Ontario Energy Board

Ontario

Ontario Smart Price Pilot
Final Report

July 2007

Prepared by IBM Global Business Services and eMeter Strategic Consulting for the Ontario Energy Board

Strategic Consulting

IBM

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Acknowledgements

The authors would like to acknowledge several people without whom this study would not have been possible.

Without the cooperation and support of Hydro Ottawa, we simply could not have completed the study. They let us share in the carefully maintained and trusted relationship between them and their customers. In particular, Owen Mahaffy, Stuart Morrison and Morgan Barnes worked many extra hours to help design the customer materials, provide base customer information, resolve specific issues with customers, support the focus groups, and ensure we had the hourly interval data we needed.

Dr Frank Wolak, a Professor in the Department of Economics at Stanford University, provided overall guidance on the study design and completed the analysis of demand response and conservation effects. The rigour and sophistication of the analysis is entirely a result of Frank's leading research.

Finally, Chris Cincar of the OEB was more than a typical client project manager. We are indebted to him for his overall guidance and detailed reviews. The overall quality of the study and final report is much enhanced through his involvement.

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July 2007

Executive Summary

In June 2006, the Ontario Energy Board (the Board) initiated the Ontario Smart Price Pilot (OSPP) project to test the reactions and impacts on consumer behaviour of different time-sensitive price structures. By August 1, 2006, 375 of Hydro Ottawa's electricity customers had been placed into one of three pricing groups and were receiving monthly Electricity Usage Statements in addition to their bi-monthly electricity bills.

The OSPP was operated until February 28, 2007 with the intent to assess:

- The extent to which various time-sensitive pricing structures cause a shift of electricity consumption to off-peak periods as measured by the reduction in peak demand
- The extent to which each price structure causes a change in total monthly consumption.
- The understandability of and acceptability by residential consumers of each pricing structure and the communications associated with each.

Results of the OSPP were measured through the quantitative analysis of demand response, total energy conservation, and participant survey responses. Qualitative feedback was garnered from focus groups and tracking of participant support calls.

The results are intended to inform the Board with respect to future decisions associated with time-sensitive prices including the potential application of critical peak pricing and any refinements to the current Regulated Price Plan (RPP) time-of-use (TOU) pricing structure and associated consumer communications. [1]

Price Designs

The OSPP tested three different price structures:

- The existing RPP TOU prices, as in the table below.
- Adjusted RPP TOU prices with a critical peak price (CPP)
- RPP TOU prices with a critical peak rebate (CPR)

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[1] - The RPP is for low volume electricity consumers that do not opt to switch to a retailer. The Board sets two-tier and TOU commodity prices as part of the RPP. Virtually all RPP consumers in Ontario currently pay two-tiered threshold (non-TOU) prices.

Time	Summer Hours (Aug 1 - Oct 31)	Price/ kWh	Winter Hours (Nov 1 - Feb 28)	Price/ kWh
Off-Peak	10 pm - 7 am weekdays; all day on weekends and holidays	3.5¢	10 pm - 7 am weekdays; all day on weekends and holidays	3.4¢
Mid-Peak	7 am - 11 am and 5 pm - 10 pm weekdays	7.5¢	11 am - 5 pm and 8 pm - 10 pm weekdays	7.1¢
On-Peak	11 am - 5 pm weekdays	10.5¢	7 am - 11 am and 5 pm - 8pm weekdays	9.7¢

TOU prices are unchanged from the Board's existing Regulated Price Plan (RPP) TOU prices

Critical peak pricing is the application of different prices for specific hours of the year when the electricity system is stressed and/or hourly energy market prices are high. For the OSPP, critical peaks were to occur only for 3 or 4 hours during the On-Peak period, and only on declared critical peak days. Critical peak days were declared based on temperature and Humidex thresholds. Participants were notified by telephone, email or text messages one day before the event.

The maximum number of critical peak days planned for the pilot was nine. During the pilot, seven critical peak events were declared due to moderate weather: two in August, two in September and three in January.

A critical peak price of 30¢ per kWh was set based on the average of the 93 highest hourly Ontario electricity prices in the previous year. For critical peak price (CPP) participants, the RPP Off-Peak price was reduced to 3.1 ¢/kWh to offset the increase in the critical peak price.

In contrast to CPP, participants on the critical peak rebate plan were provided a refund of 30¢ for every kWh reduction below their "baseline" usage during the critical peak hours. The baseline was calculated as the average usage for the same hours of the five previous non-event, non-holiday weekdays, multiplied by 125% as a weather adjustment.

All prices are related to the commodity portion of a customer's electricity bill; delivery, fixed, debt retirement, and other charges were not changed as a result of the pilot.

Customer Participation

Candidate participants were randomly selected from the population that would have smart meters installed in Hydro Ottawa's territory by August 1, 2006.

In a marked difference from other residential TOU pilot projects, the OSPP was over-subscribed after only one recruitment solicitation and within about one week. While a 10% enrolment rate was expected, in fact, out of 1,800 recruitment letters sent (600 for each targeted price group) to customers with smart meters, 459 people

responded by submitting an enrolment form before enrolment was closed, a 25.5% response rate.

The result was 373 participants in the pilot, 125 in a CPR price group, and 124 each in TOU-only and CPP groups.

The control group is a sample of 125 customers selected randomly from the population of Hydro Ottawa residential customers who had smart meters installed prior to the August 1, 2006 start of the pilot but continued to pay regular tiered (non-TOU) prices.

All treatment and control participants are RPP consumers (i.e., not on a retailer contract).

Pilot Operation

Upon enrolment, participants were provided with a table of the TOU prices, periods, and seasons for the participant's price plan on a refrigerator magnet, and a PowerWise electricity conservation brochure.

As an incentive to enrol, participants received a "thank you payment" of $75.00 at the end of the pilot, adjusted as described below.

To accommodate the needs of the pilot, participants continued to receive and pay their "normal" bi-monthly electricity bill from Hydro Ottawa.

Separately, pilot participants received monthly Electricity Usage Statements that showed their electricity supply charges on their respective pilot price plan. The statements were mailed to participants monthly, and all usage was on a calendar month basis.

At the end of the pilot, participants received a final settlement statement comparing their electricity charges on the pilot prices with what their charges would have been on the two-tiered RPP prices.

With a final settlement in March 2007, at the end of the pilot, participants received a cheque in an amount equal to the base $75 incentive adjusted by the amount of their savings or losses on TOU pricing. Thus, participants faced actual economic gains or losses based on their response, or lack thereof, to TOU prices.

Demand Response Results

The analysis of demand response or peak shifting as a result of the pilot prices was performed by Professor Frank Wolak of the Economics Department of Stanford University.

The analysis was performed to assess the following:

- Demand response via load shifting away from critical peak hours to either Mid-Peak or Off-Peak hours on critical peak days
- Demand response via load shifting away from On-Peak hours to either Mid-Peak or Off-Peak hours on all non-holiday weekdays

These effects are determined by comparing the electricity consumption behavior of customers receiving the experimental prices (TOU, CPP, and CPR) and the behavior of customers remaining on their existing two-tier RPP prices. These customer groups are the treatment and control groups respectively.

Critical Peak Days

The table below shows the amount of load shifting on individual critical peak days for all three price groups combined for the entire On-Peak period. A statistically significant shift in load away from peak periods was measured during On-Peak periods on two critical peak days called in August. No statistically significant shift was detected during the critical peak days declared in September or January, except for a counterintuitive result for January 17.

Critical Peak Day (Entire Peak Period)	Summertime Load Shifting	Actual Max Temp (°C)	Actual Max Humidex
Friday, August 18	27.7%	30.0	35
Tuesday, August 29	10.1%	25.2	28
Thursday, September 7	n/s	22.4	n/a
Friday, September 8	n/s	26.5	31
	Wintertime Load Shifting	**Actual Min Temp (°C) During Peak Period**	
Tuesday, January 16	n/s	-18.7	
Wednesday, January 17	-7.2%	-16.1	
Friday, January 26	n/s	-21.3	

Statistically significant load shifting was detected for the first two summertime and the second wintertime critical peak events – though the winter result is counterintuitive. Seven critical peak events (against a target of nine) were called during the pilot using forecast temperature thresholds of 28°C in summer (or a Humidex above 30°C) and -14°C in winter. Results are statistically significant at the 90% level, unless denoted by "n/s".

Results that are not statistically significant at the 90% level are denoted by "n/s"; however, many of the load shift results are statistically significant at the 95% and even 99% confidence level.

As detailed in the table on the following page, the resulting load shifting during critical peak hours across all four summertime critical peak days ranged from 5.7% for TOU-only participants to 25.4% CPP participants. Percentage load shifting during the

entire summertime peak period (11am to 5pm) during the same critical peak days was less, ranging from 2.4% to 11.9%.

Summertime Period	TOU only	CPP	CPR
Critical peak hours (3 or 4 hours during the peak)	5.7%(n/s)[2]	25.4%	17.5%
Entire On-Peak period (6 hours)	2.4%(n/s)[2]	11.9%	8.5%

Percentage shift in load during the four summertime critical peak days of the pilot.

All Days

Load shifting away from the On-Peak period for all days in the pilot, not just critical peak days, was also analyzed. These results showed no applicable statistically significant load shifting from On-Peak periods as a result of the TOU price structure alone.

Conservation Effects

The analysis compared the usage of the treatment and control groups before the pilot, then after going on the pilot.

These results show a 6.0% average conservation effect across all customers. All of the results are statistically significant.

Price Group	Percent reduction in total electricity use
TOU	6.0%
CPP	4.7%(n/s)[3]
CPR	7.4%
Average	**6.0%**

Conservation Effect (total usage reduction) for the full pilot period

Customer Bill Impacts

Total Load Shift Impacts

The impacts on bills were determined by calculating each individual participant's bills during the pilot under the TOU prices versus the two-tiered RPP prices. Thus, any

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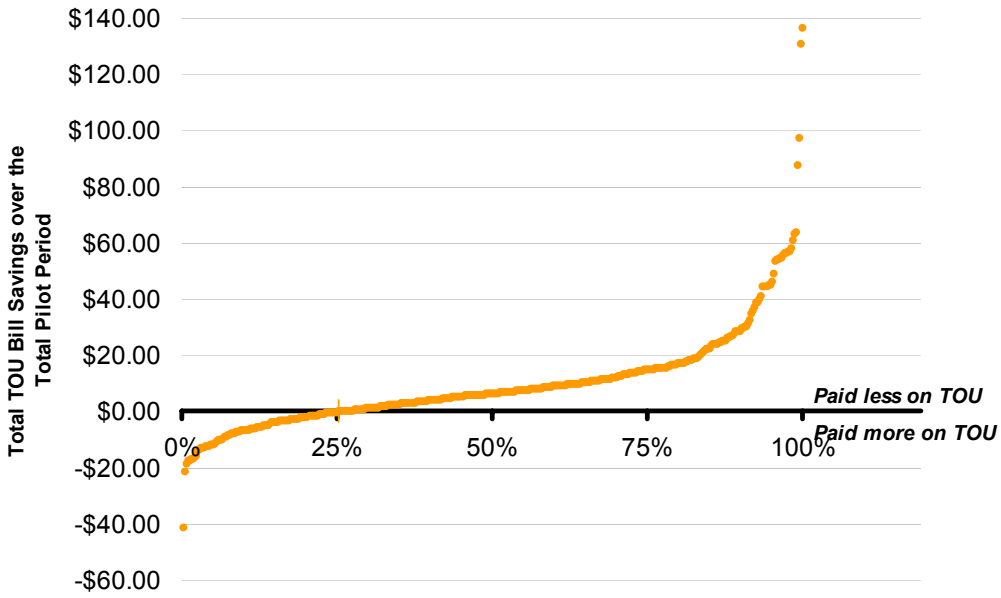
[2] The percentage reductions for the TOU-only customers are not statistically significant at a 90% confidence level and can therefore not be as readily generalized to a large population. They do represent actual reductions recorded for that group. Had there been more critical peak days, it is likely these results would be statistically significant.

[3] - This result is not statistically significant at the 90% confidence level but is included here because it is significant at a confidence level of 88%, or just less than 90%. This small difference does not apply to the other "n/s" results in this report.

bill savings is entirely a result of load shifting. Conservation effects which lower a participant's usage compared to what it would have been without TOU prices are not considered in these results.[4]

Over the course of the entire pilot period, on average, participants shifted load and paid 3.0% lower bills on the TOU pilot prices than they would have on regular tiered RPP price. Savings were spread across participants with three quarters of participants paying less on the TOU prices.

Since only seven critical peak days were declared against a target of nine, CPP participants realized savings that were somewhat overstated. Conversely, CPR participants realized lower rebates during the pilot for the same reason.



Distribution of participant bills savings on TOU prices for the total pilot period as a result of load shifting alone (i.e. not conservation). Each dot represents an individual participant's net loss or savings. Those above the line paid less on TOU prices.

Monthly Load Shift Impacts

Monthly comparisons between TOU and the two-tiered RPP threshold prices are problematic. The RPP threshold prices are designed from a year-long perspective, taking into consideration expected higher usage in summer and winter months, and

[4] - While it was the TOU price plans that triggered the "conservation effect", the reduction in consumption would be reflected in charges on both two-tier prices and TOU prices.

lower usage in spring and fall months. The RPP seasonal tier threshold changes from 600 kWh to 1,000 kWh per month in November. Under this price structure, consumers who use more than the threshold level of usage pay a higher average price in the summer than the winter. Over the full pilot, such threshold effects are offset when looking at the total bill impacts.

Monthly comparisons are provided in this report to understand the implications for participant's making individual bill comparisons. Results by individual month were generally consistent with the total.

August was the only month that the average savings across all three price groups was below zero. It was in August that the most participants experienced a significant increase, with one participant experiencing monthly increases as high as $12.81. Savings of up to $35.55 in an individual month were experienced by some participants.

These cost increases or savings were extreme. Of the approximately 2625 statements issued, 5% had TOU savings greater than $8.84. Similarly, only 5% had costs greater than $3.46.

Savings from Conservation Impacts

Savings when the conservation effect is considered would be greater. Assuming a 6.0% conservation effect alone, and based on the average price of 5.9¢/kWh, the savings would range from a few cents for the lowest volume user to over $6 per month for the largest user. Average monthly use for pilot participants was 727 kWh after conserving 6%, ranging from 683 kWh for the TOU-only group to 774 kWh for the CPR group. Thus the conservation effect at the average price of 5.9¢/kWh resulted in savings averaging $2.73 per month.

