ROBERT J. PELLATT
COMMISSION SECRETARY
Commission.Secretary@bcuc.com
web site: http://www.bcuc.com

LETTER NO. L-2-02

SIXTH FLOOR, 900 HOWE STREET, BOX 250
VANCOUVER, B.C. CANADA V6Z 2N3
TELEPHONE: (604) 660-4700
BC TOLL FREE: 1-800-663-1385
FACSIMILE: (604) 660-1102

Log No. 429

VIA FACSIMILE

January 10, 2002

Mr. Ray Aldeguer
Senior Vice-President Legal,
Regulatory Affairs and General Counsel
British Columbia Hydro and Power Authority
333 Dunsmuir Street
Vancouver, B.C. V6B 5R3

Dear Mr. Aldeguer:

Re: British Columbia Hydro and Power Authority
General Service Time of Use ("TOU") Pilot Program Evaluation Report

Thank you for your December 31, 2001 report on the General Service TOU Pilot Program. The Commission recognizes the problems with the Pilot Program but would be pleased to work with B.C. Hydro to develop a permanent program, which can overcome the initial shortcomings of the Pilot Program.

Yours truly,

Original signed by:

Robert J. Pellatt

MAG/cms

BC hydro

THE POWER IS YOURS

Ray Aldeguer
Senior Vice-President
Legal, Regulatory Affairs and
General Counsel
Phone: (604) 623-4513
Fax: (604) 623-4407

31 December 2001

Mr. Robert J. Pellatt
Commission Secretary
British Columbia Utilities Commission
P.O. Box 250
600-900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Pellatt:

RE: British Columbia Hydro and Power Authority ("BC Hydro")
General Service Time of Use (TOU) Pilot Program Evaluation Report
December 2001

Pursuant to Appendix A of the British Columbia Utilities Commission (the "Commission") Order No. G-117-99 and the direction in Commission Order G-105-00, enclosed is BC Hydro's Time of Use Pilot Program Evaluation Report.

Yours very truly,

for Ray Aldeguer
Senior Vice-President
Legal, Regulatory Affairs and
General Counsel

Enclosure

BC HYDRO

TIME OF USE PILOT PROGRAM

EVALUATION REPORT

DECEMBER 2001

Program Impact Questions

1. How many customers participated in the BC Hydro's TOU program?

2. Which TOU option did customers pick?

The following table shows that there were 505 accounts that subscribed to the BC Hydro's TOU Program. The upper half of the table breaks down this total by the TOU option chosen and the lower half breaks down the total by regional location.[1]

Table 1
TOU Subscription

By Plan Type	
TOU Option	**No. of Accounts**
A	313
B	83
C	38
D	71
Total	**505**

By Location	
Regional Location	**No. of Accounts**
Lower Mainland	163
Northern District	137
Southern Interior	89
Vancouver Island	116
Total	**505**

3. What was the response to the TOU Pricing Options?

Hourly load data for 361 of the 505 customer sites, representing approximately 61% of the total subscriber load, has been analyzed. This sub-sample of sites had hourly load data from March 2000 to the end of February 2001, which covered winter and non-winter periods. The remaining 144 sites had incomplete data for the year 2000 non-winter months, and hence were not included in the analysis.

The load response was examined from two perspectives. The first perspective compares actual percentage of consumption by peak and non-peak periods with the baseline consumption by the same periods. The baseline consumption assumes an 'averaged' customer baseline load (CBL) shape for each segment, which has been derived from a sample of representative customer sites collected prior to the start of the TOU program. The following table indicates the segments where there was, on average, noticeable price response to winter TOU pricing. The table shows instances where the

[1] Appendix A contains a table which shows the TOU subscription by SIC and building type.

percentage winter peak period consumption was lower using actual load data compared to baseline load data under each of the four TOU pricing options. This provides evidence of load shifting or conservation during the peak periods in the winter months.

Table 2

Comparison of Percentage Consumption by Period
Using Actual and Baseline Load Data

SIC		Winter A	Winter A	Winter B	Winter B	Winter C	Winter C	Winter D	Winter D
% Consumption by Period		Baseline Load	Actual Load	Baseline Load	Actual Load	Baseline Load	Actual Load	Baseline Load	Actual Load
Agriculture	Evening Peak	10.033	4.733	10.033	2.311				
	Morning Peak	0.000	0.000	0.000	0.000				
	Off-Peak	89.968	95.268	89.968	97.689				
Colleges Universities	Evening Peak			13.098	12.308				
	Morning Peak			0.000	0.000				
	Off-Peak			86.903	87.693				
Construction	Evening Peak	12.050	8.790						
	Morning Peak	0.000	0.000						
	Off-Peak	87.950	91.210						
Hotels Motels	Evening Peak			12.068	10.915				
	Morning Peak			0.000	0.000				
	Off-Peak			87.933	89.085				
Large Offices	Evening Peak	14.410	12.862	14.410	6.100	14.410	12.925		
	Morning Peak	0.000	0.000	0.000	0.000	17.283	13.567		
	Off-Peak	85.590	87.138	85.590	93.900	68.308	73.508		
Mining	Evening Peak	15.090	12.070	15.090	13.063				
	Morning Peak	0.000	0.000	0.000	0.000				
	Off-Peak	84.910	87.930	84.910	86.938				
Petroleum	Evening Peak	13.355	9.575	13.355	7.646			13.355	4.755
	Morning Peak	0.000	0.000	0.000	0.000			9.248	4.679
	Off-Peak	86.645	90.425	86.645	92.354			77.398	90.566
Restaurants	Evening Peak	14.775	10.315						
	Morning Peak	0.000	0.000						
	Off-Peak	85.225	89.685						
Retail Non Food	Evening Peak			13.748	12.423				
	Morning Peak			0.000	0.000				
	Off-Peak			86.253	87.578				
Small Offices	Evening Peak							12.893	10.076
	Morning Peak							14.093	10.409
	Off-Peak							73.015	79.515
Small Residential	Evening Peak			13.018	12.563				
	Morning Peak			0.000	0.000				
	Off-Peak			86.983	87.438				
Storage	Evening Peak	12.355	7.249			12.355	10.263		
	Morning Peak	0.000	0.000			12.690	12.680		
	Off-Peak	87.645	92.751			74.955	77.056		
Transportation	Evening Peak								
	Morning Peak								
	Off-Peak								
Wood	Evening Peak			13.618	12.218				
	Morning Peak			0.000	0.000				
	Off-Peak			86.383	87.783				

