BC hydro THE POWER IS YOURS

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July 7, 2005

Mr. Robert J. Pellatt
Commission Secretary
British Columbia Utilities Commission
Sixth Floor – 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Pellatt:

RE: British Columbia Hydro and Power Authority (BC Hydro) 2004/05 to 2005/06 Revenue Requirements Application Directive 66(page 197), Directive 69 (page 210)

This letter informs the Commission of BC Hydro's compliance with Directive 66 and the first part of Directive 69:

Directive 66: The Commission directs BC Hydro to file the executive summaries of its milestone evaluation reports and the full final evaluation reports of all its Power Smart programs.

Directive 69: BC Hydro is directed to provide information to the Commission for on-going review of Power Smart performance through:

Executive Summaries of milestone evaluation reports and full final evaluation reports for each program.

Attached are milestone evaluation summaries for ten energy efficiency demand side management programs that were completed in F2005.

Yours sincerely,

Tony Morris
Acting Chief Regulatory Officer

Summary of DSM Evaluation Reports for Fiscal Year 2004/05

Date: July 2005

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CHAPTER 1

INTRODUCTION TO POWER SMART EVALUATION

1.0 Introduction to Power Smart Evaluation

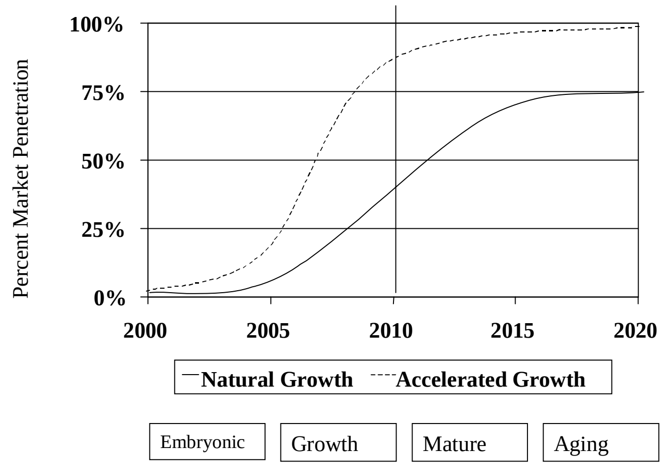
Power Smart was officially launched in March 1989 as a demand-side management (DSM) or energy efficiency initiative designed to encourage customers to use electricity as efficiently as possible and defer the need for new, more expensive power generation projects. The year following its inception, eleven programs were launched and in 1992 an Evaluation department was formed to verify savings and improve operations. By 1995 twenty-five completed evaluation reports were submitted to the BC Utilities Commission (BCUC) and more were underway. Following the completion of the October 1995 evaluation plan, Business Power Smart programs were phased out, and Residential Program investment was curtailed. As a result evaluation activities were suspended.

In late 2000, a small number of new DSM initiatives were launched, and in November 2001 the corporation prepared a new ten-year plan for DSM. As a result of the new emphasis on Power Smart, the Evaluation department was re-established in March 2002. Power Smart programs require verification of energy savings, identification of process improvements, and determination of programs enhancements to ensure customers' needs are met and energy savings are maximized in a cost effective manner.

1.1 Market Barriers

The current generation of Power Smart involves a combination of energy acquisition and market transformation programs. Market transformation programs are designed to accelerate the adoption of energy efficient technologies and practices, resulting in market transformation or lasting change in the structure of the market, such that adoption of energy efficient technologies becomes normal or standard practice. These programs strive to accelerate the natural growth of a technology and can increase overall market size, as depicted in Figure 1-1 below.

Figure 1-1
Market Transformation on the Technology S-Curve



Programs that provide lasting solutions to market barriers generally address some or all of the following barriers:

- The commercial **availability** of energy efficient technologies;
- **Awareness** of energy efficient technologies (by manufacturers, distributors, retailers, trade allies, customers);
- **Accessibility** of energy efficient technologies (product distribution, stocking, displays, sales team training, educational & promotional information);
- **Affordability** (generally energy efficient technologies are more expensive than standard technologies when introduced to the market place); and
- **Acceptance** by customers and trade allies (if the energy efficient technology provides acceptable service to customers in terms of reliability, ease of installation, operational and maintenance costs).

CHAPTER 2

EVALUATION PURPOSES AND OBJECTIVES

2.0 Evaluation Purposes and Objectives

Evaluation of energy efficiency programs provides internal and external accountability by:

(1) reducing uncertainty in the estimates of energy savings, demand savings, and reductions in greenhouse gas emissions attributable to the program, and

(2) determining the cost effectiveness of these programs compared to other energy resource options.

Evaluation of DSM or energy efficiency programs involves:

- Measuring program operations and performance objectively and systematically;
- Utilizing social-science and engineering data and methods;
- Estimating actual (achieved) energy and demand savings, and reductions in greenhouse gas emissions attributable to the program;
- Estimating permanent changes to the market penetration of energy efficient technologies attributable to the program; and
- Focusing on future decisions regarding the modification, expansion, or discontinuation of a program or a portfolio of programs.

Evaluations rely on data collected from:

- Program participants and non-participants (interviews, surveys, audits, electrical billing data, end-use metered data, building simulation modelling);
- Trade allies involved in the production, distribution or installation of energy efficient measures (equipment or processes);

- Pre-existing laboratory research and federal, provincial and municipal statistical information;
- Program designers and implementers; and
- Senior management responsible for programs and program results.

CHAPTER 3

DSM EVALUATION CATEGORIES

3.0 DSM Evaluation Categories

There are three types of DSM evaluations: process, market, and impact. Each of these evaluations has different objectives but addresses three related questions, as noted below.

3.1 Process Evaluations

"How efficient and effective is program delivery?"

Objectives for process evaluations include:

- Improving program implementation and delivery; and
- Increasing the satisfaction of customers, trade allies, and the utility through quality service delivery.

Areas that could be reviewed during process evaluations are:

- Reviews of incentive and rebate levels;
- Communication and promotional initiatives;
- Program operations and implementation;
- Customer awareness and acceptance (satisfaction) of energy efficient technologies and measures; and
- Trade ally (production, distribution & implementation) awareness and acceptance.

3.2 Market Evaluations

"How effective is the program at increasing the market penetration (market share) of energy efficient technologies and measures?"

Objectives for market evaluations include:

- Measuring increases in market penetration of energy efficient technologies; and
- Determining measures that are directly attributable to the program.

Areas that could be reviewed during market evaluations include:

- Assessments of the market potential and the market penetration over time by reviewing the availability, accessibility, and affordability of energy efficient technologies and measures.

3.3 Impact Evaluations

"What are the energy savings (change in energy consumption and for some programs, demand/capacity and greenhouse gas emissions) that are directly attributable to the program?"

Objectives for impact evaluations include:

- Measuring decreases in energy consumption or gross energy savings;
- Estimating energy savings and reductions in greenhouse gas emissions directly attributable to the program (net energy savings, energy savings over and above natural change or what would have happened in the absence of the program); and
- Determining the cost effectiveness of the program relative to other energy resource options. This involves total resource, utility, rate impact and participant cost/benefit tests.

3.3.1 Quasi-Experimental Design

Impact evaluations measure the quantitative results of programs, the energy and demand effects, and persistence, which are necessary for a cost-effectiveness analysis. With supply side projects, the primary uncertainty usually lies with the cost and timing, rather than with the estimates of energy (kWh) or demand (kW).

With the demand side, however, the greatest uncertainty is in determining the actual load impact. This uncertainty occurs in three general areas:

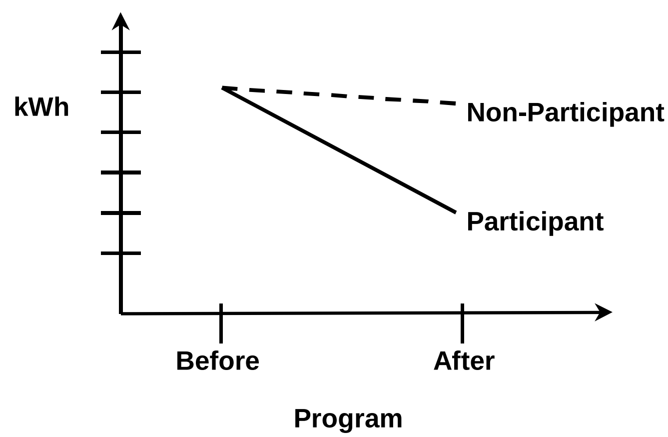
- What would have occurred if there was no program?
- What load impact did the program induce?
- How long will the load impact persist?

The Power Smart evaluation process is designed to address the areas of uncertainty for DSM energy acquisition in a comprehensive and systematic way. Evaluation findings will result in historical program savings being restated, and forward forecasts being adjusted. Impact evaluations can use several different methodologies to deal with the attribution of savings and the assessment of the influence of external factors. More than one methodology can be used in the evaluation to measure program impacts, and the results can be compared or used as upper and lower bounds for cost-effectiveness analysis. Multiple lines of evidence must be assembled to assess these complex programs. The methodologies vary with the maturity of the program and the resultant availability of information. To accommodate for weather, economic, and some natural changes in energy usage, a minimum of twelve months consumption history is required after the installation of an energy efficient technology or measure.

The basic objective of the Power Smart programs is to increase the efficient use of energy relative to what would have happened, had there been no program. Therefore, for each program or end-use, a projection is required regarding the trends in efficiency improvements occurring naturally in British Columbia. Called the ‘status quo’ or natural conservation, this projection of natural conservation must be consistent with the load forecast. In order to deal with the issue of measuring what the customer would have done without the program, quasi-experimental design techniques have been adapted from educational, agricultural, medical, and social science research.

The preferred quasi-experimental design to determine energy savings involves pre and post measurements with comparison group(s). This design includes measurement of the energy consumption before (baseline) and after program implementation for participants, which is then compared to the energy consumption before (baseline) and after program implementation of a comparison group of non-participants in the same time period. The change in consumption is compared to the estimated or projected rate of natural conservation or product adoption, as depicted in Figure 3-1

Figure 3-1
Quasi-Experimental Design



The above approach allows for the determination of impact at the evaluation's specific point in time, while accommodating weather differences, economic changes, rate changes and some natural changes in energy use. However, to meet BC Hydro's long-term energy needs, these efficiency improvements must persist over time. Therefore, evaluation also addresses the expected life of the savings. The impact on energy and demand savings, along with the expected life of those savings, is multiplied by the number of participants and cost. These are then compared to the utility's estimate of the avoided cost of energy for that time frame.

CHAPTER 4

DSM EVALUATION STAGES

4.0 DSM Evaluation Stages

As the available information and the inherent risks (uncertainty) in energy savings estimates vary over time, it is necessary to have several stages in the evaluation plan of a DSM program. The current plan includes pilot evaluations, process evaluations, market evaluations and impact evaluations. As programs continue to evolve, evaluation staff can build on previous evaluation experience and conduct less formal, more timely assessments based on a mix of techniques appropriate to the technology, market, customer needs, risks to BC Hydro, and available information.

4.1 Pilot Evaluations

Before the launch of province-wide programs, pilot projects are often run on a regional basis or within a specific segment of the market. The purpose of the pilot is to learn more about the technology, the associated savings, and potential program delivery issues in a low risk situation.

Pilot evaluations are usually conducted during and immediately after a pilot project, and generally consist of a process study and an assessment of the energy and demand savings. While the process study in the pilot evaluation cannot be as complete as one held twelve months or more after program implementation, a good deal of information can be obtained. For example, the pilot evaluation would typically include a preliminary check to determine the potential risks in the energy savings estimates, thereby providing guidance for the full program implementation and clarifying the requirements for the full impact evaluation.

4.2 Process Evaluations

Process evaluations are generally conducted six to eighteen months following the program launch and often include a market assessment. Full process evaluations focus on customers, with a secondary focus on the staff/contractors and trade allies.

A process evaluation is a systematic assessment of an energy efficiency program for the purposes of documenting program operations at the time of the examination and identifying improvements that can be made to increase the program's efficiency or effectiveness for acquiring energy resources. In addition, a process evaluation can also help increase the effectiveness of other programs by providing guidance and experience that may be relevant to other programs, particularly those under development.

4.3 Market and Impact Evaluations

Impact and market evaluations are generally conducted twenty-four to thirty-six months after program launch, when sufficient information becomes available. Initially, they focus on savings per unit and hours-of-use, while later impact and market evaluations tend to focus on rated life (hours) of the technology, persistence issues (e.g. early removal, replacement when energy efficient technology fails), and peak coincidence.

Impact evaluations focus on energy savings reported for specific incentive and rebate programs, while market evaluations examine the energy savings reported for a portfolio of programs, including programs designed to increase awareness, educate customers, or help customers identify energy savings opportunities.

CHAPTER 5

MEASUREMENT AND VERIFICATION(M&V)

5.0 Measurement and Verification (M&V)

Measurement and verification (M&V) allows BC Hydro's Power Smart portfolio to be more accountable for the energy savings that arise from its Commercial and Industrial DSM initiatives by verifying the results of the implemented energy conservation measures. The energy savings of each Power Smart project must be verified. M&V activities are designed and managed by the PS Technology Solutions department.

The following documents form the basis of BC Hydro's M&V efforts:

- The International Performance Measurement & Verification Protocol (IPMVP) (*http://www.ipmvp.org/ipmvp_det.html*); and
- M&V Guidelines: Measurement and Verification for Federal Energy Projects (FEMP).

The IPMVP and FEMP documents outline four general approaches for verifying savings. Each option has its strengths and weaknesses, and therefore is applicable in differing circumstances, as dictated by the project energy conservation measures. The range of options allows BC Hydro to tailor its M&V effort to appropriately manage the associated risk in terms of allocating resources (e.g. metering equipment, labour), cost, the technology of the energy conservation measure, the amount of the BC Hydro incentive, and the amount of savings.

