REFERENCE: LE Evidence, page 1.

Issue/Sub-Issue: Rate Design

Quote: Leading Edge Projects Inc. (Leading Edge) favours the objectives of the rate design Option A put forward by Yukon Energy Corporation (Yukon Energy) and the Yukon Electrical Company Ltd. (YECL), (together the Companies or the Utilities).

QUESTION:

(a) Would the position of LE change if the Board determines there is a need for changes to the Cost of Service Study (COSS)?

(b) Does LE accept the COSS as filed by YEC/YECL?

ANSWER:

(a) Should the Board determine that there is a need for changes to the COSS, Leading Edge would advocate changing the Block 1 energy rate. Should changes be such that the Block 1 energy rate have to increase above 12 cents per kWh, Leading Edge would advocate changing all three block rates so as to maintain a differential of about 4 cents per kWh.

(b) Leading Edge accepts most of the COSS but disagrees with the proposed new allocation of the Aishihik and Mayo Hydro plant costs entirely to energy. Leading Edge believes that the allocation should remain at 60% to energy and 40% to demand as it has been in the past.

REFERENCE: LE Evidence, page 1.

Issue/Sub-Issue: Rate Design Criteria

Quote: However, it is our view that with the use of some adjustment to the proposed rates the same objectives would be better achieved.

QUESTION:

(a) Compare and contrast the LE rate design criteria with the criteria proposed by YEC/YECL.

ANSWER:

(a) YEC and YECL list the same objectives to be balanced in determining just and reasonable rates (2009 Phase II Rate Application page 4YEC-12, and page 4YECL-7). Leading Edge does not have a differing view on these objectives. However, despite having the same stated objectives the Utilities come to very different conclusions.

YEC states: "Overall, it is concluded that incremental cost of diesel generation needs to be addressed (see section 4.3) and reflected to a material degree in rates for higher levels of use, even if not today reflected in full." (2009 Phase II Rate Application page 4YEC-21).

YECL states: "Yukon Electrical's proposed approach is based on introducing a small adjustment to rates at this time and will be in a more reasonable position to address the full optimal level of incremental costs in rates when inter-class rebalancing is allowed and when incremental costs from diesel generating sources in the hydro zone are playing an increasingly prominent role in the setting of electric rates".

There appears to be an additional underlying unstated objective that YEC takes into account that YECL does not. That objective is related to considering the impacts of the termination of the Interim Electrical Rebate (IER). In response to LE-YEC/YECL-1-15 YEC states in part "It is relevant to the Board and intervenors to understand the potential impacts on bills of the Phase II rate changes being implemented concurrently with any termination of IER". Leading Edge has stated explicitly that minimization of the impact on residential non-government bills should the IER be terminated is one of its objectives.

Leading Edge generally supports the conclusions of YEC rather than YECL for two main reasons. First is that in addition to the necessity to reflect the incremental costs of diesel generation, rates should also reflect the actual cost of new hydro generation which, in the short term, is not materially different from incremental diesel in cost. Absent the capital grants from the federal and Yukon governments (Yukon through YDC) the energy from the Mayo B hydro plant would have been in the same order of magnitude as diesel generation. The ratepayers will see only costs similar to the "heritage" depreciated hydro facilities, but in reality an increasing percentage of energy supply is of higher cost. The Mayo B supply of 30GWh or more will make up about 7% of the generation on the consolidated system. (The 2009 generation is about 392.2 GWh – 2009 Phase II application page 2-5).

The second reason is that decisions on space heating systems for homes and other buildings are based on present rates, yet their impact occurs over the following 20 or more years and the retrofit installation of alternative space heating systems are very expensive. Furthermore, space heating loads have a capacity factor of about 31.6% (see response to CW-LE-1-1(l)) with the peak loads occurring during the coldest weather. It is well known that our electrical loads already peak in winter, so electric space heating adds materially to the winter peaks and adds nothing to the summer loads. This electric space heating load is very difficult to service cost effectively with longer term lower cost hydro generation. This is due to its low load factor and because this load is non-existent in summer when our hydro supplies are high and this load is highest in winter when hydro supplies are at low levels. It is thus necessary, in Leading Edge's opinion, to be forward looking. A generation or more of ratepayers will benefit or pay for the decisions we make now.

The only difference between Leading Edge and Yukon Energy is in the matter of setting runoff rates. Yukon Energy's Option A proposes a Block 1 energy rate of $0.1090, a Block 2 rate of $0.1522 per kWh and a Block 3 rate of $0.2239 per kWh. The proposed Block 3 rate is higher than Leading Edge is comfortable with, and believes that the Block 1 and 2 rates should be somewhat higher. Note that rate schedule 1460 applicable to Old Crow has a Leading Edge proposed runoff rate of $0.40, and is excluded from this discussion.

The proposed Block 3 rate is about $0.095 per kWh (or about 74%) higher than the present runoff rate with Riders J and R included ($0.2239 - $0.1285), which is a very large increase at one time. In YEC's 2008-2009 General Rate Application when fuel prices were in the range of $1.15 per litre (YEC 2008-2009 GRA page 2-12) Yukon Energy was suggesting that an appropriate first step was to increase hydro zone residential runoff rates by 40 to50% to $0.20 to $0.22 per kWh. Given that the GRA approved fuel price for YEC is $0.96 in Whitehorse and $0.992 in Faro, and that present fuel prices are in the order of $0.85 per litre, the proposal for runoff rates is comparatively higher than requested in the GRA and seems higher than necessary. It is acknowledged that the adjustment in runoff rates requested by YEC in their recent (Phase I) GRA was unsuccessful in favour of a joint YEC/YECL Phase II GRA.

With the IER in place only customers who have bills for consumption in excess of 1500kWh would see an increase in their bill (Appendix 4.1A YEC, Table A4.4 page 4.1A-4). Monthly bills for consumption in excess of 3000kWh per month would see increases of about 40% or more. Leading Edge's proposed example rate for Block 2 is $0.16 per kWh rather than $0.1522 and customers who have bills of about 1300kWh per month or more would see an increase in their bills. Monthly bills for consumption in excess of 3000kWh per month would see increases of about 31.3% or more with Leading Edge's proposed example rate for Block 3.

