

DRAFT

June 12, 2008 revision: Added section 1 - Summary to the paper.

June 24, 2008 revision: combine Summary and Introduction; clarification of evaluation and scheduling design; clarification of CMSC implications

October 9, 2008 revision: Add update to linked wheel volumes under section 2

“Background”. Add settlement payment to section 6 “Linked Wheel Congestion Pricing Proposed Design – Settlements”.

October 20, 2008 revision: re-draft as Working Group recommendation to Technical Panel, outlining two settlement options.

November 3, 2008 revision – remove settlement payment option. Update implementation costs (section 7)

November 10, 2008 revision – incorporate solution to transfer of transactions to real-time design issue (section 5.0)

March 31, 2009 revisions - Clarify pricing used for settlements and allocation of uplifts (section 5). Clarify that recommendation, although in four parts, is really one recommendation (sections 3, 4, 5, 6). Include benefits analysis (sections 8 and 9). Include outstanding issue (section 10).

1. Summary

A linked wheel transaction occurs when a market participants simultaneously imports electricity into Ontario and exports the same quantity out of Ontario.

This initiative began in September 2007 as a market rule amendment submission from a stakeholder in the trading sector and has since been discussed at both the Technical Panel and the Inter-Jurisdictional Trading Standing Committee (IJTSC). At the request of the Technical ~~panel~~Panel, a Working Group of inter-jurisdictional traders, with IESO support, was formed in August 2008 to develop a recommended design for the economic scheduling and dispatch of linked wheel transactions. This paper is the product of the Working Group efforts.

This paper presents the recommended design to achieve congestion pricing and economic based scheduling and dispatch of linked wheel transactions. The paper identifies how linked wheel transactions should be bid, evaluated, scheduled and settled.

The paper also identifies:

- -the IESO costs of implementation;
- a quantification of the benefits of the proposed change; and

- ~~remaining design issues that should be considered if the decision is made to move forward with the proposed congestion pricing and economic dispatch of linked wheels.~~

The treatment of linked wheel transactions is of primary concern to market participants who import and export electricity. However, if changes are made to the scheduling and dispatch of linked wheel transactions, there may be consequential changes to market prices and uplift charges paid by Ontario consumers.

More detailed can be found on the stakeholder engagement page at http://www.ieso.ca/imoweb/consult/consult_se45.asp

2. **Background**

A wheeling through transaction is a simultaneous import of energy into Ontario and export of energy from Ontario by a market participant (i.e. the market participant moves energy from one neighbouring jurisdiction, through the Ontario grid and into another neighbouring jurisdiction).

The linked wheeling through transaction was introduced in the Ontario market prior to market commencement to provide a means for a market participant to move energy from one jurisdiction through Ontario to another jurisdiction and ensure that the import energy is not diverted from the market participant's intended customer in the export market.

Prior to March 2008, to effect a linked wheeling through transaction, the market participant was required under the market rules to:

- Submit an import offer, priced at -MMCP (-\$2000/MW), and an export bid, priced at +MMCP (+\$2000/MW); and
- Identify the import and export as linked through the NERC tag

The IESO evaluates separately the import and export legs of a linked wheeling through transaction, but under the existing market rules, the IESO is required to schedule and dispatch the import and export (including application of constraints) such that both the import and export quantities are equal to the lower quantity that would otherwise have been scheduled and/or dispatched. Linked wheel transactions are not eligible for CMSC payments (refer to market rules Ch 9 sec 3.5.8)¹.

In September 2007, a market participant requested an amendment to the market rules to enable the "economic dispatch of linked wheels"². The market participant asserted that the

¹ Refer to market rule amendment MR-00315 published on the IESO web site at the following link: http://www.theimo.com/imoweb/pubs/mr2006/MR_00315-R00-BA.pdf

² Refer to market rule amendment submission MR-00338 published on IESO web site at the following link: <http://www.theimo.com/imoweb/pubs/mr2007/MR-00338-Q00.pdf>

current treatment exposes a market participant conducting a linked wheel to significant and unacceptable financial risk if there is congestion on the interties. The market participant cited neighbouring jurisdictions use of 'congestion pricing' as a more appropriate treatment. Under a 'congestion pricing' model, the market participant would indicate maximum price they are willing to pay for the linked wheel to flow, where that price is measured as the difference between the sink intertie zone price and the source intertie zone price. The markets in New York, PJM and MISO were cited as examples where such a 'congestion pricing' construct is used.

In consultation with the Inter-Jurisdictional Trading Standing Committee (IJTSC), the IESO implemented an 'interim' solution to address, to some extent, the financial risk issues identified by the market participant in MR-00338. The 'interim' solution was to change to the offering requirements for the import leg of the linked wheel. Market participants are now permitted to offer the import leg at any price between -50 \$/MW to -MMCP (-\$2000/MW). All other requirements and treatment are unchanged. The interim solution was implemented in March 2008.

Between January and mid-July 2008, there was a significant increase in linked wheel transactions through Ontario relative to previous years. Prior to 2008, the average volume of linked wheel transactions on a monthly basis was less than 50 GWh. For the first six months of 2008, the monthly volume of linked wheel transactions has been between 200 GWh and 1000 GWh. In mid July 2008, the NYISO changed its tariff to prohibit certain linked wheels. The effect of the NYISO tariff change was to reduce the linked wheel volume through Ontario by a factor of over 10.

In its investigation of the congestion pricing constructs used in neighbouring jurisdictions, the IESO has determined that the constructs are similar in many respects. They all allow market participants to submit single transaction offers for a linked wheel, specifying the congestion price they are willing to pay to have a specified MW level transaction flow. They all allow linked wheel transactions to be offered and scheduled day-ahead and in real-time. There are apparent differences in the requirements for linked wheels not scheduled day-ahead but offered in real-time: PJM and MISO require such linked wheels to be offered as 'price-takers', while New York does not have any offer pricing restrictions.