The second perspective compares the percentage of total consumption by peak and non-peak periods for the winter, with similarly defined percentages for the non-winter months. This tests if load shifting took place in the winter months. It assumes that the winter and non-winter percentage breakdown of consumption by period are similar in the absence of the TOU program. The following table shows segments which, on average, had a lower percentage of peak consumption in the winter compared to the non-winter months. This provides evidence of price response during the winter months. Table 3 supports the evidence in Table 2, and also provides additional evidence of load response in some other segments. Overall, the winter and non-winter comparison provides a level of comfort in the method and assumptions originally used to establish the baseline load and to determine price response.

Table 3

Comparison of Percentage Consumption by Period Using Actual Summer and Winter Load Data

SIC	Period	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
% Consumption By	Period	Summer A	Winter A	Summer B	Winter B	Summer C	Winter C	Summer D	Winter D
Agriculture	Evening Peak	8.99	4.73	8.66	2.31				
	Morning Peak	0.00	0.00	0.00	0.00				
	Off-Peak	91.01	95.27	91.34	97.69				
Chemicals	Evening Peak	13.22	12.19						
	Morning Peak	0.00	0.00						
	Off-Peak	86.78	87.82						
Construction	Evening Peak	12.44	8.79						
	Morning Peak	0.00	0.00						
	Off-Peak	87.56	91.21						
Forestry	Evening Peak	15.25	13.78						
	Morning Peak	0.00	0.00						
	Off-Peak	84.75	86.22						
Hospitals	Evening Peak	12.56	11.99						
	Morning Peak	0.00	0.00						
	Off-Peak	87.44	88.01						
Hotels Motels	Evening Peak			11.75	10.92				
	Morning Peak			0.00	0.00				
	Off-Peak			88.25	89.09				
Ice Arenas	Evening Peak	13.01	12.93	18.32	13.52				
	Morning Peak	0.00	0.00	0.00	0.00				
	Off-Peak	86.99	87.07	81.69	86.49				
Large Offices	Evening Peak	13.49	12.86	16.76	6.10				
	Morning Peak	0.00	0.00	0.00	0.00				
	Off-Peak	86.51	87.14	83.24	93.90				
Nursing	Evening Peak			13.48	12.83				
	Morning Peak			0.00	0.00				
	Off-Peak			86.52	87.18				
Other Buildings	Evening Peak					13.84	13.87		
	Morning Peak					12.01	10.34		
	Off-Peak					74.15	75.79		
Petroleum	Evening Peak							10.21	4.76
	Morning Peak							12.53	4.68
	Off-Peak							77.26	90.57
Restaurants	Evening Peak	10.87	10.32						
	Morning Peak	0.00	0.00						
	Off-Peak	89.13	89.69						
Retail Non Food	Evening Peak			13.36	12.42				
	Morning Peak			0.00	0.00				
	Off-Peak			86.64	87.58				
Sewage Treatment	Evening Peak	11.43	10.75	12.39	10.33	12.71	2.52	11.81	5.19
	Morning Peak	0.00	0.00	0.00	0.00	14.12	2.92	13.65	5.85
	Off-Peak	88.57	89.26	87.61	89.67	73.17	94.56	74.54	88.96
Small Offices	Evening Peak	13.32	12.67			15.37	14.60	11.19	10.08
	Morning Peak	0.00	0.00			14.75	15.18	11.75	10.41
	Off-Peak	86.68	87.33			69.88	70.23	77.06	79.52
Storage	Evening Peak	12.32	7.25						
	Morning Peak	0.00	0.00						
	Off-Peak	87.68	92.75						

Finally, load response was estimated on an aggregate basis for the whole TOU sample. The interval data was used to estimate the percentages of peak and off-peak consumption using actual TOU consumption, and using customer baseline consumption. These percentages were applied to the consumption of the total sample and the change in usage was estimated, as shown in the following table. The table shows that on an aggregate basis there was a relatively small reduction in evening peak usage in the winter period (840,679 kWh, or 1.3% of CBL peak consumption). There was also an increase in usage in the non-peak winter period (6,414,564 kWh, or 1.5% of CBL non-peak winter consumption). The increase in non-winter load was 7,890,512 kWh, or .85% of CBL non-winter consumption.