In summary the only difference between YEC and Leading Edge is that Leading Edge is of the view that sending a much stronger rate "signal" to a relatively small number of customers is less desirable than sending somewhat less strong signal to a larger number of customers. In Leading Edge's view a larger energy saving is likely to result from a large number of customers taking conservation action than a very small number of customers taking conservation action. It is Leading Edge's view that a runoff rate of $0.20 per kWh rather than $0.2239 would be equally effective in discouraging electric space heat installations in new homes. Since YEC and YECL are to submit DSM plans with their next GRA, sending the appropriate signals to as many customers as possible will also increase participation rates in the proposed DSM programming.

REFERENCE: LE Evidence, Page 1.

Issue/Sub-Issue: Rate Design Criteria

QUESTION:

(a) Has LE relied on any studies with respect to the elasticity of demand for electricity? That is, for a given % increase in the energy price (cents/kW.h) there is a given % decrease in the volume (kW.h) of electrical energy consumed?

(b) For each of the Residential-Non Government rate classes, how were the pricing points for each energy block determined?

ANSWER:

(a) Leading Edge has not relied on any particular studies in choosing the example rates presented in its evidence. However, there was relevant information presented at or following the public workshop that the Utilities held in Whitehorse (in preparation for their 2009 Phase II Rate Application preparation process) on December 15, 2009 that Leading Edge is aware of (in addition to the common sense knowledge that price does affect consumption), that informs Leading Edge's decisions.

The first is a graph presented by the Utilities that compares the annual use per residential customer (UPC) in various utilities across the north over a period of about 15 years. This graph can be found in the upper left corner of page 43 of 262 (PDF) of Appendix 7.1 to the Utilities 2009 Phase II Rate Application (a copy of graph is found in Attachment 1) and in the accompanying notes on pages 75-79/262 of the same Appendix 7.1. This graph shows that in 1994 (the first year on the graph) Yellowknife (Northland utilities - NUY) UPC was about 10,300kWh compared to about 10,800kWh for YECL (mainly Whitehorse) a difference of about 500kWh per year (all numbers interpolated from the graph). The consumption for both communities trended down to about 2002 when the UPC in both communities was a little over 9,000kWh per year with YECL remaining slightly higher.

Since 2002 YECL UPC has trended up to a forecast of about 10,000kWh per year in 2009 whereas Yellowknife has trended down to a 2009 forecast of about 8,200kWh per year, a difference of about 1,800kWh per year. Leading Edge understands that there were significant cost increases for Yellowknife residential customers in or about 2002 to 2004. The present energy rate (all energy appears to be charged at the same rate) with all Riders in is in the order of $0.228 per kWh. Leading Edge does not have enough detailed information available to perform meaningful detailed analyses on the trend shown but the relationship between energy price and consumption is very suggestive. If Yukon's UPC could be reduced to about 500kWh per year above the Yellowknife forecasted 2009 UPC of about

8,200kWh per year, the savings to the grid in incremental generation would be over 18GWh per year.

The second is a graph prepared by the US Energy Information Administration and presented in its ***Annual Energy Outlook 2010.*** This graph was part of Leading Edge's submission to the Utilities (dated January 14, 2010) and all parties participating in the December 2009 workshop and is Attachment 2 to this response. This graph along with the first and last pages of the entire presentation is found on pages 235-237 (PDF) of Appendix 7.1 of the 2009 Phase II Rate Application, and the discussion that references this graph is found on pages 221-222. This content of this graph clearly indicates that higher prices are part of the reason that overall growth in electricity use is continuing to slow. While there is not enough detailed information available to make any definitive comments about price elasticity generally or in specific customer classes, the acknowledgement of price elasticity is implicit.

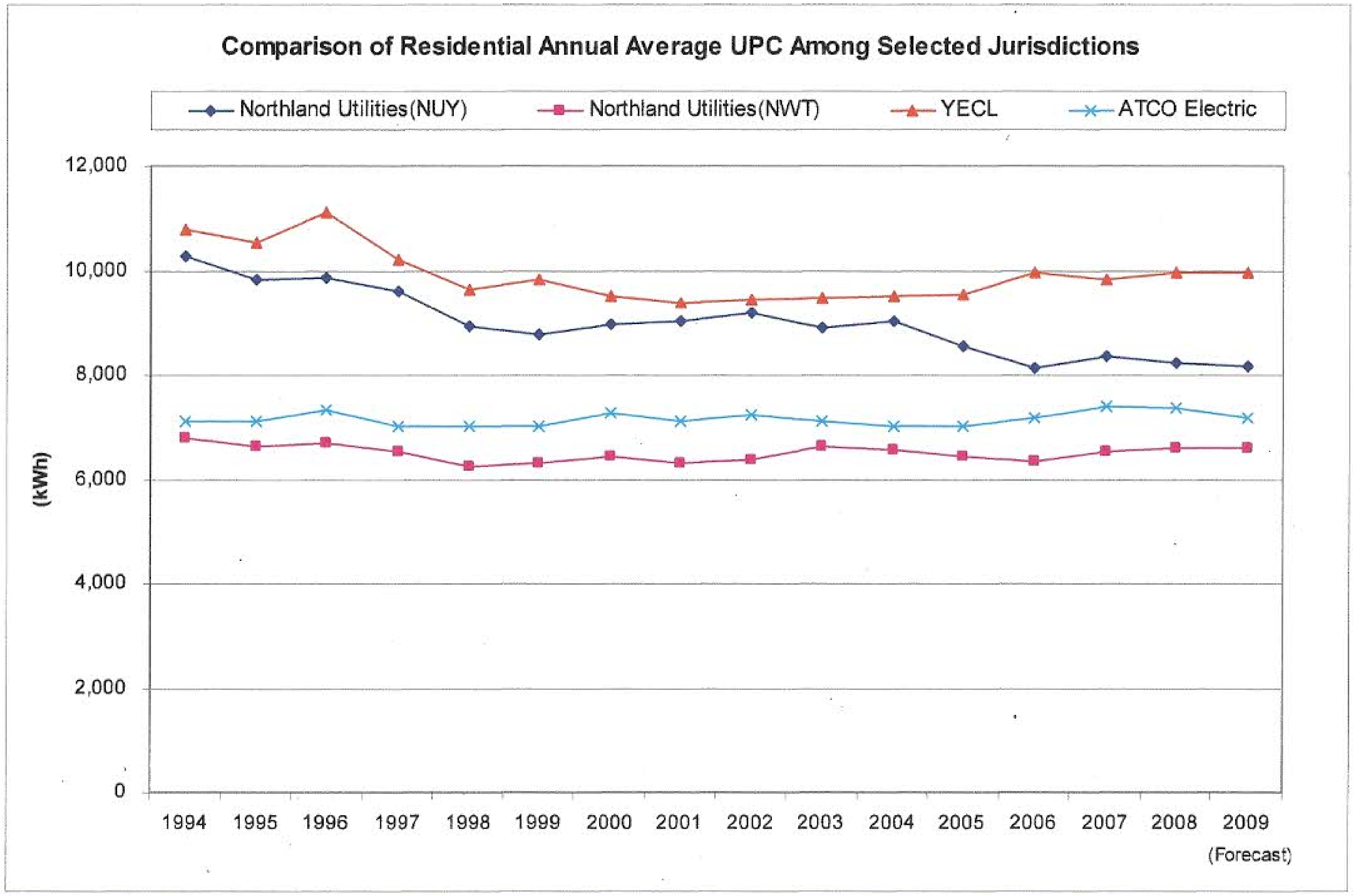
The third is a January 2010 C.D. Howe Institute Backgrounder entitled ***The Price Isn't Right: The Need for Reform in Consumer Electricity Pricing.*** This document came to Leading Edge's attention following its submission to the Utilities, but when received was sent to all parties (January 26, 2010) participating in the workshop process and is Attachment 3 to this response. Again this is not a study into price elasticity but it clearly argues for the need to use electricity pricing to elicit consumer response in electricity use and time of use for everyone's long term benefit, and presents some elasticity response data.

