

1.0 Caveat Regarding Simulations

Simulations are not accurate representations of what the actual market results and response would be if the modelled change is made. Simulations only offer directional indications, i.e. price increase or decrease, and may be used to compare the relative impacts of various proposed changes with a reasonable amount of confidence. The results of the simulations are not intended to imply a magnitude of price changes and are not capable of incorporating price sensitive response or behavioural changes as a result of the proposed change.

For example:

The simulations for December 13 use the bids and offers submitted on that trade day with the expected conditions (weather, outages, etc) and market outcomes (pre-dispatch prices, previous hour prices, etc). If the intertie transactions are able to set the real time market clearing price it will change the expectations and behaviours of some market participants. An importer or exporter will be responding to a different set of price signals than those that actually existed on December 13 and will likely offer in a different manner in response to the different conditions. Any such changes in behaviour have not been modelled in these simulations.

2.0 Simulation Details

In order to simulate the effect of allowing intertie transactions to set the real time price the IESO ran a simulation of a number of months to provide some indication of the possible price impacts. The following months were simulated:

January 2006
April 2006
June 2006
September 2005

These months were selected in an attempt to estimate the impact of the proposed change on each of the seasons. We attempted to use the most recent data possible (Winter, Spring, Summer 2006 and fall 2005). We adopted this approach for these simulations as they are meant to provide directional guidance only and simulating each season demonstrates various possible outcomes.

When investigating the data you will find that a number of days are missing. There was a problem with the data on certain days and these were omitted from the simulation. It is not likely that the omitted days will have a large impact on the analysis.

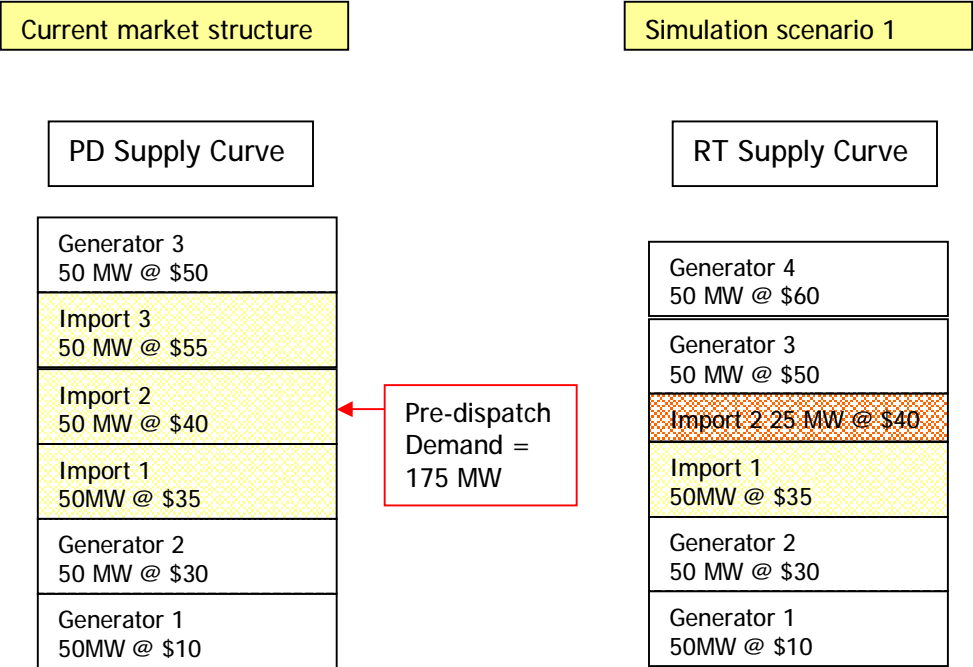
Results are included for two simulation scenarios in the accompanying excel spreadsheets.

1. Simulation of real time prices if all intertie transactions that received pre-dispatch unconstrained (or market) schedules are able to set the real time price. This methodology allows the simulation to account for transaction failures and ensures that the intertie transfer limit is not exceeded.

