders. To date, incentives have been given to customers for some demonstration projects in exchange for using the site for a test study or pilot project, data sharing, and for publicity. These have demonstrated the technical viability of some program initiatives, especially during the start-up phase.

3) Gear reducer and synchronous belt retrofit incentives are based on a formula (presented in the Measures section) proportional to \$/hp and \$/kW saved.

Many retrofits don't receive incentives because the value of the savings alone is enough to make the customer implement the retrofit. However, the incentives are still the integral part of breaking the barriers to implementing measures. With energy consumption being very low on a customer's list of costs, a potential incentive clearly gets their attention.

### MEASURES INSTALLED

Over 70% of the projects installed under the Process Improvements program up to the end of December 1992 were synchronous belt and gear reducer projects. However, together they represented only about 20% of the energy savings achieved. Following the success of these technologies within the program, they were transferred to the High-Efficiency Motors rebate program in February 1992. This is an important function of the program, whereby "customized" measures that become commonplace are moved to the prescriptive rebate side of the



---

shop. The following are the roles they played in the Process Improvements program prior to February 1992.

**Gear Reducers:** Mechanical drives are used in most industries to move and process material. The most common method of maintaining the desired speed of moving equipment is through the use of an electric motor combined with a gear reducer. Gear reducers transform the high rotational speed of motors to lower speeds compatible with the driven equipment. Inside the gear reducer, power is lost in the form of heat as a result of friction between moving parts. If a plant has many such drives the total amount of power lost can be considerable. Therefore, improving the operating efficiency of gear reducers is an important factor in reducing both electrical energy use and production costs.

The objective of the gear reducer program was to encourage customers to replace any existing gear reducer that had an efficiency of less than 88% with a more energy-efficient one. The program targeted replacing inefficient worm gear reducers which had efficiency ratings in the range of 75-90%, with more efficient helical, planetary, and cycloidal gear reducers which have efficiencies typically over 90%. [R#7]

Rebates were calculated by using a standard formula: Incentive = Input horsepower x \$5.00 (Canadian) x  $100[(100/88)-(100/\text{efficiency})]$ . The "efficiency" used in the formula is the efficiency listed by the program for that particular make and model of efficient gear reducer. The 88 represents the program's cut-off point between efficient and inefficient gear reducers. [R#4]

**Synchronous Belts:** Flexible drives, such as V belts (70-95% efficiency rating), chain drives and synchronous belts, are used in industry to transmit power over a distance and serve as a means of speed reduction or multiplication. Synchronous belts (with 98% efficiency rating) have teeth that fit into grooves cut on the periphery of the sheaves that transmit power to and from the belt. Because these belts do not slip there is no power loss through slippage. Slippage with V belt systems is the main cause of energy loss. [R#7]

The Process Improvements synchronous belt initiative offered customers a rebate for converting existing V belt drives to more efficient synchronous drives. The incentive amount for a synchronous belt was \$5 (Canadian) per

input horsepower. For example, if a customer replaced a V belt drive that was driven by a 20 HP motor, the incentive was  $\$5 \times 20 = \$100$ . [R#4]

**Refrigeration:** Refrigeration systems are used in industry primarily in two areas: food processing and food storage. For refrigeration projects, the objective of Process Improvements has been to encourage customers to include electrical energy savings measures in their refrigeration plants when existing plants are being retrofitted or new plants are being constructed.

**Other:** The gear reducers, synchronous belts, and refrigeration projects have accounted for 153 of the 216 approved projects in the program up to December 1992. The 63 "other" approved projects consisted of a wide variety of 30 different technologies. This is the essence of the program: virtually any technology that saves electricity in the industrial sector can be considered for a rebate or incentive under the given conditions.

Additional "other" projects within the program include four large retrofits (with savings over 10 GWh/yr) at pulp and paper mills. Technologies included such measures as rewinding a turbogenerator at a pulp mill's cogeneration facility, retrofitting mechanical debarkers at a log mill, and installing an automatic computer control system that monitors and balances steam production at boilers (See Case Study #1). [R#4]

## STAFFING

Willis Energy Services Ltd. has the primary responsibility for administering the program and provides 2.5 full-time equivalents to the program for program management, project evaluation, program administration, and clerical support.

