Ontario Energy Board

Staff Discussion Paper

Regulated Price Plan - Time-of-Use Prices: Design and Price Setting Issues

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Disclaimer

The views presented here are those of Board staff and do not necessarily represent the views of, and should not be attributed to, the Ontario Energy Board, or any individual Board Member

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1.0 Introduction

In the Integrated Power System Plan filed with the Ontario Energy Board ("Board") on August 29, 2007, the Ontario Power Authority projects that total conservation and demand management will result in a reduction in peak load of 4,210 MW by 2020 from all consumers. These reductions are expected to come from changes in consumer behaviour, fuel switching and improvements in energy efficiency. Time-of-use ("TOU") pricing, enabled through smart meters, is projected to contribute 575 MW of these total reductions.

Consumers can affect system peak loads by reducing their own peak electricity use and/or by shifting their electricity demand from peak periods. Consumers need information about their electricity use to guide their decisions on reducing or shifting their electricity consumption. Smart meters will provide the necessary information. In addition, reductions or shifts in consumption can be encouraged through financial incentives. TOU prices can provide a financial incentive for consumers to change their electricity use patterns.

Since April 2005, the Board has set electricity commodity prices for eligible consumers that have not chosen to contract with a retailer for electricity supply. This commodity pricing regime, the "Regulated Price Plan" or "RPP", currently applies to low-volume and "designated" consumers (including the "MUSH" sector – municipalities, universities, schools and hospitals).[1]

TOU prices have been a part of the RPP since its inception, although relatively few consumers are currently being charged TOU prices. However, within the next two years a large number of smart meters and supporting infrastructure will be deployed. In anticipation of this large scale deployment of smart meters and infrastructure, it is timely to consider whether changes to the TOU pricing framework are warranted.

1.1 Purpose

This staff Discussion Paper is intended to solicit stakeholder input, to inform staff's further work in considering and formulating policy proposals for subsequent consideration by Board Members on issues associated with the structure of TOU prices and the methodology by which those prices are determined.

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[1] As discussed in section 2.1.1, eligibility for RPP pricing will change in May, 2009.

In addition to identifying the issues, this staff Discussion Paper sets out Board staff's preliminary views regarding some of them.

Board staff's views have been informed by the results of the Board's Ontario Smart Price Pilot, which is described in greater detail below and in Appendix A, by other pilot projects approved by the Board and administered by distributors, by experience in other jurisdictions and by developments in the Ontario electricity sector over the last several years.

The Ministry of Energy is leading an initiative that explores the timing of mandatory implementation of TOU pricing and communications efforts to inform consumers. Board staff and interested stakeholders are participating in this initiative. These issues are therefore not addressed in this Discussion Paper.

1.2 Background: RPP and TOU Prices

Under section 79.16 of the *Ontario Energy Board Act, 1998* (the "Act"), the Board assumed responsibility for setting electricity commodity prices for eligible consumers effective April 1, 2005. To that end, and following extensive consultations, the Board issued a revised Standard Supply Service Code ("SSS Code") on March 11, 2005.[2] The SSS Code makes provision for two RPP pricing schemes: two-tiered prices and TOU prices. The methodology for setting both types of RPP prices is set out in the Board's Regulated Price Plan Manual (the "RPP Manual").

In 2004, the Board struck a committee of stakeholders, the RPP Working Group ("WG"), to provide input on the basic design of the RPP. The WG's recommendations were set out in a report dated December 31, 2004.

The WG concentrated on developing recommendations for two-tiered (non-TOU) pricing, recognizing that there would be some delay in implementation of time-of-use pricing pending the wide-spread deployment of smart meters. However, the WG's report did address a number of issues regarding TOU pricing to assist the Board in setting a TOU framework. The WG examined data and results from pilot and established TOU programs in other jurisdictions to assist in determining the likelihood of similar programs being effective in Ontario. The WG also

[2] Details of the process associated with the development of the RPP prices and associated instruments can be found on the Board's website at: http://www.oeb.gov.on.ca/html/en/industryrelations/ongoingprojects_regulatedpriceplan_development.htm.

discussed design features such as the price spread from Off-peak to On-peak that would stimulate changes in consumer behaviour.

The Board decided that it was important to be proactive and to indicate its intention to implement TOU pricing at an early date. The Board therefore made provision for TOU pricing in the revised SSS Code issued in March, 2005 and included the methodology for determining TOU prices in the RPP Manual.

1.2.1 How Time-of-Use Prices are Determined

The methodology currently used by the Board to set RPP TOU prices is set out in detail in the RPP Manual.

TOU pricing presupposes that the cost to supply load varies over a pre-determined time period (typically 24 hours) in response to changes in total system load (see Figure 1 in section 2.2 below). The physics of electricity and the economics of generation ensure that these conditions will exist in market-based electricity systems**.** The inability to effectively (and economically) store large amounts of electricity combines with variation in the fixed cost to variable cost ratios of specific generation technologies (and some operational limitations) to provide time differentiated changes in the cost to supply system load.

Several design principles and features underlie the current RPP TOU pricing regime:[3]

- Supply cost recovery: fundamental to all RPP prices (two-tiered and TOU) is the concept of supply cost recovery. In other words, consumers pay commodity prices that over time reflect the costs of generation, including the under- and over-payments that are inherent in a pricing system based on forecasts.
- Three price periods: load curves for RPP consumers and market price graphs indicate that three price periods, Off-peak, Mid-peak and On-peak, can be readily defined and correlated with different supply costs.
- Seasonal variations in load curves: RPP consumers have different electricity use patterns in summer and winter.

Prices for the three periods referred to above are driven by the different generation technologies and the costs of each to provide supply during those periods.

[3] As indicated in section 2.0, changes in the structure of the electricity market since 2005 may affect the continued applicability of some of these principles or features.

Off-peak prices are mainly determined by the cost of coal-fired generation plants. The price of coal has been relatively stable because of long-term supply contracts. However, as Ontario approaches the phase out of coal-fired generation, a greater proportion of coal supply may be purchased through shorter-term contracts or on the spot market at more volatile prices. Other types of generation facilities supplying power during Off-peak periods are nuclear and large hydraulic, with the output from many of these plants receiving fixed prices currently set by regulation. As a result, Off-peak TOU prices have remained relatively stable since the RPP was introduced.

Mid-peak prices are determined part of the time by relatively inexpensive coal-fired plants, and part of the time by relatively expensive gas-fired plants. The most important determinant of the Mid-peak TOU price is the relative percentage of time that prices are set by either coal- or natural gas-fired plants. Therefore, forecasts of natural gas prices are an important component of determining mid-peak prices. Natural gas market prices respond to shorter-term supply and demand conditions. As a result, forecasts of mid-peak prices tend to cycle up and down as market conditions change.

On-peak prices are determined by a combination of natural gas-fired generation, small peaking hydraulic plants, and other relatively expensive sources of supply, such as pump storage facilities.

RPP prices are set so that "average consumers" would pay the same for their electricity (commodity only) regardless of whether they are charged two-tiered or TOU prices, provided they do not change their consumption patterns. The average unit cost of RPP supply is the same for the "average" RPP consumer, regardless of the pricing structure that applies. Table 1 below illustrates this point using the most recent prices set by the Board.

Table 1: RPP Prices – Effective May 1, 2008

Two-tiered RPP Prices	Tier 1	Tier 2	Average Price
Price	5.0¢	5.9¢	5.45¢
% of Consumption	54%	46%	

TOU RPP Prices	Off-Peak	Mid-Peak	On-Peak	Average Price
Price	2.7¢	7.3¢	9.3¢	5.45¢
% of Consumption	50%	28%	22%	

1.3 Ontario's Experience with RPP TOU Pricing

Experience with TOU pricing in Ontario comes from three sources. First, two distributors (Milton Hydro and Newmarket Hydro, with a combined total of over 20,000 customers) have implemented TOU prices and one, Milton Hydro, has reported on customers' response to those prices. Second, five distributors have implemented TOU pricing pilot projects and reported their results. Finally, the Board has conducted, with Hydro Ottawa, its own TOU pilot, the Ontario Smart Price Pilot. This section summarizes information from each of these sources.

1.3.1 Customers on TOU Pricing

Milton Hydro was the first Ontario distributor to introduce TOU pricing, initiating its own "smart meter" program for all new connections soon after the RPP was introduced. Subsequently, Milton Hydro extended smart meter installations to its existing customer base.

When it implemented TOU pricing in October 2005, Milton Hydro focused on residential consumers. Subsequently, non-residential consumers eligible for RPP pricing were placed on TOU pricing when appropriate meters were installed. Currently, about 20,000 Milton Hydro customers, mostly residential, have TOU pricing. Over 700 non-residential consumers with demand of less than 50kW also have TOU pricing.

Newmarket Hydro phased in TOU pricing to eligible consumers beginning in November 2007. By the end of 2008, Newmarket Hydro expects that all 28,000 of its residential customers will have TOU pricing.