For instance, at the completion of a project involving Power Smart Partner incentives, the customer provides a signed Installation Document and paid invoices to initiate the second incentive payment of 50%. At this time, Technology Solutions schedules a site inspection to ensure that the project was completed as specified in the Incentive Agreement. The third incentive payment of 25% is initiated when Technology Solutions completes a M&V report (a minimum of 12 months after the retrofit is completed), which verifies the energy savings realized and recommends payment, if appropriate.

CHAPTER 6

SUMMARY OF PRIMARY EVALUATION STUDIES UNDERTAKEN IN FISCAL YEAR 2004/05

6.0 Summary of Primary Evaluation Studies Undertaken in Fiscal Year 2004/05

This section provides an overview of the primary evaluation studies completed or substantially completed in Fiscal Year 2004/05. Table 6-1 below provides a summary listing of these studies categorized by customer sector and electricity end use.

Table 6-1
List of Evaluation Studies Undertaken in FY2004/05

RESIDENTIAL
Appliances
• Evaluation of the Refrigerator Buy-Back Program: Phase II Vancouver Island and Phase III Province-Wide Program to July 2004 **–** December 2004
Lighting
• Analysis of BC Hydro’s 2003 Seasonal LED Lighting Initiative – May 2004
• Torchiere Lighting: Market Baseline Assessment – June 2004
• Residential Lighting Hours-of-Use Study – October 2004
• Review of Estimates of CFL Hours of Use – November 2004
• Impact Evaluation of the Power Smart Residential Compact Fluorescent Lighting Program: Phase III – Lower Mainland – March 2005
• 2004 Market Effects of BC Hydro’s Compact Fluorescent Light Program – May 2005
Retrofits
• A Baseline Assessment of the Residential Windows Market in British Columbia – October 2004
COMMERCIAL
Lighting
• Process Evaluation of the Power Smart Product Incentive Program – Phase I – March 2005
Retrofits
• Power Smart Partners Impact – Milestone Evaluation – May 2005

The following sections, presented in the same sequence as Table 6-1, summarize the above listed studies completed or substantially completed during fiscal year 2004/05. For the primary impact evaluation studies the summaries provide an overview of the program evaluated, objectives, methodology, findings, and recommendations of the evaluation. Summaries of the other evaluation studies include key information, findings, and recommendations.

6.1 BC Hydro Refrigerator Buy-Back (RBB) Program

This section summarizes the evaluation of the BC Hydro Refrigerator Buy-Back (RBB) program. The evaluation covers phase II, Vancouver Island and phase III, Province-Wide to July 2004. Phase I, CCQ (Courtenay, Comox, Quesnel) was evaluated in 2002. The current evaluation includes a process and impact component.

The RBB evaluation was conducted by internal Power Smart Evaluation staff. Research efforts began in May 2004 and the final report was completed in December 2004.

6.1.1 Introduction – Program Description

The RBB program is an electricity acquisition program aimed at motivating residential customers to turn in second operating refrigerators by offering a $30 rebate, free pick-up and disposal in an environmentally friendly manner. The program is promoted through radio and newspaper advertising, bill inserts and messages, along with displays at appliance retailers. Re-introduced in phases, the RBB program is now available on a province-wide basis (phase III) as of September 2003. Approved funding includes $9.78 million over a two-year period targeting 50,000 refrigerators. Phase II ended April 2003 and targeted 6,000 refrigerators on Vancouver Island.

Key Program Dates	
Campaign Launch	Phase II -November 2002 Phase III – September 2003
Campaign Completion	Phase II -April 2003 Phase III – August 2005
Impact Evaluation	December 2004

This evaluation covers phase II, Vancouver Island and Phase III, Province-Wide to July 2004. The objectives of this report are:

- To assess the operational effectiveness of the program.
- To estimate the direct impact of the program as a whole.

6.1.2 Findings

Surveys were conducted with participants and non-participants in June 2004. Non-participants in the Lower Mainland were asked to participate in a metering study conducted from June 30 to September 13, 2004 that metered the energy consumption of their second refrigerators for a period of 28 days.

6.1.2.1 Process Evaluation

BC Hydro's Refrigerator Buy Back program has had a positive impact on the market for secondary refrigerators. Support for the program has been high with participation levels expected to surpass targets for phase III. Approximately half of households in BC are aware of the program. In addition, customer satisfaction rates are high with 99% of respondents indicating overall satisfaction with the program.

The program is efficient in its delivery and implementation. The most important feature of the program, as rated by participants, is the free pick-up (99%), and the least important was the rebate (71%). About three in four participants say that they would still participate in the program even if there were no rebate, while 16% say that they would not participate without a rebate. Research suggests that participants are more encouraged by other features of the program. However, a move toward a lower rebate would likely reduce overall participation levels and at the same time increase free riders as a fraction of total participants. Attention should be given to the impact of such a move on the cost effectiveness of the program.

Program tracking records are well maintained and adequate in their function; however, information on the defrost-type is not collected in a comprehensive manner. The ratio of automatic to manual defrost-type refrigerators collected by the program affects program savings. The ratio should be used for planning purposes as well as energy savings calculations.

6.1.2.2 Impact Evaluation

The direct effects of the RBB program in terms of energy and demand savings are 34.96 GWh/year and 3.34 MW. These savings represent the 41,291 refrigerators collected in phase II (Vancouver Island) and phase III (Province wide) to July 2004. This includes a reduction due to cross effects occurring in electrically heated homes. Evaluated energy savings are 8% lower than reported (but 40% higher than planned).

6.1.3 Recommendations

1. **Re-examine Rebate Levels**
   There may be an opportunity to reduce the rebate level, recognizing that participation levels would likely decrease resulting in an increase in the free rider rate. Attention should be given to the impact of reducing the rebate on the cost effectiveness of the program.

2. **Address Data Collection by Clearinghouse**
   Program staff should examine the method of collecting defrost type.

3. **Adjust Reporting Records and Planning Documents**
   Program savings histories should be adjusted to reflect the evaluated direct energy and demand savings. Evaluated estimates should be included in planning documents for future phases of the Refrigerator Buy-Back program, except where program modifications would result in more conservative estimates.

6.2 Analysis of BC Hydro's 2003 Seasonal LED Lighting Initiative

This section summarizes analysis of demand-side and supply-side impacts of BC Hydro Power Smart's seasonal Light Emitting Diode (LED) initiative for the 2003 holiday season. The initiative has used a combination of public awareness building initiatives and strategic partnerships with Natural Resources Canada, select manufacturers and distributors, and local business associations to introduce and promote the energy-efficient seasonal product. While BC Hydro's residential customers were first introduced to the distinctive strawberry-shaped seasonal LEDs in 2002, they were not available in stores until the 2003 holiday season.

Power Smart's influence on the seasonal lighting market in British Columbia, including the sale of seasonal LEDs, was evaluated using a combination of retail shelf-space surveys, and a telephone survey of BC Hydro residential customers. Information gathered was used to assess BC Hydro's influence on retail stocking decisions, household awareness of the seasonal LED product, household purchases of seasonal LEDs, and the energy and peak demand savings associated with seasonal LEDs installed during the 2003 holiday season. This research supplements or updates research previously conducted for BC Hydro on seasonal lighting including the *2002 Holiday Lighting Market Assessment – Summary Report* (Sampson Research January 2003) and the *2002 Holiday Lighting Market Assessment Phase III – Adjusted Baseline Estimates* (Sampson Research August 2003).

6.2.1 Background and Objectives

BC Hydro Power Smart's seasonal Light Emitting Diode (LED) initiative is designed to transform the residential market in favour of LED seasonal lights across BC Hydro's service territory. A $5 mail-in coupon was offered by BC Hydro, for a maximum of three coupons per household, to encourage households to switch from traditional but inefficient holiday lighting styles, particularly strings that use the large 7-watt and 5-watt incandescent bulbs, to those that use energy efficient LEDs. This offer was made in conjunction with NRCan and select seasonal LED manufacturers and distributors.

Key Program Dates	
Campaign Launch	November 2002
Campaign Completion	December 2002
Impact Evaluation	May 2004

The objectives of this evaluation are:

- To assess BC Hydro's influence on retail stocking decisions, household awareness of seasonal LEDs, and purchases of the seasonal LED product,
- To provide estimates of the energy and peak demand savings associated with 2003 seasonal LED sales and of the effect of LED sales on the energy and demand for all seasonal lighting.

Sampson Research prepared this impact report. The research efforts began in

November 2003 and the final report was completed in May 2004.

6.2.2 Summary Findings

6.2.2.1 Supply-Side Assessment

In-store surveys of seasonal lighting products were conducted with 55 stores across BC Hydro's service territory in November 2003. Lower Mainland stores received a detailed survey of all holiday lighting products, while stores outside the Lower Mainland received a survey that focused on the availability and market share of seasonal LEDs only. Compared to the baseline study conducted in 2002 (Sampson Research January 2003), seasonal LEDs have made significant inroads in the BC Hydro service territory in just one season.

Key findings:

- LED holiday lights accounted for 4.2% of the linear shelf space allocated to seasonal lighting product, up from effectively zero (0.2%) in 2002. Vancouver Island had the largest proportion of LED holiday lights for sale (8.0%), while the South Interior and Northern regions had the smallest relative shares (1.3% and 0.2% respectively).

- There has been a significant shift in the market away from variations (e.g., icicle lights, etc.) to strings, including LED strings. Excluding replacement bulbs and sculptures, strings accounted for 75% of all seasonal lighting product for sale in 2003, up from 58% in 2002.

- LED strings were sold in lengths of 35, 50 and 75 LEDs. Prices varied with LED colour and string length. Prices for C9, C7 and mini-light strings were, for the most part, unchanged from 2002.

6.2.2.2. Demand-Side Assessment

A telephone survey was completed with a random sample of 802 BC Hydro residential customers in January 2004. Households were queried as to their awareness, purchases, and installations of seasonal LEDs during the 2003 holiday season. Households were asked whether their LED holiday lights displaced lesser-efficient holiday lighting styles – a key outcome required to achieve energy and peak demand savings.

Key findings:

- Seventy-one percent of BC Hydro residential customers are now aware of seasonal LEDs, up from 20% a year earlier. Awareness was highest in the Lower Mainland (76%), compared to Vancouver Island (67%), the South Interior (63%), and the North (64%).
- Twenty-five percent of all BC Hydro residential customers recalled hearing or seeing information, advertising or promotions from BC Hydro regarding LED holiday lights.
- Seasonal LEDs were purchased by 8% of all households surveyed – equivalent to 480,000 strings. An additional 4% of households tried to purchase seasonal LEDs but could not locate the product. Unrealized purchases from 2003 are estimated at 264,000 LED strings.
- Proportionately, fewer Vancouver Island residents purchased LEDs than residents in the other three BC Hydro regions (4% versus 9%).
- The energy saving / money saving aspect of LEDs was the most frequently mentioned reason for purchasing LED holiday lights (76% of all households), followed by appearance (46%) and safety (17%).
- Twenty percent of households who purchased seasonal LEDs used the five dollar mail-in rebate to reduce the cost of their purchase. The primary reason for not using the coupon was a lack of awareness (64% of households that did not use a coupon). Only 8% of households identified the rebate coupon co-sponsored by Natural Resources Canada and manufacturers / distributors as a factor in their purchase.
- Thirty-seven percent of households indicated they would definitely or probably purchase LEDs for the 2004 holiday season. Nearly one in every four (24%) households that purchased LEDs in 2003 said they would definitely or probably purchase LEDs again in 2004.

- Nearly nine out of every ten (88%) households installed the LED strings they purchased during the 2003 holiday season. Two-thirds of households used their new LED lights to displace traditional holiday lighting styles, and 16% used their purchases to augment existing displays. The remaining 17% of households indicated only a portion of their new LED lights purchases were used to displace traditional holiday lights, the rest were used to augment existing displays.
- LED lights were most commonly used to displace C9s and mini-lights. On average, 4.1 strings of traditional holiday lights were displaced by households who installed seasonal LEDs (Table 6-2).

Table 6-2
Traditional Holiday Lights Displaced by Seasonal LEDs by Households Who Installed Seasonal LEDs in 2003

String / Variation	Average Number of Strings Displaced per Household	Percent of all Strings Displaced
C9	2.3	56%
C7	0.3	7%
Mini-light	1.5	37%
Total	**4.1**	**100%**

- Households indicated that only 14% of the displaced light strings were thrown away, with the majority (68%) being left in storage. Charities and friends/family members were gifted with the displaced strings by 5% and 4% of households respectively.

6.2.2.3 Energy and Peak Demand Savings – 2003 Holiday Season

(1) The net peak demand reduction (savings) due to the displacement of C9, C7 and mini-light strings by LED lights is estimated at 52.8 MW. More than three-quarters (77%) of the reduction occurs in the Lower Mainland (Table 6-3). Vancouver Island accounted for 7% of the reduction, a number that reflects the lower penetration of LED holiday lighting. Demand peaks during the week of Christmas, between the hours of 6 pm and 7 pm. This peak may not necessarily coincide with BC Hydro’s seasonal

system peak, which because of its temperature driven nature, can occur anywhere between November to February depending upon the year in question.

(2) The majority of the demand savings from LEDs occurs because significant numbers of household used the new LED strings to displace C9 strings which consume considerably more energy than mini-lights, the second most commonly displaced holiday light. Displaced C9 strings accounted for 80% of the net demand savings.

- LED seasonal lights reduced electrical consumption during the 2003 holiday season by an estimated 9.0 GWh.