Table 4
Load Response Relative to CBL (kWh)

Season	Actual Usage		CBL Usage		Change in Usage	
12 Month 2000/2001	Peak	Non-Peak	Peak	Non-Peak	Peak	Non-Peak
Winter	62,593,525	427,951,339	63,434,204	421,536,775	-840,679	6,414,564
Non-winter		937,745,981		929,855,469		7,890,512
Total 12 Month	62,593,525	1,365,697,320	63,434,204	1,351,392,244	-840,679	14,305,076

4. What were the total customer benefits of the TOU Pilot Program?

The following table summarizes consumption and revenue for the year prior to the TOU program and during the TOU program (which ran 19 months in total). For the TOU period, 12XX revenue and actual TOU revenue are reported. The 12XX revenue is the amount that would have been billed under 12XX based on actual TOU consumption. This data is used below to determine customer benefits of the TOU program.

Table 5
Consumption and Revenue Data
For TOU Subscribers

	Consumption kWh	Revenue 12XX	Revenue TOU
CBL (12 month prior year)	1,414,826,448	$65,386,727	
Actual 12 Month (March 2000 - 2001)	1,428,290,845	$66,043,659	$65,686,659
Actual - 7 Month Extension (April to October 2001)	281,665,750	$12,638,003	$12,007,550
Actual Total - 19 Month	1,709,956,595	$78,681,662	$77,694,209

Customer benefits of the TOU Pilot Program are equal to bill savings plus consumer surplus. Bill savings are equal to the baseline bill minus the actual bill. The baseline bill is based on the CBL and the standard 12XX tariff. The actual bill is based on actual consumption and TOU prices.

Consumer surplus is an economic term used to denote the added value that a customer receives when it responds to lower prices by increasing its overall electric consumption. It is difficult to get an estimate of the value of consumer surplus without having an estimate of each customer's demand curve. Hence, the following will provide only an approximate estimate of total customer benefits.

The following defines total customer net benefit (CNB) as equal to bill saving (BS) plus consumer surplus (CS):[2]

CNB = BS+CS

= Base Bill – TOU Bill + CS
= (CBL×12XX) – (Actual load×TOU price) + (Δ load × CSV)

Where: Δ load = Actual load – CBL

CSV = consumer surplus value

Since actual load may exceed the CBL, it is possible that bill savings take on a negative value. This is reported in the first Column A in the table below. Also the value of consumer surplus requires an estimate of the customer's willingness-to-pay (or demand curve).

One estimate of CNB assumes that customers' consumer surplus value is equal to the 12XX rate:

CNB = (CBL×12XX) – (Actual load×TOU price) + (Δ load × 12XX)

= (Actual load × 12XX) - (Actual load×TOU price)

Another way to think of this is that the customer would be paying more under the base tariff assuming the higher actual load, and hence has a positive bill saving. This estimate is provided in Column B in the table below.

This estimate can be considered an upper bound of the customer net benefit, since it is likely that the consumer surplus value is valued lower than 12XX. For example, simulated values from EPRI's C-Value load response model indicated that the consumer surplus was valued at approximately 4.1 cents per kWh. The CNB using the simulated CSV value is reported for 12 months in Column C in the table below and is approximately 30% lower than the estimate in Column B.

[2] The Appendix shows graphically the customer benefit from a reduction in price under a two-part rate.

Table 6
Customer Benefits
(For Period March 2000 to 31 October 2001)

	Column A Bill Saving	Column B Bill Saving plus Consumer Surplus (CSV=12XX)	Column C Bill Saving plus Consumer Surplus (CSV=4.1 c/kWh)
Non-Winter 2000		$1,778,095	
Winter 2000/2001		-$1,421,095	
Sub-Total Annual (12 Months)	**-$299,932**	**$357,000**	**$252,108**
Non-Winter 2001 (Program extension period)		$630,453	
Total (19 Months) Without Bill Guarantee		**$987,453**	
Bill Guarantee (defined on p. 8)		$608,488	
Total Customer Benefit (With Bill Guarantee)		**$1,595,941**	

Column A: Customer Bill Saving = Bill under 12XX assuming CBL consumption – Bill under TOU rate assuming actual consumption

Column B: Customer Net Benefit = Bill under 12XX assuming actual consumption – Bill under TOU rate assuming actual consumption

Column C: Customer Net Benefit = Bill under 12XX assuming CBL consumption – Bill under TOU rate assuming actual consumption + Δ load x 4.1 cents/kWh

Note: *Taxes are excluded from these calculations.*

Assuming the upper bound estimate, the total customer benefit for the TOU program, which includes the bill guarantee, is $1,595,941.

5. What were the total BC Hydro Benefits of the TOU Pilot Program?

BC Hydro benefits of the TOU Pilot Program are equal to the change in revenues, as a result of the program, minus the change in costs.

The components of the benefit calculation for the first 12 months of the TOU program are provided in the following table. The financial impact of the extension period is examined beginning on page 17 of this report. The benefit from TOU pricing is given in row (6) in the table. The relatively low value reflects that the price response of the whole sample was not significant.[3] The table also reports the costs that were incurred for various components of the program.