(b) Leading Edge selected its example Residential Non-Government pricing points by personal judgment. Leading Edge considered a Residential Non-Government runoff rate of $0.20 per kWh (Block 3) to be as high as it was comfortable with at this time, for rate schedules 1160, 1260, and 1360. To treat Old Crow equitably a rate of $0.40 was selected (schedule 1460).

The Block 2 example rate ($0.16 per kWh) was selected on the basis of a reasonable differential with Block 3 but still higher than YEC's Block 2 to provide a stronger price signal to the customers consuming between 1000 and 1500kWh per month, and also to minimize the impact on Block 1 rates. The Block 1 rate was then adjusted to provide the balance of the revenue required from the Residential Non-Government rate class.

The intent of the example Residential Non-Government rates provided by Leading Edge was to show that YEC's objectives, with which Leading Edge was general in agreement, could be better achieved (in Leading Edge's opinion) by providing a stronger rate signal to the Block 2 consumers without being as hard on the block 3 electricity consumers. Between YECL's Option B and YEC's Option A there is a vast middle ground which went, apparently, unexplored.

Load Analysis - Residential Use/cust over time vs other utilities



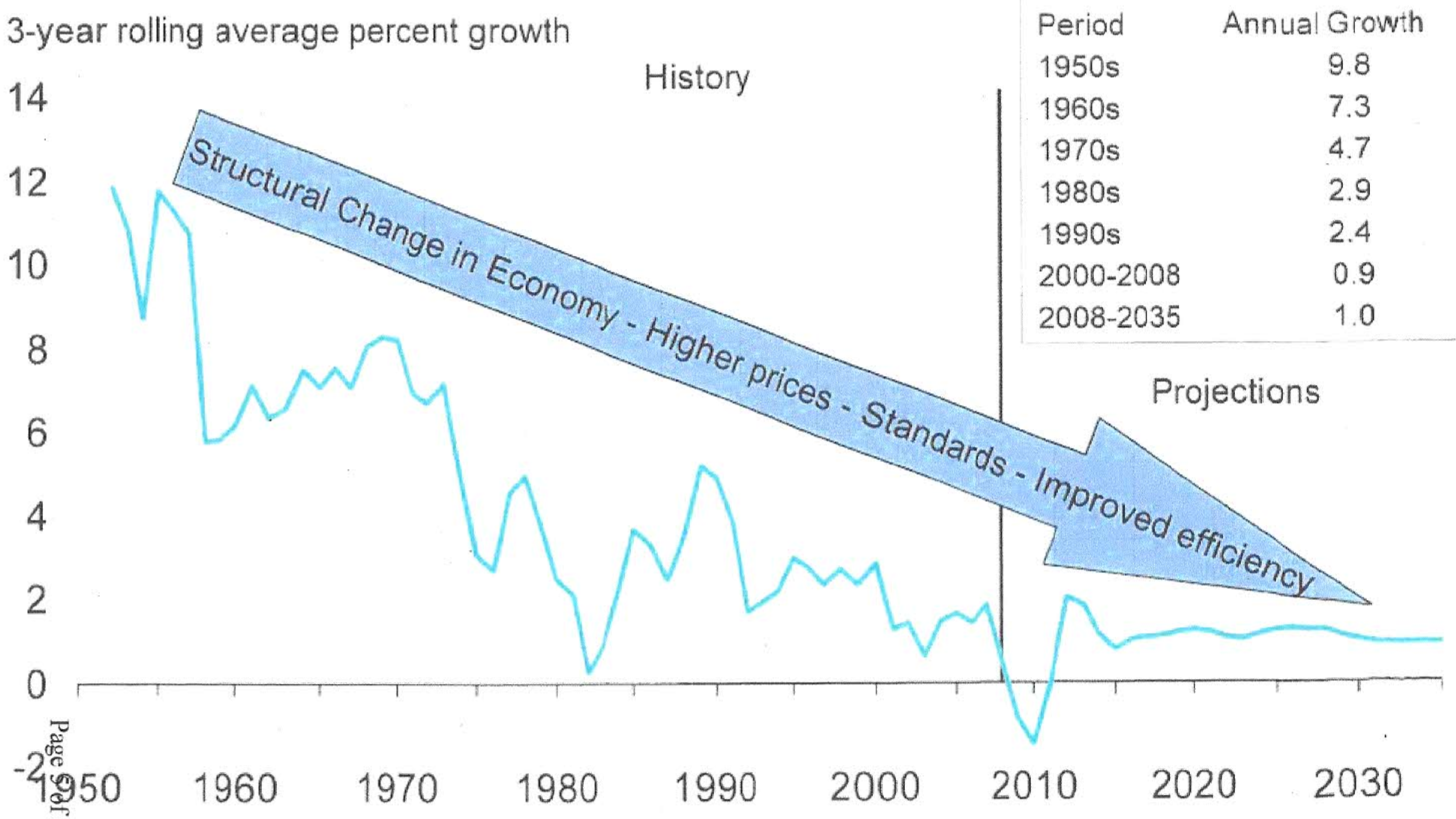
Annual Energy Outlook 2010
Reference Case