With this conservation effect added to the load shifting impacts, the average monthly TOU bill savings from both load shifting and conservation effects was $4.17. With conservation considered, 93% of customers would pay less on RPP TOU prices over the course of the pilot, than they would have on RPP threshold prices (compared to 75% without conservation being considered).

Participant Feedback

Participant feedback was gained from two primary methods:

- Three focus groups with 44 participants were conducted in Ottawa during the second week of October; one group each for CPP, CPR, and TOU participants.
- A survey of the program participants was conducted. A total of 298 surveys were returned by the survey cut-off date of December 14, 2006, for an overall response rate of 79%. The margin of error (at 95% confidence) for the overall results is ± 5.7% for the 298 surveys received.

Overall satisfaction

The majority (78%) of survey respondents would recommend the time-of-use pricing plan to their friends, while only 6% would definitely not. These results are consistent regardless of which pricing plan the participants were enrolled in for the pilot.

Respondents most frequently cited more awareness of how to reduce their bill, giving greater control over their electricity costs and environmental benefits as the top three reasons behind the satisfaction.

Those not sure or who would not recommend the program cited insufficient potential savings and too much effort as the reasons why.

Pricing preferences

Regardless of the pricing plan in which they were enrolled, the majority of participants (74%) preferred TOU-only pricing out of the four options.

While interest in the CPP and CPR plans was only moderate, less than 20% prefer the existing two-tier threshold pricing used by Hydro Ottawa before the pilot. Most would not want to go back to two-tier pricing.

Expected Bill Impact

The impact on individual bills seemed to be less than many focus group participants had hoped. Few of the focus group participants felt they had realized “large” savings on their electricity bills. In fact, many focus group participants expressed disappointment that their efforts did not result in greater savings.

These bill comparisons by participants are complicated by many factors:

- Comparisons of pilot Electricity Usage Statements calculated for each calendar month against bi-monthly bills from Hydro Ottawa calculated from various billing dates
- Comparisons of electricity commodity changes alone against a Hydro Ottawa bill that includes distribution and other charges
- (As described above in 5.3.3) comparisons between pricing structures that are designed to be revenue neutral for an entire year, but have different effects on individual months
- Finally, comparisons that do not consider the bill reductions resulting from the average conservation effect realized by participants on TOU prices.

Information Provision

Participants in the focus groups and survey respondents particularly valued the monthly usage statement and refrigerator magnet as the most useful resources to help understand the TOU prices, overshadowing the fact sheet, brochure, or any other pilot communications materials.

There was a consensus among focus group participants that bi-monthly billing frequency was not adequate within the context of smart meters and TOU pricing.

Nearly 70% of survey responses did indicate that they anticipate accessing an online statement at least monthly.

Pricing Structure Feedback

The consensus feedback among focus group participants was that TOU pricing structure was easy to understand and did not need to change:

- When asked if they would prefer only two TOU periods (off- and on-peak, without mid-peak), none of the focus group participants said they desired a change to a two-period TOU structure from the current three-period TOU structure
- For the most part (71%), survey respondents felt that the difference in price points was large enough to encourage them to shift their electricity consumption.

1 Introduction

This report summarizes the design, operation and outcomes of the Ontario Smart Price Pilot (OSPP) undertaken by the Ontario Energy Board (the Board) from August 1, 2006 to February 28, 2007. The OSPP tested the reactions and impacts on consumer behaviour of three different price structures:

- Time-of-use (TOU) prices
- TOU prices with a critical peak price
- TOU prices with a critical peak rebate

The pilot was initiated in mid June of 2006 and recruited participants were placed on the TOU prices starting on August 1, 2006. Originally the pilot was intended to end on December 31, 2006, but the Board subsequently decided to extend the pilot period until February 28, 2007 to capture the coldest winter months.

Outcomes are measured through the quantitative analysis of demand response, total electricity conservation, and participant survey responses. Qualitative feedback was garnered from focus groups and tracking of participant support calls.

1.1 Background

The Government of Ontario has committed to install a smart electricity meter in 800,000 homes and small businesses by 2007, and throughout Ontario by 2010. The continued installation of smart meters will ultimately enable the application of TOU pricing, as set by the Board, to all electricity consumers on the Regulated Price Plan (RPP), i.e., those consumers not on a retailer contract. Virtually all RPP consumers in Ontario currently pay two-tiered threshold (non-TOU) prices.

Implementation of TOU pricing on a mandatory, Province-wide basis for consumers with smart meters has been deferred pending the further deployment of smart meters. The installation of smart meters and their enrolment into the provincial meter data management and repository (the “MDM/R”) is being done on a phased basis. The MDM/R is currently under development by the Independent Electricity System Operator (IESO) and will be eventually operated by the Smart Metering Entity (SME).

The complete services to be provided or offered by the SME through the MDM/R have yet to be determined. Regulations currently contemplate that the SME will perform the following meter data functions:

- Verification, validation and editing of meter data received from distributors

- Processing and aggregation of meter data into price periods that is ready for billing purposes
- Storing and maintaining of meter and associated data

Deferral of mandatory TOU pricing has provided the Board with an opportunity to initiate the OSPP to test different time-sensitive price structures for RPP consumers. The Board also hopes to gain further insights into how consumers respond to TOU prices, prior to their large-scale introduction in Ontario.

As part of the initial development of the RPP, the Board's RPP Proposal of December 2004 made a commitment to investigate the feasibility of implementing a critical peak pricing component to supplement the TOU RPP prices. This commitment specifically identified pilot projects as part of the investigation.

1.2 Pilot Objectives

The Ontario Smart Price Pilot is intended to assess:

- The extent to which various time-sensitive pricing structures cause a shift of electricity consumption to Off-Peak periods as measured by the reduction in peak demand
- The extent to which each price structure causes a change in total monthly electricity consumption
- The understandability of and acceptability by residential consumers of each pricing structure and the communications associated with each

The results in this report are intended to inform the Board with respect to future decisions associated with CPP and CPR as well as whether refinements are needed to the current RPP TOU pricing construct and associated consumer communications.

1.3 Other RPP TOU Developments

In July 2006, the Ontario Ministry of Energy arranged with the IESO that the IESO would support the government's Smart Metering Initiative by coordinating and project managing implementation activities, including delivery of the MDM/R functionality.

Of Ontario's 80+ electricity distributors, five are now working closely with the IESO to integrate their billing systems with the MDM/R:

- Newmarket Hydro is expected to be the first utility operational with the MDM/R. They plan to introduce TOU prices in the fall of 2007.
- Chatham-Kent Hydro is already implementing TOU pricing on a small scale. On March 23, 2007, the first TOU bills were issued to 215 customers for the January 2, 2007 to March 6, 2007 read dates. Once testing is complete with the MDM/R

later this summer, Chatham-Kent Hydro plans to start the roll out of TOU pricing to all of its customers.

- Horizon Utilities is also expected to begin integration with the MDM/R later this summer, and then begin the roll-out of TOU prices.
- Since the RPP was introduced in April 2005, Ontario distributors were permitted to make TOU pricing mandatory for their customers with smart meters. Milton Hydro is the only Ontario utility that has opted to implement RPP TOU pricing on a relatively large scale for its customers with smart meters. Milton Hydro first implemented TOU pricing in October 2005 and currently has about 5,000 RPP TOU customers. The plan is to have over 15,000 customers on RPP TOU pricing by the end of the year. Milton Hydro is expected to integrate their systems with the MDM/R later this fall.
- Hydro Ottawa is expected to begin integration with the MDM/R by the end of 2007 and become the fifth Ontario distributor to implement TOU prices on a larger scale.

On June 27, 2007, the Board finalized SSS code amendments. One of these code amendments was intended to increase flexibility for distributors during the interim period by allowing distributors to implement TOU pricing on a voluntary basis for their customers.

1.4 Other Ontario TOU Pricing Pilots

In parallel with initiating this pilot, the Board also issued Standard Supply Service Code (the “SSS Code”) amendments that permit other Ontario distributors to implement similar TOU pricing pilots where they are complementary to the OSPP.

As of June 2007, the Board had approved pilot programs of four distributors under section 3.9.1 of the SSS Code.

1.4.1 Newmarket Hydro

Newmarket Hydro is operating a pilot project involving smart thermostats in conjunction with RPP TOU pricing and Critical Peak Rebates (CPR). In October 2006, 253 participants began to receive TOU bills. The pilot is scheduled to run until the end of October 2007. Notification for CPR events will be a mix of “day of” or “day before” a CPR period. The same critical peak price of 30¢/kWh is being used. Newmarket Hydro will automatically control the air conditioners of some participants using programmable thermostats during summertime critical periods. No CPR or thermostat control events have been conducted as yet (other than a technical test in November). The participants are included in six treatment groups based on combinations of being placed on CPR prices, exposed to enhanced education, and provided with a programmable thermostat.

1.4.2 Oakville Hydro

Oakville Hydro's TOU pricing pilot project involves sub-metered residential condominiums. This project will allow the Board to assess the impact on consumption of sub-metering a bulk metered condominium alone and then the incremental impact of applying RPP TOU prices. As of December 2006, 370 participants in three condominiums had been recruited.

1.4.3 Veridian Connections

Veridian Connections is operating a TOU pricing pilot project involving medium-sized business consumers. In total, 55 customer accounts with peak demand greater than 200 kW are taking part in the pilot. In aggregate, these customers represent peak demand of approximately 20 MW and annual consumption of 140 GWh. The pilot started in March 2007 and will run through to September 2007. It will allow for a direct comparison of the price elasticity of general service consumers with that of residential consumers in the other OEB-approved pilots. The results of the Veridian pilot could also be extrapolated to similar consumers of other distributors and will help inform the communication efforts of the Board, the IESO, and other electricity distributors to those designated consumers who are expected to be ineligible for RPP prices after April 1, 2008.

1.4.4 Hydro One

Hydro One's TOU pricing pilot project involves about 500 residential, farm and small business consumers and real-time in-home display monitors (as well as smart thermostats). This pilot is currently in the recruitment phase and implementation is planned over the summer of 2007.

About half of the pilot participants will not receive the in-home display monitors which will allow for a comparison between customers with and without such monitors. Participants will be asked to fill out two questionnaires during the pilot (one at the beginning and the other at the end of the pilot) to gather further information about appliance and equipment usage as well as actions taken to change the consumption patterns during the pilot project. This is intended to help better understand the reasons for potential changes in the hourly electricity consumption patterns.

1.4.5 Peterborough Distribution Inc

In addition to the above pilots approved under section 3.9.1 of the SSS Code, Peterborough Distribution Inc. (PDI) has been conducting a pilot program on TOU prices since 2005 in conjunction with two of its conservation and demand management (CDM) programs. PDI has been billing TOU prices to about 200 customers for over two years. (This pilot was approved by the Board as part of PDI's CDM plan prior to the Board's issuance of SSS Code amendments requiring approval of pilot projects involving RPP TOU pricing.)

Thermal Storage Heating for Social Housing

PDI provided financial, technical and administrative expertise to convert 124 electrically heated social housing units from baseboard electric heating to electric thermal storage heaters. The storage heaters use electricity in Off-Peak periods and store that heat in specially designed ceramic bricks for use during On-Peak periods. As such, consumption during On-Peak periods is at Off-Peak prices. Based on calculations using the methodology in the Board's TRC guide for annual CDM filings, the consumption shifted from On-Peak to Off-Peak is calculated to be 4 million KWh over the 18 year life of the 124 units. The estimated savings to the City of Peterborough's Housing Corp. is $47,500 per year.

Residential Appliance Controllers

A radio signal control system is used to control residential appliances (A/C, hot water tanks, pool pumps, clothes washers, dryers, dishwashers). The controller causes a shift in discretionary use of electricity to Off-Peak times. This CDM program, currently controlling 314 appliances for 200 residential customers, is estimated to be reducing summer peak by 155 kW and winter peak by a further 645kW. Energy savings are estimated at over $896,000 over the 12 year life of the 200 controllers. With the availability of smart metering and TOU prices, customers are volunteering to participate in this CDM initiative.

1.4.6 Summary

Together, these pilot projects cover the spectrum in terms of consumer groups currently eligible for RPP (residential in homes and condominiums, farms, small businesses and medium-size businesses). In addition, the first three pilots involve consumers in *urban* areas, while the consumers in Hydro One's pilot are in *rural* areas.

The initial distributor proposals, the Board Decision on each and (as they become available) final outcomes for these pilots are available on the OEB's website, on the same web page dedicated to the Ontario Smart Price Pilot project, at www.oeb.gov.on.ca/html/en/industryrelations/ongoingprojects_regulatedpriceplan_smartpricepilot.htm

2 Price Design

Three different commodity price structures were tested during the pilot:

- The existing RPP TOU prices
- The existing RPP TOU prices with a critical peak price
- The existing RPP TOU prices with a critical peak rebate

Participant usage on these three price plans was compared with the usage of customers in a fourth "control" group who also have smart meters but remained on the two-tiered RPP prices.

The three price structures are designed to be as revenue neutral as possible relative to each other. This is defined such that a participant whose electrical usage is distributed across the hours in the same way as the provincial average for all RPP consumers will pay approximately the same bill on all three options in the absence of any change in usage. This revenue neutral approach is the same design used in the California Statewide Pricing Pilot and the PowerCentsDC pilot in Washington D.C. By controlling for total bill amounts prior to demand response to the prices, the revenue neutral design allows for a more accurate comparison of the demand response effects associated with the three price designs tested.

All RPP TOU prices were adjusted during this pilot for all three groups to reflect changes to the RPP prices applied across the province on November 1, 2006. This change in RPP prices was relatively minor. As such, the critical peak price and rebate amount remained the same throughout the pilot. This change is important to continue a valid comparison against the prices charged to the control group.

All prices on the pilot are related solely to the commodity portion of a customer's electricity bill; delivery, fixed, debt retirement, and other charges were not changed as a result of the pilot.

All three price structures tested in the pilot are described in more detail below.

2.1 Tiered Prices for Control Group

The conventional meter RPP has prices in two tiers, one price for monthly consumption under a tier threshold and a higher price for consumption over the threshold. The threshold for residential consumers vary by season:

- 600 kWh per month during the summer season (May 1 to October 31)
- 1000 kWh per month during the winter season (November 1 to April 30).

The two-tiered RPP prices in effect during the pilot period and applied to all control group customers are provided in Exhibit 1.

Summer (Aug 1 – Oct 31)	Price/ kWh	Winter (Nov 1 – Feb 28)	Price/ kWh
First 600 kWh per month	5.8¢	First 1,000 kWh per month	5.5¢
Remaining kWh	6.7¢	Remaining kWh	6.4¢

Exhibit 1: Tiered RPP prices applicable to all RPP consumers in Ontario and paid by control group customers.