The unconstrained sequence of the DSO respects the intertie transfer limit when scheduling intertie transactions. Using only the bids and offers in real time that have received an unconstrained schedule ensures that those transactions that are able to set the price are physically able to be delivered to Ontario. This does not imply that the intertie is always being used to its capacity, only that the intertie transaction is capable of flowing.

When a transaction fails its unconstrained schedule quantity is reduced to zero. Not including these transactions in the simulation ensures that a bid/offer that sets price is actually capable of being delivered to Ontario.

Example 2.1: Pre-dispatch and real time offer Curve for simulation scenario 1. (note: exports are excluded from the example for demonstration purposes)



Observations about the real time stack:

- 1) Import 3 is not economic in pre-dispatch and does not receive a constrained schedule. It is removed from the real time stack.
- 2) Import 2 only has 25 MW of a 50 MW offer scheduled in pre-dispatch. 25 MW remains in the real time stack.
- 3) Import 1 stays in the stack as an inframarginal import. If real time demand is greater than 100 MW but less than 150 MW, import 1 will set the real time price.

We allowed intertie transactions that can not be delivered in real time to set the price in order to treat intertie transactions like domestic resources as closely as possible. There are situations when domestic resources are able to set the price when they can not deliver the energy. For example, bottled North West generation may set the market clearing price.

Failed transactions remain in this simulation scenario as we are including all offers. Removing failed transactions from the demand and supply stack but allowing bids and offers that are not economical to remain in the stack would be an inconsistent treatment to certain import and export transactions.

3.0 Data Description

The following data is included for each of the simulation scenarios:

C	D	E	F	G	H	I
PD Price	Actual 12X Price	Simulated 12X Price with current market structure	Simulation Scenario 1	Simulation Scenario 2	Difference (RowF-RowE)	Difference (RowG-RowE)

PD Price	Pre-Dispatch Price from actual market operations. The pre-dispatch price is included for reference purposes as this is representative of the most expensive economically successful import for the respective hour.
Actual 12X Price	The HOEP from actual market operations
Simulated 12X Price with current market structure	The simulated HOEP with the current market structure (intertie transactions are price takers in real time)

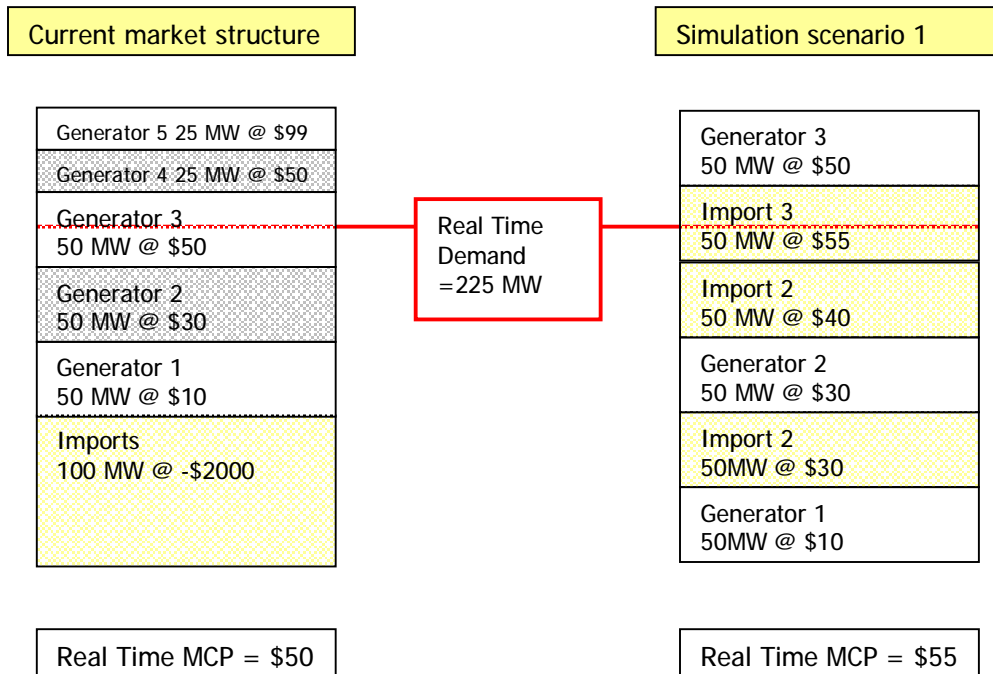
Simulation Scenario 1	The simulated HOEP when intertie transactions that have received a pre-dispatch constrained schedule are able to set the real time market clearing price
Simulation Scenario 2	The simulated HOEP when all intertie transactions are able to set the real time market clearing price
Difference (Row F - Row E)	The difference between the HOEP price with the current market structure and simulation scenario 1. Row E and Row F refer to the rows in the excel spreadsheet
Difference (Row G – Row E)	The difference between the simulated HOEP and simulation scenario 2. Row G and Row E refer to the rows in the excel spreadsheet