The Paul H. Nitze School of Advanced International Studies
December 14, 2009
Washington, DC

Richard Newell, Administrator

U.S. Energy Information Administration
Independent Statistics and Analysis
www.eia.doe.gov/

Growth in electricity use continues to slow



Period	Annual Growth
1950s	9.8
1960s	7.3
1970s	4.7
1980s	2.9
1990s	2.4
2000-2008	0.9
2008-2035	1.0

Source: *Annual Energy Outlook 2010*

For more information

U.S. Energy Information Administration home page	**www.eia.gov**
Short-Term Energy Outlook	**www.eia.gov/emeu/steo/pub/contents.html**
Annual Energy Outlook	**www.eia.gov/oiaf/aeo/index.html**
International Energy Outlook	**www.eia.gov/oiaf/ieo/index.html**
Monthly Energy Review	**www.eia.gov/emeu/mer/contents.html**

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No. 124, January 2010

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BACKGROUNDER

ECONOMIC GROWTH AND INNOVATION

The Price Isn't Right:

The Need for Reform in Consumer Electricity Pricing

Donald N. Dewees

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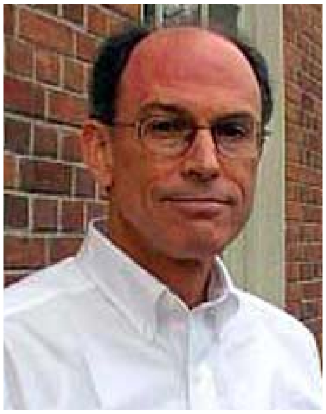
In this issue...

Ontario should introduce a pricing scheme that fully links the consumer price to peak-period generation costs, environmental costs and the high cost of new generation, reducing both financial and electrical stress on the system.



The Author of This Issue

Donald N. Dewees
is a Professor in the Department of Economics and Faculty of Law, University of Toronto.

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$12.00

ISBN 978-0-88806-796-8
ISSN 0824-8001 (print);
ISSN 1703-0765 (online)

The Study in Brief

Electricity pricing has created political problems for many Canadian provinces. Most provinces have relied on flat rates and price-freezes for electricity that may be politically expedient in the near term but have led to over-consumption, pollution, fiscal stress and excess pressures on the generation system.

This *Backgrounder* argues that Ontario should implement a pricing scheme that encourages conservation by consumers, reduces strain on the generation system, and covers the cost of operation. Such a pricing plan would equate the hourly cost of electricity generation, including the environmental cost, with what consumers pay, known as real-time pricing. Ontario is moving in this direction, but should go further by fully linking the cost of operation in periods of high strain on the generation system with the price paid by consumers.

One of the major hurdles to implementing time-of-use pricing is measuring individual customer use in multi-unit residential buildings. This can be addressed, however, with regulations that guide condo owners and rental landlords toward decisions that reap the economic benefits, when justified, of installing smart meters.

Ontario has historically been a battleground of competing principles of electricity pricing that at varying times have stressed consumer protection, economic efficiency, environmental goals, fairness amongst consumers, subsidies to favoured industries and revenue collection, amongst other goals. How Ontario balances these competing priorities will be an important determinant of the performance of its electrical system. Other Canadian provinces with similar price programs can learn from the examples Ontario has – and can – set.

About the Institute

The *C.D. Howe Institute* is a leading independent, economic and social policy research institution. The Institute promotes sound policies in these fields for all Canadians through its research and communications. Its nationwide activities include regular policy roundtables and presentations by policy staff in major regional centres, as well as before parliamentary committees. The Institute's individual and corporate members are drawn from business, universities and the professions across the country.

INDEPENDENT • REASONED • RELEVANT

Electricity pricing has created political problems for many Canadian provincial governments. This is especially true in the province of Ontario, where governments have vacillated between different consumer electricity-pricing models, motivated at times by principles and at other times by political expedience.

Prices affect behaviour and the price of electricity (apart from transmission and distribution) should be set with that behaviour in mind, not just to satisfy short-term political demands. Despite recent increases, the price level in Ontario is still too low, leaving the province ill-prepared to meet the rising cost of supplies from new facilities that will be required in coming years. This *Backgrounder* endorses introducing time-varying pricing for all small consumers and recommends increasing prices to reflect environmental costs and expensive new generation. Policies for the provision of consumer information and appliance controls should complement these pricing changes.

A pricing system that equates consumer costs with the actual cost of production would encourage consumers to conserve electricity at all times – especially peak times – reduce the strain on the generation and transmission systems and reduce the fiscal cost of the electricity system. All of these gains follow from applying the principle of economically efficient pricing.

Electricity Pricing in Ontario and the Rest of Canada

The long-standing principle that Ontario prices must cover costs was abandoned when consumer complaints about price increases in the early 1990s led the government to limit wholesale prices in 1993. After the province opened a competitive market in May 2002, consumer complaints about a tripling of average monthly prices from May to September led the government to cap prices at 4.3 cents/kWh in November 2002, crippling the market (Dewees, 2009).

Just as important as price levels, however, is the structure of prices. Today, the standard pricing for small and medium consumers of electricity in Ontario, who represent 40 percent of total consumption, is the Regulated Price Plan (RPP) which has a mildly increasing block rate – the first 600 kWh/month (summer) cost 5.7 cents per kWh and the remainder cost 6.6 cents (Table 1). In May 2009, Ontario's Minister of Energy and Infrastructure at the time, George Smitherman, announced that within two years 3.6 million Ontario customers would be on Time-of-Use (TOU) pricing with low prices at night and higher prices during mid-peak and peak weekday times (Ontario, MEI, 2009). The rollout of smart meters across the province will facilitate more TOU pricing and more sophisticated real-time pricing where the price can vary every hour or less.

Cities in British Columbia, Manitoba and Quebec also have increasing block prices. New Brunswick and PEI have declining block prices: the first block of electricity carries a relatively high price per kWh, while usage beyond this block brings a lower price. This structure was intended to cover the fixed costs of serving each customer and to encourage electricity consumption. Saskatchewan, Nova Scotia and Newfoundland and Labrador have flat prices. Alberta's Regulated Rate Option varies monthly with market prices (Table 2).