The rationale for tiered pricing was to provide a price signal to consumers to conserve until such time as smart meters are installed and TOU pricing can be applied across the province.

The tier thresholds are set such that there is roughly a 50/50 split of forecast consumption at the lower tier price and at the higher tier price, resulting in tiered prices that are distributed symmetrically around the average RPP supply cost. [5]

The two-tiered RPP prices and the RPP TOU prices are established based on the same average RPP supply cost (or average RPP price) as shown in Exhibit 2 for the most recent RPP prices as of May 1, 2007. The breakdown by TOU period (i.e., % of consumption) is based on the load profile used for all RPP consumers.

Tiered RPP Prices	Tier 1		Tier 2	Average Price
Price	5.3¢		6.2¢	5.7¢
% of Consumption	53%		47%	
Time-of-Use RPP Prices	**Off-Peak**	**Mid-Peak**	**On-Peak**	**Average Price**
Price	3.2¢	7.2¢	9.2¢	5.7¢
% of Consumption	48%	29%	23%	

Exhibit 2: Tiered and TOU RPP prices are both based on the same average RPP supply cost.

5 - See Ontario Energy Board, "Regulated Price Plan Price Report May 1, 2006 to April 30, 2007," April 12, 2006, for details. It is available at www.oeb.gov.on.ca/documents/cases/EB-2004-0205/rpp_pricereport-may06-apr07_120406.pdf

2.2 RPP Time-of-Use (TOU) Prices

The existing RPP TOU prices and hours alone (without any critical peak adjustments) were used for one of the treatment groups in the pilot. These prices reflect the changes to the RPP prices that came into effect November 1, 2006.

Time	Summer Hours (Aug 1 - Oct 31)	Price/ kWh	Winter Hours (Nov 1 - Feb 28)	Price/ kWh
Off-Peak	10 pm - 7 am weekdays; all day on weekends and holidays	3.5¢	10 pm - 7 am weekdays; all day on weekends and holidays	3.4¢
Mid-Peak	7 am - 11 am and 5 pm - 10 pm weekdays	7.5¢	11 am - 5 pm and 8 pm - 10 pm weekdays	7.1¢
On-Peak	11 am - 5 pm weekdays	10.5¢	7 am - 11 am and 5 pm - 8pm weekdays	9.7¢

Exhibit 3: RPP TOU prices are unchanged from the Board set prices

2.3 Critical Peak Pricing

As with RPP TOU prices, the Critical Peak Price was designed to be as revenue neutral as possible. The critical peak price was determined to be the average price of the highest 93 hours between June 2005 and June 2006, based on the hourly Ontario electricity prices (the HOEP).

The applicable RPP TOU prices and hours were used for all non-critical hours during the pilot; however, the Off-Peak price was reduced to 3.1 ¢/kWh to offset the increase in the Critical Peak Price of 30 ¢/kWh.

The resulting prices are shown in Exhibit 4.

Time	Summer Hours (Aug 1 - Oct 31)	Price/ kWh	Winter Hours (Nov 1 - Feb 28)	Price/ kWh
Off-Peak	10 pm - 7 am weekdays; all day on weekends and holidays	3.1¢	10 pm - 7 am weekdays; all day on weekends and holidays	3.1¢
Mid-Peak	7 am - 11 am and 5 pm-10 pm weekdays	7.5¢	11 am - 5 pm and 8 pm-10 pm weekdays	7.1¢
On-Peak	11 am - 5 pm weekdays	10.5¢	7 am - 11 am and 5 pm-8pm weekdays	9.7¢
CPP	3 to 4 hours during On-Peak, invoked up to 9 times during the pilot	30.0¢	3 to 4 hours during On-Peak, invoked up to 9 times during the pilot	30.0¢

Exhibit 4: Critical Peak Prices. The Off-Peak price is reduced under Critical Peak Prices

The CPP represents about a three-fold increase over the On-Peak price. The reason for the different percentage amounts (in terms of the reduction in the Off-Peak price versus the increase from the On-Peak price to the Critical Peak Price) is that critical

peak prices are in effect during the few hours when critical events are declared, while Off-Peak prices are in effect for over 4,700 hours (or over half of all hours).

Critical peak pricing only occurs for 3 or 4 hours during the On-Peak period, on critical peak days only. The maximum number of critical peak days planned for the pilot was nine.

2.4 Critical Peak Rebate

The OSPP also tests the impacts of a Critical Peak Rebate (CPR) pricing structure. In contrast to the CPP, the CPR provides a refund to participants for reductions below their "baseline" usage during the critical peak hours.[6] To strive for revenue neutrality, the rebate amount was set to be the same as the Critical Peak Price during critical peak hours. Also, since the incentive during the critical peak hours is a rebate, there is no adjustment in the Off-Peak price. A participant making no change in response to the critical peak events will pay the same bill on TOU plus CPR as they would if they were a participant on TOU-only prices.

The existing RPP TOU prices and hours were used during the pilot. As for CPP above, Critical Peak rebates were in effect only when critical events were declared, a maximum of nine events were planned during the pilot and only for three or four hours during On-Peak hours.

2.4.1 Baseline Determination

For a participant to receive a rebate, their consumption had to be below a baseline. This means that the higher the baseline, the easier it is for a participant to earn a rebate (i.e. use an amount of electricity less than the baseline amount).The baseline methodology was developed by reviewing other baseline methodologies used for other residential CPR programs, as well as baselines used for large commercial consumer curtailable programs. Baseline methods considered were the following:

- PJM Interconnections: Usage for the same hours in the three highest of the ten previous non-event, non-holiday weekdays
- New York Independent System Operator: Five highest of the ten previous non-event, non-holiday weekdays
- Anaheim Public Utilities: Three highest non-event, non-holiday weekdays in the first half of summer
- PowerCentsDC pilot in Washington D.C.: Three highest non-event, non-holiday weekdays in the previous month

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6 - See Appendix A, Analysis of Critical Peak Rebate Program Concept.

- San Diego Gas & Electric (SDG&E): Average of previous five non-event, non-holiday weekdays

The SDG&E approach is the most recently developed and was based on a detailed analysis of residential consumer data. Its advantage is its computational simplicity. However, because critical days are, by definition, the most extreme, SDG&E's baseline approach understates what the consumer would have otherwise used on critical days.[7] This artificially low baseline means that a customer would have to reduce peak consumption on critical days just to reach the baseline level — then further reduce consumption to earn a rebate (and certainly resulting in consumer frustration).

The team analyzed data for 2005 from a similar Anaheim TOU pilot and determined that, on average, usage of control group consumers during critical peak periods was 23% higher than their average usage during the same hours of the five previous non-event, non-holiday weekdays. In other words, this data showed that the starting point for determining a load reduction should be 23% above the five-day average, giving the customer a greater (and appropriate) opportunity to earn a rebate. Based on this analysis, a rounded-off adjustment factor of 25% was used for the OSPP.

The OSPP baseline approach gains the benefits of the San Diego method while using the adjustment factor to remove the inherent customer penalty.

The result is a baseline that is calculated as the average usage for the same hours of the five previous non-event, non-holiday weekdays, multiplied by 125%. The difference between the consumer's consumption during the Critical Event and the baseline would be subject to the CPR, creating a rebate of 30 ¢/kWh times the amount by which the participant's usage was reduced. (See Exhibit 5 for an illustration.)

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[7] - For a detailed discussion of baseline issues see Xenergy, "Protocol Development for Demand Response Calculation," Prepared for California Energy Commission, August 1, 2002.

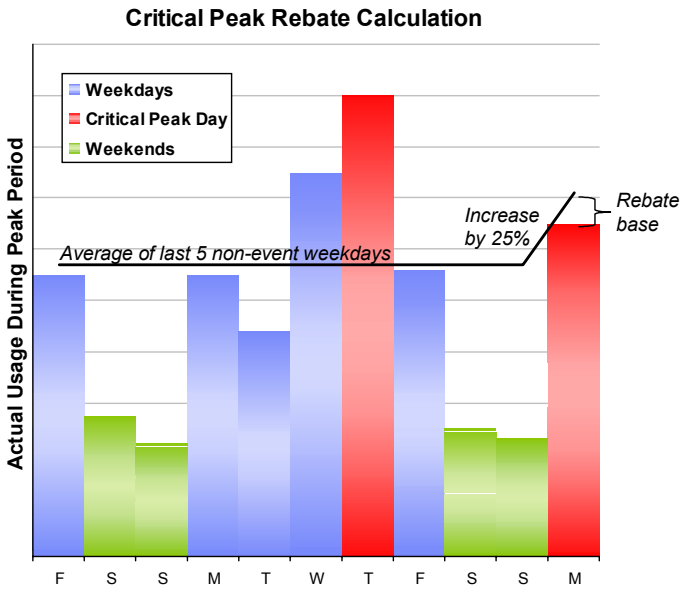

Exhibit 5: A participant's CPR baseline is determined as the average of usage during the same hours over the participant's last five, non-event weekdays, increased by 25%. The rebate is calculated as the kWh difference between the participant's CPR baseline and their actual usage on the day (the rebate base) multiplied by 30¢.

The resulting prices are provided in Exhibit 6.

Time	Summer Hours (Aug 1 - Oct 31)	Price/ kWh	Winter Hours (Nov 1 - Feb 28)	Price/ kWh
Off–peak	10 pm-7 am weekdays; all day weekends and holidays	3.5¢	10 pm-7 am weekdays; all day weekends and holidays	3.4¢
Mid–peak	7 am-11 am and 5 pm-10 pm weekdays	7.5¢	11 am-5 pm and 8 pm-10 pm weekdays	7.1¢
On-peak	11 am-5 pm weekdays	10.5¢	7 am-11 am and 5 pm-8pm weekdays	9.7¢
CPR	3 to 4 hours during On-Peak, invoked up to 9 times during the pilot	30.0¢	3 to 4 hours during On-Peak, invoked up to 9 times during the pilot	30.0¢

Exhibit 6: Critical Peak Rebate prices, where the RPP TOU prices are unchanged

2.5 Critical Peak Trigger

The team considered two approaches for triggering critical peak events. The first was to dispatch in parallel with the Independent Electricity System Operator's (IESO) voluntary Emergency Load Reduction Program, for which only large wholesale market consumers are eligible. For this program, the IESO forecasts day-ahead supply and demand and calls an event when forecast supply margins are very low. However, because this is designed to be an emergency program, it is intended to be triggered relatively infrequently (i.e., only a handful days per year are expected).

While this may be appropriate for the long term (perhaps if and when CPP is implemented province-wide), the short pilot schedule made it necessary to consider a weather trigger to increase the likelihood that a sufficient number of events would be called during the pilot period to provide the necessary data for analysis.

A weather trigger is commonly used in critical peak programs. The trigger is calculated based on historical data to determine how many times a particular temperature was exceeded (on the high side in summer, low side in winter). The team reviewed historical data for the past five years and selected temperatures which would have provided an appropriate number of critical peak events in at least four of the past five years. See Appendix B for details of the analysis.

A conservative approach was taken in selecting the trigger temperatures because, if the threshold is exceeded too many times, events need not be called (whereas if not enough events occur, insufficient data will be available for analysis).

The trigger temperatures selected were 28°C in summer and -14°C in winter. In addition, events would be called when the Humidex exceeds 30°C during On-Peak times of the day, regardless of the temperature.

3 Participant Population

3.1 Participating Distributor

To conduct the pilot, the Board needed a Ontario electricity distributor to provide candidate customers, interval meter data, and ongoing communications support. Among a variety of candidates, Hydro Ottawa was selected as the participating distributor for the following reasons:

- Hydro Ottawa had a sufficient number of smart meters installed and operating, which thus provided a suitable population from which to recruit participants prior to the start of the pilot in August 2006.
- Hydro Ottawa is expected to be a key contributor in the initial implementation of smart meters in Ontario, with plans to install some 130,000 meters by the end of 2007. This meant that the results would be directly applicable to a large number of consumers in the same area expected to soon be on time-sensitive prices.
- Two characteristics of Hydro Ottawa meant that results could potentially be appropriately generalized to RPP-eligible consumers of other Ontario distributors, particularly those installing smart meters in 2007 (mostly in the Greater Toronto Area or GTA):
  - The candidate customers are in a variety of neighbourhoods with a range of monthly electricity consumption, major appliance holdings, housing types, housing ages, and family incomes.
  - The Ottawa area climate was conducive to the pilot objectives: summertime temperature highs are nearly identical to those in the GTA and wintertime lows are lower. This is important, because research indicates that the greatest response to time-based pricing occurs at extreme temperatures.[8] These responses are greater in both absolute and relative terms. Moderate weather also occurs in Ottawa. The pilot is designed to measure demand response on an hourly basis, taking advantage of the hourly data available from the smart meters. The hourly analysis allows for estimating the demand response (and extrapolation to other locations) on moderate days and extreme days. To the extent one area, such as the GTA, has more of the extreme days, this can be accounted for in the extrapolation through weighting the results by the number of extreme days versus moderate days.

[8] See for instance, Charles River Associates, “Impact Evaluation of the California Statewide Pricing Pilot, Final Report,” February 11, 2005.

- Hydro Ottawa management committed support to the pilot, funding necessary internal operations and the thank you payments provided to participating customers.

3.2 Customer Participation

Candidate participants were randomly selected from the population that would have smart meters installed in Hydro Ottawa's territory by August 1, 2006. The experimental design was a classic side-by-side comparison of control group versus treatment groups. Participants were recruited for the three treatment options:

- Time-of-use (TOU) only
- TOU plus Critical Peak Pricing (CPP)
- TOU plus Critical Peak Rebate (CPR)

Participants were segregated by price structure. The participants were recruited independently and had no knowledge of the price structures offered to other customers. Participants were recruited using a stratified random sample to ensure that a sufficient number of participants were in each of the low, medium, and high monthly consumption groups.

Recruitment was undertaken via direct mail, using a letter co-branded by Hydro Ottawa and the OEB. (Subsequent pilot communications were branded as OEB communications.) The initial letter notified customers that they "have been selected as a participant." However, customers were not included in the pilot unless they returned the confirmation form included in the recruitment mailing. One reason confirmation was needed was to provide the correct telephone number or email address for critical peak event notifications.

3.2.1 Control Group

The control group was a sample of 125 customers selected randomly from the population of Hydro Ottawa residential customers who had smart meters installed prior to the August 1, 2006 start of the pilot but continued to pay tiered (non-TOU) prices.

All treatment and control participants were RPP consumers (i.e., not on a retailer contract).