1.3.2 Ontario Distributor Pilot Projects

On July 28, 2006, the Board amended the SSS Code to enable distributors to seek Board approval to conduct TOU pricing pilot projects.

Five distributors have implemented Board-approved TOU pricing pilot projects. As intended by the Board, these pilot projects test different aspects of TOU pricing. Most of the pilots use the Board's existing RPP TOU prices, both in terms of the price itself and the three-period structure. One project, however, tests critical peak rebate pricing. Two of the distributor pilots test TOU pricing in conjunction with innovative technologies such as smart thermostats and real time in-home display monitors. The key parameters of the distributor pilot projects are set out in Table 2 below, and a summary of each pilot project and any preliminary results reported to the Board are set out in Appendix B.

Table 2: Board-approved TOU Pricing Pilot Projects

Distributor	Type of Customer	Other Parameters
Newmarket Hydro	Residential	RPP TOU prices Critical peak rebates Smart thermostats
Veridian Connections	Medium-sized business	RPP TOU prices
Hydro One	Rural	RPP TOU prices Real-time monitors/smart thermostats
Oakville Hydro	Sub-metered residential condominiums	RPP TOU prices
Peterborough Distribution[4]	Residential	RPP TOU prices Residential appliance controllers

As noted in Table 2, the pilot projects cover many of the consumer groups that are currently eligible for the RPP (residential in homes and condominiums, farms, small businesses and medium-sized businesses). Four of the pilots involve consumers in urban areas, while the consumers in the fifth are in rural areas.

Preliminary observations from these pilot projects include the following:

- consumers responded by switching consumption from On-peak periods to Mid- and Off-peak periods;
- impacts on the total consumer bill of switching to TOU pricing depended on individual consumer conservation responses and their average electricity costs (i.e., the relative proportion of their consumption that was in each tier before switching to TOU); and,
- enabling technologies such as remotely controllable thermostats and load control devices for water heaters increased the load switching and conservation effects.

[4] This pilot was approved by the Board as part of Peterborough Distribution Inc.'s conservation and demand management plan prior to the amendments to the SSS Code allowing distributors to apply for approval to conduct TOU pricing pilot projects.

1.3.3 The Ontario Smart Price Pilot

In June 2006, the Board initiated, with the assistance of Hydro Ottawa, the Ontario Smart Price Pilot ("OSPP") project to test the impacts on consumer behaviour of different time-sensitive price structures. The OSPP involved 375 of Hydro Ottawa's electricity customers and, as described below, three different pricing structures.

A complete description of the design and results of the OSPP is contained in the *Ontario Smart Price Pilot: Final Report* posted on the Board's website on July 26, 2007.[5] The following is an overview, taken in large part from that *Final Report*.[6] Appendix A sets out further detail regarding the OSPP.

1.3.3.1 Design of OSPP

The OSPP operated from August 1, 2006 to February 28, 2007. It was designed to assess:

- the extent to which various time-sensitive pricing structures cause a shift of electricity consumption from On-peak periods, measured by the reduction in peak demand;
- the extent to which each price structure causes a change in total monthly consumption; and,
- the understanding of, and acceptance by, residential consumers of each pricing structure and the communications associated with each.

Quantitative analyses of demand response, total energy conservation, and participant survey responses were used to analyze the data from the OSPP. Qualitative feedback was obtained from focus groups and by tracking participant support calls.

The OSPP tested three different price structures:

- existing RPP TOU prices;
- adjusted RPP TOU prices with a critical peak price ("CPP"); and
- existing RPP TOU prices with a critical peak rebate ("CPR").[7]

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[5] At: http://www.oeb.gov.on.ca/html/en/industryrelations/ongoingprojects_regulatedpriceplan_smartpricepilot.htm

[6] Similarly, references to the results of the OSPP later in this Discussion Paper and in Appendix A are taken from the *Final Report.*

[7] Critical peak prices are pre-set prices, often based on avoided peak generation costs, that occur a limited number of times in a year and are pre-announced to consumers so that they can

1.3.3.2 Results from the Ontario Smart Price Pilot[8]

All three price structures resulted in load shifting and load reduction. CPP participants recorded the largest reductions in total peak load and critical peak load, followed by CPR participants and lastly by those on TOU prices only (see Table 3 below). Of note is the fact that TOU customers recorded significant reductions (5.7%) in peak load during critical peak times without the assistance of prior notification.

Participants in the OSPP also reduced their total energy consumption compared to weather-adjusted load for the same time period in the previous year. These savings, or the "conservation effect", ranged from 4.7% to 7.4%.

Electricity bill reductions from TOU pricing averaged 3% across all participants compared to bills based on two-tiered RPP prices.[9] 75% of project participants paid less on TOU prices than they would have on two-tiered RPP prices, ranging from a few cents for small volume users to $6 per month for larger volume users. If the conservation effect is added into the bill calculation, then 93% of participants paid less for electricity on TOU prices compared to two-tiered RPP prices.

Table 3: Percent Reduction in Load During Four Summer Critical Peak Days

Period	TOU only	CPP	CPR
Critical peak hours (3 or 4 hours during the peak)	5.7%	25.4%	17.5%
Entire On-Peak period	2.4%	11.9%	8.5%

respond by reducing load. Critical peak rebates are pre-set, per-kWh payments to consumers for load reductions from a pre-determined base level, also on a limited and pre-announced basis.

[8] Preliminary results for residential consumers in Hydro One's TOU pilot project show similar load shifting and conservation impacts as those observed in the OSPP.

[9] OSPP participants received statements based on the applicable pricing structure, but continued to pay on the basis of the two-tiered RPP prices. However, for convenience references below and in Appendix A refer to payments and savings based on the applicable pilot pricing structure.

2.0 TOU Pricing: Structural Issues

The original design of RPP TOU prices was based on data and market information that was available at the time. However, since that time the emergence of long-term supply contracts for new generation capacity and the regulated nature of payments that are made for a large portion of existing supply have changed the significance of Ontario market prices in determining supply costs. The "flattening" of market prices (i.e., reduced hourly volatility and lack of scarcity pricing during peak demand periods) suggests that some of the original design principles for setting RPP TOU prices should be revisited and may warrant revision to maintain or enhance their effectiveness as a shifting and conservation tool in a smart meter environment.

Two major issues that may need to be re-examined are the three-period pricing structure of TOU prices and seasonal variations in TOU prices. In addition, experience with the OSPP has provided some quantitative data and consumer-based feedback on critical peak pricing.

2.1 Three-Period Pricing

The SSS Code includes a three-period TOU pricing structure, with separate prices set for Off-peak, Mid-peak and On-peak periods. When originally developed, this pricing structure reflected a number of characteristics of Ontario's electricity sector, including RPP load profiles, generation fuel and technology mix and RPP supply costs, as well as a desire to encourage conservation and demand management. Many of these considerations remain relevant today.

2.1.1 Load Profiles and Fuel Mix

One rationale for the three-period TOU pricing structure was hourly RPP supply costs, specifically the relative "peakiness" of RPP load compared to total system load. This characteristic of RPP load is expected to increase when certain RPP consumers cease to be eligible for RPP pricing. Specifically, MUSH sector customers will be ineligible for the RPP effective May 1, 2009, as will some large commercial and industrial customers (those with an annual demand of greater than 250,000 kWh) that are currently eligible.[10] Unlike residential consumers, MUSH consumers generally use electricity on a 24-hour or 16-hour basis without significant cycling up and down within those periods. Electricity demand profiles of designated commercial and industrial consumers vary widely. In addition, although there are large users that are currently eligible notwithstanding that their annual demand exceeds 250,000 kWh, many of these have already exited the

[10] Ontario Regulation 95/05, *Classes of Consumers and Determination of Rates*, section 4(2) (as amended by Ontario Regulation 58/08).

RPP by entering into retail contracts or opting for pricing based on the wholesale price. Therefore, the fact that they will become ineligible for RPP supply can be expected to have little, or no, impact on RPP supply costs.

The three-period RPP TOU structure is also supported by Ontario's diverse generation fuel mix. Baseload generation is largely hydraulic and nuclear, while mid-merit[11] and peak generation includes fossil (coal and natural gas) and hydraulic generation. In the future, generation from natural gas-fired facilities and from renewable energy (primarily wind, but also some solar and small-scale hydraulic), will be a growing segment of total supply. This mix of fuels and technologies means that Ontario's electricity supply costs are likely to continue to show some hourly variations, regardless of how generators are paid for their output (market prices, regulated prices or contract prices).

2.1.2 Experience with the Three-Period Structure

During the initial development of the RPP, some stakeholders were concerned that a three-period TOU structure would be too complex for the average consumer. Some cited experience with U.S.-based utility pilot projects to support their assertions, claiming that only simple, two-period price structures would be effective with small-volume consumers. [12]

The OSPP provides some information about this issue, although Board staff notes that the experience of OSPP participants may not necessarily be reflective of the views of the broader public. Interviews with participants in the pilot project focus groups revealed that these residential consumers did not consider the three-period TOU structure to be too complicated. Several respondents stated that the structure was easy to understand and that simple support materials, such as a multi-coloured fridge magnet that indicated the hours and days when specific TOU prices applied, were effective as quick reminders for family members. After a load reduction or shifting pattern was established, most respondents reported that the new consumption patterns became habits and that very little remedial education was required.