Principles

Most electricity systems and regulators try to balance multiple pricing goals or principles including: economic efficiency, revenue adequacy, fairness, transparency, demands for special treatment and political acceptability. Economically efficient pricing means pricing that maximizes the welfare of all Canadians, both consumers and producers, with many of the latter being government-owned. Efficient pricing requires that the marginal price of electricity equal the marginal cost of generation. Efficient prices communicate to consumers the costs that their incremental consumption causes and to producers the value of their output. The marginal price is the price of the last kWh of power that the consumer chooses to consume. The

I would like to thank Trevor Tombe for his research assistance on this project.

Table 1: Ontario Residential Pricing: Summer 2009, RPP and TOU plus CPP Example

Price Plan	Hours	Price (¢/kWh)	Comment
Regulated Price Plan (RPP)	First 600 kWh/month: Remaining kWh:	5.7 6.6	Most Ontario customers
Time-of-Use			Growing rapidly
Off-peak	Weekdays: 10 p.m.-7 a.m., weekends: all day	4.2	
Mid-peak	Weekdays: 7 a.m. to 11 a.m., 5 p.m. to 10 p.m.	7.6	
Peak	Weekdays: 11 a.m. to 5 p.m.	9.1	
Critical Peak Pricing (CPP)	Time-of-Use prices, except: CPP on up to 9 selected days: 2 p.m. to 8 p.m.	30	Hypothetical example. Off-peak price would be reduced to compensate.

Sources: Dewees (2009); various sources.

Table 2: Selected Canadian Residential Electricity Rates

Location	Fixed Charges (dollars)	Low Rate (¢/kWh)	High Rate (¢/kWh)	Threshold (kWh/month)	Comment
Vancouver BC	3.84	5.91	8.27	1350	
Calgary AB	15.65		10.01		RRO[c]
Medicine Hat AB	6.65		11.53		RRO
Edmonton AB	17.93		8.07		RRO
Regina SK	15.31	9.38	9.38		
Saskatoon SK	15.31	9.38	9.38		
Winnipeg MB	6.85	6.25	6.30	900	
Englehart ON	20.78	5.60	6.50	1000 W[a], 600 S[b]	RPP[d]
Kenora ON	14.78	5.60	6.50	1000 W, 600 S	RPP
Toronto ON	17.75	5.60	6.50	1000 W, 600 S	RPP
Montreal QC	12.36	5.40	7.33	30 (per day)	
Moncton NB	19.73	9.69	9.22	1300	
Saint John NB	19.73	9.69	9.22	1300	
Halifax NS	10.83	11.80	11.80		
Charlottetown PE	24.57	11.78	9.14	2000	
St. John's NL	15.56	9.63	9.63		

Notes: *a* Winter. *b* Summer.
c Regulated Rate Option (Alberta): The monthly price is a blend of the spot price and long-term prices. The spot price proportion is 80 percent in July 2009 and will be 100 percent in July 2010.
d Regulated Price Plan (Ontario).

Sources: National Energy Board (2009), Manitoba Hydro (2009), BC Hydro (2009).

marginal cost is the cost of generating that last kWh of power. In the middle of the night when only baseload units are running, the short-run marginal cost may be only a few cents per kWh. On a hot summer afternoon when peaking plants are running, the short-run marginal cost may be 10 cents or more per kWh.

Marginal cost pricing is efficient because consumers respond to price by using less power if prices are high and more if prices are low. If marginal generation costs 10 cents/kWh and customers only pay 5 cents, they will use some power that is worth less to them than the cost of production. Why would we produce something at a cost of 10 cents when the customer only values it at 5 cents? We make ourselves worse off. On the other hand, if the price is 10 cents and off-peak generation costs 5 cents or less, consumers will fail to use some power that is worth more to them than the cost of production. Setting price equal to marginal cost gives both consumers and producers the right incentive.

This marginal cost is not just the operating cost of generation; it should include the value of any pollution damage caused by the marginal generation unit(s). The cost of generation for a fossil-fuelled unit discharging air pollutants and carbon dioxide should include the harm from that discharge. This harm could be valued at 1 cent to 10 cents/kWh depending on the type of fossil generation and our value of CO_2 (Dewees, 2008). Including pollution damage in the price of electricity will discourage generation from polluting sources and discourage consumption that requires dirty generation. It will also indicate how much we should spend for electricity from non-polluting sources. We do not fully include pollution damage in electricity prices today because Ontario does not rely primarily on cap-and-trade emission allowances or pollution taxes to control fossil emissions.[1] Electricity prices would increase if Ontario adopted those policies on a more comprehensive basis and continued to burn fossil fuels.

Efficient pricing also requires that customers face the long-run marginal cost of production; that is, the cost of power from new plants that are required to meet today's demands. While the economic downturn that began in 2008 has substantially reduced electricity demand, that demand will likely rebound with the economic recovery. Moreover, aging nuclear plants will soon require refurbishment or replacement, so even without substantial demand growth we will need substantial investment in generation. This is important since new generation in Ontario, whether powered by natural gas, wind, solar or nuclear, is much more expensive than the low-cost power from our massive hydro-electric facilities.[2] Peak-period electricity prices must increase to pay for new peak capacity and all electricity prices must increase to pay for new baseload capacity.

A second pricing principle is that revenues collected must, on average, cover all system costs. This is the central goal of traditional rate regulation and is no less important in a mixed competitive system. Ontario violates this principle whenever system costs exceed revenue, thus increasing the debt or tax burden associated with the system.

A third principle is fairness among customers. To the extent possible, customers should pay for the costs that they impose on the system. We should avoid compelling one set of customers to pay for the consumption of others. Off-peak consumers should not have to pay for peak-period capacity and generation.

A fourth pricing principle is simplicity and transparency. Consumers should be able to understand their electricity bill and how changing their consumption would affect that bill. Most consumers do not want to think much about their electricity use or to track real-time prices. Most do not know how much they consume at any time and thus cannot compare fixed-price plans with time-varying pricing. Some, however, are willing to give up control over some appliances, as evidenced by the modest success of plans, such as Toronto Hydro's Peaksaver program, that give a discount in exchange for utility control over the operating times of hot-water heaters and air conditioning.

1 Ontario has an emission reduction trading system for controlling nitrogen oxides and sulphur dioxide but not greenhouse gases. Coal emissions are being reduced by directives to close coal-fired power plants, not by emission caps.