4.0 Simulation Results

The simulation results show that, on average, HOEP will increase under both of the two simulation scenarios. The average price increase is the result of removing the price depressing effect of placing imports in the real time supply stack at a price of -\$2000. This effect is illustrated in example 4.1.

Example 4.1: Price depressing effect of -\$2000 imports

(note: exports are omitted from this example for demonstration purposes)



Generator 5 25 MW @ \$99
Generator 4 25 MW @ \$50
Generator 3 50 MW @ \$50
Generator 2 50 MW @ \$30
Generator 1 50 MW @ \$10
Imports 100 MW @ -\$2000

Real Time MCP = \$50

Generator 3 50 MW @ \$50
Import 3 50 MW @ \$55
Import 2 50 MW @ \$40
Generator 2 50 MW @ \$30
Import 2 50MW @ \$30
Generator 1 50MW @ \$10

Real Time MCP = \$55

Real Time Demand = 225 MW

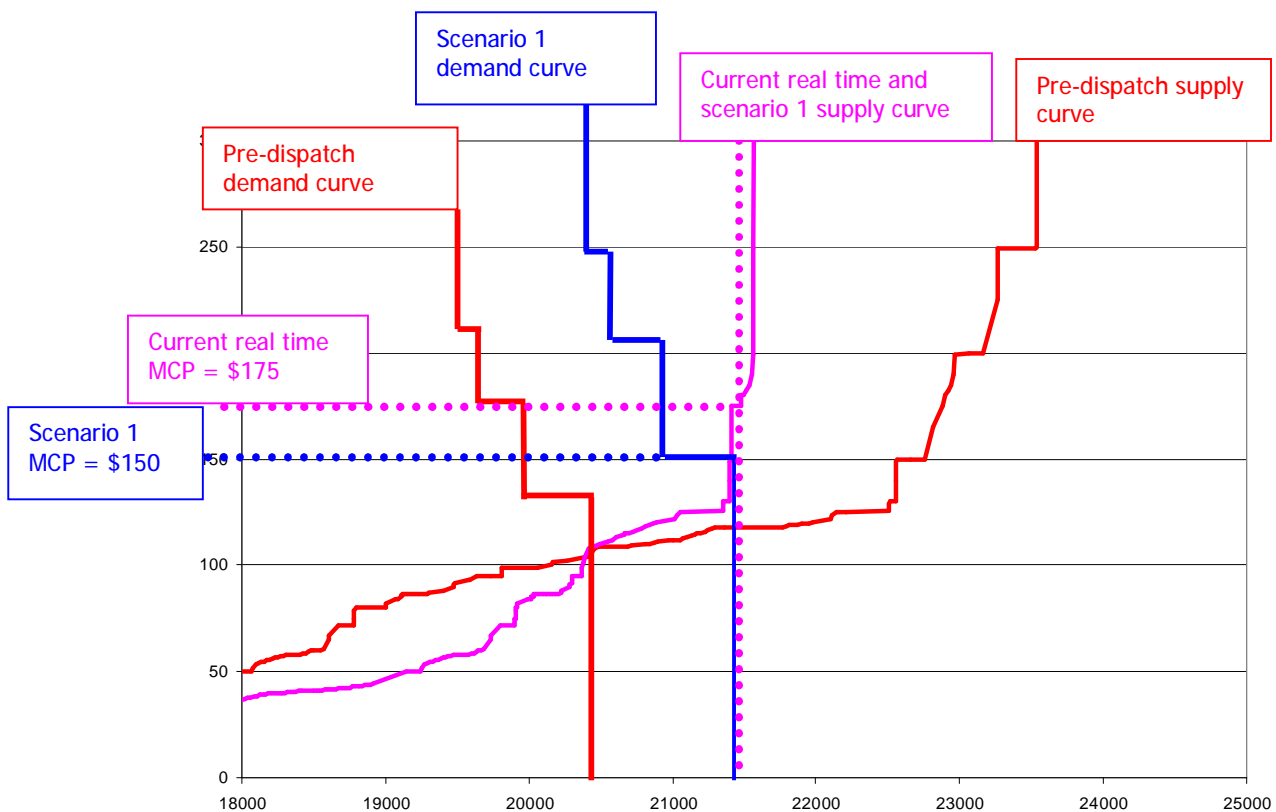
At times, the simulated price when allowing intertie transactions to set the real time price is lower than the current real time price.

