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# Preliminary Cost Benefit Analysis: Reducing the 10-minute synchronized OR requirement Operating Reserve Initiative 2

Brian Rivard  
Manager, Economics  
Market Evolution, Analysis and Research  
June 07, 2007



- IESO is advocating that a cost-benefit analysis (CBA) accompany future market rule amendments expected to have a material impact on market outcomes and market efficiency
- Preliminary CBA of market rule amendment proposal MR-00332-R00 (10-minute spin)
  - a “test case” for illustrating how IESO apply CBA to future proposed market rule amendments
- Purpose of presentation:
  - Seek comment with respect to:
    - (i) substance and findings of this particular CBA; and
    - (ii) format and presentation of CBA as a possible template for future CBAs.
- Note, current draft provides outline of CBA analysis but only rough approximation of cost/benefits

- Apply Kaldor-Hicks criterion
  - change is approved if the gains to ‘winners’ exceed the losses to ‘losers’, such that the change creates benefits that are sufficiently large to offset the losses
- Steps applied:
  - Project impact of change on key variable (quantities consumed and produced, and prices)
    - Projection needs to factor in how participants may respond to change
  - Compute costs/benefits to all affected participants
    - Use concept of consumer/producer surplus
  - Compare aggregate cost and benefits of affected individuals
    - If aggregate net benefits exceed cost then compare present value of aggregate net benefit to any implementation costs incurred

- Changes to NPCC's Regional Reserve Sharing program (RRS) allow participating areas to reduce their non-synchronized (10n) and/or synchronized (10s) OR by a total of 100 MW when the associated energy is available and deliverable.
- Proposed market rule amendment MR-00332-R00 would allow the IESO to reduce its synchronized ten-minute OR requirement by 100 MW

*Table 1: Reserve requirements assuming a first and second largest contingency of 1000MW\**

<b>Reserve Class</b>	<b>Prior to RRS</b>	<b>Status quo (100 MW RRS reduction in 10n)</b>	<b>MR-00332: 100 MW RRS reduction in 10s</b>
<b>10-min (total)</b>	$10s + 10n \geq 1000 \text{ MW}$	$10s + 10n \geq 900 \text{ MW}$	$10s + 10n \geq 900 \text{ MW}$
<b>10-min spin</b>	$10s \geq 25\% \times 1000 = 250 \text{ MW}$	$10s \geq 25\% \times 1000 = 250 \text{ MW}$	$10s \geq (25\% \times 1000) - 100 = 150 \text{ MW}$
<b>Total Reserve</b>	$10s + 10n + 30n \geq 1500 \text{ MW}$	$10s + 10n + 30n \geq 1400 \text{ MW}$	$10s + 10n + 30n \geq 1400 \text{ MW}$

\*30n requirement is equal to 50% of the second largest contingency

- Enhance productive efficiency
  - sharing of OR among jurisdictions within NPCC allows each jurisdiction to reduce their requirements because the major contingencies each jurisdiction faces are independent events or, in other words, uncorrelated
    - Each jurisdiction can maintain a lower level of OR with no significant decrease in reliability
  - MR-00332-R00 will allow Ontario to schedule up to 100 MW less of more costly 10s and meet 10-minute reserve with 100 Mw of less costly 10n
    - The province's demand can be met with less costly resources while maintaining an acceptable level of reliability.
    - Again, this change comes at little or no cost in terms of reliability as the reliability benefit of this quantity of 10s is sourced from other jurisdictions.