[3] Note that this value is also approximate since the actual data was from billing data, which only covered roughly 12 months for each account. The baseline data was manually pro-rated so that it covered exactly 365 days for each account.

Table 7
BC Hydro Benefits
(for 12 Month Period to end-March 2001)

Net Benefit Component	Method	$ Estimate
(1) Revenue based on TOU rate and actual consumption	$\Sigma(kWh_{peak} * P_{peak}) + \Sigma(kWh_{offpeak} * P_{offpeak}) +$ ΣDelivery Charges +Program Charge	$65,686,659
(2) Revenue based on standard tariff and baseline consumption	$\Sigma(12xx\ Energy_{historical} + 12xx\ Demand_{historical})$	$65,386,727
(3) Change in Domestic Revenue =(1)-(2)		$299,932
(4) Increase in winter export sales revenue minus change in winter off-peak costs	Assumes Forward Price[a] $\Delta kWh_{peak(Nov\text{-}Feb)}$ * $55 per MWh – $\Delta kWh_{off\text{-}peak(Nov\text{-}Feb)}$ * $35 per MWh	-$178,272
(5) Increase in cost of serving change in non-winter off-peak load	Assumes Forward Price[b] $\Delta kWh_{mar\text{-}oct\ offpeak}$ * $27 per MWh	$213,044
(6) TOU Price Benefit	(3)+(4)-(5)	-$91,384
(7) Incremental costs of supporting TOU program	Fixed costs, collected through work orders - Billing Administration - Software for delivery charge calculation - Marketing Communications Sub-total	 $24,000 $8,000 $20,806 $52,806
(8) Incremental capital costs for TOU metering and billing	Fixed costs based on capital expenditures -500 meters at $500 each -Meter installation -Lodestar Billing license fee -Billing Setup Sub-Total	 $250,000 $13,103 $125,000 $29,500 $417,603
(9) Bill Guarantee (for total TOU Pilot)	TOU bill – 12XX bill (where both bills are based on actual consumption, and where TOU bill is greater than 12XX bill)	$608,488
(10) Quarterly Data Reports	- Special Meter Reads and downloading of data - Reporting Labour Cost - Capital cost of handheld computer (10 @ $6500) - Software for handheld (10 @ $2000) - Sub-Total	$38,351 $61,463 $65,000 $20,000 $184,814
Total Cost (11) TOU Capital and Operating Cost[c] (12) Total TOU Cost with Bill Guarantee and Data Reporting	 (7)+(8) (9)+(10)+(11)	 $470,409 $1,263,711

Notes:

a. This estimate assumes that reductions in winter peak energy consumption can be sold under a fixed-price open-volume contract at market rates. The average winter "sell price" of $55/MWh is based on the four-hour peak period being 30% higher than the Mid-C HLH average block. The winter energy cost of serving load in the off-peak period is $35. It is assumed to be equal to the weighted average Mid-C LLH price and the HLH price that TOU considers as off-peak periods. Hence, there is an assumed profit of $20 per MWh when a customer shifts load from the peak to off-peak period. This is based on the differential between the winter "sell price" and the winter off-peak energy cost. Note that the winter costs are based on forward market prices, which reflect market value of generation energy and capacity at the bulk transmission level.

b. This estimate assumes that increases in non-winter off-peak energy consumption will be satisfied under a fixed-price open-volume contract at market rates when this product was priced. The price is the weighted average of market prices in non-winter off-peak TOU hours as forecast using the Mid-C forwards. The weighting reflects the general condition that transmission constraints limit HLH sales in the summer.

c. Note that the full capital cost of equipment is reported. This ignores any salvage value of equipment or that the equipment could continue to have use beyond the TOU Pilot.

Next Step Questions

1. Should BC Hydro's TOU be offered permanently? What is the purpose of a permanent TOU program? Can a summer program be accommodated?

Should BC Hydro's TOU be offered permanently?

BC Hydro's TOU could be offered permanently as an optional product if it can be re-priced to reflect changes in market conditions and if there is mutual benefit for BC Hydro and for customers.

The results of the TOU pilot indicate that benefits were not positive in the first year. This was partially a result of not targeting the right customer segments, as more load response would have provided greater benefits. The program also offered a bill guarantee and data reporting service, which added significant costs to the program. On a going-forward basis, any permanent TOU program would have to review these features.

What is the purpose of a permanent TOU program?

Time-differentiated commodity pricing is a good concept, since it promotes the economically efficient use of generating assets and the transmission network by discouraging growth during peak periods. It is an effective mechanism to provide customers with marginal pricing signals so that customers have the opportunity to gauge their value of incremental consumption against the market value of electricity at that time. Customers that respond to time-differentiated pricing can decrease their average cost of supply by shifting consumption seasonally or within the day.

The following issues need to be considered in a permanent TOU program:

- The product must be structured and priced to reflect value for BC Hydro. Because customers will only participate in products from which they can benefit, BC Hydro is subject to adverse-selection risks. As a consequence, the only way for all parties to achieve value is if products provide mutual benefits for BC Hydro and participants, for all different customer load characteristics. To achieve this, a permanent rate would have to be a two part rate that includes a delivery charge derived from a customer's baseline load.

