DALHOUSIE University

Department of Electrical & Computer Engineering

Faculty of Engineering

24 November 2004

Nova Scotia Utility and Review Board
3rd Floor, Summit Place
1601 Lower Water Street
Halifax, Nova Scotia B3J 3P6

Dear Sir/Madam,

Re: NSPI's General Rate Application (2004)

This letter and its accompanying report discusses NSPI's proposed Domestic Service Tariff price increase and recommends an alternative rate structure that supports price signals and reduces cross-subsidies.

If members of the Board have any questions or comments regarding this letter or the report, they should contact me at the address given below.

Yours sincerely,

Larry Hughes, PhD
Professor and Visiting Fellow
Science and Technology Policy Research Unit,
Freeman Centre, University of Sussex,
Falmer, Brighton, BN1 9RH, U.K.
Tel: +44.1273.87.6584
Fax: +44.1273.68.5865
Email: larry.hughes@dal.ca

Room C367
1360 Barrington Street
P.O. Box 1000
Halifax, Nova Scotia
Canada B3J 2X4

Tel: 902.494.3950
Fax: 902.422.7535
E-mail: e&ce@dal.ca
WWW: www.ece.dal.ca

NOVA SCOTIA UTILITY AND REVIEW BOARD

IN THE MATTER OF: *The Public Utilities Act,* R.S.N.S. 1989, c.380 as amended

- and -

IN THE MATTER OF: An Application by Nova Scotia Power Incorporated for Approval of Certain Revisions to its Rates, Charges and Regulations

Dr. Larry Hughes
Energy Research Group
Department of Electrical and Computer Engineering
Dalhousie University, Halifax, Nova Scotia, B3J 2X4

27 November 2004

Background

In 2004, Nova Scotia Power Incorporated (NSPI) applied to the Nova Scotia Utility and Review Board (UARB) for increases in all its rate classes. In the Domestic Service Tariff, NSPI has proposed an increase of 10.22 percent, from 8.61 cents per kilowatt-hour to 9.49 cents per kilowatt-hour. Using 2003 sales figures, NSPI would be expected to earn about $374,044,398.

NSPI's Domestic Service Tariff

NSPI's Domestic Service Tariff applies to about 418,900 residential customers. An analysis of NSPI's Domestic Service Tariff data shows that:

- The maximum consumption of the lowest sixty percent of residential customers (9,100 kilowatt-hours) is less than NSPI's overall residential customer average of 9,400 kilowatt-hours.
- The average residential energy consumption of a customer in the lowest 20-percent of customers is about one-thirteenth of the average consumption of a customer in the highest 20-percent of customers.
- Almost half the residential customers are responsible for about one-fifth of residential energy consumption.

- The highest 20-percent of residential customers are responsible for about one-half of residential energy consumption.

The Domestic Service Tariff is known as a flat rate (also referred to as uniform rate, straight meter rate, or single rate). The flat rate is arguably the simplest rate model, using induction-type electricity meters that record only energy consumption. The model is easily understood by customers as it applies a known price (cents per kilowatt-hour) to a given level of consumption (measured in kilowatt-hours): multiplying the two gives the customer's bill.

The flat rate

The flat rate's simplicity belies a number of limitations, notably:

- It restricts a utility's ability to create meaningful price signals.

  A price signal is a message sent to customers in the form of a price charged for a commodity; the change in price is usually intended to produce a particular result. In the flat rate, all customers pay the same price for a unit of energy, regardless of consumption. With only a single price, the energy supplier has few means available to influence customers' consumption patterns. Any change in price affects all customers; for example, raising rates to discourage consumption impacts all customers, including those with existing low levels of consumption.

- It can result in cross-subsidies by customers with demands that are not peak-coincident for those with demands that are peak-coincident.

  Since the flat rate charges a customer only for the energy consumed, not the demand, the unit price must be a 'blend' of the different costs of generation. The flat rate model implies that all customers exhibit the same consumption profile; put another way, a customer's energy consumption is assumed to be proportional to the demand they put on the system.

  The customer's price per unit of energy is obtained, in part, from the costs associated with the different types of generation. If the energy supplier meets the non-peak demand with low-cost, base-load energy and the system peak with a combination of base-load and expensive peak load energy, the price per unit of energy must be a combination of the two. Although both customers pay the same price per unit energy, the first customer pays disproportionately more per unit because the second customer consumes more energy generated during the (expensive) system peak. In short, one finds that:

- Customers with a large portion of their demand that is not coincident with the system peak are overcharged for the price of a unit of energy.
- Customers with a large portion of their demand that is coincident with the system peak are undercharged for the price of a unit of energy.

In other words, the flat rate structure does not reflect the cost of generation and can result in cross-subsidies.

Alternatives to the flat rate

There are alternatives to the flat rate structure that address these two issues. Perhaps the best known (and used by less than one percent of NSPI's residential customers) is the time-of-day rate, which charges customers different prices according to the season, day-of-week, and time-of-day. The time-of-day rate allows utilities to charge higher prices during times of peak demand, signaling customers to decrease their demand during these periods. Implementing a time-of-day rate structure requires the utility to replace existing induction-style meters (used with the flat rate) with electronic interval meters that records the consumption at a particular time. Despite the benefits of time-of-day rates, some utilities and their customers are reluctant to adopt them because of the cost of replacing existing induction meters with electronic interval meters.