Table 6-3
Peak Demand and Energy Savings Attributable to Seasonal LED Lights
2003 Holiday Season
Indoor and Outdoor Applications Combined

	Lower Mainland	Vancouver Island	South Interior	North	BC Hydro Total *
Peak Demand Savings (MW)	39.8	4.0	7.7	1.2	**52.8**
Energy Savings (GWh)	6.9	0.6	1.3	0.2	**9.0**

** totals may not sum due to rounding*

Peak demand attributable to residential seasonal light displays during the 2003 holiday season is estimated at 343.3 MW. Without the displacement effect associated with LED holiday lights, peak demand would have been 15% higher. Holiday lighting displays consumed an estimated 55.7 GWh of electricity in 2003. Consumption would have been 16% higher for the season without the displacement effect of LED strings.

6.2.3 Summary and Recommendations

Seasonal LED lights have made considerable inroads with retailers and households across BC Hydro's service area. In one season, their share of retail shelf space increased from effectively zero to over four percent. Penetration of the product among households is currently highest in the Lower Mainland, however, penetration in other regions is expected to increase in 2004 as retailers adjust their stocking plans, and consumer awareness of the LED product increases. Improving the penetration rate for Vancouver Island residents, currently the lowest of the four BC Hydro regions, may require special focus from Power Smart. Stated purchase intentions for the 2004 holiday season, plus pent-up demand from the 2003 season, suggests that demand for seasonal LEDs in 2004 will be strong.

Consumer awareness of LED holiday lights during the 2003 season was heavily influenced by retailer displays, fliers and advertising, media coverage, and word of mouth. While fewer households specifically credited BC Hydro with their awareness of LED lights, this belies BC Hydro's success in influencing retailers and using strategic partnerships to raise awareness of the seasonal LED product. BC Hydro appears to have successfully addressed both the lack of awareness of LED holiday lighting by some retail buyers and the negative impressions of LED technology held by other market players, as highlighted during the 2002 baseline study interviews.

The seasonal LED initiative has successfully displaced some of the least energy-efficient holiday lighting styles – most notably, C9 strings. Albeit representing only one season, this is an early indicator of program success.

6.2.3.1 Program Issues and Recommendations

- Four percent of Vancouver Island residents purchased LED holiday lights in 2003, less than one-half the proportion (9%) achieved outside Vancouver Island. While some of the inequality will likely diminish in 2004 as the seasonal LED product becomes more well known, program management should review their marketing plans for the 2004 season and the level of effort devoted to increasing the awareness of seasonal LEDs on Vancouver Island. Interviews with retailers on the island may provide additional information to help program management address the core of this issue.

- Despite early success in displacing C9 and C7 strings with LED strings, program messaging directed at households should continue to target these traditional lighting styles during the upcoming season.

- The combination of unmet demand from 2003 and the strength of purchase intentions for 2004 suggests that sales of LED holiday lights in 2004 will match, if not, exceed 2003 numbers. Per-person sales may decline somewhat from 2003 as the market begins to shift away from early adopters to later adopters. Given that later adopters tend to be more price sensitive, program management should consider repeating the rebate offer during the upcoming 2004 season to solidify penetration of the LED product.

6.2.3.2 Evaluation Issues and Recommendations

1. Recognizing that the seasonal LED initiative is a multi-year transformation program, BC Hydro should survey residential households shortly after the 2004 holiday season to quantify product penetration and displacement behaviours. This survey should also be used to improve BC Hydro's understanding of diversity factors that influence energy and demand attributable to holiday lights.

2. Updating baseline estimates of holiday lighting stocks, and usage behaviours should be delayed until 2005 to allow pent-up demand for LED lights to be satisfied and product penetration to increase. The 2005 survey should reassess stocks, stock utilization, usage and disposal behaviours, and diversity factors.

6.3 Torchiere Lighting Market Baseline Assessment (Component of the Compact Fluorescent Lighting Program)

Torchiere lighting fixtures are portable, free-standing floor lamps that are designed to provide indirect illumination to an area by directing light upwards, which is then reflected off the ceiling and walls. The halogen torchiere reached the North American market in the mid-1980s from the lighting design houses of Italy. Priced at hundreds of dollars, it was considered an elegant, "high tech" way to provide brilliant, white, indirect light in upscale homes.

By the late 1980s, the halogen torchiere's basic design had been copied by various factories in China and Taiwan, which were able to produce the product at a far lower cost. These less expensive halogen torchieres began reaching the North American market in quantities of millions per year by the early 1990s, and prices fell to as low as $16 per fixture. By 1995, evidence began to emerge that halogen torchieres were causing an unusual number of household fires, due mainly to the extremely high filament operating temperatures of 750°F to 1100°F.

This report was prepared by JEM Energy. Research efforts began in February 2004; the report was finalized in June 2004.

6.3.1 Background and Objectives

Due to the popularity of torchieres amongst consumers, utilities have become concerned about the high power consumption of the prevalent halogen lamps. Though inexpensive to buy, halogen torchieres use significant energy - 300 to 600 watts while incandescent torchieres use about half this amount. The energy required to operate a halogen torchiere for five years costs approximately $131.00 and an incandescent costs approximately $65.00. In both cases, the majority of energy is wasted in the form of heat. Equivalent torchieres based on CFL technology, only use 56 to 72 watts, or about one-sixth that of halogen, and reach temperatures of only 100-200°F, yet produce light comparable to that of halogen. At the approximate BC Hydro residential rate of $0.06 per kWh, and an average 4 hours use per day, each 300 watt fixture replaced with a 70 watt CFL could save its owner $20.15 per year.

Key Program Dates	
Baseline Assessment	June 2004

The objectives of this study are:

- To determine market penetration of torchieres in B.C., and
- To recommend an effective strategy to maximise the more energy efficient CFL technology to replace less efficient halogen and incandescent lamps.

6.3.2 Methodology

To determine the market penetration of torchieres in B.C., a comprehensive database of retailers and manufacturers/ distributors was developed. Questionnaires were completed via telephone calls, e-mails, and facsimiles. A total of 69 retailers, 14 distributors, and 23 manufacturers responded to the surveys.

6.3.3 Findings

- Attitudes with respect to energy efficiency and cost vary among different categories of fixtures. High-end, designer class fixture purchasers do not prioritise energy efficiency. Currently available CFL torchieres fit into the mid-range market class.

- The range of torchieres sold by retailers was often limited, and no one sold CFL torchieres exclusively. Retailers selling more than one type provided a percentage split of their sales for each light source.

Table 6-4
Current and Anticipated Growth in B.C. Torchiere Market Share by Light Source

Light Source	2003 Sales	Current Market Share	Anticipated Annual Growth (next 3 years)
Halogen	8,320	32%	0.28%
Incandescent	16,640	64%	4.80%
Compact Fluorescent	1,040	4%	22.15%

- There are approximately 700,000 halogen or incandescent torchieres in B.C., with an estimated 60/40 halogen/incandescent split in the fixtures currently in use. A sharp decline in halogen torchiere sales has resulted due to safety issues.

- Depending on the success of programs to replace existing halogen and incandescent torchieres, annual energy savings of 124-223 GWh could be realized as described in more detail below in Table 6-5.

Table 6-5
Potential Energy and Load Savings

	Source	No. of Torchieres Replaced	Existing Wattage	Peak Demand Reduction (MW)	Annual Energy Saved (GWh)	Annual Dollars Saved
LOW	Halogen	300,000	300 H	69.0	100.74	$6,044,400
	Incandescent	200,000	150 I	16.0	23.36	$1,401,600
	Subtotal	500,000		85.0	124.10	$7,466,000
MID	Halogen	420,000	300 H	96.6	141.04	$8,462,400
	Incandescent	280,000	150 I	22.4	32.70	$1,962,000
	Subtotal	70,000		119.0	173.74	$10,424,400
HIGH	Halogen	540,000	300 H	124.2	181.33	$10,879,800
	Incandescent	360,000	150 I	28.8	42.05	$2,523,000
	Subtotal	900,000		153.0	223.38	$13,402,800

- No organised promotional activity specific to torchieres, either by manufacturers, distributors or retailers was discovered by the survey. Retailers were generally open to the concept of a Power Smart initiative on torchieres.

There was overwhelming support for the concept of a rebate program on torchiere luminaries.

- Consumer awareness is by far the biggest barrier to high efficiency torchieres, based on the manufacturer and distributor surveys. Other barriers indicated were distribution chain, sales goals, retail price points, poor availability, and profit margin (in descending order of importance).

- Customers are becoming increasingly aware of energy efficient lighting and are including some discussion of it in the sales negotiating process. This is largely attributed to BC Hydro and Power Smart in their ongoing commitment to energy education. Most customers and some retailers do not appear to have a meaningful understanding of the Energy Star label.

6.3.4 Recommendations

1. Align the supply side of the lighting market to ensure wide availability of torchiere light fixtures that meet light output and brightness needs of consumers.
2. Increase awareness of the benefits of CFLs for torchieres through a well-delivered, three-pronged communication plan aimed at retailers, commercial/institutional, and homeowner and rental consumers.
3. Provide information and an estimation tool to help customers compute how much money they could save with a CFL torchiere.
4. Implement a pilot turn-in program to further engage retailers in promoting CFL torchiere technology to homeowners, condo owners and renters.
5. Support the development and implementation of CFL lighting standards to drive the market saturation of CFLs for torchieres.
6. Highlight safety considerations of halogen torchieres and promote safe alternatives in conjunction with the B.C. Fire Commissioner.
7. Investigate further benefits and partnerships with other industries to see if further consumer savings can be achieved. The insurance industry was cited as an example.

6.4 Residential Lighting Hours-of-Use Study

This section summarizes the findings from a six-month study of residential lighting hours-of-use based on monitoring of 77 light fixtures in 18 single-detached houses in the Greater Vancouver area. The objectives for this study included:

- determining the annual lighting hours-of-use for household areas / fixtures where screw-in CFLs may be used;
- investigating the presence of any "take-back" effect associated with CFL use, and if present, determining the magnitude of the effect;
- determining the coincidence of residential lighting use with BC Hydro's winter system peak demand; and,
- comparing and contrasting the findings from this study with those from other hours-of-use studies previously conducted by BC Hydro and other utilities in the Pacific Northwest.

Sampson Research prepared this study.

Take-back effect is defined as the increase in operating hours-of-use following the substitution of a CFL for an incandescent light. This effect is hypothesized to occur because substituting an energy-efficient CFL for an incandescent lamp takes away some of the incentive for households to use their lights economically.

Light fixtures in a total of eight areas of the home were monitored. These areas included:

- dining rooms / kitchens;
- bathroom(s);
- bedroom(s);
- hallways / laundry rooms;
- living rooms;

- den / study / family & games rooms;
- utility / garage / workshops; and,
- outdoor / security / porch / landscape areas.

Electricians from WESPAC Electrical Contractors of Coquitlam, BC installed and monitored Dent Instrument light loggers, returning every six weeks to verify their proper operation and to download the accumulated data. The logger units recorded the time and duration of all on and off events for each monitored lighting fixture.

6.4.1 Research Highlights

6.4.1.1 Lighting Hours-of-Use

Daily hours-of-use estimates (annualized) are provided in Table 6-6 in a range based on a mean (average) estimate, and lower and upper limits defined by a 95% confidence interval. Data from hallways/laundry rooms were combined with utility rooms/garages/workshops to facilitate comparison with other studies.

Areas with the longest operating hours included outdoor/security/porch/landscape (4.4 hours per day), living rooms (3.5), and kitchen/dining rooms (2.3). The average usage for all monitored fixtures is 2.2 hours-per-day. Estimates are based on data from 71 loggers. Data from six loggers were rejected due to logger failure, or anomalous readings.

Table 6-6
Daily Average Lighting Hours by Area / Fixture - Annualized [1]

	Lower Limit	Mean	Upper Limit
Dining Room/Kitchen	1.3	2.3	3.4
Bathroom(s)	0.5	0.9	1.3
Bedroom(s)	0.5	1.3	2.2
Hallways/Laundry/Utility/Garage/Workshop	0.7	1.7	2.8
Living Room	1.7	3.5	5.3
Den/Study/Family & Games Room	1.2	2.7	4.1
Outdoor/Security/Porch/Landscape	0.8	4.4	8.1
All Room Average	**1.7**	**2.2**	**2.8**

[1] Lower and upper limits defined using a 95% confidence interval

On an annual basis, the monitored lights are estimated to operate for an average of 818 hours, plus or minus 214 hours at the 95% confidence interval.

On average, logged hours-of-use were 77% of the self-reported hours-of-use for the monitored rooms, based on information provided by participants in BC Hydro's 2003 Residential End Use Survey. On an individual area basis, the largest absolute (either positive or negative) discrepancy between self-reported and logged hours occurred for bathrooms, bedrooms, and kitchens/dining rooms. Other lighting studies have reported on the tendency for self-reported hours-of-use to overstate actual use.

Table 6-7 compares the all-area average estimate with that obtained from other monitoring studies conducted in Pacific Northwest. The estimate of 2.2 hours per-day compares favourably with the large 1996 Tacoma Public Utilities Baseline Residential Lighting Study (3,955 light fixtures, 161 homes), the 1992 Grays Harbor (WA) PUD Compact Fluorescent Maximization Study (68 fixtures, 19 homes), and Pacific Power and Light study (Yakima, WA) (55 homes). The estimate is considerably less than that obtained in BC Hydro's 1995 Residential Light Fixture Monitoring Project (71 fixtures, 36 homes). Households participating in BC Hydro's 2003 Residential End Use Survey (REUS) reported an average of 3.0 hours-per-day for incandescent lamps.