Two B.C. Hydro Evaluation Team staff members spent a combined time of one and a half years preparing an evaluation of the program. The manager of Industrial Operations at B.C. Hydro spends as much as a few hours a week working with the Program Manager determining incentives. O'Neill and Company was contracted by the Evaluation Division to conduct a process evaluation. There are also approximately 20 Customer Service representatives that provide Power Smart services to industrial customers and interface with customers and the Program Manager. ■

# Monitoring and Evaluation

---

## MONITORING

Monitoring for the Process Improvements program is performed mainly by on-site visits made by customer services representatives and Willis Energy Services staff. After major installations field measurements are performed by customer services representatives or contracted consultants. Staff also check invoices against installed equipment prior to authorizing customer payments.

Energy savings for the program are based on engineering estimates of a given project's technology application and are input into a database. There is no guarantee, however, that the actual results will equal projections or that projects will remain in place for at least the term of the Project Agreement (generally three years), and there is no clause in the contract that gives B.C. Hydro recourse if the savings are not met. However, if the project is removed during the three-year period, the customer is required to repay part of the incentive to B.C. Hydro. The incentive is given as a 36 month forgivable loan. If the project is removed during that time, the remaining months' portion of the incentive is to be repaid, however the prior portion is the customer's to keep.

In addition to the required customer plans for measuring the actual energy savings, the Program Agreement obtains the customer's consent for B.C. Hydro to do measurements. To date, very few monitoring plans have been implemented. Thus, reports on performance are mostly anecdotal. While some customers are required to provide annual monitoring reports to the program office, B.C. Hydro evaluation staff believed that there was not an adequate procedure to assure that the reports were submitted, much less fulfilled.

The impact evaluation recommended that for the program, monitoring activities needed to be expanded as feasible. Methods of measuring energy savings, especially for large projects, need to be built into projects so that actual savings can be recorded.

## EVALUATION

A preliminary process evaluation of the program was completed by O'Neill & Co., a consulting firm located in Portland, Oregon, in the spring of 1992. Their report recommended that a full evaluation be undertaken. The en-

suing full evaluation for the Process Improvements program, which was completed in November 1993 by B.C. Hydro's own Evaluation Team, consisted of three parts: impact evaluation, process evaluation, and market evaluation. The objectives of the evaluation were to estimate the energy and capacity savings from the program, to estimate the benefit/cost ratio of the program from both social and utility perspectives, to assess the effectiveness of the program at meeting its stated goals and objectives, to assess customer response and satisfaction, to identify barriers to participation, and to provide recommendations to program management for program improvements.[R#2]

## IMPACT EVALUATION

The Impact Evaluation focused on the energy and capacity savings attributable to the Process Improvements program and its cost effectiveness. It was submitted to the British Columbia Utilities Commission in 1994, being one of ten impact evaluations filed by B.C. Hydro between July of 1992 and June of 1994.

Due to the number and variety of the projects and the inability to generalize results from one project type to another, no single measurement technique satisfied all of the evaluation objectives. Thus the techniques used included laboratory testing, site measurement, review and analysis of billing and customer records, engineering estimates, group discussions, on-site and telephone interviews, surveys, technology research, and program database review. Nearly all of the 216 projects approved at the time of the evaluation had at least some review, with a concentration on those retrofit projects that had the biggest savings potential. Program staff coordinated the collection of energy and efficiency data. Outside support was called upon to perform testing and metering work. Data collection, testing, and metering work were completed by December 1992. For this reason the savings data presented in the next section of this profile primarily focuses on projects completed between June 1990 (the program's inception) to December 1992.[R#4]

The principle finding from the evaluation was that the Process Improvements program is cost effective. The program has been flexible and responsive to customer needs and successfully has motivated customers to implement energy efficiency projects that would not otherwise have been carried out.