3.3 Recruitment Results

In a marked difference from other residential TOU pilot projects, the OSPP was over-subscribed after only one recruitment solicitation and within about one week. While a 10% enrolment rate was expected, in fact, out of 1,800 recruitment letters sent (600 for each targeted price group), 459 people responded by submitting an enrolment form, a 25.5% response rate. Another 50 customers contacted the customer support

staff by email and telephone, in most cases after the enrolment deadline. If all 50 of these additional customers had been enrolled, the total response rate would have been 28.3%. A contingency recruitment mailing, common in other pilot projects, was not necessary in this case.

The table below shows the OSPP results compared to some other pilots. Note that consumers in the California Pilot were contacted by phone as well as mail, whereas the OSPP recruitment was limited to a single mailing.

Program	Year	Enrolment Rate
Ontario Smart Price Pilot (1 mailing)	2006	25.5-28.3%
California Statewide Pricing Pilot[9] (2 mailings and 3 phone calls)	2003-2005	20.3%
Idaho Power Time-of-Day and Energy Watch (1 mailing)	2005	3.5%

Exhibit 7: A participant response rate of at least 25% on the first mailing is significantly greater than past pilots with which we are familiar.

Potential reasons for the high recruitment response rate are discussed in the discussion of focus group results, presented in Section 6.1.

Originally, 75 participants were targeted for each treatment group. However, given the response, the Board and Hydro Ottawa decided to increase funding and expand the project to 125 participants in each price group. Of the customers who had hoped to enrol in the pilot, 84 were declined participation. One customer was added to the TOU group as a concession to their persistence, making the total number of TOU participants 126. However, upon initial pilot operation meter data was not available for three customers due to technical issues. The precise number of participants resulting in the three pricing groups is in Exhibit 8.

Price Treatment Group	Number of Participants
TOU	124
CPP	125
CPR	124
Total	373

Exhibit 8: Number of pilot participants by price treatment

3.4 Participant Characteristics

Participants were asked to complete an appliance survey upon registration. More detailed appliance usage and household characteristics data were gathered in a

[9] The California Recruitment included two mailings and three phone calls per customer.

subsequent survey of the pilot participants (with a 79% response rate) in November. The relevant results of the surveys are provided in the tables below, compared against the average for Hydro Ottawa and all of Ontario.

Except where noted, all Ottawa and Ontario data are based on the 2001 Census. All comparisons with pilot participants are therefore affected by the 5-year difference in the data. Specific adjustments made to compensate for this difference are noted.

3.4.1 Heating and Cooling Characteristics

The results in Exhibit 9 show that the cooling characteristics of participants in the pilot project are very consistent with the Hydro Ottawa population, and to a lesser extent with the Ontario population at large. The space heating characteristics of the pilot participants are quite close to the provincial figures in terms of natural gas versus electric heating, as well as the percentage with electric water heating.

Also, while air conditioning penetration rates appear greater among pilot participants compared to 2003 data for Ontario as a whole, the Office of Energy Efficiency of Natural Resources Canada estimates that central air conditioning penetration is increasing in Ontario at 4.1% per annum, which would mean a 2006 penetration rate of approximately 65%.[10]

Space Cooling	TOU	CPP	CPR	Total	Pilot %	Ottawa % [11]	Ontario % [12]
Central Air Conditioning	106	109	104	**319**	**85.1%**	76.5%	57.6%
Window Air Conditioning	9	6	7	**22**	**5.9%**	8.9%	16.1%
Ductless A/C / Wall Mounted	1	0	0	**1**	**0.3%**	n/a	
No Air Conditioner	8	10	14	**32**	**8.5%**	12.6%	26.3%
No response	1	0	0	**1**	**0.3%**	n/a	n/a
Space Heating	**TOU**	**CPP**	**CPR**	**Total**	**Pilot %**	**Ottawa %**	**Ontario %**
Gas Space Heating	101	101	105	**307**	**82.3%**	86.7%	82.6%
Electric Space Heating	11	11	10	**32**	**8.6%**	3.4%	7.3%
Other	0	1	0	**1**	**0.3%**	9.9%	10.1%
None	0	1	0	**1**	**0.3%**	0.0%	0.0%
No response	11	11	10	**32**	**8.6%**	n/a	n/a

[10] Source: Modelling and Scenario Documentation, Prepared by M.K. Jaccard and Associates for the OPA.

[11] Source: Hydro Ottawa customer survey which was designed to be within +/- 3% accurate 95% of the time.

[12] Source: Office of Energy Efficiency, Natural Resources Canada "2003 Survey of Household Energy Use".

Water Heating	TOU	CPP	CPR	Total	Pilot %	Ottawa %	Ontario %
Gas or Oil Water Heating	105	108	104	**313**	**84.4%**	82.7%	85%
Electric Water Heating	17	15	20	**52**	**14.0%**	16.2%	15%[13]
No response	3	2	1	**6**	**1.6%**	n/a	n/a

Exhibit 9: Based on a survey upon enrolment, the cooling methods of pilot participants is very consistent with the Hydro Ottawa population, and to a lesser extent with the Ontario population at large. The heating methods are quite consistent.

3.4.2 Housing Characteristics

Comparisons of housing type across data sources are problematic. The Ontario average is based on the Statistics Canada surveys sampled from all Ontario households. In contrast the population of electric utility consumers in Ontario will not include apartments and other units not metered by the distributor.

At the start of the pilot, Hydro Ottawa had installed smart meters primarily in newer residential homes. However, 28% of homes were built before 2001; this was likely the population in the province (at the time) with one of the highest percentages of homes with smart meters outside of new subdivisions. ** wording **

Housing Type	TOU	CPP	CPR	Total	Pilot %	Ottawa %[14]	Ontario %[7*]
Single-family home	106	100	101	**307**	**81.9%**	54.4%	69.4%
Apartment or Condominium (Under 5 storeys)	13	15	16	**44**	**11.7%**	15.7%	30.6%
Townhouse	4	9	7	**20**	**5.3%**	22.6%	
Duplex	1	0	0	**1**	**0.3%**	7.3%	
No response	1	1	1	**3**	**0.8%**	n/a	n/a
Housing Age	**TOU %**	**CPP %**	**CPR %**	**Total %**		**Ottawa %**	**Ontario %**
Before 1970	2	2	5	3		42	49
1971 to 1980	1	1	3	2		22	19
1981 to 1990	3	0	3	2		21	18
1991 to 2000	17	23	24	22		14	14
After 2001	77	74	65	72		n/a	n/a

Exhibit 10: Housing type and housing age comparisons between pilot participants and the Ottawa and provincial populations.

[13] Source: Electricity Demand in Ontario – A Retrospective Analysis, ICF Consulting, Revised November 2005 (prepared for the Chief Conservation Officer, OPA).

[14] Source: Statistics Canada Community Profiles 2001. Does not including "Apartment in a building that has five or more storeys"

3.4.3 Socioeconomic Status

The survey data helps further profile pilot participants against the Ottawa and provincial populations (see Exhibit 11). Pilot participants are generally more educated and have a higher household income than the general population of Ottawa. There is less of difference in income compared to the province, as Ottawa has a higher percentage of lower income households than the province.

Household income is based on income for private households in the 2001 census. It has been adjusted for inflation.

Education	TOU %	CPP %	CPR %	Total %	Ottawa %[15]	Ontario %
Some High School	2	2	1	1	12	20
High School Graduate and/ or Some Postsecondary	22	13	14	16	25	27
University or College Graduate	76	85	85	83	63	53
Household Income	**TOU %**	**CPP %**	**CPR %**	**Total %**	**Ottawa %**	**Ontario %**
Less than $50,000	9	10	13	11	30	18
$50,000 to $100,000	49	40	30	43	40	47
More than $100,000	41	50	49	47	30	35

Exhibit 11: Comparisons of education and income levels between the pilot participants and the Ottawa and Ontario averages.

3.5 Control Group

To create the control group, 125 customers were selected in a stratified random sample from approximately 4,500 customers with smart meters. The 4,500 customer-pool included three groups:

- Approximately 3,200 customers who had not been solicited to participate
- An estimated 900 customers who had been solicited but did not read the solicitation (i.e. were unaware of it[16])
- An estimated 400 customers who had been solicited and decided not to volunteer for the pilot.

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[15] Data for both Ottawa (the Ontario part of Ottawa/Hull CMA) and Ontario in this table are based the 2001 census from Statistics Canada.

[16] In the California Statewide Pricing Pilot, the participating utilities reported that only 31% of customers were aware of the opportunity to participate in the pilot, in spite of receiving three mailings and three attempted phone calls. The estimate above uses the 31% figure. This is likely quite conservative, as there was only one mailing in the OSPP.

Thus, less than 10% of the control group were customers who consciously decided not to participate, and the control group behavior can served as a relatively good proxy for electricity consumption behavior of the Hydro Ottawa residential population as a whole.

4 Pilot Operation

This section describes the operational details of the pilot, including participant communication approaches, billing approach, critical peak notifications and participant support.

4.1 Participant Recruitment Materials

The recruitment packages consisted of the following:

- *Cover Letter*: Provides a brief introduction to the pilot, describes key features, and informs eligible participants how to confirm participation.
- *Fact Sheet*: Provides an explanation of all the key features of the pilot, shows the specific TOU prices, provides a sample of the monthly electricity usage statement to be received by participants (see Exhibit 12), and provides a sample of the final settlement that will be provided to participants.
- *Confirmation Form*: When signed, this form confirms the customer's participation and provides needed authorization for pilot data handling and analysis.

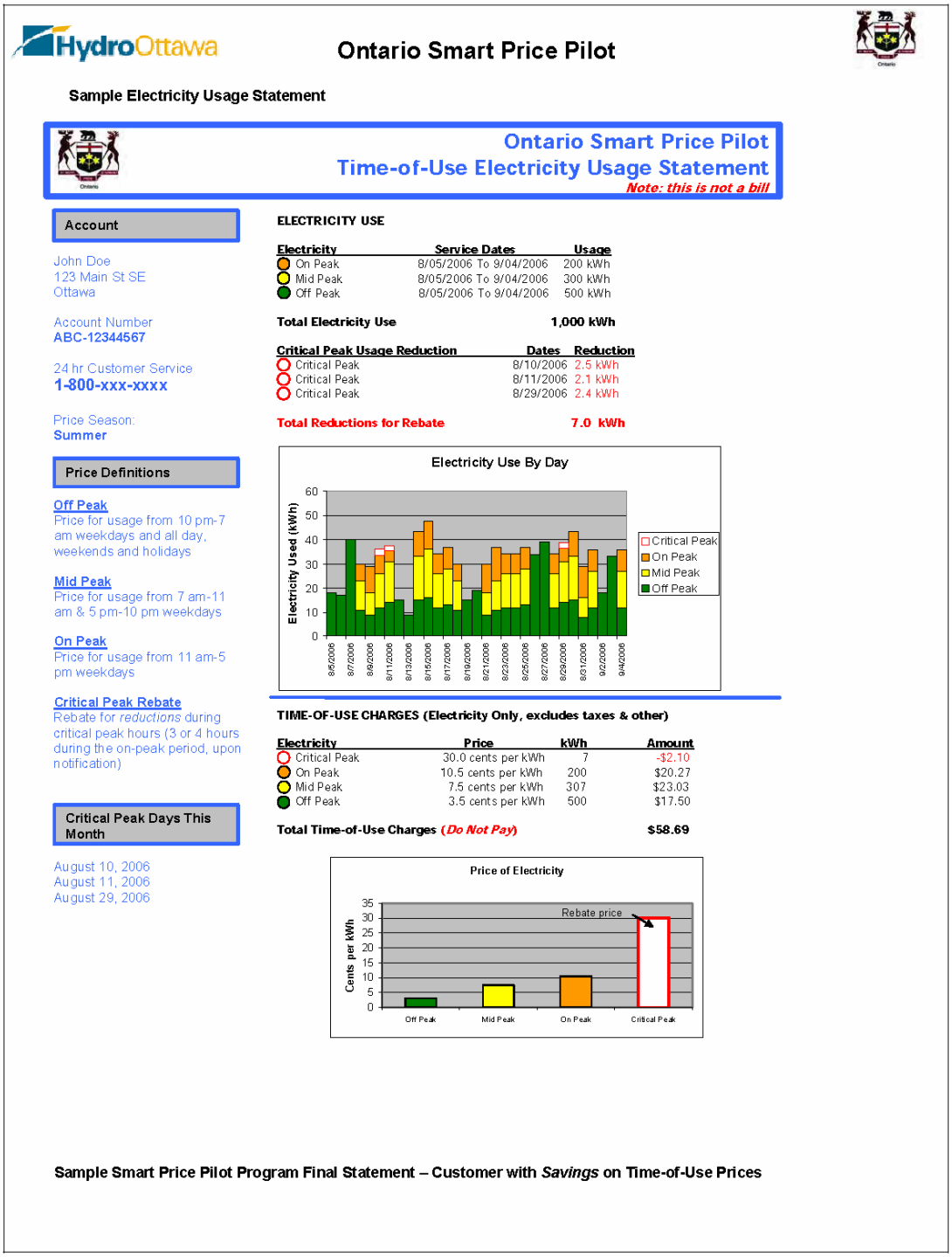
There are three versions of the Letter and Fact Sheet; one per price design group. All materials are provided in both English and French. Sample recruitment materials are included in Appendix C.

4.2 Customer Education

Initial participant education, beyond the material in the recruitment package, focused on a package mailed to each eligible participant following receipt of their enrolment form. This confirmation mailing included the following:

- *Cover Letter*: Confirms that the participant is enrolled.
- *Refrigerator magnet:* Provides a table of the prices, times, and seasons for the participant's price plan. The magnet to be sent is an adaptation of a design that was preferred by customers in focus groups conducted for a different pilot program by Hydro Ottawa. (See Exhibit 13.)
- *Electricity conservation brochure*: This PowerWise brochure provides a variety of conservation tips for electricity consumers that may be used during peak times or anytime.

A sample of the complete Confirmation Package materials is provided in Appendix D.