# Productive Efficiency Example

Reserve Type	Amount Scheduled Prior to Change	Amount Scheduled After Change
10s	250MW@\$2/MWh =\$500	150MW@\$2/MWh =\$300
10n	1150MW@\$1/MWh =\$1,150	1250MW@\$1/MWh =\$1,250
30R	0 MW =\$0	0 MW =\$0
<b>Total Cost</b>	<b>\$1,650</b>	<b>\$1,550</b>

## Productive Efficiency Gain:

$$= (\text{Cost of 10S less Cost of 10n}) \times \Delta \text{MW}$$

$$= (\$2 - \$1) \times 100 \text{ MW} = \$100$$

- It is possible that a policy change that would yield a net benefit in the absence of pre-existing distortions may actually result in net losses if those distortions exist
  - Pre-existing distortion in the Ontario electricity sector is the uniform price regime and the resulting problem of inefficient exports to New York
  - 10s initiative is expected to have downward pressure on energy prices which could result in an increase in inefficient exports
- The potential for offsetting inefficiencies caused by export arbitrage or other behavioural responses should be considered in CBA

# Preliminary Simulations Ignoring Behaviour Responses

*Table 2: Average Simulated Prices Ignoring Behaviour Responses, 6-Month Period 2006*

<b>Simulation</b>	<b>10n (\$/MWh)</b>	<b>10s (\$/MWh)</b>	<b>30R (\$/MWh)</b>	<b>MCP (\$/MWh)</b>	<b>Reduction in Production Cost \$ per hour</b>
<b>Simulation 1: (Benchmark)</b>	1.19	3.19	1.17	47.82	
<b>Simulation 2: (10s initiative)</b>	1.19	1.33	1.17	47.76	87.00
<b>Price Change due to 10s initiative</b>	0.00	1.86	0.00	0.06	

- Price reduction occurs in only those hours when the 10s requirement was otherwise binding (i.e., the IESO was only scheduling 10s in the amount of 25% of the largest contingency).
  - This occurred in roughly 55% of the hours in our simulation period
- Average hourly reduction in 10s scheduled was 44MW (substitute 44MW of 10s to 10n)
- The 10s initiative leads to a reduction in the average hourly uplift paid for reserve of roughly \$495
  - amounts to a reduction of roughly \$0.03/MWh on average

- Efficiency gains that would accrue would come within the constrained schedule – the efficiencies are based on the actual change in dispatch
- The IESO does not have a constrained dispatch simulator to estimate these efficiency savings
- Approximate using Shadow prices
  - For 6 month period in 2006 covered in our simulation of the unconstrained schedule, average hourly prices for the reserve products were \$17.02 for 10n and \$21.74 for 10s
- Approximate productive efficiency gain:
  - $(\text{Cost of 10S less Cost of 10n}) \times \Delta \text{MW}$
  - $(\$21.74 - \$17.02) \times 44 \text{MW} = \$207.68$

- **Ontario Consumers:** We assume no consumer response to the price changes in Table 1;
- **Ontario Generators:** We assume no change in generator behaviour in the short term. In the medium to long term we anticipate less net investment by generators in the ability to provide 10s reserve;
- **Exporters:** Two scenarios (i) no response to price change and (ii) increase quantity of exports by average of 6 MW per hour;
- **Importers:** We assume no change in the quantity of imports

- *Scenario 1: De minimis export response:*
  - No change in the quantity of electricity consumed by Ontario consumers;
  - No change in the quantity of imports/exports or energy produced by Ontario generators;
  - An average hourly reduction in the quantity of 10s reserve schedule in the unconstrained sequence of roughly 44 MW with a corresponding increase in the amount of 10n reserve scheduled of 44 MW; the substitution of 10s for 10n will occur mainly in off-peak periods. The reduction in 10s scheduled in the constrained sequence will be larger than 44 MW;
  - A modest reduction in energy prices of \$0.06. (The impact on energy prices is a result of the joint-optimization of energy and reserve; the reduction in the 10s reserve requirement means that at times, capacity that would otherwise be used for 10s reserve is released to provide energy.)
  - A reduction in the 10s reserve price of roughly \$1.86 cents and a corresponding reduction in the average total hourly uplift of roughly \$495. No change in the 10n and 30-minute reserve prices.
  - There will be a negligible reduction in the constrained-off and constrained on payments.

