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F2011 Demand Side Management Milestone Evaluation Summary Report

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better understand the possible effects of such awareness on consumption and possibly assess differences in consumption due to differences in awareness levels. This should include a re-examination of the survey instrument used to assess awareness levels.

5.2 Transmission Service Rate F2010

5.2.1 Introduction

The purpose of this study is to provide an impact evaluation of the Transmission Service Rate (**TSR**) in F2010, which was the fourth year of operation of the rate. This study uses an econometric model to estimate the additional impact of the TSR on energy consumption and peak demand. This is also referred to as unreported DSM, which are residual energy savings from energy conservation and efficiency and self-generation actions that were funded/installed by the customer. Unreported DSM is assumed to occur in response to the TSR and Power Smart enabling activities working in combination, but are not reported to BC Hydro. This study does not evaluate reported DSM, which are estimates of energy savings reported to BC Hydro as part of the annual CBL adjustment process. Reported DSM is typically claimed as Power Smart energy savings and evaluated through the PSP – Transmission program evaluation.

5.2.2 Approach

This study uses a multiple lines of evidence approach. Multiple lines of evidence are appropriate when no single methodology or line of evidence can provide information on all of the evaluation issues of interest. The main data sources or lines of evidence in this study include: program staff interviews, file and documents review, billing data, DSM impacts, industrial output, industrial employment, and pre- and post-implementation executive interviews.

A major source of information for this study was a set of detailed interviews with 25 BC Hydro staff and 40 executives from 34 of the largest transmission voltage customers. The interviews were based on a detailed discussion guide and were open-ended, so that customers were able to talk about the issues that were important to them.

The main purpose of the econometric analysis was to quantify the unreported impact of the TSR on purchased electricity consumption. The key point was to estimate the price elasticity of demand, which is defined as the percentage change in purchased electricity consumption divided by the percentage change in price. Because TSR customers are subjected to two prices – the Tier 1 price and the Tier 2 price – both prices need to be included in the model. Two indicators of economic activity, shipments of durable goods and industrial sector employment, were used. Finally, because purchased electricity consumption is affected by Power Smart program activity, adjusted purchased electricity consumption was defined as the sum of actual purchases plus reported DSM savings.

The model was estimated using seven years of monthly data. Actual consumption is the sum of monthly consumption aggregated across TSR customers. Reported DSM program savings are aggregated across TSR customers. Tier 1 price and Tier 2 price data are from BC Hydro data. Durable shipments and industrial employment data are from BC Statistics.

The basic method for the impact analysis uses time-series regression modeling in log linear form. Log linear models have the advantage of having coefficients that are interpretable as elasticities. In the fullest version of the model, it is assumed that the log of consumption is a linear function of a constant, the log of Tier 1 price, the log of Tier 2 price, the log of durables output, the log of industrial sector employment, and an error term as shown in Equation (1). The impact of the TSR, or estimated unreported DSM, is then given by the Tier 2 price elasticity γ

times the relative change in the Tier 2 price from the base year times Tier 2 consumption lagged one year as given by Equation (2). Note that the measured price change is from the base period rather than from the previous year, because changing industrial energy consumption in response to a price change is a lengthy process that is unlikely to be completed within the year immediately following the price change.

Table 5.2.1 summarizes the main data sources for this study.

Table 5.2.1 TSR Evaluation Issues, Data Sources and Methods

Data required	Data Source	Details
Program description, other utility rate programs	File and documents review, interviews	Review of program documents, BCUC filings, relevant official and program evaluation literature and interviews with program staff and consultants
Consumption by sector and end use	Conservation Potential Review	Consumption and demand for nine end uses by five sectors
Energy consumption by step	BC Hydro	Consumption by step by year
Rate awareness and knowledge	Executive interviews (n = 40)	Customer awareness of the rate and knowledge of the rate, in particular as it affects their business operations
Energy consumption drivers	B.C. Government data, consultant reports	Determinants or drivers of energy consumption and indicators for these determinants

5.2.3 Results

Program Rationale.

The program rationale for the TSR was examined using a program logic model, which was developed from interviews with staff and consultants, a documents review and a literature review covering selected rates for business customers among other utilities. This review and analysis confirms that the basic program logic is valid. There are strong linkages among inputs, outputs, purposes and goal statements. Indicators for key components of the logic model are clear, well defined and measurable. There are credible and strong links among inputs, outputs, purpose and goal statements and indicators are clear, well defined and measurable.