In the current market structure all exports that have bid above the pre-dispatch market clearing price will be deemed economic by the DSO and will be placed at the top of the demand stack. In figure 4.2 (below) this is illustrated as the vertical pink line (the graph is truncated at \$300. In reality the vertical section extends to \$2000 and there will be flat sections for dispatchable load bids).

The portion of the supply curve beyond the pre-dispatch demand point is steeper since only domestic resources are included in this section of the curve. This is true for the current market structure and simulation scenario 1 (scenario 1 allows only scheduled intertie transactions to set the real time price). Under scenario 1, imports and exports are scheduled up to the pre-dispatch market clearing price and remain in the stack for real time, and all other transactions are removed from the real time supply stack. The supply curve for scenario 1 and the supply curve for the current market structure are identical beyond the pre-dispatch demand point; the blue supply line is omitted for clarity.

(note: one exception to this condition is generator forced outages. When a generator suffers a forced outage their offers are removed from the real time schedule but not the pre-dispatch schedule. This will tend to make the real time supply stack steeper than the pre-dispatch supply stack. This effect was omitted in the preceding discussion for clarity)

Figure 4.2: Allowing import and exports to set the price may lead to a lower real time price



When real time demand is greater than pre-dispatch demand and intertie transactions are able to set the real time price, the price will be lower than under the current market structure. Referring to figure 4.1, when the price is \$150 the market demand for scenario 1 and the current market structure is roughly the same, approximately 21, 400 MW. When price increases to \$175 the market demand from the current market structure is still 21, 400 MW. However the demand for scenario 1 when the market clearing price is \$175 is significantly less, around 21 000 MW. This is a result of allowing exports to remain in the demand stack as a price sensitive consumer. There are more exports economical at \$150, which means a higher demand, and there are fewer exports economical when the price is \$175, reducing demand and resisting upward price movement. In essence, as the price increases, export demand decreases mitigating the upward price movement.

This illustration is only done for simulation scenario 1, the result is identical with simulation scenario 2.

