CCRE Commentary

APRIL 2016

IN THIS ISSUE:

A Truly Smart Electricity Price Plan for Ontario

by Paul N. Acchione, P.Eng, M.Eng, FCAE

Council for Clean & Reliable Electricity
transforming the way we think about power

www.thinkingpower.ca

THE AUTHOR

Paul N. Acchione, P.Eng, M.Eng, FCAE

A 44-year veteran of Ontario's power generation industry, Paul N. Acchione is now a Management Consultant at Market Intelligence and Data Analysis Corporation of Toronto. In 2013/14, he was President and Chair of the Ontario Society of Professional Engineers. A licensed professional engineer in Ontario, Paul has a BASc. and M.Eng. in Mechanical Engineering from the University of Toronto. For more than three decades, he worked for Ontario Power Generation and its predecessor companies and is currently a member of OSPE's Energy Task Force and CSA Group's Advisory Council on Renewable Energy. He is also a member of ASME, ANS, IEEE and ISA and a fellow of the Canadian Academy of Engineering.

Disclaimer

The Author undertook an analysis of the present Ontario electricity price plans and developed the OSPE smart price plan as part of his volunteer responsibilities with the Ontario Society of Professional Engineers, Energy Task Force.

The Council for Clean & Reliable Electricity
The Council is a federally incorporated non-profit organization that was formed by a group of volunteers to provide a platform for open public dialogue and a solutions-oriented approach to the challenges of the energy sector. Representatives from universities, public and private sector business leaders, and labour representatives have collaborated to broaden the public debate on energy issues. The Council has organized conferences on distributed generation, biomass, coal and nuclear, as well as public sector governance in the electricity sector.

While the Council subjects all papers to independent peer review, the views expressed are those of the author and do not necessarily reflect the opinions of the reviewers, the Council or its members.

www.thinkingpower.ca

A Truly Smart Electricity Price Plan for Ontario

Paul N. Acchione, P.Eng, M.Eng, FCAE

Any smart pricing plan for electricity should make it attractive for consumers to install automated load-shifting systems that would move their electricity use toward the lowest cost and cleanest generation—and away from current supply mixes that are more expensive and more carbon intensive.[1] However, current Ontario price plans do not provide sufficient financial incentives to justify the purchase of automated load-shifting systems.

While the province's wholesale electricity market is currently sending real-time price signals that would provide sufficient incentives, a myriad of other costs, including the Global Adjustment (GA)[2] and delivery charges, do not vary with the active generator mix and, as a result, swamp the wholesale market price in the makeup of consumers' electricity bills.

"There's a better way to price electricity."

For residential and small commercial consumers, Ontario offers a time-of-use (TOU) pricing structure through so-called smart meters. Consumers, for example, receive a discount if they do their laundry in the evenings and on weekends. But Ontario's Auditor General (Auditor General, 2014) has pointed out that in spite of a significant investment in smart metering, "[TOU] pricing had a modest impact on residential ratepayers, reducing their peak demand by only about 3%, but a limited or unclear effect on small businesses, and none at all on energy conservation." Furthermore, the Auditor General concludes in the report, "The difference between the On-Peak and Off-Peak [retail] rates has not been significant enough to encourage a change in consumption patterns."

There has to be, and is, a better way to price electricity.

ONTARIO'S CURRENT PRICE PLANS

In addition to the Auditor General's criticisms, a major study by the Ontario Society of Professional Engineers (OSPE 2011, OSPE 2013, OSPE 2015) has found serious design flaws with Ontario's other electricity price plans that were designed for larger commercial and industrial consumers, as well as for consumers that purchase power directly from licensed retailers. Collectively, these plans make it economically unattractive for consumers to shift enough load in a manner that reduces supply-system production costs and minimizes carbon emissions.

The root of the problem lies with the design of the wholesale market and the associated GA mechanism. The province introduced the GA in 2005 to ensure the power system collected sufficient revenue

[1] Ontario's base-load generation (hydroelectric and nuclear) is a low-emission and low-cost source of electricity. Ontario's gas-fired plants provide peak-load electricity and also backstop the intermittent supply from wind and solar generation.

[2] Global Adjustment is a variable monthly electricity consumption charge that reflects the difference between, on the one hand, the actual contractual and regulated costs of running the electricity supply system as well as conservation programs and, on the other hand, the actual, usually cheaper, wholesale market price. In recent years, GA has covered 60 per cent to 70 per cent of production costs, with market prices covering only 30 per cent to 40 per cent.

to cover all production and conservation costs from Ontario consumers regardless of market price.[3] Ontario exports and imports electricity with adjoining power systems at the wholesale market price plus a small uplift charge. Since the wholesale price does not include the GA component, this means, perversely, that Ontario consumers cannot purchase surplus Ontario electricity at the same low prices as adjoining power systems.