When asked if they would prefer only two TOU periods (Off-peak and On-peak), participants that did respond said they preferred the three period *status quo*. None indicated a preference for a two-period structure.

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[11] "Mid-merit" refers to generation that supplies the middle portion of the demand load curve and generally operates for more than 5 to 6 hours per day but less than 24 hours.

[12] The majority of U.S. pilot projects are based on two-price structures with critical peak pricing. Of 18 projects in a recent survey, three were based on three-tier pricing and one of these was a long-term (since 1991) rate offering for residential consumers.

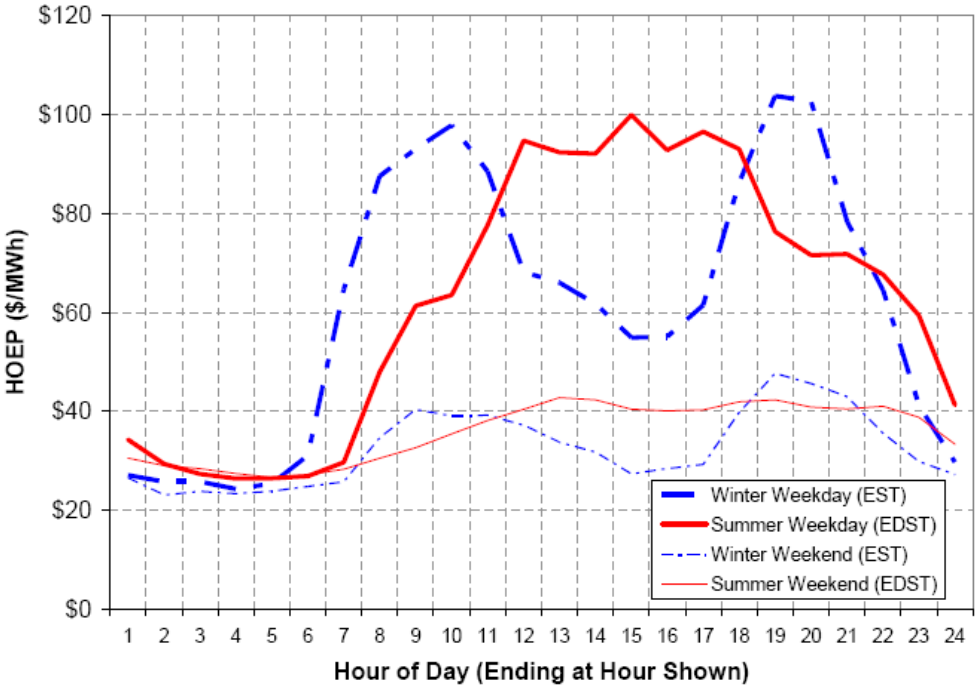
Board staff's initial view is that the three period design should be retained. The hourly variations in the cost of RPP supply referred to in section 2.1.1 continue to support this structure and, based on the results of the OSPP, the structure does not appear to be so complex from a consumer perspective as to require change. However, Board staff would be assisted by comments from stakeholders on whether and how a two-period pricing structure might better support load shifting and conservation.

2.2 Seasonal Variations

In addition to a three-period structure, RPP TOU prices include seasonal variations. Specifically, there is a seasonal difference in the hours to which the different prices apply, and On-peak prices are charged for one more hour per day in winter (seven hours) compared to summer (six hours), or an increase of 16.7%. Correspondingly, Mid-peak price hours are one hour less per day in winter compared to summer.

When the RPP was being developed, the load profile of RPP consumers was examined to determine if there was a significant difference between summer and winter hourly electricity demand and prices. The data showed differences that were considered sufficient to support seasonal variations in TOU prices (see Figure 1 below). Specifically, price data showed that winter electricity demand has a "double peak" (7 a.m. to 11 a.m. and 5 p.m. to 8 p.m.), whereas summer electricity demand has a single peak period (11 a.m. to 5 p.m.).

Figure 1: Hourly Ontario Market Electricity Prices - 2004



Board staff believes that the inclusion of seasonal variations in the RPP TOU price design is efficient from a supply cost recovery perspective because it matches hourly supply costs and prices. However, experience from the OSPP raises questions regarding the usefulness of the winter two-peak price profile and the ability to easily adapt to that profile.[13]

Seasonal variations are not unique to RPP TOU prices,; two-tiered RPP prices also have a seasonal component. Specifically, in the winter months consumption that is eligible for the lower tier 1 price increases to 1000 kW per month from the 600 kW per month threshold that applies in the summer. The seasonal component of TOU pricing does, however, have a less dramatic effect on consumer's energy bills than do seasonal adjustments in two-tiered pricing. Unlike two-tiered pricing, which effectively lowers the weighted average cost per kWh in the winter compared to the summer, TOU pricing does the opposite: the load weighted average cost per kWh increases in the winter compared to the summer. On the other hand, when tier thresholds and TOU peak hours change

[13] OSPP participants considered the seasonal variations to be relatively easy to understand, but expressed some difficulty in responding to the winter two-peak price profile. The fact that more limited opportunities for discretionary load reductions exist in the winter months relative to the summer months (where air conditioning use is discretionary for many consumers) is most likely the reason for this difficulty.

from winter to summer the opposite happens: average tier prices increase more than TOU prices.[14]

It may be unrealistic to expect that consumers will adjust their consumption patterns every six months to reflect seasonal variations in RPP TOU prices. Instead of seasonal adjustments, the prices could be adjusted to ensure cost recovery with a single annual, fixed time application of the price schedule. Elimination of the seasonal variations would also result in a simpler pricing structure, which may in turn facilitate conservation and demand management responses.

However, abandoning seasonal variations may be inappropriate because some data show that RPP load has a "single" peak in summer and a "double" peak in winter and that these peaks do not overlap (see Figure 1 above).[15] When demand and price are rising in the summer, both are declining in the winter. If the intention is to have an efficient pricing system (short of a spot price pass through) and for consumers to respond to price signals when demand reductions are most needed to increase system reliability and reduce costs, then seasonal variations would continue to be warranted because they support these objectives.

Board staff's initial view is that seasonal variations may remain appropriate, but that there is merit in revisiting the issue. Board staff would be assisted by comments from stakeholders on whether seasonal variations should be retained and, if so, whether the seasonal variations should be retained in their current form or whether they should be adjusted such that the differences between the summer and winter pricing structures are reduced.

2.3 Critical Peak Pricing

When the RPP was initially developed, the Board indicated that it would investigate the usefulness of critical peak pricing or "CPP" in encouraging conservation and increasing reliability by reducing peak demand.

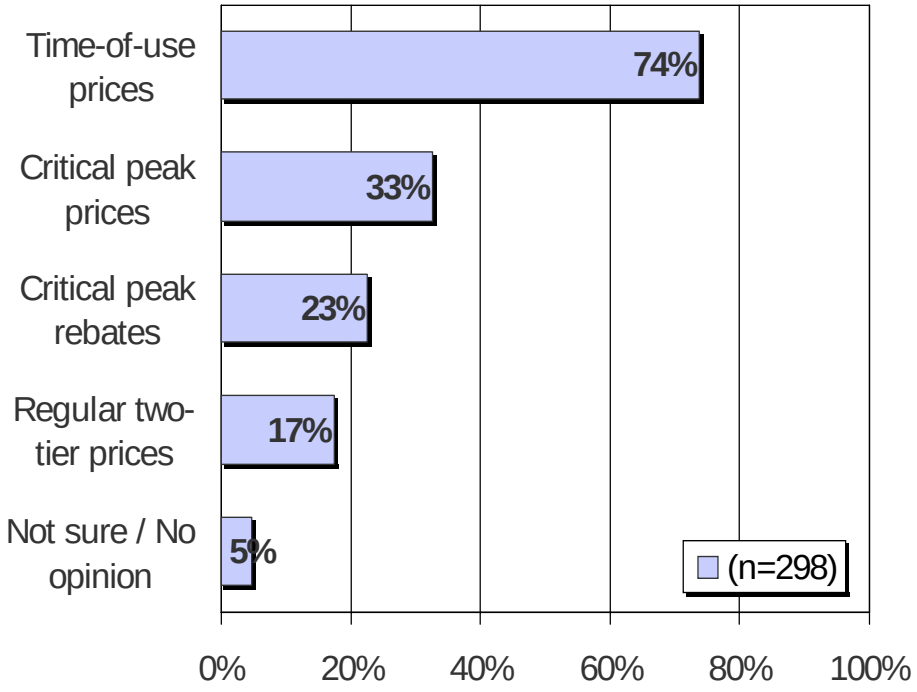
As described in Appendix A, the OSPP tested two variations of CPP, both with prior warning of CPP events: a regular CPP option where prices increased threefold (30¢/kWh) during critical peak periods compared to the On-peak TOU

[14] This relationship holds if TOU prices, which are set for 12 months, do not change over that 12 month period.
[15] The data in Figure 1 is from 2004 and was used when the RPP was first developed. As discussed in section 3 below, Board staff has observed that Ontario market clearing prices have become less volatile in the post-2005 period.

price; and a critical peak rebate or "CPR" option, where consumers were paid 30¢/kWh for reduced consumption during critical peak periods relative to a baseline. For the CPP group, the Off-peak price was reduced to 3.1¢/kWh to offset the increased costs of the critical peak price.