---

Most noteworthy among the findings of the impact evaluation is that through December 1992 the Process Improvements program resulted in savings of 26.2 GWh from 184 evaluated projects. This amount of savings is 72% of the reported savings of 36.3 GWh. For the 184 projects evaluated, the total resource cost was 1.09 ¢/kWh, or 49% of the avoided cost of new energy. Therefore, despite the downward adjustments in savings the program was still proven cost-effective.[R#4]

The difference between the reported savings of 36.3 GWh and evaluated savings of 26.2 GWh is accounted for as follows: Two completed projects with combined savings of 0.07 GWh/yr were found to have been removed from service after the incentives were claimed because they did not meet the customers' needs. One large completed project was expected to have energy savings of over 14.3 GWh/yr but was found to be operating for fewer hours than anticipated. It therefore realized savings of only 6.5 GWh/yr, a downward adjustment of 7.8 GWh. Further in-depth review of 160 projects resulted in a reduction of 2.2 GWh/yr due to projects not performing as expected. With these deductions, the reported savings were derated 36.3 GWh to 26.2 GWh/yr.

#### **PROCESS EVALUATION**

A preliminary process evaluation was conducted in the spring of 1992 by O'Neill and Company. A full process evaluation conducted by O'Neill & Company was completed in February of 1993. Its findings were incorporated into the full evaluation of Process Improvements completed in November 1993. Over 90 interviews were conducted either in person or by telephone with four different groups: participants, non-participants, consulting engineers who had been involved in several projects, and B.C. Hydro staff directly or indirectly involved with the program. In addition, all program documentation and procedures were reviewed.[R#2]

Both customers and Customer Service representatives reported that incentives would have been more effective were they better tailored to meet customer needs. Financing was identified as an important alternative to incentive payments as this would better address the cash flow problems experienced by some customers. (To date B.C. Hydro has never fully financed projects, but instead has only provided rebates which represent a portion of the retrofit

costs.) Incentives, were judged to be the appropriate tool for many projects.

The Process Evaluation revealed numerous other findings and recommendations: whenever possible build measurement into projects; improve project documentation; assist customers in conducting technical assessments; modify the project database; and conduct monitoring of some difficult projects as program-funded case studies.

#### **MARKET EVALUATION**

A market evaluation attempted to identify factors that affect the future and potential of the program. General economic forecasts for British Columbia and information for specific technologies were included in this review. Measurement, analysis, and drafting of the market evaluation report were completed in March of 1993.[R#2]

The market evaluation found that the majority of past program activity has come from a small number of large customer projects. The market evaluation revealed that these are the most cost-effective projects for the program to pursue, however, small projects carried out by smaller customers have also been cost-effective. Therefore, the evaluation recommended that the program's principal target market remain the larger industrial customers without excluding smaller customers. Finally the market evaluation supported earlier projections that many opportunities for energy conservation still exist within the industrial customer base. ■

# Program Savings

**DATA ALERT:** Program savings reported have been adjusted based on the results of the program's impact evaluation discussed in the previous section. The savings reflect projects completed between June 1990 and December 1992.

B.C. Hydro tracks their DSM programs on a fiscal rather than calendar-year basis. Thus FY 1993, for example, runs from April 1, 1992 to March 31, 1993. This profile contains two complete fiscal years' savings data and results from a partial year (FY 1993) ending December 31, 1992.

Through December 31, 1992, Process Improvements has resulted in a total annual savings of 26.25 GWh and a total cumulative energy savings of 50.75 GWh. In terms of lifecycle savings the program will result in savings of 525 GWh for the 20-year measure lifetime assigned.[R#4]

Actual evaluated demand savings are made up of 88 kW from gears, 879 kW from belts, 302 kW from refrigeration, and 4,221 kW from "other" projects for a total of 5.49 MW. B.C. Hydro assigns an industrial customer coincidence peak factor of 87% to these savings. This coincidence factor represents the percentage of the cumulative individual customer peaks that would be recorded at the time that the B.C. Hydro system one hour annual peak occurred. Using this coincidence factor the 5.49 MW reduction of peak demand was reduced to an estimated 4.8 MW. On January 11, 1993 B.C. Hydro's system peak reached a new high of 8,156 MW. Thus the program's demand reduction of 4.8 MW represents about 0.06% of the system peak.[R#4,12]

<b>PROJECT STATUS TO DECEMBER 1992</b>	<b>NUMBER OF PROJECTS</b>
<b>Total Inquiries</b>	503
<b>Rerouted</b>	38
<b>Dropped</b>	91
<b>In Process</b>	158
<b>Total Approved</b>	216
<b>In Approval Stage</b>	21
<b>Implementation</b>	11
<b>Completely Installed</b>	184

## PARTICIPATION

By December 1992 a total of 503 inquiries were received from potential participants. Of these inquiries 129 project ideas (26%) were rejected, dropped, or rerouted; 158 projects (30%) were still in the application process; and 216 projects (44%) were approved. Of the 216 approved projects, 184 projects (85%) were completed; 11 projects (5%) were nearing completion; 21 projects (10%) were in the process of implementation.