- Customer participation must reflect the seasonal nature of commodity prices and transmission constraints, and hence the value available to BC Hydro. Customers must enter into contracts that are a minimum of one-year to avoid the benefits being one-sided.

- BC Hydro must be able to reflect its level of price, volume, and foreign exchange risks. Failure to do so impacts non-participants by allowing participants to capture a disproportionate share of the program benefits. This approach is consistent with the recognition that products traded in the wholesale market are not the same as those provided to retail customers.

It is important to recognize that the market for a TOU product will change over time. For example, the pilot TOU product encouraged expanded consumption during off peak periods and load shifting. A TOU based on the forward prices seen during the fall of 2000 would encourage reduced consumption and load shifting. As such, product structure and pricing mechanisms may have to be allowed to change as circumstances change.

Can a summer program be accommodated?

A summer TOU program may be accommodated if there is value to BC Hydro from load shifting or conservation during the summer months. This value is limited by the fact that BC Hydro usually has available energy, which it exports, often to transmission limits, in the summer months. A summer TOU program can be accommodated to the extent that BC Hydro expects to have excess transmission capacity (e.g., as a result of low hydro conditions), and can benefit from additional conservation or load shifting in the summer months. These conditions prevailed in the summer of 2001, when BC Hydro primarily imported power due to unusually low reservoir levels.

2. Which aspects of the BC Hydro's TOU program can be improved?

Marketing and Subscription

- More education of customers would encourage more involvement with price responsive load management and greater energy conservation.
- Target marketing to customers with potential to conserve or load shift would improve response.
- The TOU load data provides valuable information on which customers and segments to target in any future program.
- Less paperwork will assist in the administrative process.

Billing

Staff was able to produce bills for all TOU subscribers with very little delay. In general, the process of using meter-reading sheets faxed to Billing worked well.

One of the time consuming aspects of the billing was the processing of the meter exchanges as a requirement for the CIS and meter inventory system.

The billing implementation could be improved by:

- Streamlining the process of meter exchanges.
- Eliminating data entry of meter reading sheets and moving to automated meter reading or processor technology. This would allow quicker access to customer data, which is also important for any data reporting to the customer. The collection of hourly data via automated meter reading would also allow more flexibility in changing future pricing periods and windows.
- Confirming incremental staffing required based on pilot experience.
- Increasing communication with front line Customer Services staff.

Metering

- Meter Acquisition – there were various problems resulting in delays in the purchase of the meters:
  - The original tender specified 3 element instead of 2 1/2 element TOU meters.
  - The vendor delayed delivery of the meters.
  - There was a miscommunication around the correct number of meters in the original order.
  - The vendor informed BC Hydro that the majority of meters that were shipped were not Measurement Canada certified for varh billing.

- There is a need to find a better way to get the TOU meters into the field as soon as they are required in order to minimize the time that they are held in either the local stores or the central stores.

The metering process could be improved by the following:

- Development of more technical expertise and experience with the large-scale implementation of TOU metering.
- Need to involve BC Hydro Stores and Meter Shop earlier in the meter procurement and specification process.
- Need to source multiple vendors for time constrained programs.
- Need to include a non-performance clause for vendors that do not deliver within their quoted time frame.
- Need more responsive technical support for TOU metering issues.

Data Reporting

Load profile information was provided quarterly to customers for free as part of the TOU program.

- The data reporting provided load profile information, which were several months out of date. This reduced the value of the information to customers, since they were unable to immediately relate behavioral consumption changes to the load profile reports.
- There were significant costs to providing the data reporting service.
- BC Hydro should investigate offering data reporting as a separate for-fee service, with updated load profile data (e.g., week or day before) possibly provided via the web. There is some evidence that customers would pay for such a service.

Rate Design

- Other pricing windows, such as a longer window during the afternoon (e.g., noon-6pm or 3pm-9pm), might be considered in lieu of the split window. There is some evidence that some customers would prefer this design.
- There is opportunity to design an on-peak product to fit the August through January season, which would appeal to some customers.

3. Should BC Hydro's TOU be expanded to other customer groups?

Optional time-differentiated products such as BC Hydro's TOU could be expanded to other groups, as long as there are mutual benefits to BC Hydro and to customers.

The value to BC Hydro and to customers will depend on the size of customer, prevailing market conditions, market prices and TOU price levels relative to tariff levels, and program costs.

The additional program administration and metering costs must be covered in any expansion of the TOU program. Given that the smaller commercial and industrial general service customers (less than 35kW) use relatively small amounts of electricity, it may be difficult to justify the installation and capital cost of TOU meters with this customer class.

4. How can the evaluation results be used to assist with the development of other programs?

The evaluation results can be used to identify which customer segments can benefit most from time-differentiated pricing, the extent of customer price response by segment, and also which price options and features are most attractive to customers.

The evaluation results are useful for the development of other load response products, such as real-time pricing. The results are also useful in the development of TOU options for other customer classes.

The evaluation results also provide lessons learned from implementing the time-of-use program. The lessons learned can easily be applied to implementing other optional pricing programs that may require the targeting of specific customer segments, more advanced metering and billing, and data reporting.