Awareness and Knowledge.

Customers were asked a series of open-ended questions to determine their awareness and knowledge of the TSR and to identify any issues pertaining to communications by BC Hydro. All customers had at least a general awareness of the rate.

Table 5.2.2 TSR Awareness and Knowledge

End use	General awareness of TSR (%)	Knowledge of TSR (% good or better)
October 2008 interviews (n = 23)	100	96
March 2009 interviews (n = 17)	100	71

Based on the interviews, a number of implications can be drawn with respect to awareness, knowledge and communications of TSR.

Communicating Rate Complexity.

The TSR is a relatively complex rate and information is often required at multiple levels with customers so that they can optimize the benefits of the rate for their operations. It is important that understanding of the rate is communicated to a variety of relevant managers and operational staff depending on the decision-making structure of the customer.

Role of the KAMs.

BC Hydro's Key Account Managers (**KAMs**) have played a significant role in communicating the nuances of TSR to their customers. This focussed support will continue to be essential as transmission voltage customers continue to optimize the value of the rate for their operations.

Ongoing Communications.

Changes in ownership and in leadership roles within the transmission voltage customer group will require ongoing communications efforts about the TSR. Periodic surveys to track the effectiveness of communications could be useful in identifying opportunities for additional communications efforts.

Energy Use.

Energy use and demand profiles were developed using information from the Conservation Potential Review. Energy and demand were examined for nine end uses (pumps, fans and blowers, compressors, materials handling, lighting, process equipment, building services, cooling and refrigeration and other) and for five sectors (metal mining, sawmilling, pulp and paper, basic chemicals and coal mining). Some areas for further energy conservation were identified.

Consumption and Peak Impacts.

An econometric model was used to estimate the unreported impact of the TSR on energy consumption. The model includes the price variables P1 and P2 as well as durable shipments and employment as drivers. The sign of the coefficients on the log of both the Tier 1 price and Tier 2 price are negative as expected and they are statistically significant, and the coefficients on the log of durable shipments and the log of employment are positive as expected and are statistically significant.

Table 5.2.3 provides the details of the impact analysis. As indicated above, the unreported impact of the TSR is given by the Tier 2 price elasticity γ times the relative change in the Tier 2 price from the base year times Tier 2 consumption lagged one year. The estimated run rate impact of TSR is a reduction in purchased electricity of 38.2 GWh/year for F2010 and a reduction in demand of 3.6 MW.

Table 5.2.3 TSR Impact Analysis

Fiscal Year	Tier 2 price ($/MWh)	Δ P2/P2	Tier 2 energy (GWh)	Elasticity	Δ GWh /year	ΔMW
F2010	7.36	1.6910	139	-0.1627	38.2	3.6

5.2.4 Conclusions and Recommendations

The study has several limitations. First, the industrial sector in British Columbia has been subjected to major external economic shocks. Although using sector gross domestic product (**GDP**) as a driver of the load to try to control for these shocks, this may be an imperfect control.

Second, it is premature to conclude that the observed load response is permanent rather than transitory. Third, the estimated quantitative impacts of the TSR are based on simple econometric models using sector level data, and it would be useful to repeat this study using site level information. However, at this time, comprehensive site level output information is not available. Fourth, since the whole population is in the treatment group, it is difficult to rule out the possibility that some of the estimated rate effects, in terms of reduction in load, may be due to factors outside of the rate. Fifth, it is possible that the methodology used does not capture all of the savings due to the rate. However, discussions with program management suggest that the size of additional savings is likely to be small.

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3 Transmission Service Rate F2007, F2008 and F2009

3.1 Introduction

BC Hydro introduced the Transmission Service Rate (**TSR**) in April 2006 after receiving BCUC approval. The rate involves three main components with an additional program support component outside of the TSR: (1) stepped rate; (2) time of use rate; (3) retail access; and (4) enabling activities. Each of these components is briefly discussed in turn.

The stepped rate RS 1823 replaced the RS 1821 transmission rate, which was a flat rate, with an energy cost of 2.735 cents per kWh. The stepped rate is an inverted block rate where the first 90 per cent of the Customer Baseline Load purchased by a customer is at a lower rate and the balance consumed is at a higher rate. For the introduction of the rate, the price for Tier 2 energy was set at 5.4 cents per kWh and the price for Tier 1 energy was 2.428 cents per kWh.