2 The Ontario Power Authority (2007) estimates the "levelized" cost of new gas generation at 7 cents to 10 cents/kWh and nuclear at a low 6 cents that seems to ignore the history of cost over-runs and delays associated with nuclear power. Moody's Investor Services (2008, p. 15) expects nuclear power to cost over 15 cents/kWh (US) when it comes on line late in the next decade. Hydropower from Quebec or Labrador will cost at least the average export price of 9 cents (OCAA, 2009, p. 9).

Finally, electricity pricing should achieve some degree of customer satisfaction. Unhappy customers may demand government intervention that is unpredictable. Electricity pricing exists within a political system and can be influenced by pressure on that system as we saw in 1993 and 2002. Ontario is more vulnerable than most US states to political interference because so much of the system is owned by crown or municipal corporations rather than by investors as in the US. The increasing block rates used in several provinces have the advantage of imposing higher prices at the margin but reducing the consumer's bill with the low initial rate. This reduces customer resistance to the higher marginal rate. TOU rates may also incorporate increasing block rates within each time period to offset the effect on consumers of high marginal cost with bills that are not too high. These principles do not all lead to the same results, so some balancing is necessary to implement them.

Practice

Ontario's current electricity pricing system for small consumers compares poorly against the efficiency goal. Most small consumers are on the Regulated Price Plan with no time variation in price to reflect the widely time-varying marginal cost of generation.[3] Constant prices do not communicate to consumers the costs that their consumption causes. "Smart" meters record consumption every hour or less of the day so the price could change hourly or more frequently. As smart meters are installed, some local distribution utilities are offering TOU pricing with peak, mid-peak and off-peak prices (Table 1) but the current penetration, while growing, is still small and TOU pricing is a weak approximation of the actual minute-by-minute marginal cost. Also, the electricity price does not include environmental externalities that might increase the wholesale price substantially, perhaps doubling it at times (RWDI, 2005). Ontario does not attract new generation by relying on the wholesale market price or a "capacity market" that pays a bonus to generators that are needed especially for peak periods. Instead, the Ontario Power Authority (OPA), which is responsible for ensuring adequate long-term supply of electricity, contracts for new power and the price of that power is averaged with the low price of existing facilities. The resulting average price is not nearly as high as the cost per kWh of many new facilities being planned or built.

Ontario's pursuit of the other principles is mixed. The increase in average price for small consumers from 4.3 cents in 2002 to around the 6-cent level today moves toward a price that covers system costs, although the price still does not reflect all costs. Fairness and efficiency are poor because small customers, whose use of electricity is high during peak periods when supply is expensive, pay the same price as those whose use is concentrated in off-peak periods. The latter are compelled to subsidise the former. This inequity will be reduced by the spread of TOU pricing and by the implementation of new pricing guidelines that allocate more new capacity costs to the peak period (OEB, 2009a, p. 28). Transparency is good because the pricing is simple. Consumer satisfaction seems good despite inevitable calls for cheaper power from some consumers.

Substantial problems loom over the current pricing system. When the system is stressed and marginal cost is high, small consumers do not face that high price so they have little incentive to cut consumption and save capacity costs. We are building expensive renewable generation and will build much more under Ontario's *Green Energy and Green Economy Act,* 2009.[4] Yet this high long-run marginal cost is averaged in with low-cost legacy hydroelectric power so it is invisible to consumers. New nuclear plants will most likely cost much more than the current system's average cost, but that cost will be blended with cheap Niagara power. This is inefficient and unfair. If the marginal price was higher, at all times, consumers would use less and some capacity expansion would be avoided.

Pricing Importance and Effect

The short-run price elasticity of residential demand for electricity is generally around -0.3, (EPRI, 2008, p. 20) meaning that a 10 percent increase in price will reduce demand by 3 percent. Substantial demand reductions imply unpopular price increases. Yet it is very difficult

3 The Independent Electricity System Operator (IESO), which is responsible for day-to-day operations of Ontario's electricity system, posts hourly prices on its website: http://www.ieso.ca/imoweb/marketdata/marketToday.asp .

4 Bill 150, Royal Assent received May 14th, 2009.

to reduce demand without increasing prices – many consumers are not attentive to conservation if power is cheap. Moreover, improving appliance efficiency without raising electricity prices leads to a 'rebound' effect in which consumers use the appliances more intensively, offsetting some or all of the expected conservation (Sorrell, 2007, 2010). Years of experience with conservation programs show that, without higher prices, little is achieved (Jaccard, 2007, pp. 79-99). Fortunately, the long-run elasticity after several years is greater, perhaps as large as -0.9, because consumers learn to adapt and to purchase more appropriate appliances.[5] We need to increase overall prices to reduce baseload demand and the need for costly new baseload generation.

In addition, time-based pricing using smart meters can encourage consumers to shift their consumption from peak to off-peak periods.[6] TOU pricing in which the peak price is twice the off-peak price can reduce peak demand by 3 percent to 6 percent (Faruqui and Sergici, 2009, p. 36). An alternative is real-time pricing, which can expose customers to short price peaks that are many times the average price, reducing peak demand by 10 percent (Spees and Lave, 2008).

Critical Peak Pricing (CPP) can achieve substantially greater reductions in peak demand than TOU alone. With CPP the customer pays a standard fixed price or a TOU price most of the time but is exposed to a critical peak price on a limited number of days per year when generation reserves are low. When a reserve problem is anticipated, the operator declares that the next day will be a critical peak day and the price during a specified critical peak period will be much higher than usual (Wolak, 2006, OEB, 2007). (See Table 1.) While many customers will not fiddle with their consumption on a daily basis, they will make adjustments on selected days to reduce peak consumption substantially. A survey of CPP trials found that TOU plus CPP with a critical peak price about five times the usual price reduced peak consumption among residential customers by 13 percent to 20 percent with an average of 17 percent (Faruqui and Sergici, 2009, p. 43). Critical peak reductions in Ontario pilot studies reached 25 percent in summer (OEB, 2007, p. 37). Limiting the number of critical peak days limits the resulting bill volatility. While TOU is better than flat prices, TOU plus CPP is better still.

Peak consumption can also be reduced by devices that turn off major appliances such as air conditioners or hot water heaters for a specified time during the usual peak or that cycle them on and off to reduce average consumption during that specified time.[7] Even providing consumers with real-time consumption information can lead to reduced consumption.[8] With increasing sophistication of both control and communication technology the potential for active control of more appliances is growing. For these control programs to be popular, however, the price of electricity must be substantial and the peak price must be high enough so that the customer expects significant savings from this control.