The projects that Process Improvements had approved covered a wide range of technologies, however, over 85% of the energy savings reported were from projects at pulp and paper mills. Saw mills and planer mills accounted for a further 6%, resulting in 91% of the program's evaluated savings coming from B.C.'s pulp, paper and wood products industries.[R#4]

Average energy savings per participant were calculated by The Results Center to be 164 MWh/yr for the 160 projects evaluated. This average savings is derived from participants with savings ranging from a few hundred kWh to greater than 10 GWh/yr.

When the gear reducer and synchronous belt initiatives were offered the program saw a significant level of activity from relatively small customers. This small industrial customer participation is expected to decline in the future because the gear reducer and synchronous belt initiatives were transferred to the High-Efficiency Motors Program.[R#4]

## FREE RIDERSHIP

In the Process Improvements program reporting no specific adjustment had been made to the energy savings to account for free riders. However, B.C. Hydro's process evaluation determined free ridership by asking the customers outright whether they would have implemented the measure without an incentive. Based upon these interviews, free ridership was estimated to account for about 20-30% of projects but only 5-10% of claimed energy savings. This confirms that larger projects undergo more careful evaluation of customer motivations than smaller ones.[R#6]

The inverse of free ridership is induced savings whereby non-incented savings accrue as a direct result of the program. Process Improvements reported energy savings

<b>SAVINGS OVERVIEW</b>	<b>ENERGY SAVINGS (MWh)</b>	<b>CUMULATIVE SAVINGS (MWh)</b>	<b>LIFECYCLE SAVINGS (MWh)</b>	<b>DEMAND SAVINGS (MW)</b>	<b>CUMULATIVE DEMAND SAVINGS (MW)</b>
<b>FY 1991</b>	50	50	1,000	NA	0.0
<b>FY 1992</b>	24,400	24,450	488,000	NA	0.0
<b>FY 1993</b>	1,800	26,250	36,000	NA	4.8
<b>Total</b>	26,250	50,750	525,000	4.8	

from three projects where no incentives were paid and considered these to have been induced by program activities. One of these three projects had expected energy savings of 10 GWh/yr. The project was installed after lengthy discussions which led to the conclusion that the project benefits were such that an incentive was not warranted. Excluding this large project, non-incented energy savings resulting from Process Improvements activities such as seminars, pilot studies, and the educational efforts of the customer representatives, were estimated to be at least equal to the free ridership amounts.[R#6]

## MEASURE LIFETIME

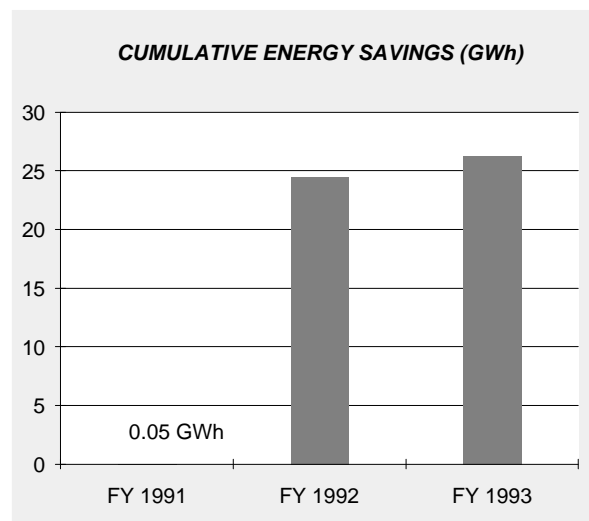
Given the diverse nature of the retrofits put into place, an average measure lifetime is difficult to assign. While some projects were expected to provide savings for more than 20 years, others would have a somewhat shorter time span. In order to calculate lifecycle energy savings and the program's cost of saved energy, an average measure lifetime of 20 years has been used.[R#4]

## GOALS AND PROJECTED SAVINGS

In 1990 Process Improvements' original goal was to have 90 industrial projects in place by January 1995 and to generate cumulative annual energy savings of 100 GWh/yr at an average total resource cost of 1.6¢/kWh. At the end of 1992 the program goals were to attain annual incremental energy savings of 68.3, 72.0, and 51.1 GWh/yr by March 1995 for the years 1993, 1994, 1995 respectively and to capture these savings at a B.C. Hydro unit cost of 0.44¢/kWh.