In its study, OSPE undertook a detailed hour-by-hour cost analysis of a residential consumer load demand on the TOU price plan over a one-year period. The purpose of that analysis was to determine if the TOU price plan provided sufficient economic incentive for that consumer to purchase automatic load-shifting equipment to achieve a flat-load demand profile.

OSPE found a number of problems with the residential TOU price plan. It also undertook a less formal review of other price plans and found similar problems with them.

"There are problems with the residential TOU price plan."

Specifically, OSPE found:

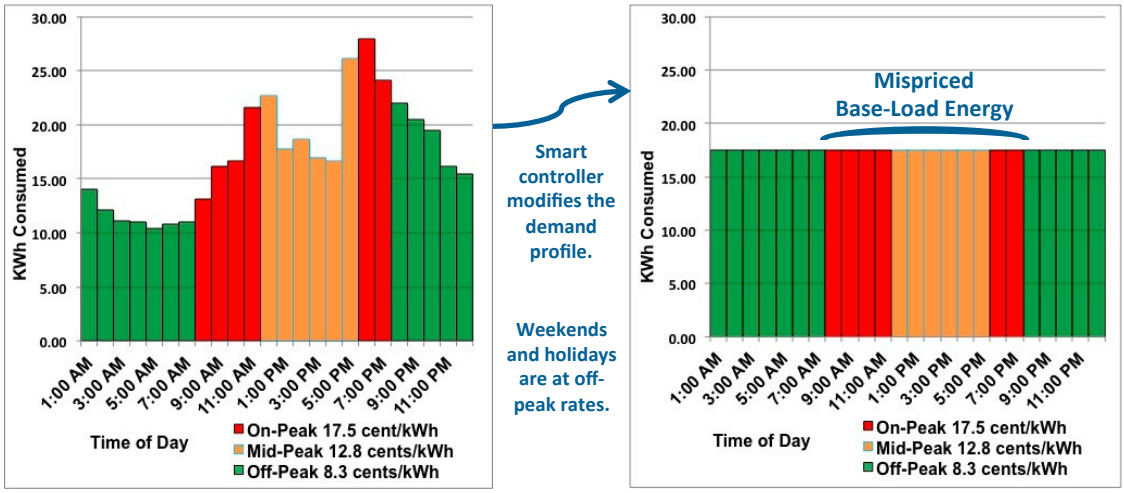
a) Increasing the ratio of on-peak to off-peak rates will not sufficiently incentivize load shifting because of fundamental design flaws in the TOU price plan.
b) None of the price plans differentiate between base-load and incremental peak-load consumption, a critical factor in the effective operation of the power system.
c) None of the price plans differentiate between dependable and intermittent supply, a critical factor in the effective utilization of the two types of generation technology.
d) All plans (except Class A large industrial) overcharge for clean base-load energy at night and grossly overcharge for clean base-load energy during the day.
e) All plans undercharge for incremental peak load energy during the day and grossly undercharge for incremental peak-load energy during the highest demand winter and summer periods, the so-called "critical peak" periods.
f) The plans do not produce enough savings for consumers who are willing to purchase new technology to create a grid-friendly demand profile.[4]

Figure 1 illustrates the design flaws described in (b), (d) and (f) above. The monthly load data on the left is actual smart meter data for a residential consumer. The load data on the right is computed using the same energy consumption but assuming the consumer has purchased load-shifting equipment to modify their beyond-the-meter demand into a grid-friendly flat profile. For this consumer, the annual savings in electricity commodity cost would be only three per cent, or about $2 per month. That is not enough to justify the equipment investment of approximately $4,000 for a typical home.

[3] Originally, generators were not guaranteed revenues through contracts or regulation so market costs alone covered all production costs. GA was introduced coincident with the introduction of price guarantees to ensure adequate levels of investment in generation and conservation.

[4] Financial incentives help pay for the technology needed to modify a consumer's typical inherent demand profile into one that is more "grid friendly."