In the context of the OSPP, CPP and CPR were both more effective tools for reducing peak demand during declared critical peak periods in the summer than were TOU prices alone (see Table 3 in section 1.3.3.2 above). However, none of the three pricing plans tested showed significant shifts in demand during winter critical peak days. In terms of the conservation effect, CPP resulted in less total conservation than TOU-only, while CPR resulted in greater total conservation. In addition, Board staff notes that pilot project participants, even those on the CPP/CPR pricing structures, preferred TOU pricing to the CPP/CPR options (see Figure 2 below).

Figure 2: OSPP Consumer Survey – Price Option Preferences



Although the empirical results from the OSPP and other North American pilot projects[16] suggest that critical peak pricing options could stimulate greater reductions in peak load than simple TOU pricing, Board staff is reluctant to recommend immediate implementation of CPP or CPR pricing for two reasons. First, Board staff notes that previous experience with a large-scale roll-out of a market-based electricity pricing methodology (spot price pass-through) generated significant consumer reaction. Second, implementation of a critical peak pricing option would require the development, deployment and testing of additional meter data communications infrastructure. The current challenges of deploying data collection infrastructure to support TOU pricing alone suggest that an incremental approach to critical peak pricing may be best.

Board staff's initial view is that critical peak pricing options – whether CPP or CPR – should be developed, and mandated for all consumers, only after consumers have greater experience with TOU pricing. Alternatively, consideration could be given to providing for critical peak pricing to be offered initially at the discretion of the distributor rather than being mandated for all consumers. Board staff would be assisted by input from stakeholders in relation to critical peak pricing generally, and to the manner and timing of implementation.

3.0 TOU Pricing: Determining the Prices

The preceding section discussed design issues relating to the structure of RPP TOU pricing. This section addresses two issues associated with the manner in which RPP TOU prices are determined; namely, supply cost recovery and the residual method for determining On-peak prices.

3.1 Supply Cost Recovery

As noted in section 1.2.1, an underlying principle of RPP pricing is that of supply cost recovery; namely, that consumers pay commodity prices that over time reflect the costs of the generation that supplies them. Indeed, the Board is

[16] The California Statewide Pricing Pilot is perhaps the best known and most widely reported pilot project with both a TOU and CPP component. Other, smaller-scale CPP pilot projects in Florida, Missouri, New Jersey, and Colorado had TOU components as well. All of these pilot projects included "smart technology" (smart/programmable thermostats, load control devices and the like) as part of the CPP component, resulting in a considerable increase in peak load reductions compared to CPP only.

required by law to forecast the cost of electricity to be consumed by RPP consumers, and to ensure that the RPP prices reflect those costs.[17]

Table 4 compares the initial set of RPP TOU prices (effective April 1, 2005) with the most recent RPP TOU prices (effective May 1, 2008). The changes in RPP TOU prices have primarily been driven by the evolving generation supply mix in Ontario and the gradual increase in Ontario's total electricity demand. Off-peak and On-peak RPP TOU prices have remained relatively unchanged (in absolute terms), while Mid-peak prices have increased because, compared to the past, natural gas-fired generation is expected to set the market price for a greater percentage of the time during Mid-peak periods.

Table 4: RPP Time of Use Prices (¢/kWh)

	Off-Peak	Mid-Peak	On-Peak	Average Cost
April 2005	2.9¢	6.4¢	9.3¢	5.32
May 2008	2.7¢	7.3¢	9.3¢	5.45
% Change (2005 to 2008)	-6.9%	14.1%	0.0%	+2.4%

Supply cost recovery can be achieved in different ways. The Board initially set RPP TOU prices that result in a ratio of 1:2:3 (Off-peak:Mid-peak:On-peak) to provide an incentive for consumers to shift their demand away from On-peak hours. Other jurisdictions have used higher or lower ratios.[18] However, the rise in Mid-peak prices referred to above, and their convergence with On-peak prices, may diminish the incentive for consumers to shift load from On-peak to Mid-peak, while increasing the incentive to shift from Mid-peak to Off-peak. Price convergence is illustrated in Figure 3, and is discussed further in Section 6 below. However, for context the following overview is provided.

[17] Ontario Regulation 95/05, *Classes of Consumers and Determination of Rates*, paragraph 3 of section 6(1).
[18] TOU prices in U.S.-based pilot projects generally had ratios in the range of 1:4 for Off-peak to On-peak prices. Although not directly comparable to the RPP TOU price ratios, at least one U.S.-based pilot project had a critical peak price that was nearly 20 times the Off-peak price. Most U.S. pilots had critical peak prices in the same range as the Board's pilot project: roughly 10 times the Off-peak price.

The Board's methodology for setting TOU prices relies on forecasts of energy demand and a simulation of supply schedules to meet that demand. These supply schedules are based on assumptions of how generators would respond to expected market conditions, including fuel prices, to ensure dispatch of their generation units and to maximize profits. These simulations result in a set of hourly price forecasts for the RPP period and a supply cost for RPP consumers.

In a "pure" market environment (i.e., when generators receive compensation based solely on market prices), generators would have an incentive to offer their output at prices to achieve their dispatch and profit objectives. However, in a hybrid market environment like Ontario's, where generators' total compensation is determined by a combination of market prices and contractual arrangements, generator offers may not reflect the same objectives as in a "pure" market environment. Therefore, market prices in a hybrid market are unlikely to display the range and volatility of prices in a pure market, leading to price convergence. Converging prices reduce the incentive for consumers to shift their demand from On-peak hours to Mid-peak or Off-peak hours.

In addition to general supply cost recovery and the 1:2:3 ratio, the Board also adopted as a principle that TOU prices should be established to recover the RPP supply costs within each TOU period. Essentially, this principle means that TOU prices are set on a "stand alone" basis within each TOU time period based on forecast demand and supply costs for the relevant time period. One approach that would retain this principle and address price convergence would be to adjust the hours for the TOU periods – increasing the number of hours per week when Mid-peak prices would apply while reducing Off-peak hours. This would have the effect of reducing average Mid-peak TOU prices and thus return the ratio close to the original 1:2:3.

Other approaches would relax the principle of recovering RPP supply costs within each TOU segment while ensuring that total costs are recovered. For example, if on the basis of segmented supply cost recovery a price resetting indicates that On-peak TOU prices should decline to a greater extent than Mid-peak and Off-peak prices, consideration could be given to keeping On-peak prices unchanged and reducing Mid- and Off-peak prices more to provide a stronger load shifting incentive. Total cost recovery would be retained but the segmented costs (Off-peak, Mid-peak and On-peak) of TOU supply would individually be over- or under-recovered.

Alternatively, if TOU pricing and other actions resulted in conservation savings such that cost recovery in a one-year period would result in unacceptable increases in On-peak prices, prices could be reset to under-recover all costs, extending cost recovery over a period greater than a year.[19]

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[19] As discussed in section 4.1 below, RPP prices must by law be set with a view to clearing the balances in the Ontario Power Authority's variance account within 12 months. This is an intended

Another option is to forecast and recover costs over a shorter, six-month period. Although the Board currently evaluates the need for RPP price changes every six months, it does this on the basis of a 12-month forecast and cost recovery over 12 months. Cost recovery and forecasting over a shorter period would better account for the cost-based differences between seasonal TOU periods and prices, resulting in a better matching of prices with forecast supply costs. This would also reduce the size of unintended cross subsidies among consumer groups and should make the calculation of RPP final variance settlement factors more accurate.

The issue is whether a more flexible cost recovery regime that sets prices on a shorter than 12-month time period would be more effective in encouraging consumer responses to TOU pricing by reducing convergence among the TOU price segments.

Comparison of data across pilot projects supports the simple conclusion that higher peak prices increase load shifting and conservation activity but the marginal benefits decline rapidly. Balancing the value of incremental load shifting against the incremental costs of consumers' behavioural changes would be a key decision factor in determining any new ratios for TOU prices or alternative price setting methodologies. However, determining the direct cost to consumers of behavioural changes is difficult – load shifting activity does not have an easily calculated monetary cost. As a result, many policymakers and economists use the avoided incremental cost of supply as a proxy for the direct cost of load shifting.