The inverted block rate is an alternative to the flat rate that does not require the replacement of the customer's induction meter. In the inverted block rate, the customer's consumption is divided into blocks; each block has a price per unit of energy consumed, which increases with each succeeding block. The customer's bill is simply the sum of consumption per block multiplied by the energy price associated with each block.

The inverted block rate offers a number of advantages over the flat rate, including:

- Price signaling. The inverted block rate allows the energy supplier to introduce price signals: low consumption customers have less of an incentive to increase consumption as this leads to a higher price per unit of energy, while high consumption customers have an incentive to decrease consumption as this leads to a lower price per unit of energy.

- Same metering technology. Both the inverted block rate and the flat rate can use induction-type meters. This means that the energy supplier is not required to purchase new metering equipment and that existing meter-reading technology can still be used. The only change required by the energy supplier is in the billing software, as the data obtained from the meter (i.e., the record of the customer's energy consumption during the billing period) remains unchanged.
- Cross-subsidies. The inverted block rate structure means that customers with small energy consumption requirements would be paying less, while those with large energy consumption requirements would be paying more. Some energy suppliers report a strong correlation between large consumption customers and higher system demand, meaning that these price shifts are cost reflective.

Applying an inverted block rate to NSPI's Domestic Service Tariff

There are no hard-and-fast rules for creating an inverted block rate structure. The following table shows a revenue-neutral (i.e., the inverted block rate revenue is the same as the estimated revenue from NSPI's proposed new flat rate), five-block inverted block rate using NSPI's Domestic Service Tariff data:

Block	**Limits** (kWh)	**Price** (¢/kWh)	**Number of Customers**	**Total consumption** (kWh)
1	3,400	8.710	418,930	1,276,971,748
2	6,300	9.194	335,144	851,447,294
3	9,100	9.678	251,358	582,858,750
4	14,000	10.162	167,572	584,479,202
5		10.646	83,786	645,701,365

Where:

- Limits are the cutoff for each block; for example, a customer consuming 3,500 kWh annually would be associated with two blocks: 3,400 kWh from the first block and 100 kWh from the second.
- Price is the price applied to electricity consumed in a block; for example, the customer consuming 3,500 kWh would pay 8.71 cents per kilowatt-hour for the first 3,400 kilowatt-hours consumed and 9.194 cents per kilowatt-hour for the remaining 100 kilowatt-hours.
- Number of customers is the number of customers per block. The greater the block number, the fewer the customers as the number is dictated by each block's limit.
- Total consumption is the total consumption by all customers in a given block.

Discussion

One argument against changing from the flat rate model to the inverted block rate model is that by having one or more of blocks with prices per unit of energy less than the existing flat rate, customers with consumptions in a lower block would use more as there would be no incentive to consume less energy. Although this argument may be true in some circumstances, in the example presented in this section, the 167,572 customers with energy consumptions that do not exceed the limits of the first two blocks (i.e., below 6,300 kilowatt-hours per year) would see maximum increases of 1.16 percent (8.61 cents per kilowatt-hour to 8.71 cents per kilowatt-hour) and 6.78 percent (8.61 cents per kilowatt-hour to 9.19 cents per kilowatt-hour), respectively. Low- or fixed-income consumers whose consumption falls into these two blocks are unlikely to consume more energy (up to the block's limit) simply because the price per unit of energy is less than that of the next block

Another argument against inverted block rates is the impact of the rate structure on high-consumption, low-income customers. These customers are typically users of electric-heating. One solution to this problem is to shift the customers to the time-of-day rate structure, which is intended for users of electric heating.

Recommendation to the UARB

NSPI's Domestic Service Tariff is a flat rate structure and as such, suffers from all the aforementioned limitations associated with the flat rate. Since NSPI has given no indication that it will institute anything other than flat rate billing for all its residential customers, an alternative to the flat rate must be instituted. Ideally, a time-of-day structure would be implemented; however, given the implementation costs associated with such a programme, it will be necessary to use existing induction-style meters for the foreseeable future.

In light of the above, the UARB should require NSPI to replace its existing flat rate billing structure with an inverted block rate billing structure. In doing so, NSPI will have the ability to generate price signals and address the issue of cross-subsidization. It will also offer an incentive for those who want to consume less since the price per kilowatt-hour falls as consumption decreases. Similarly, it will offer a disincentive for those who want to consume more, since the price per kilowatt-hour increases as consumption increases.

Allowing NSPI to maintain its present rate structure will send the wrong signal to Nova Scotians. It will show that the UARB is unwilling to help set Nova Scotia on the first step towards energy sustainability, since the inverted block rate is a logical precursor to more advanced billing structures such as time-of-day billing. The UARB will also be ignoring the plight of many low- and fixed-income Nova Scotians who will be adversely affected by NSPI's proposed 10.22 percent Domestic Service Tariff increase.

The attached report contains the details of the research described in this letter.

Additional copies of the report can be obtained from:

www.dal.ca/~lhughes2/environment/nspi_ibr/report.pdf