Figure 1 *- TOU Price Plan Misprices Base-Load Energy*

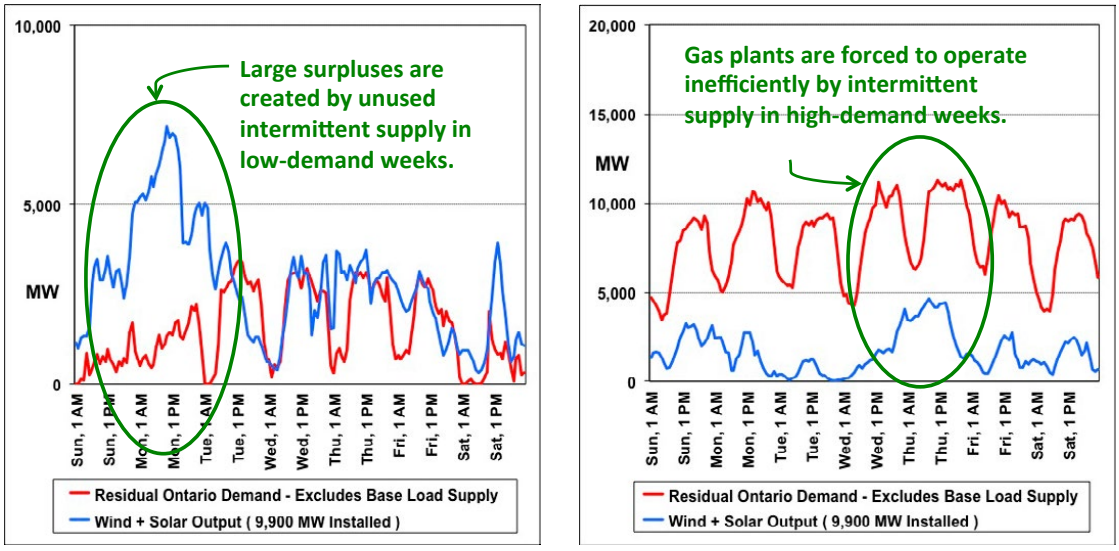


Source: Left chart - consumer smart meter data; right chart - OSPE.

"Operating rules for renewables create frequent surpluses."

Figure 2 illustrates the consequences of the design flaw described in (c) above, which does not incent intermittent energy to be used when available. OSPE projected generation data from the Independent Electricity System Operator (IESO), responsible for the day-to-day operation of Ontario's electricity system, to 2021, assuming a flat demand and planned generation capacities from the Ontario 2013 Long Term Energy Plan (Ministry of Energy, 2013). Because renewable generation is not operated in a price-sensitive fashion, the resulting electricity surplus suppresses the wholesale market price. The retail rates in this projection would not drop sufficiently to incent consumers to increase their demand. That means users would have to rely on other types of generation that, in turn, would result in higher overall carbon emissions than necessary. Furthermore, the overall supply system would be operated less economically, while surplus clean energy is exported at low prices or even curtailed (wasted).