A post-program survey of TOU subscribers would also provide additional valuable information. The information would include the features of the TOU program that the subscribers liked. It would also include any new features that they would like to see in any future offering. BC Hydro intends to undertake such a survey.

Pricing Questions

1. How different were actual market prices from the forward prices used to derive TOU prices? What was the impact on BC Hydro's Revenue?

How different were actual market prices from the forward prices used to derive TOU prices?

This question relates to how well one year-ahead forward market prices reflected actual market prices. The following table compares the forward market prices used to derive the TOU prices with actual market prices.

Table 8

Comparison of Forward and Actual Market Prices

	Forward Prices used to Derive TOU Prices			2000 Actual Prices			2001 Actual Prices		
Month	6x16 HLH Price	6x8+24 LLH Price	7x24	6x16 HLH Price	6x8+24 LLH Price	7x24	6x16 HLH Price	6x8+24 LLH Price	7x24
Jan	41.21	32.36	37.12	39.68	33.48	36.81	435.69	343.81	393.21
Feb	35.1	29.23	32.6	38.96	36.82	38.05	419.77	381.69	417.99
Mar	30.52	27.7	29.34	40.58	38.95	39.90	430.81	375.17	407.47
Apr	24.43	12.98	19.6	41.18	26.98	34.24	487.5	418.15	453.59
May	21.76	9.54	16.11	87.88	58.24	74.82	412.78	264.93	347.6
Jun	21	9.54	16.16	268.11	92.52	193.97	107.51	80.14	95.95
Jul	28.25	19.01	24.18	185.64	123.53	156.92			
Aug	36.88	36.88	45.8	317.9	165.1	250.53			
Sep	36.88	36.88	49.69	200.13	134.37	170.91			
Oct	42.52	36.04	39.66	155.29	127.44	142.41			
Nov	45.73	34.66	40.81	272.24	204.09	241.95			
Dec	45.73	34.66	40.85	850.66	489.63	675.97			

Forward prices that prevailed at the end of 1999 were significantly lower than actual prices experienced in the year 2000 and the first half of 2001. The drivers behind the extreme market prices in the West are now well documented and include supply/demand imbalance, high natural gas prices, drought conditions in the Northwest, warmer than usual temperatures, and a large percentage of generation out due to maintenance and forced outages.

The following table compares the TOU prices offered in the pilot program and the TOU prices based on 2000 actual market prices. The table shows that peak prices would be more than ten times higher and off-peak prices two to four times higher if actual market prices were used.

Table 9

Option	TOU Price Based on Forwards		TOU Price Based on 2000 Actual	
	Peak	Off-Peak	Peak	Off-Peak
A	7	3.5	84	13.2
B	10	3.3	120	11.5
C	7	3.3	84	9.6
D	10	3.1	120	6

What was the impact on BC Hydro's Revenue?

Under the TOU pilot program, bill assurance ensures that the customer will pay no more under TOU than what it would pay if actual consumption were billed under 12XX. Hence, if the customer increased consumption in both peak and off-peak periods under TOU, there would not be a revenue difference using forward versus actual market prices, since the bill guarantee would be in effect. However, if the customer curtailed or shifted load in the winter, there would be a significant difference in revenue, because of the much higher peak prices if actual market prices were used.

However, TOU programs are priced using forward market prices, since the prices are fixed over a period of time. The volatility and price level change seen during the period of the TOU program demonstrates the need to account for risk in setting TOU prices. Real time pricing programs are based on actual spot market prices, which may change as of often as each hour.

2. How are the pricing periods and price levels derived from Mid-C impacted by transmission constraints?

This question relates to whether the method used to derive the TOU pricing periods and price levels using the Mid-C forward prices is appropriate given the existence of transmission constraints.

The peak and off-peak TOU prices have been derived from Mid-C forward prices. The peak pricing windows in the TOU Pilot program are available only in the winter period (November through February). Off-peak prices apply to all other months and to the off-peak periods of the winter months.

TOU prices should ideally reflect BC Hydro's opportunity cost, which is the market price at the BC/US Border. However, the Mid-C is the closest wholesale market hub which has active trading and which also has a forward market where prices can be obtained.

When there are no transmission constraints, the Mid-C index is a good measure of the BC/US Border price. If there are transmission constraints on the BC intertie, and BC Hydro is exporting, then the BC/US Border price is expected to be lower than the Mid-C price. If there are transmission constraints on the BC intertie, and BC Hydro is importing, then the BC/US Border price is expected to be higher than the Mid-C price.

For the TOU Pilot program, it was assumed that there is relatively little value in encouraging load shifting away from peak times during the non-winter months, and off-peak TOU prices apply.[4] It was assumed that BC Hydro is exporting and facing transmission constraints during the summer months of August and September, when Mid-C prices are high for the HLH period. For these months, the LLH values were assumed for all hours. For other non-winter months, the Mid-C forward HLH and LLH prices for each month were averaged to provide a flat price for each month. The TOU off-peak price was derived by the average of the non-winter prices along with the winter

[4] Similar assumptions were made for most of the non-winter months in the Transmission Service Time-of-Use Pilot Program (December 1999).

Mid-C off-peak prices, where the prices were weighted by the number of hours in each month. The assumptions regarding transmission constraints proved accurate in the summer months of 2000, as BC Hydro had significant exports, often to transmission limits, during this period.