According to B.C. Hydro's Conservation Potential Review, the first phase of which was completed in February of 1992 by an outside consultant and reviewed by the utility's staff, theoretical energy savings in British Columbia's in-

dustrial sector are estimated to be fully 35% of industrial power sales, or about 6,000 GWh/yr. While this represents a technical rather than an achievable market potential and includes activities such as entire plant redesigns, it does indicate that the opportunity exists for substantial industrial savings.

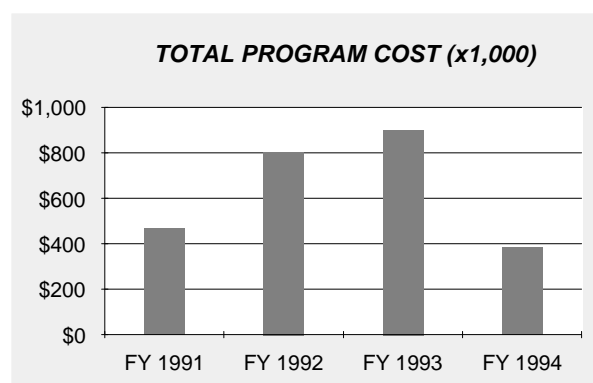


While this profile only deals with actual evaluated savings, many of the approved projects are still "in the pipeline," meaning that they are in the process of being completed. Only when complete are their energy savings tallied. Program managers estimate that as of June 1994 unofficial program total annual savings (including projects "in the pipeline") are 135.5 GWh. If all these Process Improvements program projects currently completed and "in the pipeline" were realized, they would represent 0.45% of B.C. Hydro's total industrial power sales, or 1.2% of the identified potential. While this level of savings is on track relative to the program's long-term objectives, clearly the program is only beginning to capture the savings potential in British Columbia's industrial sector.[R#4,13] ■

# Cost of the Program

**DATA ALERT:** Unlike the evaluated savings information presented which captured only part of FY 1993, the cost information presented herein (US 1990 \$) covers four full years of fiscal year data including FY 1994.

The total cost to B.C. Hydro for the program including incentives, administration, and corporate overheads through March 31, 1994 has been \$2.6 million. In FY 1991 the program cost \$469,000. Then the program costs nearly doubled in FY 1992 to \$802,000 mainly due to activity levels. The following year costs continued to incline totaling \$900,000. The most recent year, FY 1994, has since seen a decline in program costs to \$384,000.



## COST EFFECTIVENESS

B.C. Hydro has found the program to be cost effective. The 184 installed projects discussed in the Monitoring and Evaluation section had a total resource cost of 1.09 cents/kWh or 49% of the utility's avoided cost of new energy. Furthermore, B.C. Hydro has calculated a benefit to cost ratio of 2:1 for the Process Improvements program for the 1991-1992 period.[R#4]

Using an average measure lifetime of 20 years, The Results Center calculates that the cost of saved energy ranges between 0.56 and 0.91 cents/kWh based on discount rates ranging from 3% to 9%. At a 5% discount rate, for instance, the program cost B.C. Hydro 0.66¢/kWh.

## COST PER PARTICIPANT

The Results Center calculated the cost to the utility per participant for the first 3 fiscal years of the program based on total expenditures and the number of contracts signed each year. This calculation applies to the original 184 evaluated projects and an additional 33 projects completed in FY 1993. It revealed that the average cost to the utility per participant was \$10,005. This does not include the total cost to customers since the program's inception, estimated to be in the order of \$3.1 million.

Customer costs are estimated and then presented by project participants at the time they submit their applications. For every dollar of incentives, customers paid an average of \$1.89 towards their projects. Thus the average payback period for customers is 2.9 years. Without the incentive payments the simple payback period increased to 3.9 years.