The Economics of Smart Meters, Apartment and Condo Sub-metering

The capital, operating, communication and administration costs for smart meters in single-family homes generally add about $1/month compared to the cost of the standard kWh meter.[9] This additional amount is much less than the customer electricity savings of over $4/month found with TOU pricing in the Smart Pricing Pilot conducted by the Ontario Energy Board, the regulator (OEB 2007). Some of the electricity savings represent electricity waste that the customer was not aware of until the meter change but some represents a sacrifice of comfort or utility. As a result, the net customer benefit may seem less than $4. However, since electricity is under-priced by at least 50 percent at peak times, the social savings from conservation and peak reduction are valued at much more than $1/month. The replacement of kWh meters with smart meters for residential customers seems to be economically justified (see the Cost-Benefit box for details).

5 See EPRI (2008, p. 20) for a survey and synthesis of many empirical studies.

6 See, e.g., Mountain (2010), Faruqui and George (2005).

7 For example, the Toronto Hydro Peaksaver program reduces usage for up to four hours on weekday afternoons.

8 Mountain (2010.) Faruqui, Sergici and Sharif (2009) survey the literature and find savings from information devices ranging from 3 to 13 percent.

9 The OEB has approved additions of $1/month for Toronto Hydro, $1.15 for Ottawa Hydro, $0.93 for Hydro Networks, and $0.47 for Festival Hydro.

Box: Cost-Benefit Analysis of Single-Family TOU Pricing.

In the Ontario Energy Board (OEB) Smart Price pilot involving single-family homes, the average monthly consumption was 775 kWh prior to implementation and 727 afterwards. On average, 23 percent was consumed during peak hours and, if peak conservation is proportional to total conservation, that would represent a monthly demand reduction during peak hours of 10kWh. If the true cost of peak power is at least 10 cents/kWh, $1 would be saved in generation costs. The lost consumer satisfaction would be roughly the change in quantity multiplied by the average between the flat price (5.7 cents) and the TOU price (10 cents), or 7.85 cents, leaving a net gain of $0.22 ($1 minus 78.5 cents). In the off-peak period, the price would be less than 5.7 cents, the consumer would use more electricity and would have more satisfaction and less cost, adding to the net gain from TOU pricing. This confirms that not only has the customer saved money, but is also better off after accounting for losses and gains in satisfaction.

Multi-unit residential buildings that are bulk-metered represent both a special opportunity and a challenge for better pricing. Twenty-six percent of Ontario residents live in multi-unit buildings[10] and between 75 to 90 percent of these buildings have bulk-metering[11] so about 7 percent of Ontario's electricity is bulk-metered. Substantial reductions in overall consumption and in peak consumption can be achieved by converting multi-unit apartment and condominium buildings from bulk-metering to sub-metering with individual smart meters for each unit. Installing individual smart meters with TOU pricing for each unit can reduce total electricity consumption by 12 to 20 percent and up to 30 percent in electrically heated buildings.[12] Peak electricity use typically declines less than overall use, often by around 10 percent.[13]

However, the cost of installing sub-metering and the savings that can be achieved depend on the design of the building. At one extreme is a building with large units, with electric heat, hot water, laundry appliances, stove, and air conditioning in each unit and with separate wiring for each unit. All of the energy used in a unit can be captured by a sub-meter. Here the cost of installing a sub-meter for each unit should be modest and the opportunities for energy conservation and peak reduction are substantial, so on average savings should exceed costs.[14] Still some units, such as corner units with extensive exterior exposure, may experience higher costs than with bulk-metering.

At the other extreme is a building with central heating and air conditioning, central hot water, communal laundry facilities and small units. Here the opportunities for energy conservation and peak reduction that can be induced by sub-metering are limited to careful use of lighting and appliances such as the stove and home entertainment systems. The benefits of sub-metering are small. If the building has electric heating wired collectively for several adjacent small units, sub-metering would require expensive re-wiring, which would likely be uneconomic. Even with electric heat, in a rental building the landlord determines the exterior insulation so the tenant has little control over heating and cooling costs.

One problem is that the cost of managing customer accounts and bills for each unit, rather than for the building as a whole, appears substantial. While studies of sub-metering suggest that the energy cost reductions arising from conservation behaviour greatly exceed the

10 Statistics Canada, Income Statistics Division, Cansim, table 203-0019 and Catalogue no. 62F0026MIE.

11 Federation of Rental Housing Providers of Ontario testimony and Stratacon, Inc. testimony to the Ontario Standing Committee (2006); Toronto, 2008, p. 2.

12 The Oakville Pilot Study found reductions of 14 percent to 33 percent in overall kWh usage in three buildings from smart sub-metering. Park Properties reported a 33 percent electricity reduction from smart sub-metering of 2,500 suites. New York State found reductions of 12 percent to 20 percent in overall kWh usage with simple sub-metering (NYSERDA, 2001).

13 The Oakville Pilot Study found a 10 percent reduction in peak electricity use from replacing bulk-metering with TOU.

14 The New York State study found net benefits to residents of $2 to $4 per month including reduced electricity costs. The Oakville Pilot and OEB Smart Pricing Pilot suggest net savings of $3 to $6 per unit per month after deducting meter costs up to $1 per month.

cost of installing and maintaining the meters, those studies ignore the fixed customer charge imposed by distribution utilities. Toronto Hydro's fixed customer charge is about $17/month[15] while competitive meter service providers generally charge between $10 and $20.[16] Such charges exceed the average sub-metering savings from reduced consumption found in most studies. If these charges truly reflect the cost of serving one more customer by a local distributor or a sub-metering company then sub-metering appears uneconomic. Under-pricing of electricity makes it hard to assess sub-metering, but if we double the price of peak electricity to reflect pollution and high capacity costs the net customer benefits may still be negative. The cost of metering, billing and servicing an account would have to be well under $10/month to make sub-metering economic in many buildings.