In the winter months, it was assumed that Mid-C is a good proxy of opportunity cost, since BC Hydro is likely to be generation rather than transmission constrained in these months. Peak TOU prices apply during the peak pricing windows in the winter to encourage conservation or load shifting from peak periods. Any marginal load made available by the TOU program in peak periods can be exported at Mid-C prices. Reduced demand during peak periods may also reduce purchases required to meet system peaks when BC Hydro is generation constrained. The assumptions regarding transmission constraints proved accurate in the winter months including November 2000 to February 2001. During these months, BC Hydro both exported and imported power, but seldom to transmission limit levels.

Since there are few trades at the BC/US Border, the difference between the Mid-C price and BC/US Border price during a transmission constraint cannot be determined. The reason for accepting the Mid-C price as a reasonable proxy for a BC market price is that the unadjusted Mid-C price is simple and transparent.[5]

3. Should a permanent program be structured to reflect BC Hydro's own costs of peak period generation, transmission and distribution or should generation and transmission prices reflect peak revenue opportunities available from export markets? What would be the difference in peak pricing?

A permanent program which offers short and medium term contracts has to be structured so that energy prices reflect BC Hydro's forward market (or opportunity) costs to ensure benefits exist for non-participating customers and BC Hydro. The ability of customers to self select ensures that benefits will occur for participants. The energy prices reflect the market value of generation energy and capacity.

BC Hydro operates its system to maximize value in the wholesale electricity market, subject to its domestic market obligation. TOU has been designed to send price signals in order that customers can make marginal consumption decisions in light of expected market conditions.

If long-term contracts are developed, energy prices should reflect the long-run opportunity cost of energy. These prices would reflect the different long-run opportunity costs of serving load by time of day. The peak prices could also reflect the value in delaying transmission and distribution investments to the extent that the expected load reduction during peak periods delays the need for future system additions.

---

[5] This is the argument used in supporting the Mid-C index for pricing Rate Schedule 1853, Transmission Service-Station Service for Maintenance and Blackstarts (effective January 2001). Rate Schedule 1853 is offered on a permanent basis, and for simplicity the Mid-C pricing does not reflect the transportation differential to the BC/US border or the presence of transmission constraints.

4. How will a permanent program impact the appropriate revenue requirement collection from the commercial class and TOU commercial customers?

The TOU rate is a two-part rate. The first part collects the historic revenue requirement and reflects the customers' embedded cost use of the system. The second part is based on the TOU rate and, assuming the rate is designed correctly, should provide benefits to BC Hydro when compared to the standard rate. Ideally, the historic embedded costs should be allocated in a manner consistent with other embedded cost general-service rates. The expected benefit, however, should be allocated across all customers. From a practical perspective, however, this benefit would be immaterial and in BC Hydro's view it would not be worthwhile to complicate an allocation study in an effort to capture the effect of allocating the benefits over all customers.

5. Should a permanent program be based on a revenue neutral initial pricing by customer or by class of customer?

BC Hydro's current assumption is that a permanent TOU rate would be offered as an optional rate. Given the optional nature of the rate, the program would be based on revenue neutral initial pricing by customer when the customer's consumption characteristics do not change. The rate would thus also be revenue neutral on a customer class basis.

Implementation Question

1. Did BC Hydro adequately bill and meter customers on the Pilot?

Billing

Yes, customers were adequately billed on the Pilot program. BC Hydro chose not to modify its legacy billing system to accommodate the TOU pricing. Instead it used a new stand-alone billing system that was being used for its largest commercial and industrial accounts. The billing service team met all targets set for them and was able to have all bills issued on time and error free.

Metering

Yes, once meters were installed, customers were adequately metered. However, the meter supply process was a challenge in that there were delays and certification problems with the supplier. When the meters did arrive there were problems with the receipt of the TOU meters into our warehousing system because they did not conform to the energy and demand meter format of most of our meters. Once the TOU meters were issued into the field, there was no timely way of finding out whether or not they had been installed. A hard copy work order had to be returned to the head office to determine that installation had occurred. As a result, the meter acquisition and installation process took longer than expected.

Since the spring and summer months did not have time-differentiated pricing, the delays in meter installation did not affect customer billing in this period. However, the delays resulted in the extension of the program by seven months so that BC Hydro could keep its commitment to provide 12 months of hourly consumption data to all TOU subscribers.

Impact of the Program Extension

This section examines the financial impact of the seven month program extension (31 March 2001 to 31 October 2001) of the TOU Pilot program. BC Hydro requested the extension, as it had committed to providing customers who enrolled in the TOU Pilot program with 12 months of hourly consumption and load profile data. Although, 505 customers were transferred to TOU rate schedule 1267 prior to 31 March 2000, there were delays in the installation of the time-of-use meters. Hence, not all customers had received 12 months of load profile data by the end of March 2001. Customers were therefore given the option of staying on the program till the end of October 2001. There were 181 accounts that were on TOU during some portion of the extension period.

The financial impact is reported in the table below. It assumes that the baseline consumption is the same as actual consumption. Hence the net financial impact to BC Hydro is the change in revenue plus the additional billing and reporting cost.