## COST COMPONENTS

The Cost Overview table presents incentive costs as well as administration and overhead costs. Incentive costs of \$1.24 million account for 48% of total program costs. Administration costs which include labor, materials, consulting, computer costs, printing and graphics, and technical and market research, account for 38% of total program costs at \$976,000. Overhead accounts for the balance costing \$336,000, or 14% of the total. ■

<b>COST OF SAVED ENERGY AT VARIOUS DISCOUNT RATES (¢/kWh)</b>	<b>3%</b>	<b>4%</b>	<b>5%</b>	<b>6%</b>	<b>7%</b>	<b>8%</b>	<b>9%</b>
<b>FY 1991</b>	63.05	69.02	75.27	81.78	88.54	95.54	102.7
<b>FY 1992</b>	0.22	0.24	0.26	0.29	0.31	0.33	0.36
<b>FY 1993</b>	3.36	3.68	4.01	4.36	4.72	5.09	5.48
<b>Average</b>	0.56	0.61	0.66	0.72	0.78	0.84	0.91

<b>COSTS OVERVIEW</b>	<b>INCENTIVES (x1000)</b>	<b>ADMINISTRATION (x1000)</b>	<b>OVERHEAD/MGMT. (x1000)</b>	<b>TOTAL COSTS (x1000)</b>
<b>FY 1991</b>	\$250	\$153	\$66	\$469
<b>FY 1992</b>	\$335	\$346	\$121	\$802
<b>FY 1993</b>	\$472	\$285	\$143	\$900
<b>FY 1994</b>	\$186	\$192	\$6	\$384
<b>Total</b>	\$1,243	\$976	\$336	\$2,555

### **CASE STUDY: MECHANICAL DEBARKER RETROFIT**

One of the largest projects approved through the Process Improvements program was a mechanical debarker project. After discussions between Power Smart staff and B.C. Hydro Transmission Customer Services staff, it was determined that the customer had the opportunity to replace his large hydraulic debarker with a mechanical debarker. Debarkers remove the bark from logs as they first enter the mill system. A hydraulic debarker subjects logs to high pressure water jets that blast the bark off the logs. The mechanical debarker is a machine with knives that rotate around the log to cut off the bark. Although the production throughput of the two systems is considered comparable, the hydraulic system takes about 2,100 horsepower to operate, whereas the mechanical system takes only about 250 horsepower.

The expected savings were based on the debarker operating for 8,000 hr/yr and an electric motor demand saving equivalent to 1,700 horsepower. It was determined that the portion of the hydraulic debarker system that was affected by the conversion was consuming about 11.56 GWh of electricity per year. The energy consumption of the corresponding mechanical system was estimated to be 0.82 GWh per year, resulting in an estimated net savings of 10.74 GWh per year, nearly 90%. This savings assumed that the debarkers were running at full name-plate capacity for the 8,000 hr/yr. In practice this is not the case and thus savings were reduced by an 11% motor loading factor resulting in evaluated savings of 9.03 GWh/yr.

B.C. Hydro calculated that the customer cost was 0.47 cents/kWh saved and the program's operating cost was 0.15 cents/kWh saved. Based upon a 2.5 cent savings to the customer for every kWh saved, the customer payback period for energy savings reported by the program was 2.2 years. The total cost of the retrofit was \$523,900.

Due to the size of savings for the debarker project, its incentive arrangement was to be decided by negotiation. Significant, previously unrecognized, spin-off benefits arising for the conversion were also identified. After a number of discussions with the customer and his engineering consultants, the program determined that based on the costs and benefits of the replacement to the customer, no incentive would be offered to assist with the cost of the replacement. Consequently this customer qualified as induced savings, an individual who adopted a program-recommended action as a result of program activity, but who did not receive an incentive from B.C. Hydro. [R#4]