Policymakers must determine in which types of buildings the benefits are most likely to exceed the costs, considering the true value of electricity. The 2006 *Residential Tenancies Act*[17] proposed to allow landlords to unilaterally install sub-meters but required them to reduce rents to compensate for the elimination of 'free' hydro. Landlords were concerned about the required rent reduction, especially if they had to compensate tenants for the new monthly customer charges. To ensure that all costs are weighed by the landlord and to avoid uneconomic sub-metering, sub-metering should remain at the discretion of the building owner and landlords should be required to reduce rents in the amount of past electricity costs plus the monthly customer charges that tenants will have to pay to the electricity distributor. A recent Ontario Energy Board decision (OEB, 2009b) illustrates the difficulty of making this work in practice, so more rules may be required.

In Ontario, legal barriers in the past made it difficult to sub-meter existing condo buildings. Condominium buildings were required to amend their "declaration" (essentially a constitution), which required 80 percent owner approval, an impossibly high barrier.[18] Recent regulations have eliminated the requirement to amend the "declaration" facilitating sub-metering when the condominium board wants to proceed.

Smart meters and TOU pricing benefit those whose load is concentrated in the off-peak and those who can reduce their peak consumption. On the other hand, it will raise costs for those who consume more during the peak and who cannot or will not respond. It has been suggested that many small businesses cannot cut their peak consumption – the restaurant has to cook meals when people want to eat and stores cannot turn off the lights during the afternoon peak (Andrew, 2009). An Ontario study found that residents of seniors' housing and affordable housing responded very little to peak pricing and thus found their bills unchanged or increased with TOU pricing (Simmons and Rowlands, 2007). While some individuals and groups may not respond in the short run to TOU pricing, it is plausible that over a longer time period technology and methods of response could be developed that would assist these groups to reduce their costs. In the short run, there will be losers from any change in pricing. However, abandoning TOU pricing to avoid imposing costs on these groups throws out the baby with the bathwater. We should instead look for compensation outside the electricity system for groups whose bills would rise substantially from the proposed pricing, who are proven to be unable to respond and who deserve public support.

Where Do We Go From Here?

Ontario's plan to apply TOU pricing to 3.6 million customers in Ontario by June 2011 was followed by a Toronto Hydro announcement that most single-family Toronto households would be on TOU by mid-2010.[19] This is a good start. I recommend going a few steps further.

15 Toronto Hydro, Draft Rate Order (April, 2009). Schedule 7, Tariff of Rates and Charges.

16 For example, Stratacon quotes a monthly administrative charge of $11 per unit for one sub-metering installation. Stratacon, 2009, "Sub-metering – the Masaryktown Experience," http://www.stratacon.ca/node/138. The Enbridge fixed charge is $12.55/month. http://www.enbridgeelectric.com/EEC/BillComponents.aspx .

17 Bill 109, *Residential Tenancies Act*, 2006, section 137.

18 If 25 percent of the owners used much more electricity than the average they would have a strong incentive to vote against the amendment rather than pay for their actual usage.

19 *Toronto Star,* 14 May, 2009, "Toronto set for time-of-day use power pricing."

First, time-of-use pricing should be the default or standard regulated service for all customers with a smart meter. Success will not come from voluntary TOU programs that will be rejected by those we most want involved – those with peak loads coinciding with the system peak.[20] The Minister's announcement was not clear that TOU pricing would be mandatory. It must be mandatory to gain maximum effect. In multi-unit residential buildings smart sub-metering should be voluntary except where it is clear that the likely benefits justify the costs. The TOU rates can also incorporate an increasing block price to limit increases in the overall cost of electricity for small users.

Second, critical peak pricing (CPP) should be added to TOU pricing as the regulated standard service. TOU plus CPP is much more effective than TOU alone (OEB, 2007, p. 37). Greatly increasing the price on a small number of critical peak days would further reduce peak demand on days when demand threatens to exceed supply. This would give every consumer an incentive to reduce peak demand vigorously on critical days, saving capacity expansion costs. Because most generation, transmission and distribution in Canada is still government-owned, we have more flexibility to adopt such a sophisticated standard supply than most US states with investor-owned utilities. If the administration of CPP requires time-consuming changes to meter data systems and/or billing systems as suggested by Ontario Energy Board (OEB) staff, this could be postponed to allow those changes, but it should be clear that CPP is to be a central part of the new standard pricing system. This is consistent with the recommendation of the OEB staff (OEB, 2008, p. 15). Furthermore, customers who prefer real-time pricing, paying the spot price every hour, should have that option.

Third, the price for all consumers should be increased to include the costs of environmental damage. This could be achieved by using a cap-and-trade system to control air pollution and either a similar system or a carbon tax for greenhouse gas emissions. The price of carbon dioxide emissions must be substantial, reflecting the urgency of the problem. This would force generators to include the price of allowances or the carbon tax in their bids, thus building it into the time-varying Ontario market price. However, the emissions trading must be applied to all sectors of the economy to avoid creating incentives to shift from using electricity that embodies the price of pollution to burning fossil fuels directly. Until these systems come into play, a TOU system with high peak prices can limit the demand for electricity when polluting fossil units are most likely to operate.

The price should also reflect long-run marginal costs, the cost of new generation units. If new generators are paid more than 10 cents, consumers should pay more than 10 cents for peak consumption. Since peak-period demand determines system capacity, peak users should pay the full costs of peaking capacity. This argues for further increases in the peak and mid-peak prices in the TOU system. The May 2009 TOU prices (Table 1) have a peak price only 2.16 times the off-peak price. The OEB's 2009 revision to its pricing manual shifts more costs to peak periods but not necessarily enough. At the same time, off-peak demand will contribute to the need for new baseload generation so off-peak prices should reflect the cost of this generation.

As we move to time-varying pricing for all consumers of regulated supply, we should also help them to control their usage. Appliance control programs offered by the local distribution utility would be a first step. Providing consumers with information about their consumption helps them to control that consumption. Provincial ministries should actively promote such programs. However, these programs are supplements, not substitutes for realistic pricing.

Finally, the public needs to understand why we are changing prices. Ontario's competitive market failed politically in 2002 in part because the public was poorly informed about what was happening and why. If we want to improve retail pricing in Canada, we need an effective public information program. If we want to adopt prices that reflect environmental harm, expensive new capacity and peak costs, we must explain to consumers why this is good for all of us. Selling this message is perhaps the greatest challenge to efficient electricity pricing.

20 Voluntary TOU programs generally yield low participation rates (Faruqui and George, 2005). Even the very successful Ottawa Hydro pilot only attracted 30 percent participation. Fortunately, a majority of the Ottawa participants liked the program and said they would recommend it to their friends (OEB, 2007, p. 54).

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