Board staff suggests that the threshold question for revising the TOU price setting methodology to reduce price convergence among the TOU pricing periods is whether the hours for each price period should be adjusted or whether the principle of supply cost recovery within each TOU pricing period should be relaxed.

If hours are to be adjusted, should they be adjusted to restore the 1:2:3 ratio in the original design?

If the principle of supply cost recovery within each TOU pricing period is to be relaxed, then Board staff notes that the following additional issues may arise:

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outcome ("with a view to") rather than one that is expected to be realized with precision given forecast uncertainty and inaccuracy. Recovery of the variance account balance over a period of more than one year would require legislative change.

- ***Should the Board focus on maintaining the 1:2:3 ratio and, as a result, recover supply costs across more than one TOU period if needed?***
- ***Should the Mid-peak price be adjusted, perhaps closer to the midpoint between the Off-peak and On-peak prices? For example, by basing the Mid-peak price on the "average" RPP price?***
- ***Should the range of Off-peak to On-peak prices be "stretched", perhaps by including forecasts or estimates of segmented uplift costs in the price setting process?***
- ***Should multi-period cost of supply recovery be examined to provide more flexibility in setting prices? Should a reduction in the cost recovery period to six months be considered for consistency with the frequency of price changes?***
- ***Assuming that a price ratio methodology is retained by the Board, should the Board consider price ratios as a variable, changing from one RPP period to the next to reflect changes in policy priorities and/or cost recovery concerns?***
- ***Should the Board adopt an "avoided incremental cost of supply" methodology for On-peak prices and then adjust Mid-peak and Off-peak prices to recover total supply costs, regardless of the resulting price ratios?***

3.2 "Residual Cost" Method for Determining On-peak Prices

The Board's current method for determining TOU On-peak prices is a "residual cost" method. Specifically, after forecasting the total cost of RPP supply and the prices necessary to recover supply costs based on the RPP load shape for two of the three time-related pricing periods (Off-peak and Mid-peak), the third price (On-peak) is determined by dividing the forecast of residual supply costs by the remaining forecasted load.

This price setting method could as easily be applied to Mid-peak or Off-peak prices as it can to On-peak prices. As long as the forecast of RPP supply costs and load for two-tiered and TOU consumers is based on similar RPP load shapes, the residual method will work. Currently, the Board assumes in its forecast that all RPP consumers have similar load shapes – there are no significant differences in the load shapes of consumers that have two-tiered or TOU pricing. As TOU pricing and smart meters become more prevalent, however, load shapes for RPP consumers on TOU and two-tiered pricing are likely to diverge. As such, there may be merit in revisiting the appropriateness of the residual method once the necessary data becomes available.

Smart meters will allow a more accurate tracking of consumers' load shapes and improve the capability to forecast RPP supply costs. Smart meters and supporting data infrastructure will therefore enable the development of a more precise price setting methodology for TOU prices than is possible today. In addition, metering and data tracking will permit TOU prices to evolve as and when consumers shift their electricity usage over time. Further, a more precise tracking of load and generation will reduce uncertainty in determining RPP supply costs, minimizing the risk premium currently embedded in RPP prices (the "stochastic adjustment") and lowering the probability of large variance account balances. All of these refinements will improve the accuracy of setting all RPP prices.

As TOU metering data becomes available, Board staff proposes that this data be used to consider improvements in the price forecasting methodology. For this to occur, the meter data will need to be available in a form and at intervals compatible with the RPP forecasting methodology.

4.0 Variance Account Issues

Under section 25.33 of the *Electricity Act, 1998*, the Ontario Power Authority maintains a variance account ("VA") where under- and over- recovery of forecast RPP supply costs are accumulated. The end-of-period VA balance is included as part of the forecasted supply cost when RPP prices are reset, whether the balance is positive or negative.

4.1 Recovery Period

By law, RPP prices must be adjusted with a view to clearing the VA balance within 12 months (or such shorter period as the Minister of Energy may direct).[20] In a two-tiered pricing environment where individual load shapes and the collective RPP load shape change gradually over a period of time, variance recovery over 12 months appears to be appropriate.

TOU pricing can potentially cause load shapes to change more quickly and significantly than two-tiered pricing. Load shifting will reduce the On-peak load to which a fixed, per unit VA balance recovery factor can be allocated while increasing load in Off-peak periods. In addition, as the OSPP results show, TOU pricing can induce a significant conservation response, reducing total load. The requirement to recover VA balances over a fixed period is another factor that could cause TOU price differentials to deviate significantly from the Board's

[20] Act, section 79.16(3).

current 1:2:3 ratio. As previously noted, this convergence of TOU prices could reduce the effectiveness of the TOU load shifting incentive significantly.

Board staff's initial view is that there may be merit in examining recovery of the VA balance over a different or varying period in a TOU-only or a TOU-dominant RPP system as a means of enhancing the effectiveness of TOU prices. Board staff would be assisted by stakeholder input on this issue, bearing in mind that some options may only be feasible if legislative changes are made.

4.2 Variance Account Charges – Allocation and Triggers

Currently, the Board's method of setting RPP prices and recovering (or returning) VA balances is to include the VA balance as part of the forecasted cost of RPP supply.[21] The VA balance is recovered as a uniform charge (or credit) for all energy. About 50% of the variance is currently recovered during Off-peak periods and less than 25% during On-peak periods.

Another way to consider VA recovery in a TOU price regime is to allocate VA clearing charges to the segmented TOU prices according to when the VA balances are generated. This would result in a weighted allocation with different unit charges applying to On-peak, Mid-peak and Off-peak prices. However, this "causal allocation" of the VA balance is most likely to result in a narrowing of the TOU price range. Off-peak prices are likely to under collect compared to the RPP average unit supply cost, generating a VA balance debit and a price "adder" for the next price setting. On-peak prices are likely to do the opposite, generating VA balance credits and price "decrements".

The current method of forecasting RPP supply costs offers another way to pro-rate VA balances to TOU prices as follows. The calculation of the total RPP supply cost accounts for uncertainty and volatility in some forecast parameters through the "stochastic adjustment". The stochastic adjustment is calculated through a Monte Carlo simulation procedure that assigns probability distributions to some forecast parameters. However, several important forecast parameters have asymmetric probability distributions (in other words, not all outcomes are equally probable). For example, nuclear generation plants usually operate at capacity factors of between 80% and 90%. Therefore, these facilities are more likely to "under-generate" than to "over-generate". Similarly, during unexpectedly cold or hot weather, prices and consumer demand for electricity tend to be higher than expected. The net result is that the RPP would be "expected" to end the

[21] The VA balance is to be eliminated whether it is positive or negative. For ease of reference, this section refers to the recovery of VA balance amounts or VA balance charges or costs, but should be understood as applying equally to the return of VA balance amounts or VA balance credits.

year with a small unfavourable variance if there were no adjustment (the stochastic adjustment for these types of asymmetric probabilities).

Approximately 25% of the stochastic adjustment is currently allocated to the Mid-peak TOU price and 75% is allocated to the On-peak TOU price because the risks that generate the stochastic adjustment occur primarily during those time periods. Instead of a uniform charge on all RPP TOU supply, VA recovery costs could be pro-rated on a basis similar to the stochastic adjustment, corresponding with the time and load periods that generate the VA balances.

One impact of this type of VA cost recovery method would be that periods of negative VA recovery (a charge) would increase the TOU price ratios and periods of positive balance recovery (a credit) would decrease the price ratios. To preserve the price ratios, positive and negative VA balances could be allocated differently (there could be a limitation on the pro-rating to keep TOU price ratios within an acceptable range).

Asymmetric allocation of the VA balance recovery charges across TOU prices raises the possibility of using the VA balance mechanism to enhance conservation and/or load shifting. For example, positive balances (credits) could be used to only reduce Off-peak prices, resulting in On-peak prices higher than they would otherwise be (and providing a greater incentive to shift load from On-peak periods). This type of allocation could result in a greater probability that the VA balance will not be cleared within the 12-month period, resulting in a *de facto* multi-period recovery regime. As noted above, this may not be permissible absent an amendment to the Act.

The RPP pricing regime currently has an automatic price adjustment “trigger”. If the VA account has a balance that differs from the forecast balance by $160 million during a quarter (three-month period), then as set out in the RPP Manual the Board must adjust RPP prices. As a trigger for two-tiered RPP prices, the $160 million level (equivalent to approximately a 0.2 cent per kWh change in average RPP prices) is appropriate. This may not be the case for a TOU pricing regime. In a VA allocation system that evenly distributes the VA balance on the basis of a uniform per kilowatt-hour charge, the $160 million limit to adjust two-tiered prices ensures that the adjustment is significant and reduces the probability of frequent adjustments within the RPP period.