# Environmental Benefit Statement

<b>AVOIDED EMISSIONS BASED ON 50,750,000 kWh saved 1991 - 1993</b>						
<b>Marginal Power Plant</b>	<b>Heat Rate BTU/kWh</b>	<b>% Sulfur in Fuel</b>	<b>CO2 (lbs)</b>	<b>SO2 (lbs)</b>	<b>NOx (lbs)</b>	<b>TSP* (lbs)</b>
<b>Coal</b>	<b>Uncontrolled Emissions</b>					
A	9,400	2.50%	109,417,000	2,596,000	525,000	52,000
B	10,000	1.20%	116,674,000	1,005,000	339,000	251,000
	<b>Controlled Emissions</b>					
A	9,400	2.50%	109,417,000	260,000	525,000	4,000
B	10,000	1.20%	116,674,000	100,000	339,000	17,000
C	10,000		116,674,000	670,000	335,000	17,000
	<b>Atmospheric Fluidized Bed Combustion</b>					
A	10,000	1.10%	116,674,000	307,000	167,000	84,000
B	9,400	2.50%	109,417,000	260,000	210,000	16,000
	<b>Integrated Gasification Combined Cycle</b>					
A	10,000	0.45%	116,674,000	207,000	33,000	84,000
B	9,010		104,951,000	75,000	25,000	5,000
<b>Gas</b>	<b>Steam</b>					
A	10,400		63,641,000	0	145,000	0
B	9,224		55,267,000	0	346,000	16,000
	<b>Combined Cycle</b>					
1. Existing	9,000		55,267,000	0	212,000	0
2. NSPS*	9,000		55,267,000	0	100,000	0
3. BACT*	9,000		55,267,000	0	14,000	0
<b>Oil</b>	<b>Steam--#6 Oil</b>					
A	9,840	2.00%	92,111,000	1,396,000	165,000	156,000
B	10,400	2.20%	97,694,000	1,384,000	207,000	100,000
C	10,400	1.00%	97,694,000	198,000	166,000	52,000
D	10,400	0.50%	97,694,000	581,000	207,000	32,000
	<b>Combustion Turbine</b>					
#2 Diesel	13,600	0.30%	122,257,000	243,000	378,000	21,000
<b>Refuse Derived Fuel</b>						
Conventional	15,000	0.20%	145,145,000	374,000	492,000	109,000



---

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 accompanying page is to allow any user of this profile to apply B. C. Hydro's level of avoided emissions saved through its Proccess Improvements 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 include 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 / Transferability

---

## LESSONS LEARNED

Overall, satisfaction with Process Improvements is high among both customers and B.C. Hydro staff. It has fulfilled its original vision of being a tool to respond to customer-specific energy saving ideas. It has succeeded in achieving energy savings at a low price for B.C. Hydro.

According to B.C. Hydro's own evaluation, many opportunities exist for ramping up the program. In fact, given its open-ended design, Process Improvements has the potential for outliving the other industrial Power Smart programs. Flexibility and speed of response are critical factors to its success to date. As the program expands it will need to give even more attention to the timing needs of its customers.

Process Improvements has been effective at achieving load reduction for B.C. Hydro. This is particularly the case if, as it seems, non-incented projects more than offset free riders. The program's field experience can be leveraged to help advance the technical knowledge of engineers and vendors.

Process Improvements can also serve as a laboratory for developing standard rebate offerings for future Power Smart programs.[R#6]

The 1993 Process Improvements Program Evaluation revealed insights into what worked, didn't work, and what could be changed to improve the program. The following is a synopsis of its key findings:

**Project initiation:** The primary barriers to participation in the program are (1) the customers' lack of capital for investing in cost-reducing equipment, (2) the customers' lack of resources for identifying potential projects, and (3) the amount of time and money required for the technical assessment that must accompany a project application while there is no assurance of acceptance.[R#6]

If B.C. Hydro wishes to increase the number of applications, increasing funds for more technical assessments would be an appropriate place to start. The next step should be to help customers identify potential projects. The program could utilize trade allies and its own educational activities more intensively. The research and field test activities of the program also provide a good method for identifying project opportunities and could be expanded.

**Marketing:** Process Improvements is a very important tool for Customer Service representatives, helping them focus their visits on the customer and enabling them to respond to customer ideas. The personal marketing approach is appropriate given B.C. Hydro's apparent desire to manage the pace and breadth of program implementation.

To reach an industrial audience, communications need to be as specific and targeted as possible. Should B.C. Hydro wish to ramp up Process Improvements, avenues for promoting and publicizing the program include equipment or system vendors, contractors, the design community, and industry trade associations.