Figure 4.3: Summary Statistics for Entire Study Period

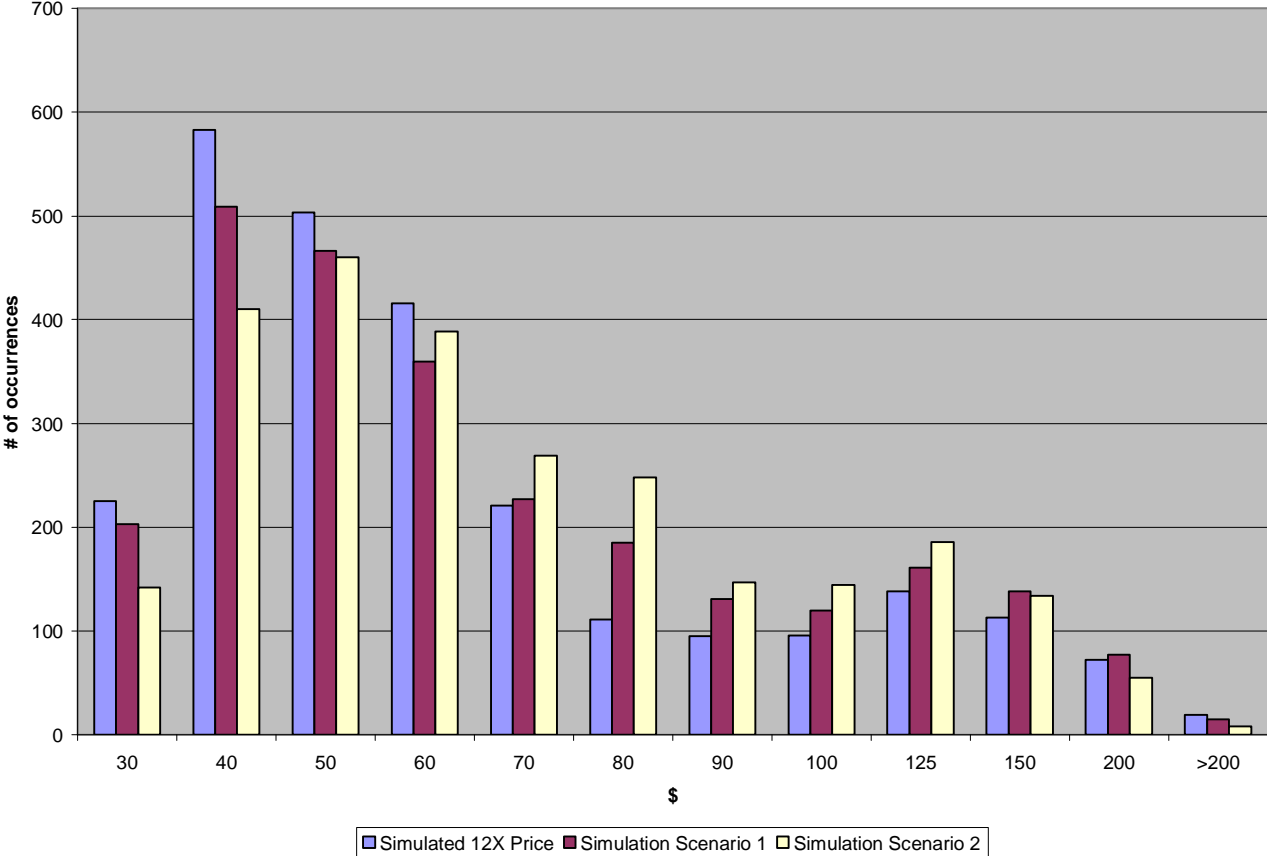
	HOEP				
	Pre-Dispatch	Simulated 12X	Actual real time	Simulation Scenario 1	Simulation Scenario 2
Min	\$4.70	\$4.52	\$4.28	\$5.11	\$13.02
Max	\$370.11	\$634.97	\$639.97	\$479.15	\$301.96
Median	\$60.00	\$49.80	\$49.81	\$52.66	\$57.04
Mean	\$69.75	\$61.17	\$61.60	\$64.91	\$66.55
Standard Deviation	\$37.38	\$38.76	\$39.64	\$39.46	\$34.00

Investigating figure 4.3 one will notice that the standard deviation for both of the simulation scenarios has decreased relative to the status quo, indicating a decrease in price volatility, albeit a moderate decrease for scenario 1. This is expected when intertie transactions remain in the supply and demand stacks in real time.