Figure 2 *- Price Plans Do Not Incent Use of Intermittent Renewable Supply*

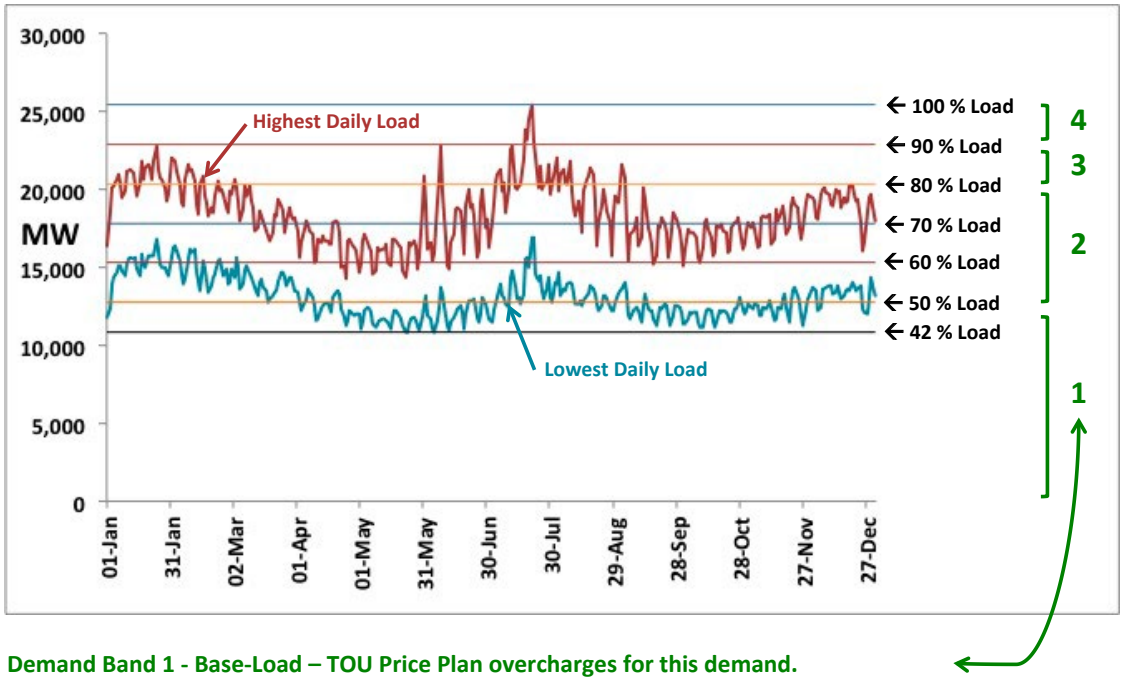


Source: IESO 2011 load data, Ministry of Energy 2013 Long Term Energy Plan capacity data and OSPE.

Figure 3 illustrates the design flaw described in (d) and (e) above related to the mispricing of electricity. The IESO load-demand data (2011) and OSPE's analysis used the average annual cost of electricity for each generation technology according to the Ontario Energy Board (OEB) in its regulated price-plan analysis (OEB, 2015). OSPE adjusted that cost data for different capacity factors in different seasons to arrive at the conclusions shown in Figure 3.

"Current price plans misprice electricity."

Figure 3 *- Current Price Plans Misprice Electricity*



Demand Band 1 - Base-Load – TOU Price Plan overcharges for this demand.
Demand Band 2 - Intermediate Load – TOU Price Plan fairly charges for this demand.
Demand Band 3 - Peak Load – TOU Price Plan grossly undercharges for this demand.
Demand Band 4 - Critical Peak Load – TOU Price Plan grossly undercharges for this demand.

Source: IESO, OECD, OSPE.

A SMART ELECTRICITY PRICE PLAN

Ontario's existing smart metering system has one major positive—it is a key enabler of a smart pricing plan. However, to be effective in modifying consumer load demand, it needs to be integrated with an energy storage and control system so that the load response is automatic and does not require constant attention by the consumer. The smart pricing plan should also reward consumers for installing this automated equipment with a lower electricity bill. The marketplace will then incent consumers to select the most cost-effective technologies and load-shifting schemes.

A smart price plan should make it attractive for consumers to:
- Use clean base-load generation 24 hours a day;
- Use clean intermittent generation when it is available; and
- Use surplus clean generation to displace fossil fuel consumption.

To accomplish this, a discount is required on the use of clean electricity and a premium should be placed on the use of fossil-fuel electricity.

A truly smart price plan needs to contain features that will remove the GA and other delivery charges when surplus clean electricity is being curtailed or exported at low prices. To simplify and facilitate adoption, a stable rate for surplus electricity should be established in advance, based on historical market data. The rate should be fixed semi-annually or annually.[5] In any event, it is important not to offer discounted prices on fossil-fuelled electricity because that would encourage higher greenhouse gas emissions.

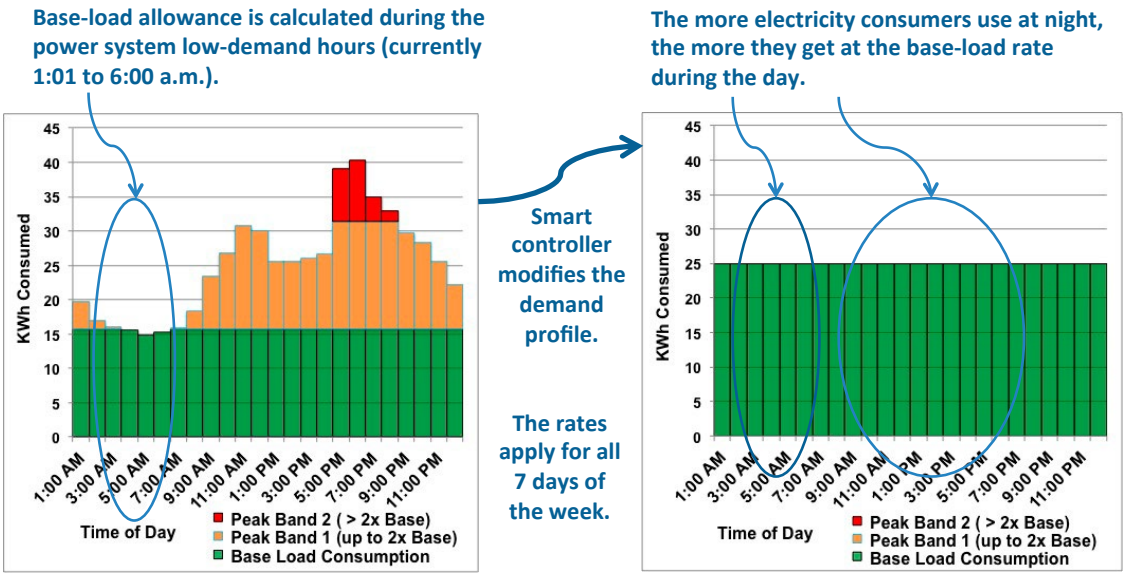
Figure 4 depicts OSPE's proposed smart electricity price plan[6] that has the following rate steps:

- five cents/kWh for consumption below the base-load allocation (the average hourly consumption from 1:01 a.m. to 6:00 a.m. during the month/billing period);
- 15 cents/kWh for consumption within Peak Band 1 (up to 2x Base Load);
- 30 cents/kWh for consumption within Peak Band 2 (above 2x Base Load);
- three cents/kWh for the surplus clean electricity that could be exported; and
- one cent/kWh for surplus clean electricity that would be curtailed.

"Remove the GA when there is surplus clean electricity."

For control purposes by the consumer's automatic equipment and for billing purposes by the Local Distribution Company, the IESO would have to provide a signal to indicate when surplus clean electricity is either being exported at low prices or curtailed (wasted). Indeed, the IESO has this information as a normal course of its power system operating responsibilities.

Figure 4 *- OSPE Smart Price Plan*



Source: Left chart – consumer smart meter data; right chart – OSPE.

[5] This forecasted rate could be established, administered and reconciled against actual costs in the same way as the Regulated Price Plans currently used by most residential and small commercial consumers (Ontario Energy Board, 2015).

[6] The surplus and export aspects are not illustrated in Figure 4.

The smart price plan should also be voluntary. This will not only help garner public support but will ensure people who cannot afford to invest in load-shifting systems will not be forced to accept a plan that could increase their bills if their peak consumption is higher than the average consumer.

The OSPE analysis calculated a potential 46-per-cent, or $26 monthly, reduction in commodity charges for this residential consumer under its smart-price plan. That consumer would also see additional savings if he/she also used surplus clean electricity when available to displace fossil fuel use. Savings of this magnitude are sufficient to incent consumers to purchase the $4,000 of automatic technology that would improve grid performance and reduce greenhouse gas emissions.

If a similarly designed smart pricing plan were introduced for large industrial consumers, it would complement the cap-and-trade system that Ontario plans to introduce. Larger emitters could sell unused carbon emission certificates if they displace their fossil fuel consumption using surplus clean electricity.

"Incent consumers to adopt a grid-friendly load profile."

CONCLUSION

A smart electricity price plan can successfully incent consumers who subscribe to the plan to adopt a grid-friendly load profile. This would lower electricity production costs, reduce greenhouse gas emissions and reduce the amount of surplus clean electricity that is presently exported at low prices or curtailed (wasted).

REFERENCES

Auditor General of Ontario. 2014. Annual Report. Available at: http://www.auditor.on.ca/en/content/annualreports/arbyyear/ar2014.html

Ontario Energy Board. 2015. "Regulated Price Plan (RPP)." November. Available at: http://www.ontarioenergyboard.ca/oeb/industry/regulatory+proceedings/policy+initiatives+and+consultations/regulated+price+plan

Ontario Ministry of Energy. 2013. "Achieving Balance: Ontario's Long Term Energy Plan." December Available at: http://www.energy.gov.on.ca/en/ltep

Ontario Society of Professional Engineers. 2011. Letter to Ontario Energy Board re file EB-2010-0364 Time of Use rates. March 9. Available at: http://c.ymcdn.com/sites/www.ospe.on.ca/resource/resmgr/doc_advocacy/2011_sub_9mar_tou.pdf

Ontario Society of Professional Engineers. 2013. Letter to Ontario Ministry of Energy re file EBR 001-9490 Long Term Energy Plan. September 13. Available at: http://c.ymcdn.com/sites/www.ospe.on.ca/resource/resmgr/doc_advocacy/2013-09-16_ospe_ltep_submiss.pdf

Ontario Society of Professional Engineers. 2015. "A Smart Grid Electricity Price Plan." June. Available at: http://c.ymcdn.com/sites/www.ospe.on.ca/resource/resmgr/DOC_advocacy/2013_DOC_Energy_SmartGrid.pdf

Organisation of Economic Development. 2010. "Projected Costs of Generating Electricity – 2010 Edition." International Energy Agency and Nuclear Energy Agency. Available at: https://www.iea.org/publications/freepublications/publication/projected_costs.pdf