**Incentive determination:** The three-tiered system where smaller projects' incentives are formula-derived, larger projects' are negotiated, and gear reducer and synchronous belt projects are also formula-derived is an approach that increases the speed and reduces the administrative costs of smaller projects and is a good example of appropriate program flexibility.

The program currently uses a model of 5 cents and 10 cents (Canadian) per first year kWh saved for projects costing over and under \$50,000 (Canadian), respectively, or buying down customers' payback periods to two years, whichever is less. This model represents a ceiling for incentives which keeps the negotiation process in check. Additionally, B.C. Hydro's Manager of Industrial Opera-

---

tions provides a secondary level of approval of customer incentives. This constant documentation and then review of each customer case by both Willis Energy Services and B.C. Hydro provides the checks and balances of accurate customer incentive determination. This results in an incentive that is most advantageous to B.C. Hydro.[R#13]

Negotiation of incentives for large projects appears to be a successful part of the Process Improvements concept. By enabling the incentive to be customized to the particular situation, negotiation results in lower project costs than would be likely with a fixed-rebate formula. Furthermore, by providing the context for an in-depth examination of customer needs and motivations, negotiation becomes a tool for identifying free riders.[R#6]

**Verification and monitoring:** While project installation is properly verified before incentive checks are issued, there is no formal tracking to assure that projects remain in place for the minimum three-year period required by the contract. Additionally, plans need to be instituted for long-term tracking to verify program savings over time.

Actual field measurements are necessary to confirm that the anticipated energy savings from projects have indeed been realized. Periodic impact evaluations are not sufficient for programs dealing with customized industrial applications. Thus, project monitoring must be an ongoing Process Improvements activity.[R#6]

**Program design:** Financing is a commonly reported need of customers and is seen as a way for Process Improvements to address the current shortage of capital for energy efficiency projects. In some situations financing as an incentive has the potential for delivering the same results as rebates, but at a much lower cost to B.C. Hydro over time.[R#6]

**Dynamics and administration:** The program is considered to be well run. The sub-contracting arrangement for

the administration of the program has worked well to date and the program is well integrated with the rest of B.C. Hydro's operations. A new database has been developed, project summary sheets are used to track projects internally, and all conversations and decisions are now clearly documented.[R#6]

## TRANSFERABILITY

The Process Improvements program is transferable mainly in areas containing a high concentration of large industrial customers. Much of the program's savings have come from customized large industrial retrofits that required the flexibility of the program in order to implement any type of conservation measures. This program has a logical program design which allows for innovation, supports other DSM activities, and can be implemented at low cost.

In terms of parallel programs, Pacific Gas and Electric offers a Customized Electric Rebate Program (see The Results Center Profile #4) that provides similar flexibility and a clever program interface with its prescriptive rebate programs. Like the Process Improvements program, as energy-efficient technologies mature and become more accepted in the marketplace, these technologies can be shifted from the custom incentive approach to the more streamlined, prescriptive path. ■

# References

---

1. B.C. Hydro, "1993 Annual Report."
2. B.C. Hydro, "DSM Evaluation Plan Process and Procedures," Evaluations Department, June 1993.
3. B.C. Hydro, "1992 Annual Report."
4. Gordon Boyd and Michelle Ternes, B.C. Hydro, "Process Improvements Program Evaluation," November 1993.
5. Power Smart, "Annual Report," 1992/1993.
6. B.C. Hydro, "Process Evaluation of the Power Smart Process Improvements Program," O'Neill & Company, Inc., February 1993.
7. E Source, "Drivepower Technology Atlas," August 1993 Edition.
8. Linda Dong, Financial Planning Analyst, B.C. Hydro, Power Smart, personal communication, March 1994.
9. B.C. Hydro, "The Power Smart Source Book," October 1993.
10. B.C. Hydro, "Power Smart Progress Report," January 1994.
11. Dennis Nelson, Manager, Program Evaluation, B.C. Hydro, Power Smart, personal communication, April - May 1994.
12. Michelle Ternes, Industrial Evaluation, B.C. Hydro, Power Smart, personal communication, March - June 1994.
13. Jon Hessen, Program Manager, Willis Energy Services Ltd., Vancouver, B.C., personal communication, April - June 1994.

**Special thanks to Dennis Nelson, Michelle Ternes, and Jon Hessen for their guidance and support throughout the development of this profile.**