Time of use rate RS 1825 is an optional rate, which allows customers to reduce their energy bills by changing when they consume electricity. The time of use rate is designed to encourage customers to shift load from peak periods to off-peak periods. The time of use rate also has the same Tier 1 and Tier 2 split, but pricing varies by time of day and season of the year. There are no customers on Time of Use rates at the present time.

Retail access allows customers to purchase some or all of their electricity from suppliers other than BC Hydro. This has the objectives of encouraging the development of independent power producers as well as a more competitive market for bulk electricity in British Columbia (**B.C.**). No customers have chosen the Retail Access option to date.

Program enabling activities are designed to help customers with the identification, appraisal and implementation of projects to reduce energy consumption. Program enabling activities were not included in the terms of reference for this evaluation.

The purpose of this study is to provide an impact evaluation of the TSR, based on the first three years of its implementation.

3.2 Approach

This study uses a multiple lines of evidence approach. The main data sources or lines of evidence included in this study include: program staff interviews; file and documents reviews; billing data; DSM impacts; industrial output; industrial employment; and pre-implementation and post-implementation executive interviews.

A major source of information for this study was a set of detailed interviews with 25 BC Hydro staff and 40 executives from 34 of the largest transmission voltage customers, with the executive interviews conducted in two rounds in October 2008 and March 2009, respectively. The interviews were based on a detailed discussion guide, but they were conversational and open-ended, so that customers were able to talk about the issues that were important to them.

The study used econometric modelling to estimate the impact of the rate on purchased energy consumption. The key point is to estimate the price elasticity of demand, which is defined as a percentage change in purchased electricity consumption divided by the percentage change in price. Because TSR customers are subjected to two prices – the Tier 1 price and the Tier 2 price – both prices need to be included in the model. Two indicators of economic activity are

used; shipments of durable goods and industrial sector employment. Finally, because purchased electricity consumption is affected by Power Smart activity, adjusted purchased electricity consumption is used, which is defined as the sum of actual purchases plus estimated Power Smart savings.

The model is estimated using 83 months of data from April 2002 through February 2009. Actual consumption is the sum of monthly consumption aggregated across TSR customers. Power Smart savings are amortized estimates of savings adjusted for persistence and aggregated across TSR customers. Tier 1 price and Tier 2 price are from BC Hydro data. Durable shipments and industrial employment are from B.C. Statistics.

The basic method for the impact analysis uses time-series regression modeling in log linear form. Log linear models have the advantage of having coefficients that are interpretable as elasticities. It is assumed that the log of consumption is a linear function of a constant, the log of Tier 1 price, the log of Tier 2 price, the log of durables output, the log of industrial sector employment and an error term as shown in Equation (1). The impact of stepped rates is then given by the Tier 2 price elasticity γ times the relative change in the Tier 2 price from the base year times Tier 2 consumption lagged one year as given by Equation (2).

$$(1)\ logGWh_t = \alpha + \beta\ logP1_t + \gamma\ logP2_t + \delta\ logdur_t + \zeta\ logemploy_t + error_t$$

$$(2)\ \Delta GWh_t = \gamma * \Delta rate_t * Tier2\_consumption_{t-1}$$

3.3 Results

Energy Savings. The impact of the stepped rate was examined in two ways: first, an examination of trends in energy consumption for BC Hydro's main customer classes with a view to comparing transmission voltage customer consumption trends with consumption trends for other rate classes and, second, an estimate of the impact of the TSR on energy consumption using an econometric model. On the first point, from F2006 to F2009, residential sales increased at an average annual rate of 3.3 per cent, light industrial and commercial sales increased at an average annual rate 0.7 per cent, other sales increased at an average annual rate 4.4 per cent and total sales were essentially flat, but large industrial sales fell at an average annual rate 4.3 per cent. This is significant support for the hypotheses that the TSR has reduced electricity sales and increased electricity savings. On the second point, the estimated impact of the TSR is given by the Tier 2 price elasticity γ times the relative change in the Tier 2 price from the base year times Tier 2 consumption lagged one year. The estimated impact of the TSR is a run rate reduction in purchased electricity of 236 GWh per year for F2007, 126 GWh per year for F2008 and 113 GWh per year for F2009 for a total of 474.4 GWh per year over three years. The run rate refers to the estimated savings if the response to the rate were in place for a year. It should be noted that the reduction in Tier 2 energy is also driven by two other factors, the level of economic activity as reflected by the log of durable shipments and the log of employment variables and the impact of DSM program enabling activities.