Under the current market structure import offers and export bids are removed from the real time supply stack. This creates discontinuities in the supply and offer curve. Allowing intertie transactions to remain in the real time supply stack will allow the price to move smoothly up and down through the bid and offer laminations without the jumps of the current market structure. This can be demonstrated by comparing the standard deviations of scenario 1 and scenario 2. Under scenario 1 only offers that are below the pre-dispatch clearing price remain in the real time supply stack. This reduces volatility for all real time prices below the pre-dispatch clearing price. Below the pre-dispatch

clearing price there are import and export transactions that may set the price providing greater laminations and hence greater price stability. This effect is demonstrated more clearly under scenario 2. Allowing all intertie transactions to set the real time price provides laminations throughout the curve, not limited to below the pre-dispatch clearing price.

Figure 4.4: Histogram of HOEP for simulations



5.0 Expected Market Place Response

In general, it is expected that the potential increase to the real time price will be mitigated to some extent by the actions of importers and exporters. Importers are expected to offer lower and/or more MW to capture the higher expected real time price and exporters are expected to bid lower or less MW to avoid the expected higher real time price.

The table below attempts to explain the impact of the proposed change on the various groups of stakeholders in the province

Stakeholder	Response
Consumers	<p data-bbox="451 233 1406 302">Given the current bidding behaviour of consumer market participants, no behaviour change is expected from this participant group.</p> <p data-bbox="451 348 1398 459">Periods of substantial price increase may result in reduced consumption from price-sensitive consumers that are not dispatchable loads or market participants.</p> <p data-bbox="451 506 1430 657">An increase in HOEP will tend to increase the global adjustment credit (or decrease a global adjustment debit) as generators are earning more revenue through the energy price and would need to receive less from their revenue guarantees, or would pay more due to their revenue caps.</p>
Importers	<p data-bbox="451 701 1427 894">Importers offer in expectation of the pre-dispatch constrained and unconstrained prices since it is these prices that they are scheduled on. Since the pre-dispatch methodology is not changing a substantial change in importer behaviour is not expected. Importers will still need to offer to be economically successful in pre-dispatch.</p> <p data-bbox="451 940 1406 1094">However, if generator and export offers change and alter the pre-dispatch results importers will adjust their offers to remain successful in pre-dispatch. This will likely force importers to lower their offers, or increase offered quantities, which will have a price mitigating effect.</p>
Exporters	<p data-bbox="451 1100 1430 1293">It is expected that exports will decrease in response to the expected increase in HOEP. As was recently discussed at the MPWG, with a 10% increase in HOEP an 18% reduction in the average export is anticipated. This applies downward pressure on HOEP, mitigating to some extent the expected price increase.</p> <p data-bbox="451 1339 1430 1409">The exporter response to the increase in HOEP is expected to mitigate, to an unknown extent, any price increase.</p>
Generators	<p data-bbox="451 1453 1406 1646">With the expected increase in average prices it is thought that generators will alter their offering behaviour. It is likely that generators will have an incentive, through increased prices, to start their units earlier in the day to be on line at minimum output for the periods where the higher prices are expected.</p> <p data-bbox="451 1692 1430 1877">At the end of a generators production day they may have an incentive to remain online as the earlier hour's prices may have covered their fixed start up costs and prices may be higher in this period. This will provide an incentive to generators to lower their offers near the end of their production day as their daily fixed costs have a greater potential of being satisfied.</p>

	<p>The possible increase to HOEP as a result of the proposed change will attract more imports which will decrease the reliance upon domestic generation and these competitive forces may compel generators to lower their offers if they are economically able to do so. If we assume that generators are already offering at their lowest rational price (the short run marginal cost) then a reduction in output from domestic generators is expected as imports will displace some internal generation.</p> <p>For the generators in the province who have a CES style contract with the OPA, the potential increase in revenues is mitigated by the fact that they will receive less revenue through the global adjustment mechanism as their energy market revenues would be closer to covering their monthly net revenue requirement.</p>
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6.0 Expected Impact on CMSC and IOG

IOG

IOG was designed to protect importers from the price risk of being scheduled an hour ahead and being settled on real time prices. Allowing intertie transactions to remain in the real time supply stack at their offer price and giving them the ability to set price removes the real time price risk that IOG is designed to protect them from. Allowing intertie transactions to remain in real time supply stack will allow the current CMSC regime to ensure that an import will receive their as offered costs through energy and CMSC payments. Eliminating IOG will, by necessity, eliminate the IOG offset amount as well.