Table 6-7
Comparison of Residential Lighting Hours-of-Use Estimates – All Room Averages Various Studies

	Lower Limit	Mean	Upper Limit
BC Hydro, 2004 [1]	1.7	2.2	2.8
Tacoma Public Utilities, 1996 [2]	na	2.0	na
BC Hydro, 1995 [3]	3.8	4.6	5.8
Grays Harbour PUD, 1992 [4]	na	2.5	na
Pacific Power & Light, 1991 [5]	na	2.0	na
BC Hydro REUS, 2003 [6]	2.9	3.0	3.1

[1] *BC Hydro Residential Lighting Hours-of-Use Study, 2004*
[2] *Tacoma Public Utilities Baseline Residential Lighting Energy Use Study, 1996*
[3] *BC Hydro Residential Light Fixtures Monitoring Project, 1995*
[4] *Grays Harbour PUD Compact Fluorescent Maximization Study, 1992*
[5] *Pacific Power and Light Yakima WA, 1991*
[6] *BC Hydro Residential End Use Study, 2003 – estimates based on self-reported data*

6.4.1.2 Coincidence Factors

Figure 6-1 provides the weekday 24-hour load profile for the seven households areas and the all-room average for the January to February period. For the all room average, load coincident with BC Hydro's evening peak (17:00 to 19:00 hours) varies from 0.17 to 0.30 as the overall household lighting load is increasing during this two-hour window. Maximum peak load for all monitored lights occurs between 19:20 and 19:25 hours (0.32).

Figure 6-1
Residential Hours-of-Use Study
Winter Weekday Profiles

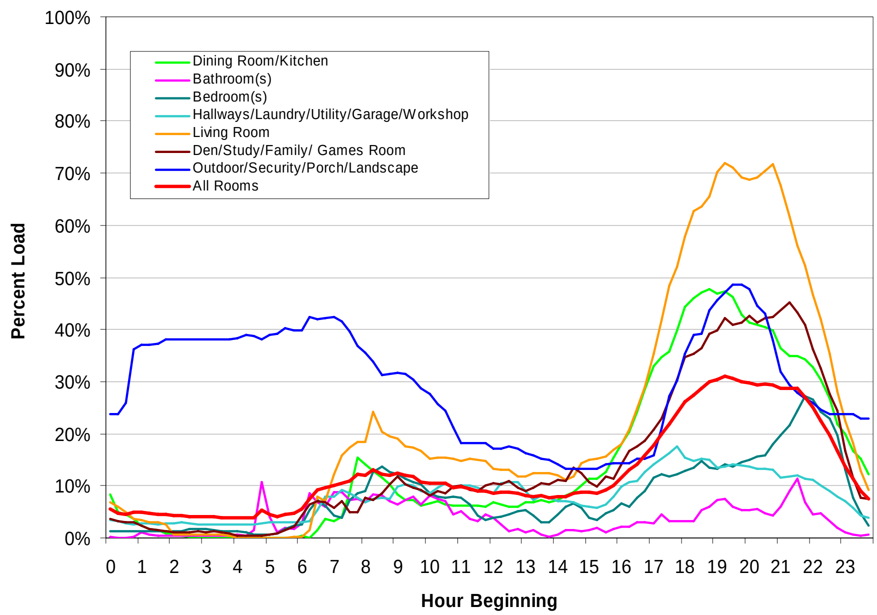


Table 6-8 summarizes the peak coincident factors by room/area in the house. Living room lights display the highest coincidence (0.53 on average) with BC Hydro's supper hour peak, followed by kitchen/dining areas (0.41), and den/study/family/games room and outdoor/security/porch/ landscape areas (0.31 each). Coincidence with BC Hydro's morning peak (8:00 to 10:00 hours) averages 0.12 but can, depending upon the timing of the morning peak, vary from 0.10 to 0.14.

Table 6-8
Lighting Coincidence Factors –
BC Hydro's Winter Weekday Evening Peak (17:00 to 19:00 hours)

Area	Minimum [1]	Mean [2]	Maximum [3]
Kitchen / Dining Room	0.31	0.41	0.49
Bathroom(s)	0.02	0.04	0.07
Bedroom(s)	0.11	0.13	0.15
Hallways/Laundry/Utility/Garage/Workshop	0.13	0.15	0.18
Living Room	0.35	0.53	0.66
Den/Study/Family/ Games Room	0.20	0.31	0.40
Outdoor/Security/Porch/Landscape	0.15	0.31	0.46
All Room Average	**0.17**	**0.24**	**0.30**

[1] Lowest proportion of lights turned on during the 17:00 to 19:00 hour period based on 5 minute interval data.
[2] Average proportion of lights on during the 17:00 to 19:00 hour period based on 5 minute interval data.
[3] Highest proportion of lights turned on during the 17:00 to 19:00 hour period based on 5 minute interval data.

6.4.1.3 Take-Back Effect

Take-back effect was determined by using a dual analysis approach of comparing mean hours-of-use during the CFL phase (3 months) with the mean hours-of-use during the incandescent phase (3 months) for each fixture, and regression analysis using binary variables for the presence of CFLs. Where necessary, lights were normalized for seasonal changes in daylight hours before comparing their pre- and post-means.

In the end, the results from the analysis of take-back proved to be inconclusive as there was effectively an equal chance that operating hours could increase (31% of all monitored lights), decrease (35%) or stay the same (34%) following the installation of a CFL.

6.4.2 Conclusions and Recommendations

The results of this study provide useful information to better understand lighting use behaviours of BC Hydro's residential customers. The results are consistent with those observed in other hours-of-use studies conducted in the Pacific Northwest, including the large 1996 multi-utility study led by Tacoma Public Utilities (Tacoma 1996).

Following are the main recommendations from this study:

- Where possible, energy savings calculations should use hours-of-use estimates specific to individual rooms / areas in the house, with incandescent /

CFL bulb counts obtained at the same level of sub-dwelling detail.

- Where and when possible, future hours-of-use monitoring studies should estimate hours-of-use for lighting fixtures in kitchens independently of dining rooms, reflecting the differences in lighting hours-of-use observed between the two areas in past surveys and monitoring studies.

- Hours-of-use estimates from this study should be compared with hours-of-use estimates obtained from earlier studies to better understand how point-in-time and time-based factors influence hours-of-use. This comparison should address:

    - differences in hours-of-use between CFLs installed through direct influence of BC Hydro (program participants) and indirect influence (spillover / market effects); and,
    - the influence of increasing incidence and penetration of CFLs on hours-of-use, including exploring the presence of any systematic differences in between early and later adopters of CFLs.

- The presence and magnitude of self-reporting bias in survey-based estimates should be explored to allow appropriate comparisons with light logger results. This exploration should include a review of relevant literature including, but not be exclusive to, residential lighting evaluations (i.e., recent literature has addressed the issue of informant accuracy in self-reported estimates of internet use).

6.5 Review of Estimates of CFL Hours-of-Use

6.5.1 Introduction

In 2001 BC Hydro established a ten-year demand-side management (DSM) plan designed to deliver 3,500 GWh/year of energy through a ten-year investment of about $600 million. As part of the plan, Power Smart (PS) rolled out the Compact Fluorescent Lighting (CFL) program in 2002. The CFL program is an electricity acquisition and market transformation program aimed at motivating residential customers to obtain the best long-term value from their choice of household lighting and to shift customer behaviour and the lighting market so that efficient usage becomes a way of life. The program involves the bulk purchase of CFLs and, in partnership with retailers, distribution of two free CFLs to utility customers.

This review was undertaken by Dr. Edward Vine of the Lawrence Berkeley National Laboratory.

6.5.2 Background and Study Objectives

In the fiscal year ending March 2004, BC Hydro calculated direct energy savings effects[1] from participant and non-participant telephone surveys, arriving at an estimated 4.7 hours per day (HPD) of CFL usage on average. BC Hydro calculated market energy savings effects[2] from BC Hydro's 2003 Residential End-Use Survey (REUS), arriving at 4.3 HPD of CFL usage on average. In fiscal year ending March 2003, BC Hydro had calculated lower direct and market energy savings calculations - 3.5 HPD. More recently, BC Hydro completed a monitoring project involving light logging of 77 light fixtures in 8 areas of 18 homes, suggesting an average 2.2 HPD in comparison to an estimate from REUS data of 3.0 HPD. Because of the varying estimates of hours of use (HOU) from different methodologies, BC Hydro requested this study (this report) to conduct the following activities:

- Review the current approaches BCH PS Evaluation uses to estimate CFL HOU and that are incorporated in calculations of direct and market energy savings attributed to the PS CFL initiative;
- Review approaches and research other jurisdictions used to estimate and validate HPD assumptions incorporated in evaluated energy savings of residential CFL initiatives addressing both direct and market energy savings impacts; and
- Develop recommendations, supported by rationales, to improve and enhance the reliability, validity and/or precision of current approaches to estimating

[1] Direct effects refer to the impacts of a utility's direct program effects, including CFL giveaways or purchases made by a utility-sponsored CFL coupon.

[2] Market effects are defined as the incremental increase in CFL sales that occur as a result of a utility's influence on the supply and demand characteristics for CFLs sold in its service territory (Sampson Research 2004a).

HOU for both direct and market impacts in both the short term (current fiscal year) and the longer term (next 3 fiscal years).

The first objective was completed by reviewing key CFL lighting evaluation studies and reports prepared by BC Hydro. The second objective was completed by conducting an extensive literature search on key CFL lighting evaluation studies and reports in the United States. The findings from each review process were compared and a set of key recommendations were made.

6.5.3 Recommendations

The following recommendations are provided to improve and enhance the reliability, validity and/or precision of current approaches to estimating HOU for both direct and market impacts in both the short term (current fiscal year) and the longer term (next 3 fiscal years).

6.5.3.1 Short term (current fiscal year)

- BC Hydro should use the **same** HPD estimates for direct and market effects, until further studies prove otherwise.
- BC Hydro should use 2.2 HPD as the reference for BC Hydro monitored data.
- BC Hydro should use 4.7 HPD as the reference for BC Hydro survey data.
- BC Hydro should use a correction factor of 0.77 and apply it to the survey data for obtaining the HPD that should be used in calculating program savings: HPD of 3.6. This same method can be used for more detailed estimates (e.g., interior lights versus exterior lights, or room by room).

6.5.3.2 Longer term (next 3 fiscal years)

- BC Hydro should continue to use lighting loggers in combination with one or more other methods for the same group of consumers. There is value in conducting small samples of installed CFL HOU metering to verify self-reported survey data and for developing adjustment or correction factors. As shown in this report, the correction factor can be derived by taking the ratio of the logged results to self-reported results among the group participating in the logging, and multiplying that ratio times the responses from the overall survey (phone or mail) sample. Because of the variations among households, it is recommended that the metering study extend across a full year.

- BC Hydro should conduct a separate study on market effects of CFLs. This study would be similar to the study for program participants, but would focus on nonparticipants. For example, in addition to conducting a light logging study on a representative, hierarchically nested sub-sample of program participants in the PS CFL program, another light logging study would be implemented in the same year on a representative, hierarchically nested sub-sample of respondents in the planned market effects surveys in the coming years.

- Due to the variation among rooms, both studies of direct and market effects should monitor hours-of-use for CFLs and incandescent lighting in a representative sample of individual rooms/areas in the home, including exterior lighting. And as noted by Sampson Research (2004b), CFL HOU in kitchens should be estimated separately from CFL HOU in dining rooms.

- BC Hydro should provide sufficient resources for conducting these evaluations, since the measured program success is dependent on the accuracy of CFL HOU. Approximately 5-15% of the Power Smart CFL program should be spent on evaluation – this budget should be sufficient to implement the above recommendations, as well as to address some of the sources of variation in HOU, so that the level of uncertainty of this valuable resource is reduced.

6.6 Impact Evaluation of the Power Smart Residential Compact Fluorescent Lighting Program – Phase III – Lower Mainland

6.6.1 Background and Objectives

The Power Smart Residential Compact Fluorescent Lighting program is an electricity acquisition and market transformation program aimed at shifting customer behaviour and the lighting market so that efficient usage becomes the norm. Under this program, Compact Fluorescent Light bulbs (CFLs) were purchased in bulk by BC Hydro and then distributed free of charge to utility customers though redeemable vouchers at partnering retail outlets. The CFL program occurred in four phases: Courtenay-Comox Valley and Quesnel Pilot (phase I - 2002), Vancouver Island (phase II – 2002/2003), Lower Mainland (phase III – 2003/2004), and North/South Interior (phase IV - 2004).

This section presents an impact evaluation of the Lower Mainland campaign (phase III). This impact evaluation was prepared by internal Power Smart Evaluation staff. Indirect or market effects are examined separately.

Key Program Dates	
Campaign Launch	**October 2003**
Campaign Completion	**March 2004**
Impact Evaluation	**March 2005**

* CFL Market Effects Update Survey (Synovate, 2003)

The objectives of the evaluation are as follows.

- to assess awareness and acceptance levels for CFLs in the Lower Mainland.
- to determine the direct energy and demand savings associated with the phase III Lower Mainland CFL program (as opposed to indirect effects associated market transformation).

6.6.2 Methodology

The impact evaluation employed a cross-sectional quasi-experimental design involving comparison groups of 301 participants and 300 non-participants, who were surveyed in November 2004 approximately one year after the residential CFL give-away program was launched in the Lower Mainland. Participants and non-participants were contacted by telephone after being randomly selected from program lists maintained by BC Hydro. Additional data for the impact evaluation was obtained from program tracking systems.

6.6.3 Findings

The Lower Mainland program was successful from a process and impact perspective. Key results include the following.

- The initiative increased awareness of CFLs from 80% (baseline) to 88% eight months to one year after the program ended.

- Overall satisfaction with CFLs is high for participants and non-participants who report average satisfaction ratings of approximately 4 out of 5 (where 5 is very satisfied).
- 1,322,732 free CFLs were distributed through the program and redemption of program coupon added an additional 43,164 CFLs.
- 22% of participants and 8% of non-participants were influenced by the program to purchase additional CFLs without any assistance from the program. These individuals purchased an average of more than 6 bulbs per person.
- As of January 2005, the initiative has achieved cumulative run rate savings of 102 GWh/year and 30 MW for the fiscal year. The energy savings results are more than two times higher than original program estimates.