A $160 million minimum adjustment in a TOU-only pricing regime may result in segmented price adjustments greater than the 0.2 cents per kilowatt-hour adjustment in the two-tiered pricing system. The magnitude of these unit adjustments will depend on how the VA balance is allocated to the TOU price segments. Weighting an interim VA adjustment in the same manner as the VA is allocated at the regular, periodic RPP price settings could result in significant deviations from target TOU price ratios. These types of outcomes would indicate that the Board may need flexibility in allocating interim price adjustments (i.e., setting a different “trigger” level), and may require weighting mechanisms for

these adjustments that differ from the allocation mechanisms for the regular VA clearing. For example, allocation of the VA interim balance on the basis of a percentage of total demand or a percentage of total costs represented by the three-period TOU prices may be more appropriate.

The issue of possible cross-subsidies in VA balance allocation could occur during the period when TOU customers and two-tiered customers co-exist in substantial numbers. These cross-subsidies arise when one segment of RPP consumers receives benefits (or pays costs) that were not the result of their consumption. Maintaining two variance accounts would be one method of avoiding cross-subsidies. However, administering two variance accounts and calculating two final VA settlement factors will add complexity and expense to the data collection, billing and settlement processes for the Independent Electricity System Operator and for distributors, and may not be warranted to address what would be a temporary problem.

One way to avoid or minimize additional settlement system expense to address cross-subsidy and VA allocation complications for distributors would be to ensure that all (or a significant majority of) RPP consumers within a distribution service area have smart meters before TOU pricing is implemented.[22] Although this could slow the province-wide adoption of TOU pricing, it would largely avoid controversy arising from consumers questioning distributors about the reasons for their electricity bills differing from those of their neighbours.

Board staff seeks input from stakeholders on the appropriateness of the current VA allocation when RPP becomes predominantly TOU. In addition, staff seeks comments on the importance of maintaining target TOU price ratios through weighted or proportional VA allocation and interim adjustments and whether, or how, inherent cross-subsidies in VA allocation should be addressed.

5.0 Billing Issues

Participants in the Board's OSPP post-project survey indicated that monthly bills with daily consumption data were very useful in planning their electricity consumption. Currently, most distributors issue bills bi-monthly with consumption data aggregated for the entire billing period.

To extend monthly billing and detailed consumption data to all consumers would require significant infrastructure investment by distributors and possibly the Smart Metering Entity (in relation to the meter data management and meter data repository or the "MDM/R"). Board staff is concerned that the incremental

[22] Hydro One with its large and geographically disperse service area would be a logical exception to this "rule".

benefits of this additional investment may not be sufficient to justify the costs. Moreover, at this early stage of data and billing infrastructure development not all future ancillary uses of additional data collection are known.

Board staff would be assisted by stakeholder input on the costs and benefits of requiring either monthly billing and/or the provision of more detailed consumption data to consumers in support of TOU pricing (including any critical peak pricing options).

Another billing issue that arises with the introduction of TOU pricing is the impact of equal billing. Equal billing smoothes the impact of fluctuations in electricity costs, assisting consumers to absorb the financial impact of demand and price changes over a period of time. As a result of this smoothing, equal billing can dilute the immediate "cause and effect" message that is the primary incentive of TOU pricing. For smart meters and TOU pricing to be effective in encouraging peak load shifting, consumers need information that will reflect the impact of their actions in a relevant timeframe. Board staff recognizes, however, that equal billing can carry benefits for distributors and consumers,[23] and that there may well be approaches where the necessary information can be made available without eliminating those benefits.

Board staff questions whether equal billing is fully compatible with the objectives of TOU pricing. However, staff would be assisted by stakeholder input on this issue, including proposals for measures that could be implemented to address consumer information needs while allowing equal billing and TOU pricing to co-exist.

6.0 Longer term Issues

Over the last several years, TOU On-peak and Mid-peak prices have converged. The most recent TOU price setting, announced on April 11, 2008 and effective May 1, 2008, shows a divergence in these TOU prices compared to the previous price setting. Board staff is undecided if this is a one-time occurrence or indicates the beginning of a longer-term trend.[24] However, the convergence of TOU prices presents a challenge to the current methodology of setting TOU prices. The

[23] The question of equal billing more generally is being explored in the consultation on customer service and other issues associated with the provision of service by electricity distributors (EB-2007-0722). See, in particular, section 1.1.4 of Board staff's March 6, 2008 Discussion Paper entitled "Electricity Distributors: Customer Service, Rate Classification and Non-payment Risk", which is available on the Board's website.

[24] Staff notes that the most recent RPP price setting relied on more comprehensive and accurate load data than previous price settings. This data adjustment may be responsible for this increased spread in TOU prices; convergence may resume in future price settings.

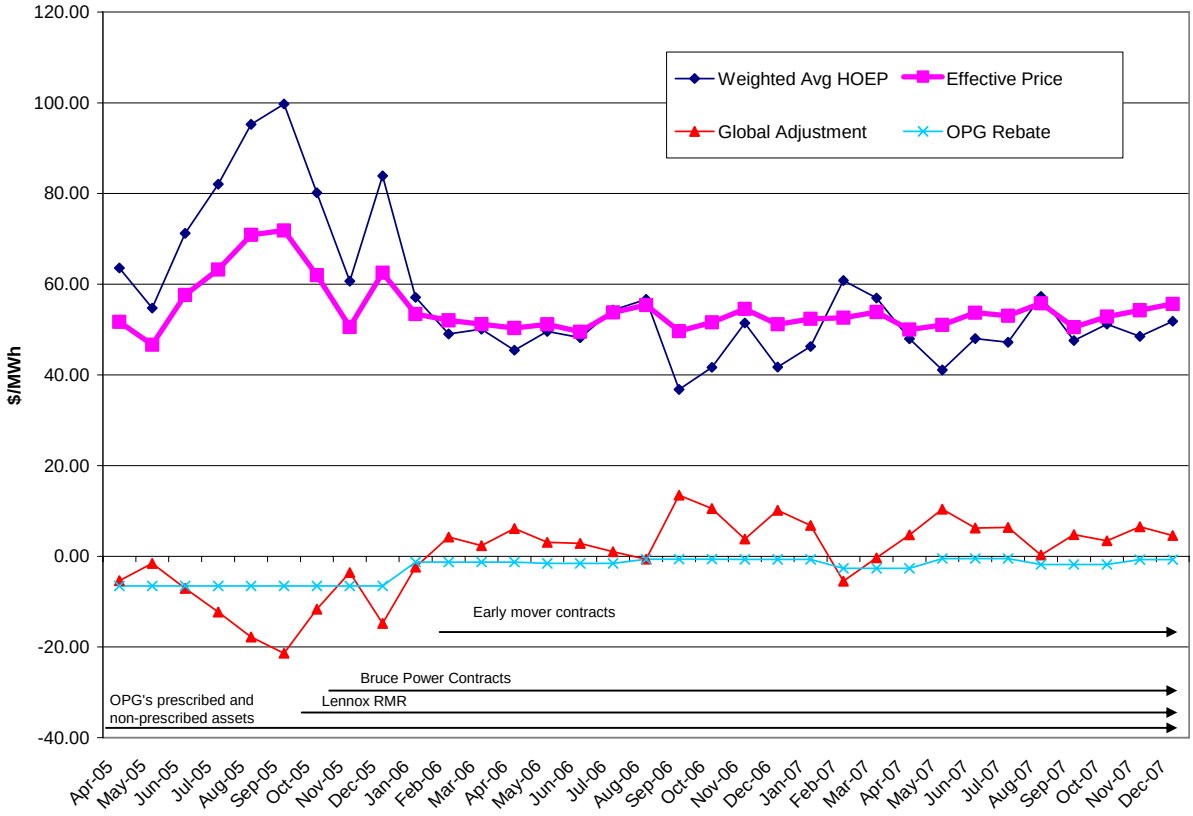
following discussion addresses some of the reasons for TOU price convergence and policy and methodology responses to address it.

Changes in natural gas prices have been a factor in converging TOU prices, a second and likely more sustained cause for this price convergence is the change in the structure of Ontario's wholesale electricity market and how most generators are compensated since the advent of the hybrid market. Approximately 80% of Ontario's total supply is either under long-term contract (some contracts have a combination of capacity and market price payments) or various forms of administered pricing. Peaking generators no longer have to depend on a limited number of hours of high market prices in a year to recover operating costs and make a return on capital invested, and thus have no incentive to bid up market prices to recover these costs.

Since 2005, the instances of market price volatility and scarcity pricing have declined substantially. Figure 3 below illustrates this point. This Figure shows the weighted average HOEP and the "effective price" since the inception of the RPP, as well as when certain pricing and contract arrangements took effect.[25] The "effective price" is what all consumers (not just RPP-eligible consumers) paid for energy over the period.

[25] The "effective price" equals the weighted average HOEP, adjusted for the Global Adjustment and the OPG Rebate (on those of OPG's assets that are not paid a legislated or regulated price). Note that the Global Adjustment has been both positive and negative; the OPG Rebate (if paid) is always negative.