HydroOttawa

Ontario Smart Price Pilot

Sample Electricity Usage Statement

Ontario Smart Price Pilot
Time-of-Use Electricity Usage Statement
Note: this is not a bill

Account

John Doe
123 Main St SE
Ottawa

Account Number
ABC-12344567

24 hr Customer Service
1-800-xxx-xxxx

Price Season:
Summer

Price Definitions

Off Peak
Price for usage from 10 pm-7 am weekdays and all day, weekends and holidays

Mid Peak
Price for usage from 7 am-11 am & 5 pm-10 pm weekdays

On Peak
Price for usage from 11 am-5 pm weekdays

Critical Peak Rebate
Rebate for *reductions* during critical peak hours (3 or 4 hours during the on-peak period, upon notification)

Critical Peak Days This Month

August 10, 2006
August 11, 2006
August 29, 2006

ELECTRICITY USE

Electricity	Service Dates	Usage
On Peak	8/05/2006 To 9/04/2006	200 kWh
Mid Peak	8/05/2006 To 9/04/2006	300 kWh
Off Peak	8/05/2006 To 9/04/2006	500 kWh

Total Electricity Use **1,000 kWh**

Critical Peak Usage Reduction	Dates	Reduction
Critical Peak	8/10/2006	2.5 kWh
Critical Peak	8/11/2006	2.1 kWh
Critical Peak	8/29/2006	2.4 kWh

Total Reductions for Rebate **7.0 kWh**

TIME-OF-USE CHARGES (Electricity Only, excludes taxes & other)

Electricity	Price	kWh	Amount
Critical Peak	30.0 cents per kWh	7	-$2.10
On Peak	10.5 cents per kWh	200	$20.27
Mid Peak	7.5 cents per kWh	307	$23.03
Off Peak	3.5 cents per kWh	500	$17.50

Total Time-of-Use Charges ***(Do Not Pay)*** **$58.69**

Sample Smart Price Pilot Program Final Statement – Customer with *Savings* on Time-of-Use Prices

Exhibit 12: Sample of Electricity Usage Statements provided monthly to all participants; the statements differed slightly to reflect the differences between TOU, CPP, and CPR prices.

HydroOttawa

Ontario

ONTARIO SMART PRICE PILOT / PROJET PILOTE DE PRIX INTELLIGENT
TIME OF USE PERIODS AND RATES / PÉRIODES D'UTILISATION ET PRIX

Day of the Week Jours de la semaine	Time Heures	Time of Use Périodes d'utilisation	Price/Prix* (¢/kWh)
Weekends & Holidays Fins de semaine et fériés	All Day / Toute la journée	Off-peak / Période creuse	3.5 ¢
Summer Weekdays (May 1st - Oct 31st) Jours de semaine l'été (du 1er mai au 31 octobre)	7 am to 11 am / 7 h à 11 h	Mid-peak / Période moyenne	7.5 ¢
	11 am to 5 pm / 11 h à 17 h	On-peak / Période de pointe	10.5 ¢
	5 pm to 10 pm / 17 h à 22 h	Mid-peak / Période moyenne	7.5 ¢
	10 pm to 7 am / 22 h à 7 h	Off-peak / Période creuse	3.5 ¢
Winter Weekdays (Nov 1st - Apr 30th) Jours de semaine l'hiver (du 1er novembre au 30 avril)	7 am to 11 am / 7 h à 11 h	On-peak / Période de pointe	10.5 ¢
	11 am to 5 pm / 11 h à 17 h	Mid-peak / Période moyenne	7.5 ¢
	5 pm to 8 pm / 17 h à 20 h	On-peak / Période de pointe	10.5 ¢
	8 pm to 10 pm / 20 h à 22 h	Mid-peak / Période moyenne	7.5 ¢
	10 pm to 7 am / 22 h à 7 h	Off-peak / Période creuse	3.5 ¢

Effective August 2006 / Efficace le 2006 août

Exhibit 13: A sample of the fridge magnet provided to all participants

4.3 Incentive Approach

As an incentive to enrol, participants received a "thank you payment" of $75.00 (adjusted, as described in Section 4.4 below) at the end of the pilot. Specifically, $50 was provided as an incentive for remaining on the pilot for the full period and $25 was provided for completing the pilot survey.

Such an incentive is consistent with incentive payments of $75 to $100 made in similar pilots. Numerous researchers have concluded that the incentive does not present an issue when analyzing the effect of prices on pilot participants. The reason is that the incentive payment is a fixed externality; participants receive credit for the $75 simply by participating. Any savings or losses on their time-based pilot prices do not change the fact that they will receive the incentive payment, beyond reducing or increasing it.

4.4 Billing

To accommodate the needs of the pilot, participants continued to receive and pay their "normal" bi-monthly electricity bill from Hydro Ottawa. This bill was issued by Hydro Ottawa every other month at a different time during the month for any given customer.

Separately, pilot participants received monthly *Electricity Usage Statements* that showed their electricity supply charges on their respective pilot price plan. These statements emphasized the amount of electricity consumed (in each pricing period) and the TOU price of electricity (in each period by day). The statements were mailed to participants monthly, and all usage was on a calendar month basis.

Participants did not remit the dollar amounts shown on the electricity usage statements. Instead, at the end of the pilot, participants received a final settlement comparing their electricity charges on the pilot prices with what their charges would have been on the two-tiered RPP prices.

With a final settlement in March 2007, following the end of the pilot, participants received a cheque in an amount equal to the base incentive adjusted by the amount of their savings or losses on TOU pricing. Thus, participants faced actual economic gains or losses based on their response, or lack thereof, to TOU prices.

Given the above, only the incentive payment amount is affected. As such, the pilot has been designed to have no impact on utilities financial systems or the RPP variance account held by the Ontario Power Authority.

4.5 Critical Peaks

4.5.1 Critical Peak Notification

At the time of enrolment, participants indicated their preference for receiving automated notification of critical peak events by phone, e-mail, or text messages (on cell phones). Notifications were delivered on the day before a critical peak event, usually in the afternoon, no later than 5:00 pm.

Some participants asked for two modes of notification. This proved to be helpful when one mode of contact failed. A few participants did not provide any phone or e-mail contact information. Phone numbers were obtained from Hydro Ottawa for all but one of these participants, and those were put on the call list for notification.

We were unable to obtain contact information beyond a mailing address for one participant in the CPR group. This person did not receive any critical peak notifications during the pilot, and was excluded from analysis of the results.

Critical peak notification success rates were typically between 95% and 98% over the pilot period. If an automated phone message was picked up by the receiver, whether it was an answering machine or a live person, the message was considered to be delivered. If an e-mail was not bounced back or otherwise marked as “undeliverable,” it was considered successfully delivered.

Focus group feedback indicated that participants were generally satisfied with the mode of day-ahead e-mail or phone notification they had chosen. Some had to work

out their filtering process for unwanted phone calls, but this was not a significant barrier to participating in the critical peak test group.

4.5.2 Summertime Critical Peak Events

During the summer period of the pilot, four critical peak events were called based on day-ahead forecasts that exceeded the thresholds. Actual temperatures on the event days are provided below.

Critical Peak Day	Time Period	Actual Max Temp (°C)	Actual Max Humidex	Time of High Temp	Mean Daily Temp (°C)
Friday, August 18	1:00 - 5:00 pm	30.0	35	4:00 pm	23.5
Tuesday, August 29	2:00 - 5:00 pm	25.2	28	3:00 pm	20.8
Thursday, September 7	2:00 - 5:00 pm	22.4	n/a	4:00 pm	15.7
Friday, September 8	2:00 - 5:00 pm	26.5	31	3:00 pm	19.9

Exhibit 14: Actual temperature and Humidex characteristics of declared summertime critical peak events against a temperature trigger of 28°C and a Humidex of 30°C during On-Peak times

Since the summer was moderate compared to previous summers (the previous five years were analyzed to establish the critical peak dispatch threshold), the events represented situations just slightly over the threshold values, or in some cases the actual temperature was below the day-ahead forecast and the threshold. This is significant because other pilots have found that less load shifting occurs on moderate days in comparison to extreme temperature days.

4.5.3 Wintertime Critical Peak Events

Three critical peak events were called in winter based on a day-ahead forecast of below -14°C during On-Peak hours.

Critical Peak Day	Time Period	Actual Min Temp (°C)	Actual Min Temp (°C) During Peak Period	Mean Daily Temp (°C)
Tuesday, January 16	5:00 – 8:00 pm	-20.5	-18.7	-14.9
Wednesday, January 17	5:00 - 8:00 pm	-25.3	-16.1	-19.8
Friday, January 26	7:00 – 11:00 am	-22.1	-21.3	-20.2

Exhibit 15: Actual temperature characteristics of declared wintertime critical peak events against a temperature trigger of -14°C

During the pilot, seven critical peak events were declared (a total of 23 hours) compared to a maximum of nine events.

4.6 Participant Support

The implementation team provided both telephone and email support for participants. The phone support is staffed from 11:00 am – 8:00 pm Ottawa time. Support was available in both English and French.

Only about a dozen participants used the e-mail support feature of the project to resolve issues related to their participation. These participants had questions regarding metering, critical peak times, and minor changes to their billing information. Where appropriate, inquiries were forwarded to a contact at Hydro Ottawa to be addressed.

The OSPP telephone support line received approximately 235 calls and voice messages. About 150 of the calls were directly related to the OSPP, with most of these were inquiries during the recruitment phase of the project. Around 60 calls were mistaken faxes or wrong numbers, since another organization has mistakenly listed this number as their toll-free number. The remaining 25 calls were not related to the pilot project; they were questions about the participants' regular Hydro Ottawa service or they were calls from non-participants who wanted to know about smart metering in general.

Phone support logs indicate that callers were knowledgeable about and involved in the management of their electricity usage. In about a dozen of the roughly 30 calls which were specifically about the pilot project, logged in the month immediately after the enrolment period, callers articulated to the phone support staff that they were using their participation in the pilot project and their access to smart meter data as a way to gain more control over their relationship with the utility.

5 Demand Response and Conservation Impacts

Impacts on pilot participants were modelled and measured from three perspectives:

- Demand response impacts, or the amount of load shifting away from critical peak or On-Peak hours
- Conservation effects, or the reduction in total electricity consumption, regardless of when (or which TOU period) the electricity is used
- Bill impacts, comparing what participants paid on the TOU prices versus what they would have paid on the two-tiered RPP prices

5.1 Demand Response Impacts

The analysis of demand response or peak shifting as a result of the pilot prices was performed by Professor Frank Wolak of the Economics Department of Stanford University.

The analysis was performed to assess the following:

- Demand response via load shifting away from critical peak hours to either Mid-Peak or Off-Peak hours only on critical peak days
- Demand response via load shifting away from On-Peak hours to either Mid-Peak or Off-Peak hours on all non-holiday weekdays

These effects are determined by comparing the electricity consumption behavior of customers receiving the experimental prices (TOU, CPP, and CPR) and the behavior of customers remaining on their existing two-tier RPP prices. These customer groups are the treatment and control groups respectively.

5.1.1 Analytical Model

To analyze the load reductions during peak and critical peak times, a nonparametric conditional mean estimation framework was used. The framework used customer-level fixed effects and day-of-sample fixed effects.

The fixed effects approach uses a separate intercept term for each customer to control for effects that are unique to that customer and relatively constant over the time period being examined. The unique effects of the stable, but unmeasured characteristics of each customer are their “fixed effects” from which this method takes its name. These fixed effects are held constant. The fixed effects nature of the model means the model does not need to include unchanging customer characteristics such as house size, appliances, etc.

Controlling for fixed effects controls the amount of variance (noise) the model is faced with, since each customer has a different base load, a different response to weather, and a different pattern of consumption that changes over time. This approach also provides for a much closer fit to the data than most models, as individual responsiveness is incorporated.

This approach has worked well in estimating the impacts of mass-market programs such as the California Statewide Pricing Pilot, the Idaho Power critical peak pricing pilot, and the Sacramento Municipal Utilities District air conditioning direct load control program.

More details on the model and the full results can be found in Appendix E.

5.1.2 Critical Peak Shifting Results

Exhibit 16 shows the amount of load shifting on individual critical peak days during the summer for all three price groups combined. These results are for the Entire On-Peak Period. Results that are not statistically significant at the 90% level are denoted by "n/s"; however, many of the load shift results are statistically significant at the 95% and even 99% confidence level.[17]

A statistically significant shift in load away from peak periods was measured during On-Peak periods on two critical peak days called in August.

Critical Peak Day (Entire Peak Period)	Summer	Actual Max Temp (°C)	Actual Max Humidex
Friday, August 18	27.7%	30.0	35
Tuesday, August 29	10.1%	25.2	28
Thursday, September 7	n/s	22.4	n/a
Friday, September 8	n/s	26.5	31
	Winter	**Actual Min Temp (°C) During Peak Period**	
Tuesday, January 16	n/s	-18.7	
Wednesday, January 17	-7.2%	-16.1	
Friday, January 26	n/s	-21.3	

Exhibit 16: Shifts in consumption for each of the seven days when a critical peak was declared. n/s denotes that the results where not statistically significant.

The only statistically significant load shifting evident by members of the three price groups during the five critical peak days in September or January was an *increase* in

[17] - The statistical precision of each specific result may be determined using the standard error, which is included in Appendix E for each of the results.

load on January 17. This may be a statistical anomaly or the greater difficulty of shifting load during the winter identified during the focus groups.

Given the lower number of data points, results for individual price groups, for individual events are not statistically significant.

Exhibit 17 provides the estimated percentage shift in load across the seven days (four in summer, three in winter) when a critical peak event was called, broken down by season and by participant price group.

"Critical peak period" refers to the fraction of the entire On-Peak period of the day that the critical peak period covers (only three or four hours of the six- or seven-hour On-Peak period on each critical peak day were critical peak hours).

	TOU only	CPP	CPR
Period		**Summer**	
Critical Peak hours (3 or 4 hours during the Peak)	5.7%(n/s)	25.4%	17.5%
Entire On-Peak period	2.4%(n/s)	11.9%	8.5%
Mid-Peak	n/s	n/s	n/s
Off-Peak	n/s	n/s	n/s
		Winter	
Critical Peak periods	n/s	n/s	n/s
Entire On-Peak period	n/s	n/s	n/s
Mid-Peak	n/s	n/s	n/s
Off-Peak	n/s	n/s	n/s
		Total	
Entire On-Peak period	n/s	8.1%	5.2%
Mid-Peak	n/s	n/s	n/s
Off-Peak	n/s	n/s	n/s

Exhibit 17: Shifts in consumption during the seven days (four in summer, three in winter) when a critical peak was declared. n/s denotes that the results were not statistically significant.

Statistically significant results were obtained for CPP and CPR price groups during critical peak and On-Peak periods on the summer critical peak days. The most dramatic was a 27.7% shift in load by the CPP price group during the event of August 18. The percentage reductions shown for the TOU only customers are the

actual reductions recorded for that group; had there been more critical peak days, it is likely these results would be statistically significant.[18]

Other notable outcomes include:

- The average demand reduction across both critical peak groups (25.4% and 17.5% for CPP and CPR respectively) during critical peak hours was 21.5%.
- TOU-only participants did not demonstrate a statistically significant shift in load on critical peak event days. Unlike CPP and CPR participants, these participants were not notified of the event the day before.
- Participants demonstrated a much better ability to shift load in the summer relative to winter.
- No statistically significant load shifting was evident by members of any of the three price groups during the Mid-Peak periods of critical peak days.