6.6.4 Recommendations

6.6.4.1 Recommendations for the evaluation group:

1. Further refine estimates of key variables that can have a significant impact on energy savings but are currently derived from self-reported estimates solicited through telephone surveys. The evaluation group should initiate these studies. The intent of the research would be to augment the quality of currently existing information and research. The following variables are suggested for additional research.
    - The correction factor used to account for the difference between self-reported and metered hours-of-use estimates should be further refined through the expansion of light metering studies to include larger sample sizes and longer study periods (e.g. one year of data collection). The hours-of-use estimates derived from the logger studies should be compared to self-reported estimates derived from both on-site and telephone surveys.
    - Installation Rate – An attempt should be made to verify the actual installation rates of CFLs in residences.

6.6.4.2 Recommendations for the marketing group:

1. Adjust reported program savings for the Lower Mainland residential CFL program to reflect the evaluated direct energy and demand savings.

2. Since evaluation does not plan to conduct a separate impact evaluation for the North and South Interior CFL giveaway program, where appropriate use key input parameters derived from the Lower Mainland impact evaluation to update reported energy savings for the Northern and Southern Interior CFL program.

3. Where appropriate and applicable, include evaluated estimates for key variables in planning documents for future CFL give-aways or programs including updates to current planning documents (e.g. 10-year plan).

6.7 2004 Market Effects of BC Hydro's Compact Florescent Light Program

6.7.1 Background and Approach

This evaluation updates the energy and peak demand savings attributable to the market effects of BC Hydro Power Smart's residential Compact Fluorescent Lamp (CFL) initiatives for fiscal year 2003-04 and the first ten months of fiscal year 2004-05. Market effects are defined as the incremental increase in CFL sales, and the associated energy and peak demand savings attributable to BC Hydro's efforts to transform the British Columbia market for CFLs. Market effects, by definition exclude energy and demand savings from BC Hydro's direct program effects. Direct program effects (impacts) are outside the scope of this research and are reported separately by BC Hydro.

This evaluation also explored the merits of using a traditional quasi-experimental methodology to estimate market effects. A representative sample of households not directly influenced by BC Hydro's CFL programming (Saskatchewan) were surveyed with the objective to develop an alternate estimate of baseline CFL sales – that is, sales of CFLs that would have naturally occurred among BC Hydro's residential customers if BC Hydro had not conducted its CFL initiatives. This alternative approach was explored in response to concerns that the current methodology may underestimate the market effects, and commensurate energy and peak demand savings, attributable to BC Hydro's residential CFL initiatives.

The market effects presented in this report cover all BC Hydro related spillover for its CFL programming for fiscal years 2001-02 through 2004-05. Any estimates of program spillover determined via independent evaluations of the program's direct effects, either collectively or by program phase, are implicitly included as part of this report's overall estimate of market effect.

This evaluation was done by Sampson Research.

6.7.2 Key Findings

6.7.2.1 Supply-Side Assessment

Supply-side research conducted for this evaluation included in-store surveys of household lighting products for a randomly selected sample of retailers (n=61), mystery shopper interviews with retail sales staff (n=52), and interviews with CFL manufacturers (n=8).

Compared to the baseline study conducted in 2002 (XENERGY 2002), there have been significant improvements in the availability, accessibility, and affordability of CFLs sold in British Columbia.

Key supply-side findings:

- CFLs occupied 10.3% of total household lighting shelf space in November 2004, up from 8.9% in November 2003, and 6.1% in September 2002.
- Year-over-year increases in shelf-space shares were observed for all BC Hydro regions except Vancouver Island. Notable increases were observed in the South Interior and Northern regions consistent with BC Hydro CFL programming in these regions during 2004.
- Spiral CFLs now represent 73% of all CFLs for sale, up from 22% in 2002.
- Twenty different manufacturer brands of CFLs were observed in November 2004, up from 14 in 2003. The number of CFL models increased to 172, up from 90 in 2002.

- The vast majority of CFLs (85%) are available in either 6,000 or 10,000 hour models. CFL product rated at 8,000 hours increased from 7.2% of all CFL product for sale in November 2003 to 13.7% in November 2004.
- CFL product bearing the ENERGY STAR® logo accounted for 86% of all CFL product, up from 62% one year ago
- Sixty-three percent (63%) of all CFL product now retails for less than $6 per CFL. In the post-survey period, CFLs have been observed on sale for as low as $1.67 each. The weighted average price of all CFLs for sale declined by 16% in the past year.
- The purchase price (first cost) for a typical spiral CFL rated at 10,000 hours is now 50 cents per 1,000 hours of life – lower than the first cost of a typical 1,000 hour incandescent.
- Only 6% of all salespersons that spoke with the mystery shopper provided guidance on how to save the most energy from using CFLs (i.e., installing them in fixtures with the highest hours-of-use) without specific prompting. When prompted, the percentage increased to 51%.
- Sixty-five percent (65%) of sales staff suggested the best way to choose a CFL of sufficient brightness was to match incandescent wattage with that indicated on the CFL package. Only 15% of salespeople suggested matching on the basis of light output (lumens).
- Only 19% of sales staff knew the typical lifespan of a CFL without referring to reference materials. Another 14% chose / needed to read from the CFL package.
- CFL awareness/knowledge among sales staff was highest in the home improvement / hardware retail segment and lowest in the grocery store segment, although awareness/knowledge varied considerably from store-to-store in all retail segments.

- CFL manufacturers cited the increase in consumer and retailer awareness, declines in prices, and the increased cost of electricity as the most three important factors influencing CFL sales in Canada during the past five years.

- CFL manufacturers attributed the decline in CFL prices during the past five years to two factors: the decline in production costs associated with increased production volumes, and the shift in production to Asia.

- The majority of manufacturers credited BC Hydro and its delivery model of involving manufacturers, retailers, and government with setting the standard for a successful and well run program. Several manufacturers credited BC Hydro with influencing current or planned CFL initiatives in Manitoba, Ontario, and Quebec.

6.7.2.2 Demand-Side Assessment

A telephone survey of 608 BC Hydro residential customers was conducted in late January and early February 2005. The purpose of the survey was to assess household awareness of CFL technology and BC Hydro CFL programming, the stock of installed CFLs, acquisitions and installations during the past year, replacement behaviours, hours-of-use, and knowledge of CFL attributes and operating characteristics. The survey updated information gathered from telephone surveys conducted in 2002, 2003, and 2004.

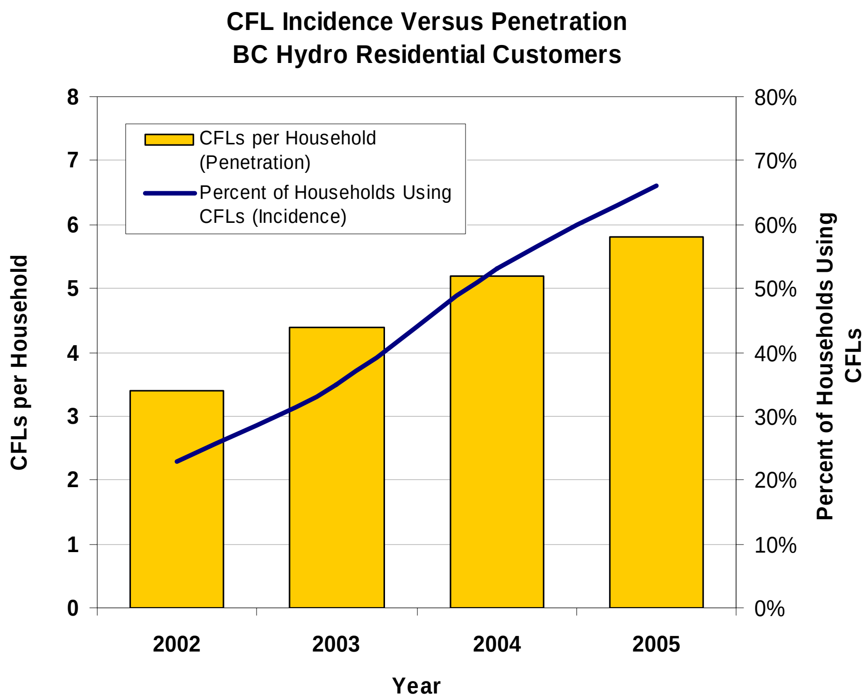
Key findings:

- Eighty-nine percent (89%) of households surveyed were aware of CFLs, unchanged from January 2004, but up from 74% in 2002.

- Three quarters (75%) of all households recalled BC Hydro information, advertising or promotions on CFLs, up from 65% as of January 2004 and 22% as of May 2002. Recall of BC Hydro information or other programming in BC Hydro's South Interior and Northern regions increased commensurate with BC Hydro programming directed at these two regions during 2004. Statistically speaking, the percentage of residents recalling BC Hydro promotions no longer differs between the Lower Mainland / Vancouver Island and South Interior / Northern region clusters.

- Two thirds (66%) of all BC Hydro residential customers now have at least one CFL in use (incidence), up from 55% in 2004, and 23% in May 2002 (Figure 6-2).

Figure 6-2



- On average, 5.8 CFLs are installed per household using CFLs (penetration). This is up from an average of 5.2 CFLs in January 2004.

- An estimated 5.6 million CFLs are installed in BC Hydro customer homes as of January 2005, up from 1.1 million in 2002.

- Forty-eight percent (48%) of all BC Hydro residential customers have received a free bulb from BC Hydro.

- Nearly six out of every ten households (55%) who acquired a free CFL in 2004 purchased additional CFLs. On average, these households purchased 5.9 CFLs each.

- Respondents reported paying an average of $7.55 before rebates for their most recent CFL purchase. This estimate is comparable to the weighted average cost of a CFL calculated from the shelf-space study when sales taxes are added ($7.48).

- Ninety percent (90%) of all CFLs provided by BC Hydro, regardless of time period, have been installed.

- One in four households have replaced a CFL – two thirds choosing to replace the CFL with another CFL. Nine percent of households replaced the CFL because they were dissatisfied with it performance.

- Self-reported estimates of daily hours-of-use for CFLs based on usage ranged from an average of 6.1 hours for the most heavily used CFL to an average of 1.7 hours for the fourth most heavily used CFL.

6.7.2.3 Comparison Group Findings

A randomly chosen sample of households (n=601) in Saskatchewan were surveyed during the last week of January and the first week of February 2005. The primary purpose of the survey was to evaluate using a comparison group as an alternative method of determining the incidence and penetration CFLs that would have occurred in British Columbia if BC Hydro's had not undertaken to transform the market for compact fluorescent lighting. Saskatchewan was chosen as comparison group because its residents have seen only limited direct programming regarding CFLs – either from local utilities or through government agencies (federal or provincial).

Key findings:

- Eighty five percent (85%) of Saskatchewan respondents were aware of CFLs. Awareness was primarily obtained from retailers, television and radio, and friends or family. Information provided by the local electric utility was mentioned by 10% of aware respondents.

- Forty-three percent (43%) of Saskatchewan households are using CFLs (incidence), and they averaged 7.0 installed CFLs each.

- A review of possible socio-demographic factors between BC Hydro and Saskatchewan survey respondents that might explain the higher penetration of

CFLs in Saskatchewan yielded two possible factors – disproportionately fewer households with annual household incomes above $40,000, and higher residential electricity rates (58% higher than BC Hydro's residential rate as of May 2004). Both factors improve the economic benefit of using CFLs.

Decision:

Despite the limited amount of direct CFL programming, the awareness, incidence, and penetration of CFLs in the comparison group are at levels experienced in British Columbia approximately a year and half ago. However, there is sufficient evidence to support BC Hydro's claims that the success of its CFL programs has spilled over to other regions of Canada, including Saskatchewan, via manufacturers, retailers, and other utilities. While not the only factor influencing the market for CFLs in these regions (e.g., price declines, differences in real household incomes and electricity prices), the evidence is sufficient enough to conclude that using Saskatchewan as a baseline for the calculation of market effects would unduly penalize BC Hydro. With this conclusion, the methodology used to calculate market effects for fiscal years 2001-02 through 2003-04 was retained and extended to estimate the market effects for the 2004-05 fiscal year.

6.7.2.4 Market Effects

Table 6-9 summarizes the acquired energy and peak demand savings attributable to BC Hydro's market effects for fiscal years (FYs) 2001-02 to 2003-04, the first ten months of fiscal year 2004-05, and a projection to the end of fiscal year 2004-05.[3] Estimates for 2003-04 fiscal year have been updated with information on direct and indirect CFL acquisitions during February and March of 2004 – information unavailable at the time of the 2004 market effects evaluation. Market effect acquired energy savings for the first ten months of FY 2004-05 are estimated at 122.5 GWh. Total acquired energy savings for FY 2001-02 to 2004-05 year-to-date (YTD), less removals, is estimated at 200.1 GWh. Including a projection for the remaining two months of FY 2004-05 increases the total acquired energy savings for the four years to 235.5 GWh.

[3] Acquired energy represents the amount of energy (GWh) saved (accumulated) during the time period in question. Acquired energy numbers are used in BC Hydro's load forecast.

The total reduction in peak demand attributable to the cumulative effect of BC Hydro's market effects as of January 2005 is estimated at 77.4 MW.