Table 10
Financial Impact of TOU Program Extension
(April 2001 to October 2001)

	Method	$ Estimate
(1) Revenue based on TOU rate and actual consumption	$\Sigma(kWh_{peak} * P_{peak}) + \Sigma(kWh_{offpeak} * P_{offpeak}) + \Sigma$Delivery Charges	$12,007,550
(2) Revenue based on standard tariff and baseline consumption	- Σ(12xx Energy + 12xx Demand) - Assumes baseline consumption equals actual consumption, since baseline has not been established for the extension period	$12,638,003
(3) Change in Domestic Revenue =(1)-(2)		-$630,453
(4) Additional Billing and Reporting Cost		$13,137

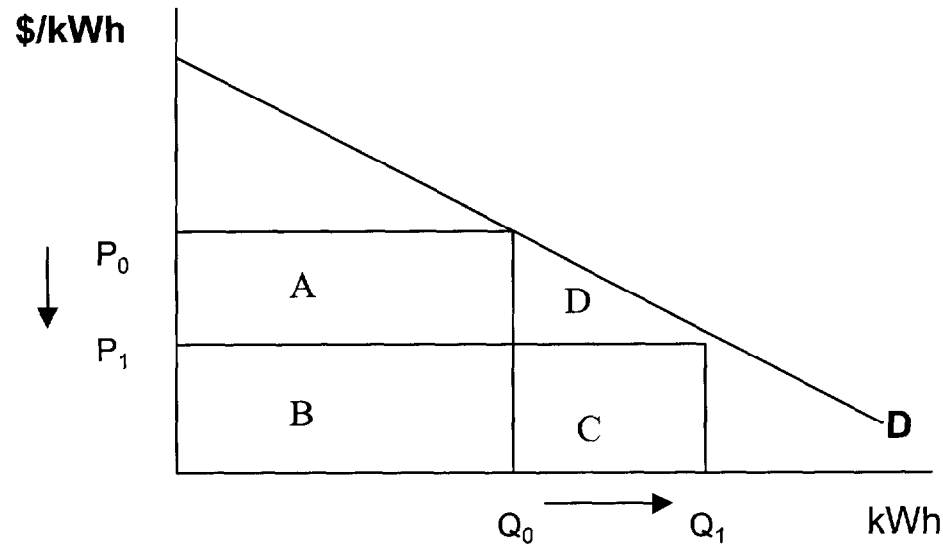
Appendix A

Table A.1
TOU Subscription by SIC and Building Type

	kWh	Percentage	No. Sites	Percentage	Average kWh
Agriculture	22,750,102	1.6%	14	2.8%	1,625,007
Chemicals	4,538,880	0.3%	1	0.2%	4,538,880
Colleges Universities	87,232,667	6.2%	21	4.2%	4,153,937
Construction	5,069,699	0.4%	3	0.6%	1,689,900
Food and Beverages	49,779,040	3.5%	7	1.4%	7,111,291
Forestry	12,227,904	0.9%	3	0.6%	4,075,968
Hospitals	62,514,350	4.4%	27	5.3%	2,315,346
Hotels Motels	55,497,347	3.9%	24	4.8%	2,312,389
Ice Arenas	49,650,179	3.5%	29	5.7%	1,712,075
Large Offices	176,630,338	12.5%	39	7.7%	4,528,983
Mining	17,420,710	1.2%	9	1.8%	1,935,634
Nursing	2,208,445	0.2%	1	0.2%	2,208,445
Other Buildings	33,530,644	2.4%	22	4.4%	1,524,120
Other Manufacturing	113,396,633	8.0%	36	7.1%	3,149,906
News Press	10,540,800	0.7%	1	0.2%	10,540,800
Petroleum	29,751,114	2.1%	14	2.8%	2,125,080
Pulp and Paper	34,008,000	2.4%	1	0.2%	34,008,000
Restaurants	1,618,040	0.1%	3	0.6%	539,347
Retail Food	9,758,046	0.7%	11	2.2%	887,095
Retail Non Food	114,556,189	8.1%	8	1.6%	14,319,524
Schools	44,651,687	3.2%	77	15.2%	579,892
Sewage Treatment	45,206,905	3.2%	51	10.1%	886,410
Small Offices	40,901,342	2.9%	34	6.7%	1,202,981
Small Residential	946,114	0.1%	1	0.2%	946,114
Storage	52,807,500	3.7%	13	2.6%	4,062,115
Transportation	8,056,625	0.6%	6	1.2%	1,342,771
Wood	329,577,148	23.3%	49	9.7%	6,726,064
	1,414,826,448	100.0%	505	100.0%	

Appendix B

The following chart shows the customer benefit from a reduction in price under a two-part rate. The TOU rate is a two-part rate, where the customer pays the base bill if it does not change its consumption profile.



Base Bill

The Base Bill is equal to the customer baseline load billed under the standard tariff:

Base Bill = A+B

Under a two-part rate, the customer pays a fixed or delivery charge (DC) equal to the area A.

DC = Base Bill – $Q_0 \times P_1$
= $P_0 \times Q_0 - Q_0 \times P_1$
= A+B-B
= A

The bill under the two-part TOU rate is:

TOU Bill=DC+Energy Charge
=A+B+C

The customer benefit from the TOU rate is:

Customer Benefit = (Bill Saving) + (Consumer Surplus)
= -C+(C+D)
= D