5.1.3 Time-of-Use Peak Shifting Results

On days when a critical peak event was not declared, all participants were effectively on the TOU-only price structure. Exhibit 18 shows the results. The only statistically significant load shifting detected on these days was a counterintuitive increase in the on-peak usage of the CPP group.

Price Group	Shifting from On-Peak
TOU Customers	n/s
CPP Customers	-10.8%
CPR Customers	n/s

Exhibit 18: Load shifting on all weekdays, except holidays, during the full pilot period. The result for the CPP customers is counterintuitive.

5.2 Conservation Effect

While a main purpose of time-of-use and critical peak pricing is to reduce peak demand, these programs also typically result in a small reduction in total electricity consumption as well. There are three reasons a small reduction often occurs, even though it is not the primary objective in relation to TOU pricing.

- Higher peak or critical peak prices induce load reductions during peak hours, not all of which is shifted to other times. Some reductions are uses that are shifted to

[18] - The results for the TOU-only participants are relatively consistent with the results of the California Statewide Pricing Pilot which were 5.5% (inner summer) and 2.3% (outer summer) when only On-peak and Off-peak prices applied.

other time periods, such as laundry. In these cases, the usage is “recovered” at other times. In other words, consumption or load has only been “shifted”. Other reductions, such as lower lighting, are not recovered, as there is no reason for it.

- Dynamic pricing programs cause participants to have a higher awareness of how they use electricity, which, in turn, results in lower consumption.
- These programs usually increase the amount of usage information, or feedback, received by the customer, also lowering consumption.

5.2.1 Analytical Model

The basic methodology for assessing the conservation effect was the same as that used for load shifting. Again, a nonparametric conditional mean estimation framework was used.

A key difference from the load shifting analysis is that the conservation analysis utilized billing period data from the previous year for pilot customers. The reason is that too little of the necessary data was available from smart meters, because the conservation analysis requires comparing the usage of the control and treatment groups before and after being placed on the pilot prices.

Specifically, the analysis compares the usage of the two groups (technically four, since the treatment customers were on three different price plans) before the pilot, then after going on the pilot. By comparing the differences between the groups for the pre-experimental period with the experimental period, the conservation effect is revealed. For example, if the treatment group used 2% less than the control group during the same period last year, but 5% less during the pilot period, the conservation effect is calculated as 3%.

Adjustments for weather and other externalities are not required as the analysis is comparing total usage of the control and treatment groups for the same period the previous year and during the pilot period.

5.2.2 Conservation Effect Results

Exhibit 19 provides an estimate of the total reduction in electricity consumption caused by a customer’s being on the pricing pilot.

The average is overall reduction in electricity use across price groups is 6.0%.

These results show conservation of 6.0%, 4.7%, and 7.4% for TOU, CPP, and CPR customers, respectively. All of the results are statistically significant.

Price Group	Percent reduction in total electricity use
TOU	6.0%
CPP	4.7%(n/s)[19]
CPR	7.4%
Average	**6.0%**

Exhibit 19: Conservation Effect (total usage reduction) for the full pilot period

Average Electricity Usage

We calculated the average electricity usage of the three price groups during the pilot period. Exhibits 20 and 21 summarize the results. The higher consumption of the control group relative to the three price groups is consistent with the finding of the load impact analysis that participation in the pilot produced a conservation effect.

Average	TOU	CPP	CPR	Total	Control Group
Average Monthly Electricity Usage (kWh)	683	723	774	727	810

Exhibit 20: Average monthly usage by price group and control group during the pilot period.

These averages are consistent with the average monthly usage for Hydro Ottawa customers in 2007 (725 kWh), and for the province (813 kWh).

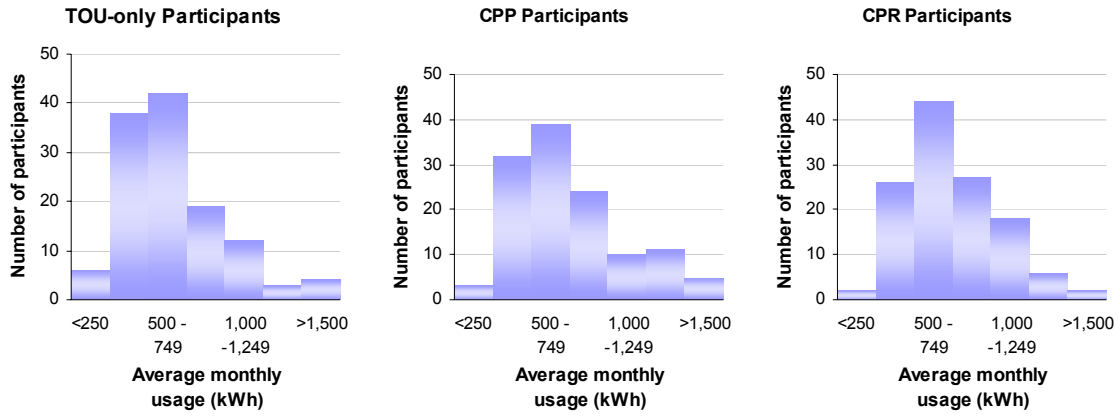


Exhibit 21: Distribution of average monthly usage by price group during the pilot period

[19] - This result is not statistically significant at the 90% confidence level but is included here because it is significant at a confidence level of 88%, or just less than 90%.

5.3 Customer Bill Impacts

5.3.1 Quantifying Load Shift Bill Impacts

This element of the evaluation compares what consumers on the pilot price plans paid for their electricity commodity charge relative to what they would have paid had they remained on the two-tiered RPP prices.

For the pilot, the three price structures were designed to be as revenue neutral as possible relative to each other and the tiered RPP prices. “Revenue neutral” was defined such that a participant whose electricity usage is distributed across the hours in the same way as the provincial average for all RPP consumers would pay approximately the same bill on all three options (and the tiered RPP prices) in the absence of any change in usage.

Given the above, any change in the timing of electricity use caused a change in the bill. The change in the bill was calculated by determining the bill amount each month for each participant for two pricing plans: TOU prices (TOU, CPP, or CPR) and two-tiered RPP prices.

Both the RPP TOU and two-tiered RPP bill amounts were calculated using the hourly electricity usage information collected via the smart meters. Thus, for this portion of the bill impact analysis, it was assumed that the TOU prices had zero effect on total electricity use.

Based on the above, the analysis below addresses five key questions:

- How many participants saved money on TOU prices, and how many paid more compared to the existing two-tiered RPP prices?
- What was the average savings?
- What were the extremes, the greatest individual participant savings and the greatest individual loss?
- What were the differences by price group?
- What were the monthly variations; particularly how extreme could the difference for one month be for an individual participant?

5.3.2 Entire Pilot Period Load Shift Bill Impacts

Exhibit 22 and

Total Pilot Period Difference (Tiered-TOU)	TOU only	CPP	CPR	All
Average	+$5.46	+$12.68	+$12.22	+$10.13
Minimum	-$41.37	-$21.14	-$16.67	-$41.37

Maximum	+$63.49	+$61.28	+$136.64	+$136.64
Average	1.8%	4.2%	2.9%	3.0%
Minimum	-12.3%	-7.6%	-9.1%	-12.3%
Maximum	+13.9%	+13.8%	+10.7%	+13.9%
% of Participants Saving on TOU	64%	83%	77%	74%

Exhibit 23 summarize the total impacts on bills from load shift across the entire seven months of the pilot – August 1, 2006 through February 28, 2007.

The pilot prices were designed with the intent to be revenue neutral for CPP participants. The summertime Off-Peak price was reduced from 3.5 to 3.1 ¢/kWh to compensate for the higher CPP price, based on an assumption of *nine* critical peak events. However, due to the moderate weather, only *seven* critical peak events could be called. If this was known upfront, it suggests the Off-Peak price should have been reduced by only 0.3 ¢/kWh. As a result, the savings for the CPP participants are somewhat overstated.

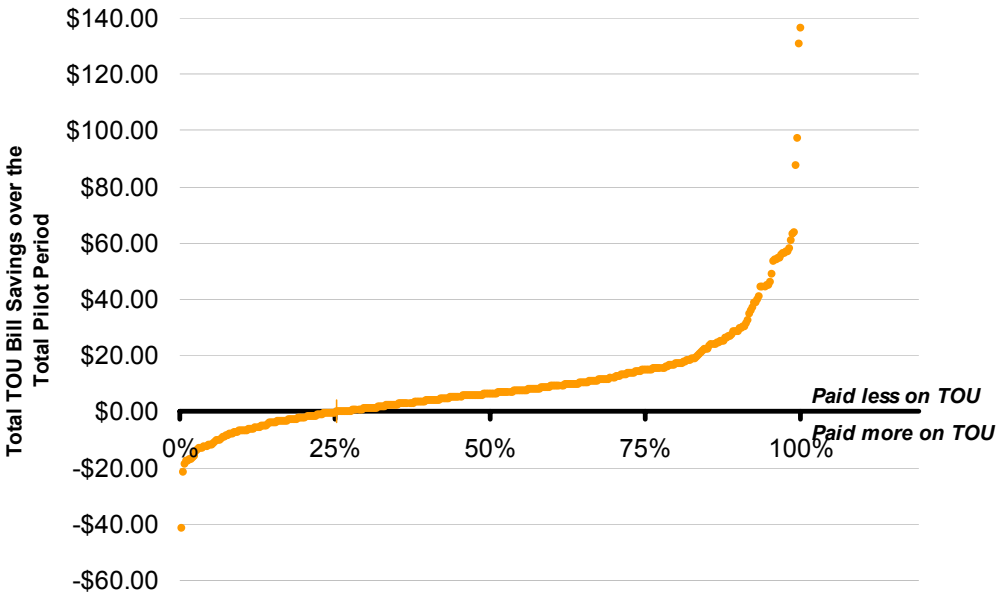


Exhibit 22: Distribution of participant bills savings on TOU prices for the total pilot period. Each dot represents an individual participant's net loss or savings. Those above the line paid less on TOU prices.

Total Pilot Period Difference (Tiered-TOU)	TOU only	CPP	CPR	All
Average	+$5.46	+$12.68	+$12.22	+$10.13
Minimum	-$41.37	-$21.14	-$16.67	-$41.37
Maximum	+$63.49	+$61.28	+$136.64	+$136.64
Average	1.8%	4.2%	2.9%	3.0%

Minimum	-12.3%	-7.6%	-9.1%	-12.3%
Maximum	+13.9%	+13.8%	+10.7%	+13.9%
% of Participants Saving on TOU	64%	83%	77%	74%

Exhibit 23: Distribution of participant bills savings on TOU prices for total pilot period. In the table, a "+" sign equals a savings or a lower *bill on TOU/CPP/CPR.*

Key observations include:

- Participants, on average, paid lower bills on the TOU pilot prices than they would have on tiered RPP price, with 75% of participants paying less on the TOU prices.
- The average total savings was $10.13, or $1.44 on average per month.
- The greatest individual *savings* was $136.64, (although this was an extreme individual result, the 95th percentile was $46.90, or an average of $6.70 per month).
- The greatest individual *cost* was $41.37 (similarly, the 5th percentile was much less extreme at $11.30, or an average of $1.61 per month).

As expected given their lower average usage (see Exhibit 20), TOU-only participants had the lowest average savings. Lower consumption results in a lower average price on the two-tier prices which in turn results in lower savings relative to charges on the TOU price plans. This effect is greater than any difference in load shifting behaviours between the groups.

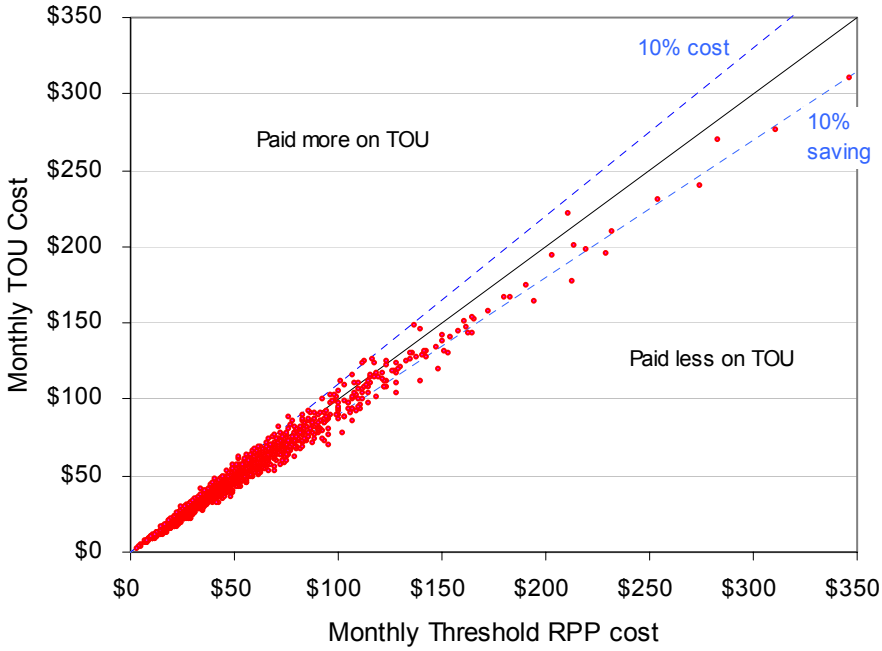


Exhibit 24: Distribution of total monthly statement amounts on one of the TOU prices vs. two-tiered RPP threshold prices

5.3.3 Individual Month Impacts from Load Shifting

Monthly comparisons between TOU and the two-tiered RPP threshold prices are problematic. The RPP threshold prices are designed from a year-long perspective, taking into consideration expected higher usage in summer and winter months, and lower usage in spring and fall months. The RPP seasonal tier threshold changes from 600 kWh to 1,000 kWh per month in November. Under this price structure, consumers who use more than the threshold level of usage pay a higher average price in the summer than the winter. Over the full pilot, such threshold effects are offset when looking at the total bill impacts.

Monthly comparisons are provided in this report to understand the implications for participant's making individual bill comparisons.