Table 6-9
Acquired CFL Installations, Energy Savings, Peak Demand Savings
BC Hydro Market Effects

Fiscal Year	Incremental CFL Installations (000)	Total CFLs Installed as of FY End (000)	Annual Acquired Energy Savings GWh [1]	Peak Demand Savings MW [2]
2001-02	89.8	89.8	3.7	1.6
2002-03	255.9	345.7	10.8	3.8
2003-04 [3]	1,145.3	1,491.0	65.5	24.8
2004-05 YTD [4]	2,038.2	3,529.2	122.5	79.4
Total 2001-05 YTD	**3,529.2**	**----**	**202.5**	**---**
Less Removals	49.7	49.7	2.4	2.0
Net 2001-05 YTD	**3,479.5**	**3,479.5**	**200.1**	**---**
Net 2004-05 FY estimate [5]	*2,529.4*	*4,020.4*	*155.5*	*77.4*
Net 2001-05 FY estimate	***3,970.7***	***3,970.7***	***235.5***	**---**

[1] Represents cumulative energy savings achieved by the end of the fiscal year is question for all CFLs installed to that point.
[2] Peak demand associated with all market effect CFLs installed as of the month of January in each fiscal year.
[3] Revised March 2005.
[4] Represents the first ten months of FY 2004-05.
[5] Estimated fiscal year total for 2004-05 based on actuals for April 2004 to January 2005, and projections for February and March of 2005.

Table 6-10 presents the CFL market effects for BC Hydro in terms of the incremental run rate for energy savings based on CFLs installed in each of the four fiscal years. Run rate savings represents the rate of energy savings (GWh per year) at the end of the fiscal year. The run rate for energy savings for all CFLs installed during fiscal years 2001-02 to 2004-05, less removals, is projected at 216.2 GWh per year.

Table 6-10
Run Rates - CFL Installations and Energy Savings
BC Hydro Market Effects

Fiscal Year (FY)	Incremental CFLs Installed (000)	Energy Savings Run Rate GWh/Yr [1]
2001-02	89.8	6.4
2002-03	255.9	18.4
2003-04	1,145.3	71.8
2004-05 YTD	2,038.2	98.3
Less removals	49.7	2.4
Net 2004-05 YTD [2]	1,988.5	95.9
Net 2004-05 FY estimate [3]	*2,529.4*	*119.6*
Net CFLs as of Mar 31, 2005 [4]	***3,970.7***	***216.2***

[1] Represents expected annual energy savings based on the market effect CFLs installed during the fiscal year in question, as of the end of the fiscal year.
[2] Represents the first ten months of FY 2004-05, less removals.
[3] Estimated fiscal year total for 2004-05 based on actuals for April 2004 to January 2005, and projections for February and March of 2005, less removals.
[4] Represents expected annual energy savings from March 31, 2005 forward based on all market effect CFLs installed during the four fiscal years, less removals.

As of the end of fiscal year 2004-05, an estimated 4.0 million CFLs are attributed to the market effects of BC Hydro's residential CFL initiatives.

Energy and demand savings are expected to continue for several years, subject to the traditional issues of persistence (e.g., premature removals, failures, etc.), no attempt has been made in this report to estimate the longevity or diffusion profile of these effects.

6.7.3 Summary and Recommendations

6.7.3.1 Summary

The market for compact fluorescent lighting in BC Hydro's service territory has changed considerably since BC Hydro first began promoting CFLs in 2001-02. Many of these changes were noted in detail in past evaluations of BC Hydro's market effects (Sulyma 2003, Sampson Research 2004a). Research conducted for this evaluation confirms that many aspects of the CFL market – from the perspective of both suppliers and consumers – continued to improve during 2004. Increases were observed in the amount of retail shelf-space dedicated to CFLs, the number of manufacturer brands represented, and the number of models available to consumers. The "first cost" economics of CFLs has continued to improve – with 10,000 hour CFLs now costing as little as 50 cents per 1,000 hours – well below the comparable first cost of a typical incandescent bulb. Sixty-three percent of all CFL product on retailer shelves in November 2004 was priced below $6.00 per CFL. Sale pricing has drawn down the purchase price of a CFL to as low as $1.67 per CFL or roughly 28 cents per 1,000 hours.

Compared to January 2004, improvements in product availability and pricing have been accompanied by significant increases in the incidence and penetration of CFLs amoung BC Hydro's residential customers. Indeed, two-thirds of all BC Hydro households are now using CFLs and these households have, on average, 5.8 CFLs installed. Regionally, significant increases in both retail shelf space and the incidence and penetration of CFLs observed for South Interior and Northern residents correlate with the expansion of BC Hydro's CFL programming to these regions in 2004.

CFL manufacturers view BC Hydro's residential CFL program as well run. They credit its operational model of partnering with manufacturers, retailers, and the federal government with influencing utilities and governments in other regions of Canada to adopt similar approaches to their CFL initiatives. While the majority of manufacturers were reluctant to credit BC Hydro with the significant decline in CFL prices, BC Hydro's CFL programming is one of the factors credited with increasing the awareness and sales of CFLs among consumers.

The spillover effect of BC Hydro's influence on supply-chain agents in other jurisdictions of Canada is the primary reason why the use of a comparison group of households (Saskatchewan) was rejected for use as an alternate baseline of CFL use. However, findings from the comparison group survey offer considerable perspective of the growing awareness and use of CFL product among households not directly influenced by BC Hydro's demand-side management programming. Indeed, the dramatic improvement in the economics of CFLs and the awareness of the technology among households both inside and outside of BC Hydro's service territory means that it will be increasingly difficult to attribute incremental improvements in the incidence and penetration of CFLs in British Columbia to the influence of BC Hydro programming for FY 2005-06 and beyond. Retaining the energy savings achieved and credited to this point (persistence) should be a primary program focus, particularly as it involves influencing the CFL replacement behaviours of households.

Summarized, the market effects of BC Hydro's residential CFL initiatives include:

- Incremental installations of 1.145 million CFLs in FY 2003-04, and projected 2.529 million for FY 2004-05.
- Acquired energy savings of 65.5 GWh for FY 2003-04 and 155.5 GWh for FY 2004-05.
- Total acquired energy savings for the 2001-02 to 2004-05 period of 235.5 GWh.
- Run rate savings as of the end of March 2005 are estimated at 216.2 GW.h per year.
- Peak demand savings as of January 2005 are estimated at 77.4 MW.

All energy and peak demand savings estimates have been reduced by net CFLs taken out of service (removals) and cross effects occurring in electrically heated homes. A cross effect benefit arising from reduced air conditioning load has not been factored into these estimates. These estimates are conservative in this regard.

6.7.3.2 Recommendations

- To ensure persistence of claimed savings, BC Hydro should continue its education and awareness campaigns directed at consumers and retailers (particularly their staff). Emphasis should be placed on educating people on how to maximize energy savings from CFLs, how to select a CFL of appropriate wattage and lumens, and discouraging the replacement of worn out CFLs with incandescent product.
- Evaluation effects should shift towards quantifying the persistence of market and program effects in future surveys of residential customers.
- BC Hydro should use its relationship with manufacturers and retailers to push for improvements in CFL product choices based on CFL shapes (e.g., globes and par/reflectors).

- Self-reported hours-of-use based on fixture usage suggests that the average hours-of-use declines rapidly as the penetration of CFLs increases.

  BC Hydro's evaluation unit should incorporate this most recent research into its overall hours-of-use evaluation initiative.

6.8 A Baseline Assessment of the Residential Windows Market in British Columbia

6.8.1 Objectives

The primary objectives and issues addressed in this baseline assessment are:

1. Develop a baseline against which future Power Smart activities affecting the windows market can be assessed;

2. Assess the market effects multipliers of previous Power Smart windows related activities; and

3. Estimate the impact of these previous activities on energy savings and the nature of the residential windows market in BC.

This Baseline assessment was prepared by the Heshong Mahone Group, Inc.

6.8.2 Issues

In realizing the above objectives, the issues include:

Issue 1. Market characteristics
What are the key characteristics of the current and recent British Columbia windows market, including number of customers by segment (new home and retrofit); nature of the distribution chain; role of manufacturers, distributors and importers and retailers: and trends in prices (or affordability) and sales (or acceptance) for various types of windows?

Issue 2. Customer awareness and usage
How have the awareness and acceptability of high-efficiency windows changed among customer populations, and what are the prevailing attitudes about these high efficiency windows?

Issue 3. Trade ally awareness and stocking

How have the levels of awareness, availability, and accessibility of high-efficiency windows changed among distributors, retailers, suppliers and installers, and what are the prevailing opinions about these products?

Issue 4. Customer decision making

How has the decision-making process regarding windows purchases among the target populations changed, if at all, and what are the key points of influence?

Issue 5. Attribution

What impacts have BC Hydro promotional and program activities had on domestic sales of energy-efficient windows and what are the impacts on energy savings?

Issue 6. Cost effectiveness

What is the cost effectiveness of energy efficient windows? This issue will primarily be addressed from the perspective of the unit energy savings and unit costs of residential windows, both as a baseline and projecting forward. This data may be useful to BC Hydro program planners in projecting program costs and benefits in the next phase of program operation.

6.8.3 Study Approach

The approach for this study used interviews and surveys as the primary data collection methodology to characterize the residential windows market and its actors. We surveyed 38 supply side market actors, including British Columbia windows manufacturers, builders, remodelers, retailers, and distributors. We also surveyed 983 consumers in BC Hydro's service territory using a large web-based survey for homeowners.

Additionally, we used a computational modelling tool to estimate the energy savings realized under different window scenarios. We used data from the surveys to estimate the current distribution of window types by housing type and by the four major BC Hydro service territories within British Columbia.

6.8.4 Findings

Supply side actors, from manufacturers to retailers agree on several issues. There is major agreement in the penetration of efficient window products in the market: low penetration of 15-20% in the new construction market and higher penetration of 25-30% in the remodel market.

As expected, there was near unanimity that higher first cost and inadequate customer knowledge are currently the two most significant barriers to the market penetration of efficient window products. While many market actors would welcome a BC Hydro windows program (primarily for the incentives and co-marketing), a significant number of actors cited the lack of appropriate building codes and standards as a significant barrier. This finding stands in sharp contrast to other areas of North America, where building codes are viewed as unnecessary governmental interference. Upgrading to energy efficient windows requires an unacceptably long payback period for some ratepayers, due to the mild climate in some areas of B.C., coupled with the relatively low cost of electricity.

One of the most surprising findings was the negative perception of previous attempts at standard setting (ER) and labelling (Power Smart). Market actors in general thought the standards are too low, encouraged inferior products or are inappropriate for the climate conditions of Vancouver Island and the Lower Mainland.

Consumers rate the most important criteria for windows selection as cost, energy efficiency, and quality of construction. The least important criteria are the Power Smart designation and availability. Yet, when it comes to a customer’s willingness to pay for attributes, the attributes that seem most valuable are energy efficiency and quality of construction. Energy efficiency is the common element in both ratings. However, supply side actors sharply disputed this criterion and cited the lack of customer education as among the biggest barriers to penetration.

Consumers get information about windows most often from supply-side actors, namely contractors and retailers. Together, these actors account for 54% of the responses. However, the source that consumers trust most is BC Hydro, although only 8% of respondents say that is their source of information about windows.

The BC Hydro legacy programs served to improve window efficiency in both the new construction and remodel markets. The estimated annual energy savings due to these legacy programs is approximately 4.2 GWh/yr for the new construction market and approximately 3.9 GWh/yr for the remodel market. Considering the potential future savings when consumers and builders choose energy efficient windows, the expected annual energy savings are between 0.38 and 4.2 GWh/yr (new construction) and between 0.90 and 7.4 GWh/yr (remodel). This range of savings depends on the existing number of efficient windows, the target market penetration, and the method used to estimate the annual sales volume of windows to the new construction market. This range of savings is quite broad especially due to the wide range of target market penetration values, 30% to 100%, used in the analysis.

6.8.5 Recommendations:

BC Hydro should get manufacturers directly involved in data gathering on windows production. This approach has worked in the U.S., with manufacturers agreeing to provide data to third parties with individual manufacturer information legally protected in confidentiality. In this way, BC Hydro can monitor and track their market progress on an ongoing basis.

A market transformation program for efficient windows can do much to improve the penetration of efficient windows. Because the market chain is increasingly characterized by direct sales from manufacturers, a co-operative program, where manufacturers provide in-kind contributions, may be the best approach. It does not appear that the larger manufacturers will need to make any major changes in their production processes to meet the new ENERGY STAR standards, so a program that encourages the market is a win-win for all parties.

At the same time, Canada should continue working to improve its building codes and standards. If the ENERGY STAR brand is restricted to windows only, the chances of “backsliding” are increased unless the floor is raised behind the new standard.

Although consumers appear to value energy efficiency, they generally do not carry this through to the purchase decision. This would indicate the need for more education directed to increase brand confidence, rather than general energy efficiency values.

If BC Hydro considers promoting efficient windows again, it should consider the negative impact of periodic, rather than constant involvement in markets. What will increase business involvement and insure program success is the knowledge and confidence that BC Hydro is committed to this mission for the long term, and that programs will continue uninterrupted for a number of years.

6.9 Process Evaluation of the Power Smart Product Incentive Program – Phase I

6.9.1 Introduction

The Power Smart Product Incentive Program (PIP I) was launched in November of 2003 to identify and capture energy savings opportunities among BC Hydro's small and medium commercial customers. The program uses monetary incentives to encourage customers to complete simple retrofit installations of energy efficient products. Immediate energy savings are obtained without lighting system redesign.

A process evaluation of PIP I was conducted between September 15, 2004 and November 10, 2004. The purpose was to examine the effectiveness of program design, implementation, and operation in achieving goals and objectives as defined in the business case.

This process evaluation was conducted by internal Power Smart Evaluation staff.

6.9.2 Results

The key strengths of the program are its self-service delivery mode, its online and automated delivery process, and its engagement of suppliers and contractors in the process. However, these strengths are currently not fully developed and supported in PIP I. The process evaluation found evidence that issues associated with the application and the application process may be hindering customer participation in the program.