Table 3.1 Electricity Sold by Customer Class (GWh)

	F2004	F2005	F2006	F04-06 Annual % Change	F2007	F2008	F2009	F06-09 Annual % Change
Residential	15,646	15,814	16,261	2.0	16,651	17,553	17,861	3.3
Light industrial & commercial	17,175	17,459	17,913	2.2	18,268	18,406	18,265	0.7
Large industrial	15,505	16,177	16,428	3.0	15,989	15,380	14,303	-4.3
Other	1,825	1,755	1,838	0.4	2,003	1,961	2,083	4.4
Total domestic	50,151	51,025	52,440	2.3	52,911	52,300	52,512	0.0

The impact of the stepped rate on energy consumption is estimated using an econometric model. Table 3.2 presents the results of three nested econometric models. Model 1 includes only price variables and excludes other economic drivers of the load. The sign of the coefficient on the log of Tier 1 price is negative as expected and it is statistically significant (indicated with ***), but the coefficient on the log of Tier 2 price is not statistically significant. Model 2 includes the price variables as well as durables shipments as drivers. The sign of the coefficient on the log of Tier 1 price is negative as expected and it is statistically significant, but again the coefficient on the log of Tier 2 price is not statistically significant. Model 3 includes the price variables as well as durables shipments and employment as drivers. Now, the sign of the coefficients on the log of both Tier 1 price and Tier 2 price are negative as expected, and they are statistically significant and the coefficients on the log of durable shipments and the log of employment are positive as expected and are statistically significant. The preferred regression is Model 3, which has the greatest explanatory power and signs on the price variables, which meet a priori expectations. The results from Model 3 are therefore used in the subsequent analysis.

Table 3.2 Regression Models (Log Adjusted Sales in GWh)

	Model 1	Model 2	Model 3
Constant	20.5857*** (0.0193)	11.6596*** (1.4848)	6.5693*** (1.8247)
LogP1	-0.1694*** (0.0393)	-0.1914*** (0.0326)	-0.2069*** (0.02990)
LogP2	0.0791 (0.0751)	0.0614 (0.0632)	-0.1627** (0.0789)
Log durable shipment	-	0.6145*** (0.1014)	0.5601*** (0.0931)
Log employment	-	-	0.9250*** (0.2231)
Adjusted R^2	0.71	0.82	0.85
Sample size	83	83	83

Table 3.3 provides the details of the impact analysis. As indicated above, the impact of the TSR is given by the Tier 2 price elasticity γ times the relative change in the Tier 2 price from the base year times Tier 2 consumption lagged one year. The estimated impact of TSR is a run rate reduction in purchased electricity of 236 GWh per year for F2007, 126 GWh per year for F2008, 113 GWh per year for F2009 for a total of 474.4 GWh per year over three years. Reduction in

Tier 2 energy is also driven by two other factors, the level of economic activity as reflected by the log of durable shipments and the log of employment variables and the impact of DSM program enabling activities.

Table 3.3 Impact Analysis

	Tier 2 Price	Δ P2/P2	Tier 2 Energy Lagged	Price Elasticity	Δ GWh/year
F2006	2.735	-	-	-	-
F2007	5.4	0.9744	1,488	-0.1627	235.9
F2008	5.4	0.9744	795	-0.1627	126.0
F2009	7.36	1.6910	410	-0.1627	112.8
F2007-F2009	-	-	-	-	474.7

3.4 Conclusions and Recommendations

1. Process Evaluation. Recommend that a further round of Executive Interviews be conducted in the spring of 2010 to assist with a future evaluation of the TSR. The scope and content of the executive interview information collection protocol should be harmonized with the information needs of rate management.

2. Impact Evaluation. Recommend that the possibility of using customer specific data be explored for the next impact evaluation. This could include estimation of a statistically adjusted engineering model if appropriate drivers of individual customer loads can be obtained.

3. Reporting. Recommend that the evaluated estimates of energy and peak savings be used in future reporting for F2007, F2008 and F2009.