Exhibit 25 and Exhibit 26 summarize the same information, but by individual month. Results by individual month were generally consistent with the total. Key observations include:

- As expected, savings were generally greater in the "shoulder months"; September through to a mild December. More than 80% of customers paid less than the threshold RPP prices during these months, and no one paid an increase of more than $7.00 in a month during these four months.
- Savings of up to $35.55 in an individual month were experienced by participants. These savings were extreme. The 95th percentile over all months was $8.84, meaning only 130 of the approximately 2,625 statements issued had savings greater than $8.84.
- Not unexpectedly, August was the only month that the average savings across all three price groups was below zero. August was the month when a participant experienced the largest increase for an individual monthly bill compared to the tiered RPP price ($12.81 for a TOU-only participant). The highest individual increase in any other month was $8.28 in February, whereas in August, 14 customers' costs increased that much.
- Results in January, when three critical peak events were declared, are also as to be expected. Participants paying CPP prices paid the most (average of -$1.29), TOU participants were nearly neutral (+$0.58), and CPR participants saved the most (+$1.63).
- The average savings for all three price groups was greater than zero for every month, except three instances:
  - TOU and CPP customers paid more on average in August (with two critical peak events)

– CPP customers paid more on average in January (with three critical peak events)

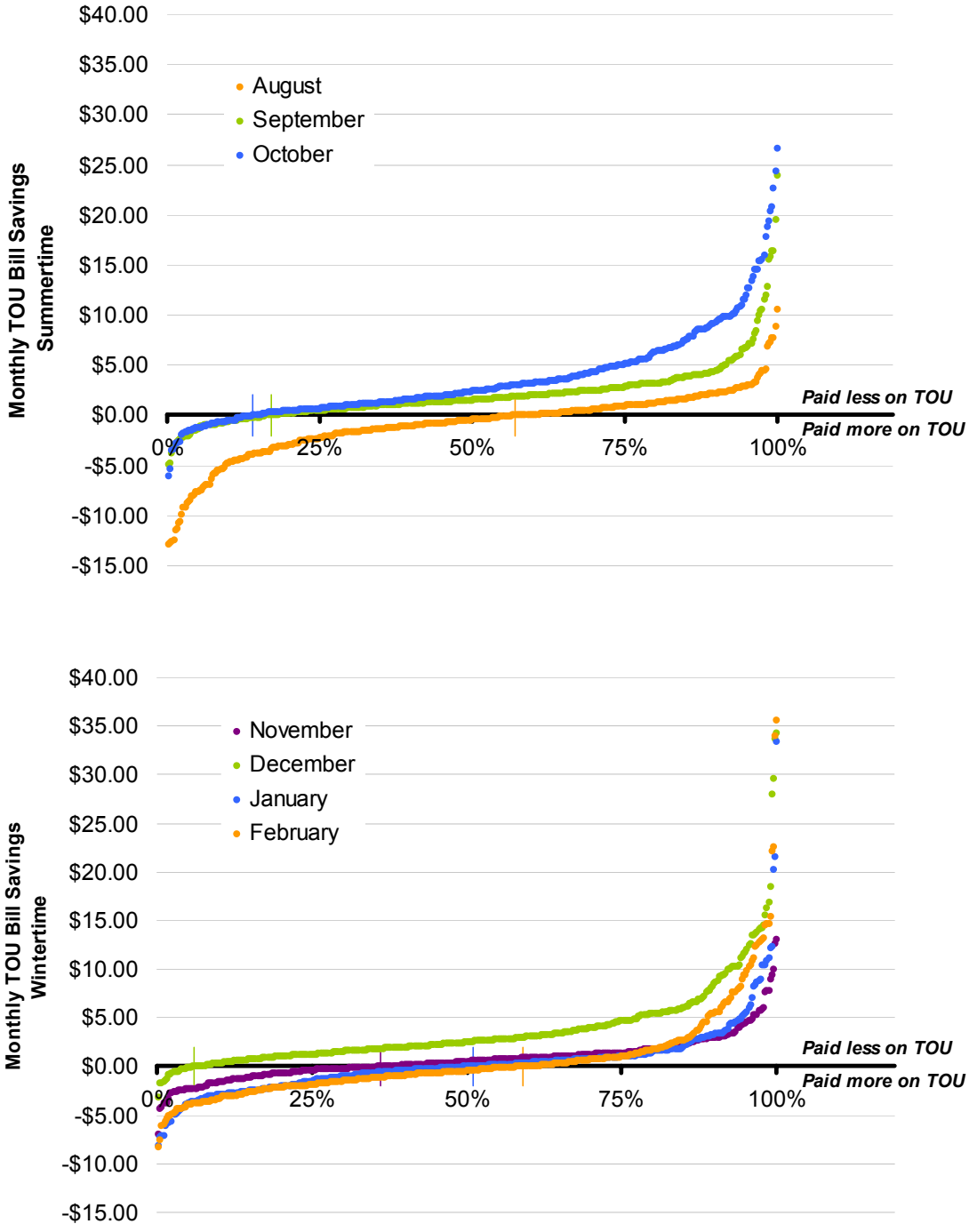


Exhibit 25: TOU savings on participant bills during individual months. Each dot represents an individual participant's net loss or savings. Those above the line pay less on TOU prices.

Month	TOU Savings	TOU only	CPP	CPR	All
August	Average	-$1.71	-$1.49	$0.42	-$0.94
	Minimum	-$12.81	-$12.79	-$7.84	-$12.81
	Maximum	$4.01	$4.60	$10.52	$10.52
	% of Participants on TOU	40%	34%	54%	43%
September	Average	$1.26	$2.45	$2.63	$2.11
	Minimum	-$4.95	-$2.96	-$4.76	-$4.95
	Maximum	$12.91	$15.81	$23.90	$23.90
	% of Participants on TOU	76%	93%	81%	83%
October	Average	$1.85	$6.61	$2.36	$3.62
	Minimum	-$5.31	-$0.81	-$6.06	-$6.06
	Maximum	$17.77	$26.58	$20.81	$26.58
	% of Participants on TOU	78%	100%	82%	86%
November	Average	$0.39	$1.24	$0.61	$0.75
	Minimum	-$4.36	-$6.89	-$3.73	-$6.89
	Maximum	$9.46	$10.03	$13.11	$13.11
	% of Participants on TOU	60%	78%	55%	64%
December	Average	$3.01	$4.28	$4.03	$3.77
	Minimum	-$3.08	-$1.76	-$1.68	-$3.08
	Maximum	$18.48	$16.32	$34.29	$34.29
	% of Participants on TOU	95%	96%	92%	94%
January	Average	$0.60	-$1.29	$1.64	$0.32
	Minimum	-$4.86	-$8.15	-$5.74	-$8.15
	Maximum	$12.41	$7.14	$33.35	$33.35
	% of Participants on TOU	55%	22%	70%	50%
February	Average	$0.08	$1.07	$0.61	$0.59
	Minimum	-$8.28	-$5.63	-$7.48	-$8.28
	Maximum	$15.46	$22.22	$35.55	$35.55
	% of Participants	38%	52%	33%	41%
All Months	Average	$0.79	$1.85	$1.76	$1.47
	Minimum	-$12.81	-$12.79	-$7.84	-$12.81
	Maximum	$18.48	$26.58	$35.55	$35.55

Exhibit 26: TOU savings on participant bills during individual months. A "+" sign equals a lower bill on TOU/CPP/CPR.

5.3.4 Bill Impacts from Conservation

The above analysis on bill impacts considers only the load shifting aspects of TOU prices; conservation effects are not included. In other words, it mimics the results of

what a shadow bill program would portray to consumers, where consumers would receive two statements—one based on threshold prices, the other based on TOU prices—*for the same amount of consumption*.

As described in Section 5.2, however, TOU prices have a conservation effect that lowers the overall consumption.

Here, we are limited to applying averages. Assuming a 6.0% conservation effect alone, and based on the average RPP price of about 6.3¢/kWh during the summer months and the lower-tier RPP price of 5.5¢/kWh for the winter months, the savings would range from a few cents for the lowest volume user to over $6 per month for the largest user. Average monthly use for pilot participants was 727 kWh after conserving 6%. Thus the conservation effect at an average price of about 5.9¢/kWh resulted in savings averaging $2.73 per month.[20]

Therefore, on average, participants experienced a monthly savings from both load shifting and conservation on the TOU prices as compared to the two-tiered threshold prices is $4.17.

Savings Source	TOU Bill Savings
Load Shifting	$1.44
Conservation	$2.73
Total Average Monthly Bill Savings During the Pilot Period	$4.17

Exhibit 27: The average monthly TOU bill savings from both load shifting and conservation effects was $4.17.

With this conservation effect considered, 93% of customers would pay less on RPP TOU prices over the course of the pilot, than they would have on RPP threshold prices (compared to 75% without conservation being considered).

[20] - The average RPP price was not used for the winter months because the usage of participants in the pilot was below the winter threshold of 1000 kWh. As a result, the lower RPP tiered price was used to provide a more accurate estimate of the savings due to conservation.

6 Participant Feedback

6.1 Approach

Two formal means of gathering participant feedback were used: focus groups with representatives from each pricing group and a survey targeted at all participants.

6.1.1 Focus Groups

Three focus groups were conducted in Ottawa during the second week of October; one group each for CPP, CPR, and TOU participants. There were 44 participants involved. The focus groups were scheduled so that participants would have had sufficient experience with the program to speak knowledgeably, yet there would be enough time to make minor changes in the pilot if warranted by the feedback.

The focus groups provided the OEB with participant feedback on the following items:

- Why participants chose to participate in the pilot
- How did participants feel about various elements of the recruitment process
- How did participants like the monthly electricity usage statements and what did participants value the most (i.e., if one item could be included in their regular bill)
- Where relevant, participant responses to the information on the critical peak events
- What actions they took and their understanding of the rationale for TOU pricing

More detail on the focus groups is provided in Appendix F.

6.1.2 Participant Survey

As part of this study, IBM's National Survey Centre conducted a survey of the program participants. A dual methodology was implemented for the survey:

- Invitations to participate in an online survey were sent to all participants on November 22, 2006 who had provided an email address as part of the study.
- The mail survey was distributed by regular mail on November 23, 2006 to all participants who did not provide email addresses as part of the study. The mail surveys also contained unique links to the online survey to encourage participants to complete it online.

A total of 298 surveys were returned by the survey cut-off date of December 14, 2006, for an overall response rate of 79%. The margin of error (at 95% confidence) for the overall results is ± 5.7% for the 298 surveys received.

The margin of error for the different sub-groups presented throughout the report varies depending on the sample size (See Exhibit 28).

Price Group	Responses	Margin of Error
TOU only	94	±10.2%
CPP	103	± 9.7%
CPR	101	± 9.8%
Total	**298**	**± 5.7%**

Exhibit 28: Margin of error by pricing group

As a reference, ± 10% margin of error indicates a difference of at least 20 percentage points is needed to prove a statistically conclusive result.

The complete survey results are provided in Appendix G.

6.2 Rationale for Participating

The top reasons given by focus group participants in all three treatment groups for participating in the pilot were:

- They knew TOU pricing was coming in the near future and wanted to be prepared by seeing how they would fare economically under the TOU price plan
- They liked the idea of being able to monitor their own electricity usage with the tools provided by the project
- They perceived that the design of the TOU pricing and the feedback on their usage would give them more control over their electricity bill

Only a handful of focus group participants indicated that receiving a $75 incentive payment was one of the top three motivations to enrol in the project.

6.3 Communications Feedback

6.3.1 Letters and Fact Sheets

The focus group results indicated that the initial participant education (e.g. recruitment letter, fact sheets, enrolment confirmations, magnets, and electricity conservation brochures) were clear and understandable. In some cases, participants who scrutinized the educational materials overcame initial scepticism towards the project and came to understand that TOU prices were beneficial to consumers and not a “money grab”.

6.3.2 Refrigerator Magnet

The discussion in the focus groups regarding the magnet underscored two things:

- The importance of presenting TOU prices and periods in a clear and concise format, because virtually all participants found the prices understandable “because of the magnet”

- The importance of producing this information in a durable and reproducible form, such as a magnet, because consumers refer to the information frequently and in multiple places as they are adjusting to the TOU prices.

Participants used the refrigerator magnet frequently and provided the most feedback on this educational tool. They reported that it was easy to explain the TOU prices or the pilot project's intent to their friends and neighbours, and to understand it themselves, by referring to the magnet.

They also manage their own electricity usage in response to the prices by referring to the magnet at various times and in various places. They often duplicated the information on the magnet to post in their kitchens, laundry rooms, and near their thermostats, where they would be making decisions about running major appliances such as dishwashers, laundry machines, and air conditioners.

The survey results reinforced the importance of the magnet and on the format used. Participants prefer (61%) the tabular format for displaying the different time periods and associated time-of-use prices over a more graphical approach.

All participants were provided with a replacement fridge magnet before the price change in November. (If it continues to include actual prices, a requirement for keeping the magnet up to date should be noted before any larger distributions are undertaken.)

6.3.3 Conservation Brochure

Because most participants understood the primary purpose of this project was to encourage load shifting, the conservation brochure was not as salient an educational tool. However, many would characterize their participation in the pilot as including an awareness of conservation as well as peak load shifting, and they referred to the brochure to find out how to lower their consumption in general ways at all times, which they saw as contributing to their successful peak load reduction

6.3.4 Statement Provision

Focus group participants and survey results were generally complimentary of the frequency of the usage statements, the colors and presentation of their daily usage graphs, and that the statements seemed more personal or informative than their regular utility bill. In fact, 93% of 282 survey respondents agreed (strongly or otherwise) that the information on the statements was helpful in understanding how much electricity was used during different periods.

The most important aspect of the statements to focus group participants was the daily consumption breakdown by TOU price. Participants identified this as the priority item that should be added to their "normal" electricity bill from their utility, in any future mandatory TOU pricing regime.

The statements were provided monthly, in contrast to the bi-monthly bills Hydro Ottawa customers currently receive. There was a consensus among focus group participants that bi-monthly frequency was not adequate within the context of smart meters and TOU pricing.

Online access to energy information was seen by focus group members as less important than informative monthly bills. Nearly 70% of survey responses did indicate that they anticipate accessing an online statement at least monthly. Only 11% indicated a desire for accessing information daily.**

Frequency of accessing usage statement by internet/e-mail	Responses
Daily	10.6%
Weekly	27.4%
Monthly	31.8%
Less frequently	18.8%
Never	11.3%

Exhibit 29: Survey responses to anticipated frequency of accessing information on electricity usage statement if available by internet or e-mail

In the majority of cases across the three treatment groups, participants understood the information as presented, paying close attention to the times and amount of their electricity usage.