6.9.3 Recommendations

1. Increase the exposure of customers to clear, consistent information on process steps and requirements.
2. Employ a communication specialist to review the e-mail communication system in detail.
3. Work to improve the usability of the online application site, with the goal to make

the application process as straightforward and intuitive as possible for first-time users.

4. Develop and implement plans to capitalize on the abilities of trade allies to contribute to the success of the program.

5. Conduct a review of “In Progress” applications older than 3 months to determine the cause of applications that have not been updated for a significant amount of time.

6. Make certain program requirements more flexible in order to accommodate the needs and business realities of customers.

7. Review the risks and potential rewards associated with providing customers with online calculators that include general information on product costs (or the range of costs) and appropriate disclaimers.

8. Review the incentive levels to assess their effectiveness in promoting customer participation, but pursue the removal of significant process and program related barriers to customer participation before increasing the incentive levels.

6.10 Power Smart Partner: Milestone Evaluation Report – June 2005

6.10.1 Introduction

This summary presents an overview of an evaluation of BC Hydro’s Power Smart Partner Program (PSP or the Program) conducted by Quantec, LLC. This evaluation is based on nearly 250 PSP projects completed prior to July 2003, representing about 100 separate customer entities. In addition, 91 projects (conducted by 59 separate customer entities) were assessed that involved only PSP energy studies. This report covers PSP incentive projects only; it does not address consultative energy savings and energy savings associated with the e.Points program.

BC Hydro identified the three following research issues that were to be addressed:

1. Customer and trade ally knowledge/transformation,

2. Customer decision-making related to energy efficiency, and

3. Direct energy and demand savings.

Quantec conducted the following primary activities to prepare this evaluation:

- Review Program materials and information and conduct interviews with key Program staff to document PSP implementation and characteristics, and BC Hydro staff's perspectives.
- Conduct telephone surveys with both participating and non-participating customers to address knowledge and behavior issues.
- Review BC Hydro's M&V reports and analyze customer billing data to quantify the effects of the Program.

This evaluation was initiated in November 2003 and was planned to be completed by the end of 2004. However, difficulties obtaining the participating and non-participating customer billing data and contact information, and timing issues with other BC Hydro studies, resulted in schedule delays and scope changes. The major scope change was the deletion of a requirement to collect primary information from trade allies.

6.10.2 Customer Knowledge and Behaviour

The first two research issues listed above were addressed through telephone surveys examining awareness and knowledge about the Program; awareness, knowledge, and behaviour related to energy efficiency; and influences of PSP on energy-efficiency awareness, knowledge, and behaviour. Our surveys covered four groups:

- Non-participants – Customers who were eligible for PSP, but had not signed up as a PS Partner.
- Partner non-participants – Customers who were Partners, but had not taken any actions under the Program.
- Energy study-only – Partners who had conducted one or more energy studies

as part of PSP but had yet to implement a project yet for which they had received PSP incentives.

- Full participants – Partners who had implemented one or more projects prior to July 2003.

6.10.3 Survey Samples and Characteristics

Table 6-11 shows the number of customers in each group that were in our original sample pool that were contacted for a survey, the number of completed surveys targeted with each group, and the number of surveys completed. We attempted to contact and conduct a survey with every customer in the original sample pool. The table also shows that we had a target of completing surveys with all energy study-only and full participants; the two other groups were random samples selected from larger customer samples provided by BC Hydro.

Table 6-11
Customer Survey Samples

Customer Group	Original Sample Pool	Completes Targeted	Completes
Non-participants	241 (sample)	100	52
Partner Non-participants	459 (sample)	200	104
Energy Study-only	59 (census)	59	35
Full Participants	105 (census)	105	64

The Program identified three sectors that it originally targeted: SUCH (schools, universities and colleges, and hospitals), Non-SUCH (manufacturing, high technology, property developers, property managers, retail, government, and small industrial), and Industrial.

About 30% to 50% of respondents in each group were independent firms; school districts were more common in the full-participant group than in any other.

In all groups, about three-fourths of customers reported energy-efficiency decisions were made at the facility rather than at another location. About half the full participants, Partner non-participants, and non-participants said that decisions about controlling energy costs or making energy-efficiency improvements were the responsibility of an "in-house staff person or energy manager." Property managers were the subgroup most likely to have an in-house energy person. Study-only customers were unique – about half said that this responsibility was shared by a group of facility staff. No more than 16% of customers in any group said they provided incentives to business units or staff for managing energy costs.

The use of a payback period criterion to assess efficiency investments tended to be correlated with the degree of Program participation. The share of each group using a payback period requirement were as follows:

- 61% of full participants
- About 45% of study-only and Partner non-participants
- 23% of non-participants

Use of an internal rate of return (IRR) criterion was less common across all groups.

6.10.4 Awareness, Knowledge, and Behavior Findings

The vast majority (70% or more) of full participants and study-only customers heard about the Program from their Key Account Manager (KAM); on the other hand, only about 20% of customers in the other two groups mentioned KAMs (see Table 6-12). This suggested that KAMs have been quite effective working with, recruiting, and getting customers involved as active Program participants.

Table 6-12
Where Customers Heard about PSP

	Full Participants	Study-Only	Partner Non-Participant	Non-Participant
BC Hydro Account Manager	74%	70%	25%	18%
Materials provided by BC Hydro	6%	3%	32%	38%
Contractor, consultant, or supplier	6%	9%	7%	13%
Other BC Hydro customers	0%	9%	6%	15%
Industry organization	3%	6%	4%	0%
Program advertising	0%	0%	21%	26%
Other	10%	3%	10%	5%
Total Responding	64	33	104	39

Note: Partner non-participants and non-participants were permitted to identify more than one source so percentages total slightly more than 100%.

Full participants and study-only participants rated expected energy savings and Program financial assistance as the main reasons they participated in the Program (see Table 6-13). Both groups also rated the assistance provided by KAMs as the third most important factor.

Table 6-13
Importance of Factors in PSP Participation Decision

Factor in Decision to Participate in PSP	Full Participant		Study Only	
	Rated 4 or 5	Mean	Rated 4 or 5	Mean
Expected energy savings	97%	4.7	91%	4.5
Program financial assistance	89%	4.4	73%	4.1
Assistance provided by BC Hydro Account Manager	81%	4.2	61%	4.1
Opportunity to have an Energy Study conducted	56%	3.6	61%	3.8
Program technical assistance	45%	3.4	42%	3.4
Pre-approved Power Smart Alliance contractors	39%	2.8	15%	2.3

Note: Ratings were based on a scale from 1=”not at all important” to 5=”extremely important.”

Despite not participating in PSP, 75% of non-participants were aware of the Program.

PSP non-participants and non-participants most frequently associated incentives, energy managers, and energy studies with the Program (54% or more identified these components). Respondents were least familiar with e.Points bonuses. Although non-participants indicated that they were quite familiar with Program services, their responses suggested that Program knowledge was not always very accurate.

The most common reasons given for becoming a Power Smart Partner were primarily financial. The least important reasons given were the technical assistance available, e.Points bonuses, and public relations benefits for the organization.

The most common reasons Partner non-participants gave for not yet conducting an energy study were: internal funding was not available for studies and/or upgrades and the organization had already had a study done independent of the Program. Fifty-one percent of these customers said they expected to conduct a PSP energy study within the next year.

Both Partner non-participants and non-participants were asked how important energy efficiency was in their organization’s equipment purchasing/ installation decisions. This question reflected BC Hydro Program staff’s expectation that customers who were less involved with PSP were less likely to consider energy efficiency an important decision factor. Table 6-14 shows how different non-participant groups rated the importance of energy efficiency. At least 49% of the respondents in the groups shown said that energy efficiency was “very” or “extremely” important. The main differences were in the share of respondents who said energy efficiency was “not very important.” About a fourth of the customers unaware of PSP did not consider energy efficiency to be important.

Table 6-14
Importance of Energy Efficiency

	Partner Non-Participants	Non-Participants	
		Aware of PSP	Unaware of PSP
Extremely important	13%	13%	15%
Very important	36%	45%	38%
Important	45%	32%	23%
Not very important	7%	11%	23%
Total	***103***	***38***	***13***

Non-participants were asked an open-ended question about why they had not joined the Program yet, and the most common responses were the need for more Program information (28%) and budget concerns (17%). Fourteen percent of non-participants said they had no interest in becoming a Partner. Among non-participants who were aware of the PSP, the most significant thing BC Hydro could do to encourage them to participate was directly contacting them and providing Program information.

6.10.5 Program Effects

Before a customer can receive PSP incentives to install energy-efficient equipment, an energy study must be conducted. Not surprisingly, a larger share of full participants (70%) were satisfied with the energy studies than study-only customers (42%). Dissatisfaction with the energy studies was low in both groups.

The ways customers thought BC Hydro could make the studies more effective basically fell into two categories: be more realistic about the economics and improve the way the studies are implemented.

Only 37% of full participants installed all the measures recommended in the energy studies. The main reasons for this were financial: lack of capital or the equipment did not meet the customer’s investment criteria.

Of the study-only customers interviewed, 39% said that they installed recommended measures without PSP incentives. Program staff believed this occurred at times because the payback was shorter than allowed by PSP. Sixty-one percent said that the Program was at least “somewhat influential” in the decision to install the measures.

Table 6-15 shows the breakdown of measures installed by PSP full participants, by sector. Almost none of the participants interviewed said that installed equipment had stopped working, been removed, or been taken out of service.

Table 6-15
Distribution of Measures Installed (All Participants)

Measure Type	All Full Participants		
	SUCH	Non-SUCH	Industrial
Lighting Retrofit	61%	66%	10%
Lighting Controls	5%	7%	0%
HVAC Retrofit	19%	6%	0%
HVAC Controls	13%	8%	0%
Refrigeration	0%	3%	0%
Insulation	0%	2%	0%
Water Measures	0%	2%	20%
Vending Misers	2%	0%	0%
Industrial Measures	1%	8%	70%
Total Installations	***180***	***120***	***10***

The surveys of non-participants (both Partners and non-Partners) showed that lighting, HVAC equipment, and motors were the most common equipment types they had installed in the past three years (typically, 30% or more said they had installed these equipment types). Among Industrial customers, the incidence of compressed air equipment installation was also high.

Overall, these customers stated that a little less than half the equipment, on the average, was more efficient than required by code. The selection of high-efficiency equipment, however, was affected to a significant degree by the Program. More than half the Partner non-participants said that the Program influenced them to install higher-efficiency equipment, and nearly 40% of non-participants said the Program had influenced their selection.

To analyze free ridership, we asked full participants a series of questions about what they would have done if they had not participated in the Program. Based on their responses, a free-ridership estimate was derived for each participant and measure, taking into account the likelihood of installing high-efficiency equipment and the quantity of such equipment participants said they would have installed without the Program. The resulting estimated free-ridership percentages are shown in Table 6-16 along with the 90% confidence interval range.[4] Unfortunately, the small sample sizes limited the precision of the

[4] No confidence interval is shown for Industrial sector because there was no variation in the estimated free-ridership for the customers analyzed.

estimates. Based on these results we cannot conclude that the free-ridership rate is different between lighting and other measures or between SUCH and Non-SUCH customers.

Table 6-16
Survey-Based Free-Ridership Estimates

Equipment Type	SUCH	Non-SUCH	Industrial	Overall
Lighting	24% ±15% (85)	5% ±5% (48)	0% (1)	12% ±7% (134)
Non-Lighting	38% ±25% (49)	11% ±9% (23)	0% (8)	17% ±11% (80)

The 90% confidence interval is shown and the number of observations is shown in parentheses.

To examine how much spillover effect the Program had, full participants were asked whether additional energy-efficient equipment had been installed at any sites (participating or not) since Program participation.[5] Table 6-17 summarizes responses by sector.

Table 6-17
Participants Who Installed Efficient Measures without PSP Incentives

Location	SUCH	Non-SUCH	Industrial
Participating sites	56%	49%	80%
Non-participating sites	67%	27%	20%

To assess spillover, we also asked participants how influential PSP had been in their decision to install additional efficient measures. In all sectors, at least 64% of participants said the Program was “very influential” in their decision to install additional efficient measures at participating sites; at non-participating site, 39% said the Program was “very influential.” Based on these results, participation led to at least

- 31% of PSP participants installing some additional efficiency measures at the participating site without a PSP incentive; and,

[5] All non-participating sites mentioned were located in the BC Hydro service area.

- 8% of PSP participants installing efficient measures at other sites without an incentive.

Because different customers reported the amount of spillover in different units it was not possible to quantify the magnitude of spillover. Based on these survey results, however, we believe that the magnitude of participant spillover was significant and was on the order of the free-ridership.

We were able to derive an approximate measure of spillover among non-participants who installed higher efficiency equipment, in part due to the Program. Table 6-18 presents the estimates by equipment type for both Partner non-participants and non-participants. The values represent the percent of each customer groups' equipment replaced with higher-efficiency equipment as a result of the Program. Although the estimated values were relatively small, their overall magnitude could be significant since the number of customers in these groups was relatively large.

Table 6-18
Estimated Spillover for Non-Participants

Equipment Type	Partner Non-Participants	Non-Participants
Lighting Retrofit	3%	1%
Lighting Controls	1%	0%
HVAC Retrofit	2%	2%
HVAC Controls	3%	2%
Motors	3%	2%
Compressed Air	2%	1%
Other	3%	1%

6.10.6 Program Satisfaction and Effects on Behavior

Participants were extremely satisfied with the energy-efficient equipment that was installed: 86% said they were "very satisfied" and 9% said "somewhat satisfied." Sixty-four percent were "very satisfied" with the energy savings, 25% were "somewhat satisfied," and 9% said it was "too soon to tell." Customers also were highly satisfied with the technical assistance provided by BC Hydro with 66% "very satisfied" and 19% "somewhat satisfied." These very positive results suggested that participants considered the technical assistance to be important, which would contrast significantly with the low importance rating that non-participating Partners gave to technical assistance.