- *Scenario 2: Modest export response:*
  - No change in the quantity of electricity consumed by Ontario consumers;
  - A modest increase in the quantity of exports of electricity from Ontario to surrounding jurisdictions – likely less than an average of 6 MW per hour and mainly in off-peak periods;
  - A negligible increase in the quantity of electricity produced by Ontario generators equal to the amount of any increase in exports (less than 6 MW per hour on average);
  - No change in the quantity of imports from surrounding jurisdictions;
  - A negligible decrease in energy prices – the response from exports would mitigate the initial downward pressure on the HOEP
  - An average hourly reduction in the quantity of 10s reserve schedule of roughly 44 MW with a corresponding increase in the amount of 10n reserve scheduled of roughly 44 MW- the substitution of 10s for 10n will occur mainly in off-peak periods. The reduction in 10s scheduled in the constrained sequence will be larger than 44 MW;
  - A reduction in the 10s reserve price of roughly \$1.86 cents and a corresponding reduction in the average total hourly uplift paid for reserve of roughly \$495.
  - There will be a negligible reduction in the constrained-off and constrained on payments.

# Estimated Impacts on individual's/group's welfare

## Scenario 1

Participant Class	Changes Impacting Surplus	Cost/Benefit
<b>Consumers</b>	Decrease in Energy Payment $= \$0.06 \times 16,695 \text{ MW} \times 8760 \text{ hours}$ $= \$8.77 \text{ million}$ Decrease in OR Uplift Payment $= 92.78\% \times \$495 \times 8760 \text{ hours}$ $= \$4.02 \text{ million}$	$\$12.79 \text{ Million}$ Less: GA and OPG Rebate Transfer $= -\$0.06 \times 80\% \times 17,840 \text{ MW} \times 8760$ $= -\$7.50 \text{ million}$ <b>Benefit = \$5.29 million</b>
<b>Ontario Generators</b>	Decrease in Energy Revenue $= \$0.06 \times 17,840 \text{ MW} \times 8760 \text{ hours}$ $= \$9.38 \text{ million}$ Decrease in OR Uplift Payment $= \$495 \times 8760 \text{ hours}$ $= \$4.34 \text{ million}$ Reduced Production Cost $= \$207.69 \times 8760$ $= 1.82 \text{ million}$	$\$11.90 \text{ Million}$ Less: GA and OPG Rebate Transfer $= -\$7.50 \text{ million}$ <b>Cost = \$4.40 million</b>

<b>Participant Class</b>	<b>Changes Impacting Surplus</b>	<b>Cost/Benefit</b>
<b>Exporters</b>	Decrease in Energy Payment $= \$0.06 \times 1,300 \text{MW} \times 8760 \text{hours}$ $= \$0.68 \text{ million}$ Decrease in OR Uplift Payment $= 7.22\% \times \$495 \times 8760 \text{hours}$ $= \$0.31 \text{ million}$	<b>Benefit = \$1.0 million</b>
<b>Importers</b>	Decrease in Energy Revenue $= \$0.06 \times 550 \text{MW} \times 8760 \text{hours}$ $= \$0.30 \text{ million}$	<b>Cost = \$0.30 million</b>
<b>Net Benefit/Cost</b>		<b>Benefit = \$1.60 million</b>

- Net benefit achieved approximate net efficiency gains
- Under Scenario 2, some of the efficiency gains estimated in Scenario 1 will be dissipated by the export inefficiencies.
  - The estimated inefficiency per MW of export is an average of about \$8 per MW.
  - For a change of 6 MW, the lost efficiency would be \$420,480. This lost efficiency would offset the efficiency gains from saving 10s reserve cost.
- Under scenario 2, the efficiency gains would be about \$1.60 million less \$420,480 which is roughly **\$1.18 million.**
- Welfare changes will be same in direction but smaller in magnitude

- The IESO estimates that there would be a one-time cost of approximately \$5,000 to change the software and related tools
- Annual net benefit from the 10s is estimated to be between \$1.18 and 1.59 million per year
- Using a discount factor of 5% and looking at the present value of these annual net benefits over a 10 year period, the present value net benefit is estimated to be between \$16.8 million and \$22.6 million.
- Based on preliminary approximations, CBA would indicate reason to approve MR-00332-R00