Example 5.1: Import transactions and eliminating IOG payments.

If the pre-dispatch price is \$100 and an importer offers 120 MW at \$90 they will be deemed economic in pre-dispatch and receive a constraint schedule for the hour. As can be seen from the example below, the importer is receiving at least their offer price in every interval through energy and CMSC payments, eliminating the need for an IOG top up.

i	Dispatch Schedule (DQSI)	MCP	Offer Price	Market Schedule (MQSI)	Energy Market Revenue	CMSC (MQSI-DQSI)*(MCP-Offer)	Total revenue (energy + CMSC)
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1	10	\$70	\$90	0	$10 * \$70 = \700	$(0-10)*(\$70-\$90) = \$200$	\$900
2	10	\$80	\$90	0	$10 * \$80 = \800	$(0-10)*(\$80-\$90) = \$100$	\$900
3	10	\$75	\$90	0	$10 * \$75 = \750	$(0-10)*(\$75-\$90) = \$150$	\$900
4	10	\$78	\$90	0	$10 * \$78 = \780	$(0-10)*(\$78-\$90) = \$120$	\$900
5	10	\$81	\$90	0	$10 * \$81 = \810	$(0-10)*(\$81-\$90) = \$90$	\$900
6	10	\$76	\$90	0	$10 * \$76 = \760	$(0-10)*(\$76-\$90) = \$140$	\$900
7	10	\$85	\$90	0	$10 * \$85 = \850	$(0-10)*(\$85-\$90) = \$50$	\$900
8	10	\$92	\$90	10	$10 * \$92 = \920	$(10-10)*(\$92-\$90) = 0$	\$920
9	10	\$93	\$90	10	$10 * \$93 = \930	$(10-10)*(\$93-\$90) = 0$	\$930
10	10	\$92	\$90	10	$10 * \$92 = \920	$(10-10)*(\$92-\$90) = 0$	\$920
11	10	\$90	\$90	10	$10 * \$90 = \900	$(10-10)*(\$90-\$90) = 0$	\$900
12	10	\$94	\$90	10	$10 * \$94 = \940	$(10-10)*(\$94-\$90) = 0$	\$940
					\$10 006	\$850	\$10910.00

Table 5.1: IOG uplift for the simulation months

	Real Time 2005	Real Time 2006	Day Ahead 2006
January	\$4 790 657	\$2 647 035	N/A
April	\$5 278 509	\$1 375 828	N/A
June	\$5 319 142	\$2 070 068	\$348 941
September	\$7 426 260	N/A	N/A

CMSC

Eliminating IOG and replacing its function with CMSC will unilaterally increase CMSC. CMSC will likely increase by an amount greater than the reduction in IOG. IOG is an hourly top up payment, ensuring an importer is earning their as offered costs for the entire hour. The CMSC calculation is done in such a way that ensures costs are covered in every interval. Unlike IOG, profit earned in one interval is not used to compensate for losses incurred in another interval.

In recent work on the ramp rate multiplier issue it was discovered that an increase to the real time price will produce a decrease in CMSC payments. This is the result of generators receiving more revenue through energy payments as opposed to the CMSC construct. As it is expected that the proposed price increase will be mitigated to an unknown extent it is difficult to estimate how much CMSC will reduce as a result of an increase to the real time market clearing price.

Any effects of this change on CMSC for reasons other than those related to IOG are difficult to estimate. There are situations where CMSC will increase and other situations where it will decrease. Therefore, the overall net effect on CMSC is not known.