Figure 3: Market and Effective Prices (2005 – 2007)



The convergence of TOU On-peak and Mid-peak prices and the diminishing relevance of market prices as a reference for TOU prices may continue into the future. The supply contracts entered into by the Ontario Power Authority are long-term. If these contracts are not revised to convert capacity payments to time-dependent energy payments, then the lack of market-based scarcity pricing is likely to remain. Furthermore, regulated pricing for output from OPG's prescribed assets appears to be a long-term policy commitment of the Government.

One supply source with the potential to reduce the proportion of supply that receives administered prices and to expand market pricing is OPG's non-prescribed assets (fossil and smaller-scale hydraulic). The price cap for this generation is scheduled to expire in early 2009. Currently, OPG's non-prescribed generation assets account for 22% of Ontario's total electrical energy supply. This supply, when combined with the existing merchant generation (15% of total energy), may be sufficient to enhance the relevance of Ontario's wholesale market clearing price as a reference for setting TOU prices.

In addition, as OPG phases out its coal-fired generation capacity, replacement capacity will be required. Similar to the situation for OPG's non-prescribed assets, the manner in which this replacement capacity relates to the market, either through contracts or merchant activity, will be important for determining the relevance of market prices for setting TOU prices in the future. Moreover, if much of the replacement price-setting capacity in the Off-peak period is natural gas-fired generation, then price differences between Off-peak and Mid-peak periods can be expected to diminish.

These uncertainties about the ability of market-determined prices to provide a basis for future TOU price schedules suggest that future TOU price setting may require an alternative price setting methodology to maintain significant price differentials. Alternatives include "ratio-based prices"[26] (e.g., ratio-based could be a 1:2:3 ratio for off-peak, mid-peak and on-peak prices) or "avoided cost" reference prices.

Ratio-based prices can be price schedules that are set on the basis of expected consumer response and a policy goal to achieve a target for load shifting or conservation response. Alternatively, ratio-based prices can be designed to be revenue neutral, assuming no price response from consumers. This type of price setting depends on estimates of price elasticities of demand and detailed information on consumer load profiles. Such information will become more readily available as smart meters are more widely deployed.

Avoided cost reference prices for peak load depend on calculating the value to consumers of consuming an incremental unit of peak supply. An avoided cost-based peak price would be set at a level that would deter consumers from purchasing an incremental unit of peak supply. These prices may be based on the marginal cost of production for existing, or potential, marginal supply.

If adopted, these alternative methodologies may require a re-evaluation of the Board's principles for setting TOU prices. Ratio-based or avoided cost price setting methodologies are not based solely on supply cost recovery. Instead, these price setting methodologies are used to support a specific policy objective such as a target reduction in peak electricity demand; supply cost recovery may be an incidental outcome but is not guaranteed nor a primary objective.

[26] "Ratio-based" refers to a price setting methodology that would rely on pre-determined ratios to set the prices for remaining categories of prices after an initial "reference price" is calculated. For example, using the Board's existing RPP price setting methodology an average future unit supply cost could be calculated. This unit cost could be used as the Mid-peak price with Off-peak and On-peak prices being determined as ratios of the Mid-peak price.

Board staff would be assisted by stakeholder input on the issue of whether the underlying principles of RPP TOU price setting may require re-evaluation to respond to continuing price convergence. Board staff would also be assisted by stakeholder input on alternative price setting methodologies that the Board could consider in the event that price convergence continues and appears to be impairing the effectiveness of TOU prices in stimulating load shifting.

7.0 Questions to Guide Stakeholder Input

As indicated in section 1.1, this Discussion Paper is intended to solicit input on issues associated with the structure of TOU prices and the methodology by which those prices are determined. To guide stakeholders in the preparation of comments on those issues, Board staff has prepared a list of questions in relation to each of the issues explored in this Discussion Paper.

1. Structural Issues

- Should the three-period TOU pricing structure be retained? If not, what alternative approach should be considered and why?
- Should the seasonal variation in TOU pricing be retained? If so, should it be retained in its current form or should adjustments be made (for example, to simplify by having only one On-peak period during the day in the winter)?
- Should critical peak pricing be implemented as part of the RPP TOU prices?

  If yes,
  - When should this be done?
  - Should CPP or CPR be used?
  - Should the program be mandatory or voluntary for consumers?

2. Price-setting Methodology

- Should the Board retain a price setting methodology that focuses on the recovery of supply costs on a “segmented” basis? Alternatively, should the Board set prices to recover total supply costs only, while under- and over-recovering in individual TOU price segments?
- Should multi-period cost of supply recovery be examined to provide more flexibility in setting prices? Should a reduction in the cost recovery period to six months be considered for consistency with the frequency of price changes?

- Should the 1:2:3 ratio for TOU prices be reconsidered? If so, how should the ratio be adjusted?
- Should the Board consider the 1:2:3 ratio as a variable, adjusting it to respond to policy priorities and/or cost recovery issues?

3. Variance Account Issues

- Should the recovery period for VA balances be changed?
- Should the current practice of a uniform charge (or credit) per kWh for variance account recovery/return be modified? If not, should the VA balance charges or credits be pro-rated like the stochastic adjustment?
- Should the VA balance clearing amount be allocated differently depending on whether it is a credit or debit?
- Is the $160 million trigger appropriate in the context of a TOU RPP pricing regime that could result in TOU price adjustments larger than 0.2 cents per kilowatt-hour? Should the allocation methodology provide maximum flexibility to address price ratio issues or should it rely on a rules-based methodology for certainty reasons?
- Despite the possibility of additional settlement costs, should the Board consider a two variance account system (including two adjustment trigger amounts) to address cross subsidy issues during a transition period when TOU pricing becomes more prevalent?

4. Billing Issues

- Should all distributors be required to bill TOU customers on a monthly basis? Why or why not?
- If yes, what are the implications for investments in billing and meter data infrastructure?
- If yes, should monthly billing be phased in? Over what time period should this phase-in occur?
- How could equal billing be retained while preserving the TOU incentives for load switching and/or load reduction?

5. Longer Term Issues

Board staff would welcome any comments on alternative methodologies for setting TOU prices to address the issue of price convergence.

Appendices

1. **Appendix A – Overview of Ontario Smart Price Pilot (OSPP)**
2. **Appendix B – Overview of Distributor Pilot Projects**

Appendix A - Overview of Ontario Smart Price Pilot (OSPP)

In June 2006, the Board initiated, with the assistance of Hydro Ottawa, the Ontario Smart Price Pilot ("OSPP") project to test the impacts on consumer behaviour of different time-sensitive price structures. The OSPP involved 375 of Hydro Ottawa's electricity customers and, as described below, three different pricing structures.

OSPP Pricing Structures

The OSPP tested three different price structures:

- Existing RPP TOU prices (see Table 2 below);
- Adjusted RPP TOU prices with a critical peak price ("CPP"); and,
- Existing RPP TOU prices with a critical peak rebate ("CPR").

Table 1: RPP 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¢

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

The maximum number of critical peak days planned for the OSPP was nine. During the pilot, seven days of critical peak events were actually declared: two in August, two in September and three in January. A critical peak price of 30¢/kWh was set based on the average of the highest hourly Ontario electricity prices in the previous year. For critical peak price participants, the RPP Off-Peak price was reduced to 3.1¢/kWh to offset the increase in the critical peak price.

In contrast to the CPP, participants on the CPR 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.

Participants in OSPP

Candidate participants were randomly selected from the population that would have smart meters installed in Hydro Ottawa's service territory by August 1, 2006. The OSPP was over-subscribed after only one recruitment solicitation and within about one week. A 10% enrolment rate was expected. However, 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 - a 25.5% response rate. 375 participants were selected, and are referred to as "treatment" participants.

A control group of 125 customers was 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. This group was on two-tiered (non-TOU) prices only.

All treatment and control participants were RPP consumers.

Communication Materials, Electricity Usage Statements and Incentive Payment

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

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

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 were on the two-tiered RPP prices.

Participants received a cheque based on a $75 incentive payment plus or minus 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.

Results and Conclusions from the Ontario Smart Price Pilot

The analysis of demand response or peak shifting as a result of the pilot prices 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; and,
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 were determined by comparing the electricity consumption behaviour of customers exposed to the pilot prices (TOU, CPP, and CPR) and the behaviour of customers remaining on two-tiered RPP prices.

Critical Peak Days

A statistically significant shift in load away from peak periods was measured during the four critical peak days called during the summer months.

Table 2: Percent Reduction in Load During Four Summer Critical Peak Days

Period	TOU only	CPP	CPR
Critical peak hours (3 or 4 hours during the peak)	5.7%	25.4%	17.5%
Entire On-Peak period	2.4%	11.9%	8.5%

TOU-only participants demonstrated a 5.7% shift during critical peak times in the summer. These customers were not notified of the event, but there is more potential load shifting during hot critical peak times.

No statistically significant shift was detected during the three critical peak days declared in January.

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 statistically significant reductions in summertime On-Peak period consumption of 8.1% and 5.2% for CPP and CPR customers, respectively. The results for TOU-only customers and wintertime On-Peak periods were not statistically significant.