They actively used the information to gauge their hourly consumption and made adjustments in the times of their electricity use. They were well versed enough in the format to be able to look at their daily records and attempt to explain spikes or declines in usage (“I was working from home that week” or, as one phone caller said, “I’m going to see what happens when I fire up my kiln on a weekday”).

Focus groups also indicated a strong desire to compare costs under current Two-tiered RPP prices with the RPP TOU prices. They suggested that the Electricity Usage Statements be modified to include their other charges (e.g. distribution and debt recovery) so that they could see what they would really be paying under the TOU prices.

They also suggested that, in order to compare the monthly statement with the regular bi-monthly bill, the statement needed to include a calculation of what they would have actually paid under the tiered prices.

These and other suggestions about format were considered and incorporated where possible by the project implementation team. For instance, subsequent statements provided pilot participants with a comparison of their bills under the TOU and tiered prices. This was the change that most participants felt was most important. The other change was not felt to be as important given that all of the other (non-commodity) charges would not be materially affected or not affected at all.

6.4 Electricity Use Changes and Understanding of TOU Pricing Rationale

Participant feedback, particularly the focus groups, also provided qualitative input regarding actions participants took in response to being in the pilot and having the pilot prices.

Most focus group participants understood that an appropriate response to TOU prices would be to find opportunities to shift more electricity usage to the Off-Peak periods. For a typical participant, this translates into doing their laundry and dishwashing during Off-Peak times, and turning their thermostats down in advance of critical peak events.

Some participants also implemented some less common measures. For example, prior to the pilot, one participant cleaned his pool from 7-7 during the *day*. After the pilot started, the pool was cleaned from 7-7 during the *night.*

Survey respondents indicated that they were more likely to significantly change how they use electricity during On-Peak and critical peak periods. They indicated that the Mid-Peak price point did not have much of an influence on their electricity usage patterns (which is consistent with the intent).

The typical focus group participant would post the TOU price and schedule table (as printed on their refrigerator magnet and in the enrolment fact sheets) in their kitchen and laundry room to remind them of the best times to do laundry or run their dishwashers.

Many considered these to be easy practices to implement to keep their electricity bills under control. Others were willing to change their behaviour to fit the reality of electricity costs, in the hopes that this would result in lower overall prices in the future.

Most focus group participants began these practices as soon as they enrolled in the pilot. After receiving their first few Electricity Usage Statements and seeing the effect of their usage behaviour on their costs, many participants continued their load shifting practices with little adjustment, although a few later realized that they wanted to compare how they fared on TOU prices with and without shifting their usage, and considered trying a month without shifting to develop their own baseline for consumption.

Some found it difficult to fit load-shifting behaviour in their lifestyles. For example, some families with small children attested to the difficulty of curtailing their laundry activity during Mid-Peak and On-Peak periods. However, it is encouraging to note that even those families that were unable to change their load shape felt they were not penalized under the existing TOU prices. No one felt as if the TOU prices were

the “money grab” and “gouging” that many had feared and/or perceived going into the pilot.

Not all participants understood the policy rationale behind managing peak demand, but a few expressed the perception that, regardless of whether the peak demand was attributable to industry or the residential sector, if every consumer did their part to reduce peak load, eventually the system would be more reliable and they could keep electricity prices down as a result. A number of participants also discussed the need to avoid brown-outs and/or black-outs.

6.4.1 Critical Peak Groups

In response to a critical peak notification, customers might reset their thermostats by a few degrees, as suggested by the PowerWise marketing materials provided to the participants, or plan on dining out or cooking on an outdoor grill during a critical peak event. Those participants with timers on their dishwashers and programmable thermostats would experiment with setting their appliances to consume less power during peak times. Some noted that they first used their timers after the pilot started.

The rule of thumb used was that for a critical peak event, only the essential “non-negotiable” appliances (such as refrigerators) would continue to run. However, for the most part, focus group respondents felt that they had already pared back their electricity consumption to the minimum in response to the On-Peak price, and that there was no more shifting they could accomplish in response to CPP or CPR during a critical peak period.

6.4.2 Expected Bill Impact

The impact on individual bills seemed to be less than many focus group participants had hoped. Very few of the focus group participants realized what they would consider “large” savings on their electricity bills, and in fact many focus group participants expressed disappointment that their efforts did not result in greater savings. Some considered that it was not worth the extra effort to do laundry late at night or on weekends for such small bill savings, while some stated that their primary motivation was electricity conservation and that the small savings were not a concern.

These bill comparisons by participants are complicated by many factors:

- Comparisons of pilot Electricity Usage Statements calculated for each calendar month against bi-monthly bills from Hydro Ottawa calculated from various billing dates
- Comparisons of electricity commodity changes alone against a Hydro Ottawa bill that includes distribution and other charges

- Comparisons between pricing structures that are designed to be revenue neutral for an entire year, but have different effects on individual months (As described above in the description of monthly bill impacts)
- Finally, comparisons that do not consider the bill reductions resulting from the average conservation effect realized by participants on TOU prices.

6.5 General Program Satisfaction

6.5.1 Main Benefits of the Program

Being more aware of how to reduce their bill and knowing when electricity is being used are clearly the top benefits of the time-of-use pricing plan. Being more conscious of peak usage is also a main benefit according to pilot participants.

	Total	CPP	CPR	TOU
More aware of how to reduce bill	100.0%	100.0%	100.0%	100.0%
More aware of when electricity is used	90.6%	94.7%	93.2%	84.2%
More conscious of peak usage	85.6%	87.2%	82.5%	87.1%
Gives greater control over costs	67.1%	59.6%	75.7%	65.3%
More aware of total consumption	56.4%	58.5%	49.5%	61.4%
Benefits the environment	52.3%	50.0%	53.4%	53.5%
Other benefits	1.3%	2.1%	1.0%	1.0%
No benefits	0.7%	1.1%		1.0%
Total	100.0% (n=298)	31.5% (n=94)	34.6% (n=103)	33.9% (n=101)

Exhibit 30: Responses to "What is the MAIN benefit the time-of-use pricing plan offers to its customers?" Note that column percentages may add to more than 100% due to multiple responses.

6.5.2 Program Satisfaction

The majority (78%) of survey respondents would recommend the time-of-use pricing plan to their friends, while only 6% would definitely not.

Respondents most frequently cited more awareness of how to reduce their bill, giving greater control over their electricity costs and environmental benefits as the top three reasons behind recommending time-of-use pricing. (See Exhibit 31 for further reasons why and why not.)

These results are consistent regardless of which pricing plan the participants were enrolled in for the pilot.

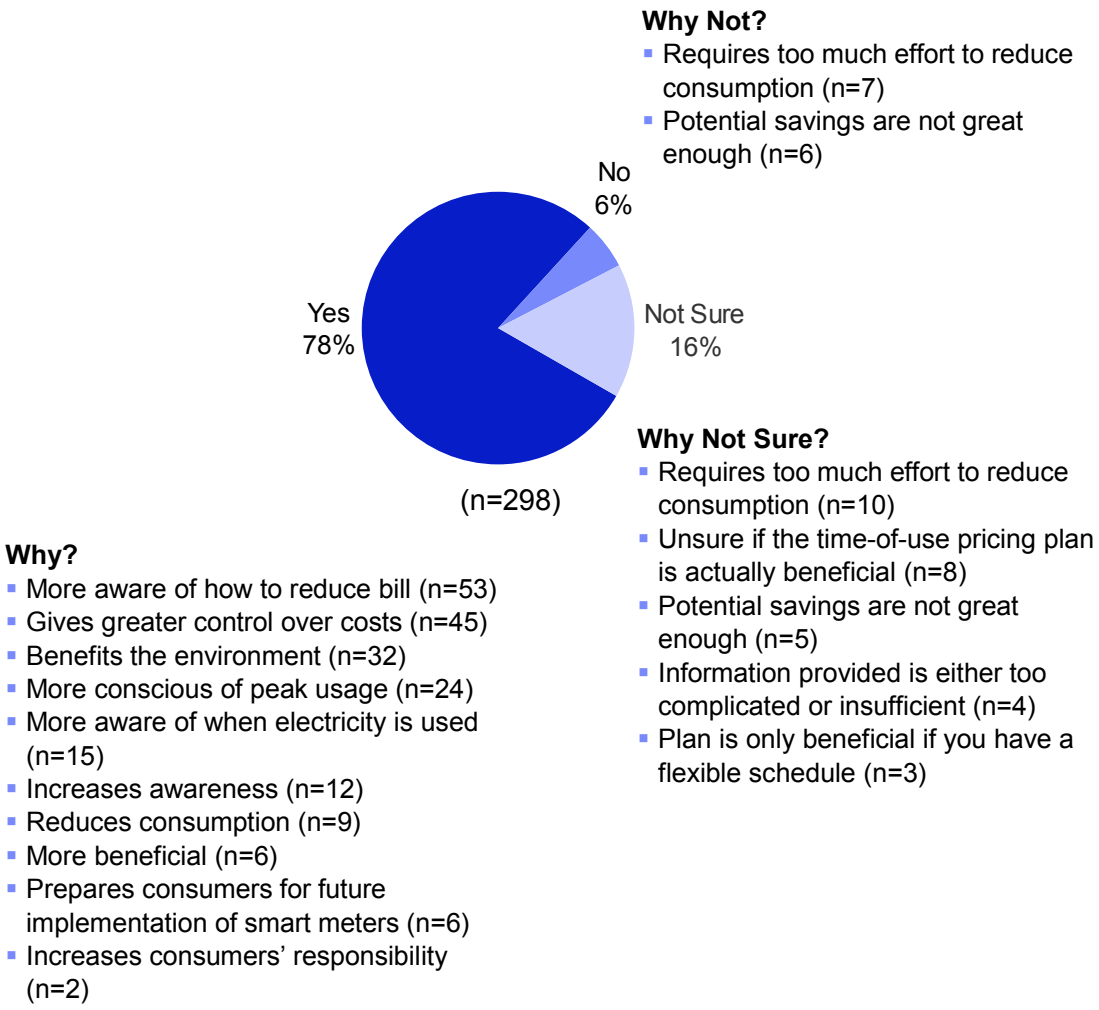


Exhibit 31: Would you recommend the time-of-use pricing plan to your friends if the pilot project was expanded? Why or why not?

6.6 Pricing Structures Preferences and Understanding

6.6.1 Pricing Structure Preferences

The majority of participants (74%) preferred TOU-only pricing out of the four options. This was consistent regardless of which pricing plan in which they were enrolled.

While interest in the CPP and CPR plans was only moderate, less than 20% prefer the existing two-tier pricing used by Hydro Ottawa before the pilot. Most would not want to go back to two-tier pricing. (See Exhibit 32).

Notably, participants enrolled in the TOU-only pricing plan were significantly less likely to indicate that the CPP plan was of most interest to them.

Note that participants were provided with a one-sentence description of the pricing plans and most likely had no experience with any plans other than the one they were on for the pilot.

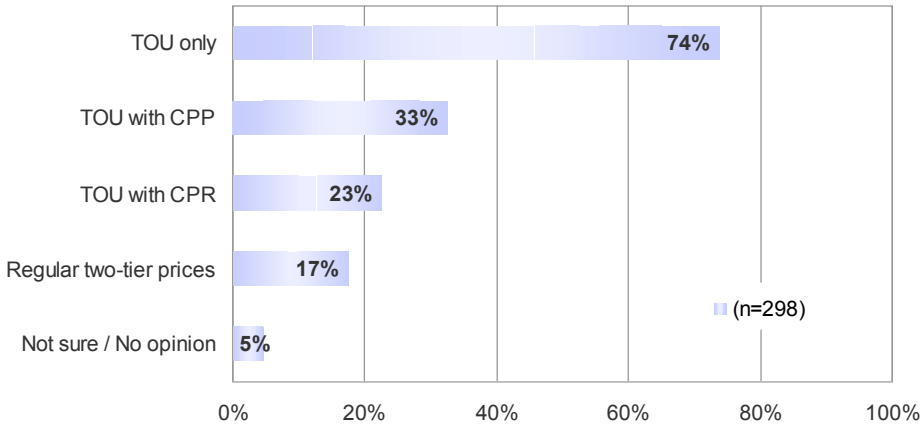


Exhibit 32: Three-quarters of participants preferred TOU-only pricing over the other options, including the current tiered pricing.

Other notable results include:

- Participants enrolled in the TOU-only price plan were significantly less likely to indicate that the CPP or CPR plans were of *most* interest to them (only 19%).
- 42% of CPP participants chose CPP as the *most* interesting to them. While 36% of CPR chose the CPR plan.

6.6.2 Pricing Structure Recall

We tested the recall abilities of participants during the survey. Participants were instructed to not refer to their fridge magnets or other materials.

This survey was completed after only less than four months on the new TOU prices and within one month after a change to the TOU periods from the summer to the winter periods.

The following were the results:

- 38% of survey respondents were able to correctly identify that the price changed four times during a summer weekday.
- 30% of survey respondents were able to correctly identify that the price changed five times during a winter weekday.

In regard to the start time of the On-Peak and Off-Peak periods:

- 35% of survey respondents could correctly identify 11:00 AM as the start of the summertime On-Peak period.

- Another 25% confused the start of the Mid-Peak with the start of the On-Peak period. They thought the On-Peak started at 7:00 AM. That is actually the start of the summertime Mid-Peak period.
- Other responses were spread evenly from 5:00 AM to as late as 5:00 PM

Respondents were better able to recall the end of the On-Peak period:

- Over half of the survey respondents correctly identified 5:00 PM as the end of the summertime On-Peak period.
- Responses from remaining participants ranged from 10:00 PM to 7:00 PM.

After being one month into the winter period when surveyed, participants were more likely to correctly identify the start and end times of the wintertime On-Peak periods than summertime:

- 47% correctly identified the start and end of the morning peak
- 40% correctly identified the start and end of the evening peak.

All of these results are consistent regardless of the plan in which participants were enrolled.

6.6.3 Pricing Structure Feedback

The consensus feedback among focus group participants was that TOU pricing structure was easy to understand and did not need to change:

- When asked if they would prefer only two TOU periods (off- and on-peak, without mid-peak), none of the focus group participants said they desired a change to a two-period structure from the current three-period structure
- For the most part (71%), survey respondents felt that the difference in price points was large enough to encourage them to shift their electricity consumption.
- While all except one participant considered these TOU prices relatively easy to understand, the one participant who would not have characterized the prices as “easy” wanted to acknowledge an added layer of complexity in that there were seasonal changes in the schedule of on-, mid- and off-peak periods; and that winter TOU prices would be more difficult with two on-peak periods each weekday. At the same time, he did not consider this too difficult to understand.