Satisfaction with KAMs was very high; 92% of participants said the KAM was "very helpful" and the other 8% said "somewhat helpful." Additionally, several customers commented on how important the KAM was to the success of their participation.

Customers were less satisfied with the amount of paperwork required by the Program. Although a majority of full participants said the amount of paperwork was "about right" or "minimal," nearly a third felt that it was "excessive."

Full participants and study-only customers differed in how much effect they thought the Program had on customers' awareness of ways to increase energy efficiency (see Table 6-19). Nearly half the full participants said the Program increased awareness "substantially," compared to only 12% of study-only customers. Similarly, when the two groups were asked how Program participation affected the customer's willingness to invest in energy-efficiency projects, 38% of full participants said their willingness "increased substantially" compared to only 12% of study-only customers.

Table 6-19
Effect on Awareness of Ways to Increase Efficiency

	Full Participants	**Study Only**
Increased awareness substantially	47%	12%
Increased awareness somewhat	44%	61%
Did not change awareness	9%	27%
Total	***64***	***33***

6.10.7 Evaluation

6.10.7.1 Methodology

In this study, savings estimates are characterized in terms of three distinct categories:

1. *Initial Gross Savings Estimates* (Program Savings) – savings estimates derived using engineering calculations during the project design phase;

2. *Verified Savings* – inspected savings verified by BC Hydro through its M&V procedures; and,

3. *"Net" Savings* - actual impacts of the Program, taking into account effects such as free-ridership, spillover, and naturally occurring conservation.

The ratio of "net" to initial gross savings estimates represents the savings *realization rate*, that is, that portion of expected gross savings that are directly attributable to the Program.

We estimated net savings using a regression-based method known as the statistically adjusted engineering (SAE) approach. This approach involved estimating a regression model with the following specification:

$$ADC_{it} = \alpha_i + \beta_1 LIGHTINGEE_i + \beta_2 OTHEREE_i + \lambda_1 HDD_{it} + \lambda_2 CDD_{it} + \varepsilon_{it}$$

Where, for each customer i and calendar month t,

- ADC_{it} is the average daily consumption during the pre- and post-participation periods for participants and non-participants;
- αi is a unique intercept for each participant and non-participant;
- $LIGHTINGEE_i$ is the initial engineering estimate of lighting savings and appears in the estimation only for PSP participants during the post-participation period;
- $OTHEREE_i$ is the initial engineering estimate of other measure savings and appears in the estimation only for PSP participants during the post-participation period;

- β_1 and β_2 represent savings realization rates for lighting and other measures respectively; a value of 1 represents a 100% realization rate;
- HDD_{it}, is average daily heating degree days based on facility location;
- CDD_{it} is the average daily cooling degree days based on facility location; and,
- ε_{it} is the error term.

Since this specification includes both participant and non-participant samples, the parameter estimates explicitly take into account the effects of non-Program related factors that influence electricity consumption.

We estimated the parameters of this model using a statistical procedure known as "analysis of covariance (ANCOVA) of fixed-effects" in which each project is treated as a separate case with its own unique intercept (α_I). This technique captures the unique characteristics of individual sites that affect electricity use and, hence, savings.

The analysis started with the 247 projects completed through June 2003. The types of measures and estimated initial gross savings, by sector, are shown in Table 6-20. Given the characteristics of the Industrial sector projects, it was necessary to exclude them from the SAE analysis. Since the survey results demonstrated no free-ridership among Industrial customers, we used BC Hydro's M&V results as the estimate of net savings for these projects.

Table 6-20
Disposition of Participant Sample by Customer Group

	SUCH	Non-SUCH	Industrial	Program
Number of Projects				
Lighting	129	101	1	231
HVAC	58	19	0	77
Refrigeration	0	7	0	7
Other	3	6	2	11
Industrial	1	11	8	20
*Total**	*128*	*109*	*10*	*247*
Total Initial Gross Program Savings				
Lighting	25,641,501	25,414,826	156,137	51,212,464
HVAC	5,009,824	11,038,111	0	16,047,935
Refrigeration	0	194,348	0	194,348
Other	168,563	305,911	23,860,000	24,334,474
Industrial	312,654	3,754,445	41,939,166	46,006,265
*Total**	*31,132,542*	*40,707,641*	*65,955,303*	*137,795,486*

* The sum of the individual measure installations is more than the total because more than one type of measure can be installed in a building.

Data used in the impact assessment were compiled from the BC Hydro Program tracking system, BC Hydro billing data system, and meteorological data. After cleaning the various data, the original number of participating facilities for analysis was reduced from 210 to 140.

The quasi-experimental research design used in this study presupposes that the Program participant (treatment) and non-participant (comparison) groups are comparable. To ensure comparability between the two groups, non-participants in each sector were drawn so that the distribution of annual consumption matched that of participants. The matching of the two samples was accomplished in two steps:

- Participants in each group were assigned to four quartiles based on their total annual consumption.
- Samples of non-participant were drawn through 500 Monte Carlo simulations to obtain a sample with a frequency distribution similar to participants in each quartile.

6.10.7.2 Summary of Results

Energy Savings Estimates and Realization Rates. Table 6-21 presents estimated *beta* coefficients for lighting and other measure initial gross savings. The absolute values represent "realization rates," i.e., net savings are calculated as the product of realization rates and Program (initial gross) savings. The results also show that all coefficients have the right sign and are statistically significant at a 99% or higher confidence level.

Table 6-21
Estimated Parameters of the SAE Model (R^2=0.99)

Variable	Estimated Beta Coefficients	T-test
Intercept*	4,341	20.6
Lighting Initial Gross Savings	-0.74 (±0.05)	-23.9
Other Measure Initial Gross Savings	-0.93 (±0.19)	-8.2
Average Heating Degree Days (HDD)	7.26	5.3
Average Cooling Degree Days (CDD)	62.0	15.8

* Represents the average intercept across all individual models.

Based on our analysis, the lighting realization rate is 0.74 with a 90% confidence interval from 0.69 to 0.79. The estimated realization rate for other measures is 0.93 with a confidence interval ranging from 0.74 to 1.12.

Table 6-22 presents pre-Program energy consumption, Program savings, verified savings, and our estimates of net savings for the three sectors and overall. Net savings, on average, represent nearly 90% of initial gross savings estimates. The savings realization rate was highest in the Industrial sector (101%) and lowest for the SUCH group (78%). On average, net Program savings represent 18% of pre-Program consumption in the SUCH, 13% in the Non-SUCH, and about 2% in the Industrial sectors.

Table 6-22
Overall Savings Summary, Sample Projects

	SUCH	Non-SUCH	Industrial	Overall
Number of Customers	112	89	9	210
Total Pre-Program Annual Usage (kWh)	131,614,000	253,253,000	2,680,482,000	
Average Pre Program Annual Usage (kWh)	1,175,123	2,845,543	297,831,283	NA
Average Post Program Annual Usage (kWh)	942,098	2,656,214	NA	NA
Total Program Savings (kWh)	31,132,542	40,707,641	65,955,303	137,795,486
Total Verified Savings (kWh)	30,606,892	42,292,726	66,543,917	139,443,535
Net Savings (kWh)	24,200,418	33,176,827	66,543,917	123,921,162
Savings Realization Rate	77.7%	81.5%	100.9%	89.9%

When our modelling results were combined with the estimates for the Industrial sector, 74% of the initial gross savings from lighting measures and over 99% of initial gross savings from all other measures combined were realized.

Realization Rate Issues and Implications

As described earlier, realization rates estimated using this approach simultaneously embody the effects of all Program and non-Program factors that influence energy savings, including free-ridership and spillover.

One such factor is interaction effects between end uses, in particular lighting and space conditioning. When efficient lighting measures are installed, the energy consumption needed for heating typically increases and energy for cooling decreases. Since commercial buildings served by BC Hydro have larger space heating loads than space cooling loads, it is likely that the overall interaction effect of higher efficiency lighting on space conditioning energy use, including the consumption of fans and pumps, would be an increase in usage. In our analysis, this would translate into a smaller lighting savings realization rate for buildings with both electric and non-electric heat.

Another factor that might decrease the estimated realization rate is spillover that reduces the energy consumption of non-participants. Our survey analysis showed that the Program did influence non-participants to reduce their energy consumption.

Although not all factors would reduce the estimated realization rate, we believe that our method produces a reasonably conservative estimate of the realization rates. Potential lighting/HVAC interaction effects can be relatively large and have a significant impact on the observed lighting realization rate.

Demand (kW) Impacts

Program demand impacts were estimated by applying measure coincidence factors derived from end-use load shapes. Demand impacts were calculated for two daily periods. Demand impacts were calculated in terms of both average annual (aMW) and peak-coincident demand impacts. Table 6-23 shows that the projects analyzed in this study can be expected to achieve more than 15 aMW in capacity savings and a peak load reduction of more than 18.5 MW.

Table 6-23
Summary of Energy and Demand Impacts, Sample Projects

	SUCH	Non-SUCH	Industrial	Overall
Program Savings (kWh)	31,132,542	40,707,641	65,955,303	137,795,486
Net Savings (kWh)	24,200,418	33,176,827	66,543,917	123,921,162
Demand Impacts:				
aMW	2.76	3.79	7.60	14.15
6:00 a.m. – 10:00 p.m. MW	3.62	4.96	9.96	18.54
5:00 p.m. – 7:00 p.m. MW	3.32	4.56	9.15	17.04

As shown in Table 6-24, for the full-participants conducting projects through fiscal year 2005, we estimated net impacts of the Program at nearly 380 GWh/year, which represents about 90% of the initial gross savings estimates. These savings are equivalent to about 43 aMW in capacity savings and peak impacts of 52 MW.

6.10.8 Recommendations

6.10.8.1 Savings Estimates

We recommend that BC Hydro adjust its estimates of Program savings for projects through March 2005 to reflect our net savings adjustments:

- 379.6 GWh energy savings per year; and
- 52.2 MW demand savings (5:00 to 7:00 pm).

For future savings estimates, we recommend applying the realization rates shown in Table 6-25 to adjust BC Hydro's initial gross savings to calculate net savings. In the longer-term we offer research recommendations later to refine these estimates and address free riders and spillover explicitly.

6.10.8.2 Programmatic

Customer Satisfaction

We recommend that BC Hydro solicit customer feedback on the Program participation process and paperwork and make any necessary adjustments to ensure consistency and accuracy and minimize paperwork requirements. We also recommend improving the energy-study process by increasing flexibility, ensuring that the process is timely, and providing more assistance with the process, energy issues, and paperwork.

Table 6-24
Summary Cumulative Impacts by Sector and Year

Year	Savings Estimate	SUCH	Non-SUCH	Industrial	Overall
2002	Initial Gross	5,067,106	8,868,845	25,796,509	39,732,460
	Reported Net	4,590,696	7,858,320	22,791,216	35,240,232
	Evaluated Net	3,862,983	7,120,169	26,024,856	37,008,009
2003	Initial Gross	15,463,142	57,246,585	41,087,394	113,797,122
	Reported Net	13,890,780	51,949,356	37,541,484	103,381,620
	Evaluated Net	11,788,555	45,959,242	41,451,094	99,198,891
2004	Initial Gross	29,156,509	118,405,176	98,587,852	246,149,537
	Reported Net	26,273,748	106,921,044	90,427,608	223,622,400
	Evaluated Net	22,227,897	95,059,158	99,460,536	216,747,591
2005	Initial Gross	51,175,115	157,020,172	212,674,249	420,869,535
	Reported Net	45,724,704	141,741,336	196,675,053	384,141,093
	Evaluated Net	39,014,107	126,060,412	214,556,809	379,631,327
Sector Net-to-Gross Ratio		76%	80%	101%	90%

Table 6-25
Realization Rates: Net Savings/Initial Gross Savings

	Industrial	SUCH + Non-SUCH	Program
Lighting Measures	100%	74%	74%
Other Measures	101%	93%	99%

Program Promotion and Recruitment

KAMs should continue to play a major role in the Program outreach. If demands on KAMs are likely to become excessive, BC Hydro should set up other mechanisms to give potential participants the required hands-on assistance.

KAMs should increase their efforts to track when customers are planning to conduct major renovations or retrofits and work with them to use PSP as a way to make significant efficiency improvements as part of these projects.

Direct customer promotion should be expanded to reach those customers who have not yet taken an active role in the Program. Information (such as case studies) demonstrating the benefits of the Program for specific customer types and circumstances should be developed and actively disseminated.

Program promotional materials should be used as a means of educating customers about the use of economic criteria to evaluate energy-efficiency projects. BC Hydro should expand awareness of the technical assistance offered through the Program and should concentrate on informing Partner non-participants about the availability and benefits of technical assistance.

Program Tracking

The customer and Program application tracking systems used by BC Hydro should continue to be improved. Information should be maintained for all key events in each project (and site) so that project histories can be tracked and reconstructed. All end-use energy savings estimates, by project and site, also should be maintained in a consistent, easily accessible database.

6.10.8.3 Evaluation

Based on our findings, we believe that BC Hydro could benefit from the information that would be provided by conducting the following research:

- Update this study with a similar evaluation of projects conducted since mid-2003 and reflect updated savings adjustments (such as those BC Hydro is preparing for efficient lighting).

- *Expand the free rider and spillover analyses*. Expand these analyses with additional survey data and include the full range of Program savings channels such as e-Points and consultative savings. Because of the importance of these factors, this is a high priority research area.

- *Examine the relationship between customer energy decision-making processes and Program participation,* for example, why customers that have a group of facility staff responsible for energy cost control and efficiency appear to be less likely to follow up an energy study with project implementation.

APPENDIX A

APPENDIX A: CHRONOLOGICAL LIST OF EVALUATION PUBLICATIONS

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