Conservation Effects

To assess the extent of conservation in the pilot project groups, each participant's electricity consumption in the year prior to the pilot project was weather-adjusted and compared to consumption over the same period in the pilot project. This analysis was segmented by control group and TOU pricing participant groups.

All participant groups reduced their consumption. Reasons for the different conservation impacts among the pricing groups are difficult to ascribe. However, a logical conclusion is that the communication and other materials provided to participants raised the general awareness across all groups about how to reduce electricity use. All of the results were statistically significant.

Table 3: Conservation Effect for the Full Pilot Period

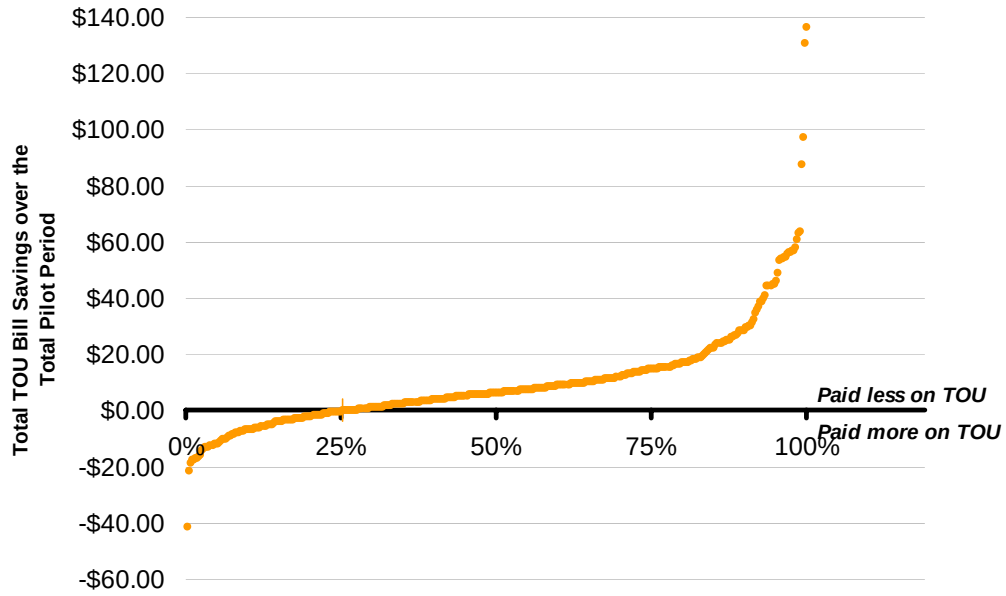
Price Group	Percent reduction in total electricity use
TOU	6.0%
CPP	4.7%
CPR	7.4%

Customer Bill Impacts

The impacts on customer's bills were calculated using the hourly electricity usage information collected from the smart meters. Conservation effects were not considered in these results. Thus, any bill savings were entirely a result of load shifting.

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

Graph 1: Participant's Bill Savings on TOU prices for the Total Pilot Period



Note: Each dot represents an individual participant's net loss or savings on TOU pricing compared to tiered pricing. Those above the line paid less on TOU prices.

Savings from the conservation effect increased the total bill reduction. Assuming a 6.0% conservation effect and based on the average price of 5.7¢/kWh, the average savings would have ranged from a few cents for the lowest volume user to over $6 per month for the largest user. When the conservation effect was added to the load shifting impacts, 93% of customers paid less on RPP TOU prices over the course of the pilot than they would have paid on RPP two-tiered prices. Without the conservation effect, 75% of customers had lower bills under TOU prices compared to two-tiered prices.

Participant Feedback

Participant feedback was obtained using two primary methods:

1. Three focus groups with 44 participants each were conducted in Ottawa during the second week of October; one group each for CPP, CPR and TOU participants.

2. A survey of the program participants was conducted. A total of 298 surveys were returned by the survey cut-off date, for an overall response rate of 79%. The margin of error (at 5% confidence) for the overall results was ± 5.7% for the 298 surveys received.

a. Overall satisfaction

78% of survey respondents stated that they would recommend the TOU pricing plan to their friends, while only 6% would definitely not. These results were 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 and giving greater control over their electricity costs as the reasons behind their satisfaction with the pilot. Those not sure or who would not recommend the program cited as reasons insufficient potential savings and too much effort.

b. 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% preferred the existing two-tiered RPP pricing. Most commented that they would prefer to not go back to two-tiered pricing.

c. Expected Bill Impact

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

d. Materials

Participants in the focus groups and survey respondents in particular cited the monthly Electricity Usage Statements and refrigerator magnet as the most useful resources for understanding TOU prices, overshadowing the fact sheet, brochure, or any other pilot communications materials. Focus group participants stated that bi-monthly frequency of billing statements was inadequate within the context of smart meters and TOU pricing. Nearly 70% of survey respondents indicated that they anticipated accessing an online statement at least monthly if it was available.

e. Pricing Structure Feedback

The consensus feedback among focus group participants was that the 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.

Appendix B - Overview of Distributor Pilot Projects

Newmarket Hydro

Newmarket Hydro operated 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 ran until the end of October 2007. Notification for CPR events was given either on the day of or a day before a CPR period. The same critical peak price of 30¢/kWh as the Board's Ontario Smart Price Pilot was used. Newmarket Hydro automatically controlled the air conditioners of some participants using programmable thermostats during summertime critical periods. The participants were divided into six treatment groups based on combinations of being placed on CPR prices, exposed to enhanced educational materials, or provided with a programmable thermostat.

Preliminary Results as Reported by Newmarket Hydro

- On-peak and Mid-peak use decreased by 0.4% and 0.3%, respectively.
- Off-peak use rose by 0.7%; most of the increased demand occurred during the mid-week Off-peak hours.
- Enabling technologies assisted participants in reducing demand, particularly during critical peak periods; participants with remotely controlled thermostats reduced use more than participants without the technology during critical peak periods.
- "Day ahead" notification for CPR events was more effective than "day-at-hand" notices; customers reduced demand throughout the day, not just the CPR period, when notified "day ahead".
- Compared to two-tiered prices, TOU prices resulted in a slight increase in commodity charges of 2%. This was due to the fact that, while on two-tiered prices, most participants paid Tier 1 prices (i.e., prices below the average cost of RPP supply). Under TOU prices, participant costs were still less than the average cost of RPP supply, but not as much less as was the case under two-tiered prices.
- Total consumption increased by 1.1% with TOU prices compared to two-tiered prices.
- 64% of participants said they would recommend TOU pricing to their friends; 27% were unsure if they would recommend TOU pricing.
- There was a positive correlation between successful demand shifting and a participant's knowledge of the TOU pricing periods and structure.

Veridian Connections

Veridian Connections operated a TOU pricing pilot project involving medium-sized business consumers. There were 55 customer accounts with peak demand greater than 200 kW taking part in the pilot. In aggregate, these customers represented peak demand of approximately 20 MW and annual consumption of 140 GWh. The pilot started in March 2007 and ran through to September 2007. It will allow for a direct comparison of the price elasticity of business consumers relative to residential consumers in the other Board-approved pilots. This pilot was also intended to help inform communication efforts in relation to designated consumers who were initially expected to be ineligible for RPP prices after April 1, 2008 but who now remain eligible until May 1, 2009.

Preliminary Results as Reported by Veridian Connections

- Responses to TOU prices and the associated impacts varied between the two segments of customers in this pilot – multi-residential, bulk metered residential customers and MUSH sector customers.
- Both sets of consumers reduced their total consumption under TOU prices – 2.8% for the residential customers and 0.1% for the MUSH sector customers.
- Average price impacts depend on the segment of the two-tiered price that the customer would otherwise pay. Over 80% of the residential consumers would have paid tier 1 prices only. Switching to TOU increased their average price by just over 1%. By contrast, for MUSH participants whose usage would be largely at tier 2 prices, TOU pricing resulted in an average price decline of about 10%.

Oakville Hydro

Oakville Hydro's TOU pricing pilot project involved 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. It involved 370 participants in three condominiums.

Preliminary Results as Reported by Oakville Hydro

- After changing from bulk to individual metering, consumption declined by an average of 20% for all three buildings.
- All three buildings displayed reductions in consumption during On-peak and Mid-peak periods after shifting to TOU prices. In two of the buildings, reductions during Mid-peak periods were double the reductions during On-peak periods in percentage terms.

- Enabling technologies helped specific consumers to make significant load shifts from On-peak and Mid-peak periods to Off-peak periods.
- Bill impacts depended on the segment of the two-tiered price that the customer would otherwise pay. In two buildings, 85% of pre-TOU consumption was at tier 1 prices. These consumers paid, on average, slightly more on TOU pricing compared to two-tiered pricing. Participants in the third building (65% of pre-TOU consumption at tier 1 prices) paid slightly less under TOU prices than under two-tiered pricing.

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). Implementation was planned for 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.

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.

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 Total Resource Cost guide, 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, clothes dryers and 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.