3. Recommended Linked Wheel Economic Dispatch Design [Part 1 - Market Participant Offers](#)

Market participants wishing to transact a linked wheel would submit a single offer for the linked wheel that would specify:

- The source boundary entity and control area³

³ Source and sink would be neighbours to Ontario i.e. New York, Michigan, Quebec, Manitoba or Minnesota

- The sink boundary entity and control area³
- The NERC transaction tag
- Two to twenty price-quantity pairs, where the price in each p-q pair indicates the maximum difference between the sink intertie zone price and the source intertie zone price that the participant is willing to pay to have the corresponding MW quantity flow as a linked wheel.

4. Recommended Linked Wheel Economic Dispatch Design [Part 2](#) – Evaluation and Scheduling in Pre-Dispatch

A linked wheel transaction bid would be evaluated in pre-dispatch as a single transaction, not as a separate import and a separate export.

Quantity 'X' of a linked wheel transaction would be scheduled in pre-dispatch when:

- Linked wheel bid price for the quantity 'X' \geq (sink pre-dispatch intertie zone [shadow price](#) *minus* source pre-dispatch intertie zone [shadow price](#)); and
- [Applicable tie line limits](#) not binding.

The linked wheel would be evaluated separately in both the pre-dispatch constrained and unconstrained sequences, so that other transactions and internal resources are appropriately scheduled in both sequences. This will also ensure that intertie congestion prices (ICPs) are determined correctly in the pre-dispatch unconstrained sequence.

Evaluation and scheduling of intertie transactions (imports, exports and linked wheels) would be done on the basis of the measured benefit of the transaction:

- Benefit of import transaction measured as "source pre-dispatch intertie zone price *minus* import offer price".
- Benefit of linked wheel transaction measured as "linked wheel bid price *minus* (sink pre-dispatch intertie zone price *minus* source pre-dispatch intertie zone price)"
- Benefit of export transaction measured as "sink pre-dispatch intertie zone price *minus* export bid price".

Linked wheel, import and export transactions, as well as internal supply and consumption, [would be](#) evaluated simultaneously and scheduled, subject to the following constraints:

- Linked wheel injection MW quantity at source equal to linked wheel withdrawal MW quantity at sink;
- Benefit of individual transaction is positive;
- Source intertie line capacity not exceeded; and
- Sink intertie line capacity not exceeded.

The linked wheel transaction quantity scheduled in the pre-dispatch constrained sequence would be subject to check-out with neighbouring jurisdiction to determine the transaction quantity that will flow.

5. **Recommended Linked Wheel Economic Dispatch Design [Part 3](#) – Scheduling in Real-Time**

The pre-dispatch constrained schedule quantity that passes check-out, is carried forward to real-time constrained sequence. The pre-dispatch unconstrained schedule quantity is carried forward to real-time unconstrained sequence. The pre-dispatch scheduled quantities would be transferred to the real-time sequences such that the linked wheel schedule is fixed for the dispatch hour, as they are under the existing market rules.

6. **Recommended Linked Wheel Economic Dispatch Design [Part 4](#) – Linked Wheel Settled on Basis of Pre-Dispatch Constrained Sequence Prices**

Energy:

Energy payment = [pre-dispatch constrained [schedule](#)-sink intertie zone [shadow](#) price *minus* pre-dispatch constrained source intertie zone [shadow](#) price] *times* real-time constrained schedule quantity⁴

Intertie Offer Guarantee (IOG):

Not eligible. There is no “offer” price in the sense contemplated for use in IOG.

Congestion Management Settlement Credit (CMSC):

Not eligible.

Design Issue—Internal Congestion and Transmission Losses Charges

The pre-dispatch constrained sequence intertie zone prices include pre-dispatch congestion on the interties, the internal (i.e. Ontario) congestion between the interties and the internal (i.e. Ontario) transmission losses between the interties. On that basis, it may not be appropriate that linked wheels be subject to uplift charges for Ontario CMSC and transmission losses as they are today. However, the existing uplift charges are determined on the basis of real-time conditions, not pre-dispatch. Is internal congestion forecasted in the pre-dispatch constrained sequence a reliable indicator of real-time internal congestion?

Other market charges:

No change from current practice. Refer to discussion above regarding the internal congestion and transmission losses design issue. Linked wheels would not be allocated the ‘socialized’ Ontario congestion or transmission losses uplift charges, as these costs are included in the pre-dispatch constrained prices used for settlements.

The Working Group, while aware of a market rule amendment request to change the allocation the market uplift charges to linked wheel transactions⁵, did not discuss the

⁴ Energy payment could be a credit if pre-dispatch constrained [schedule](#)-sink intertie zone [shadow](#) price is less than pre-dispatch constrained [schedule](#)-source intertie zone [shadow](#) price i.e. the linked wheel is flowing against congestion.

allocation of other market uplift charges to linked wheel transactions. The proposed design assumes that the allocation of market uplift charges to linked wheel transactions would not change except as noted above for socialized costs for Ontario congestion and transmission losses. Members of the Working Group stated that this assumption does not mean the members agree with the current allocation of market uplift charges for linked wheel transactions. The members do acknowledge that consideration of changes to the current allocation of market uplift charges for linked wheel transactions is beyond the scope of the Working Group activities, but suggest that such consideration should occur.

7. IESO Cost of Implementation

The IESO has estimated the following implementation costs:

- ~500 k\$ to make changes to the Market Participant Interface (MPI) to allow the single transaction linked wheel offers and Dispatch Scheduling Optimizer (DSO) to evaluate the linked wheel as single transaction against the applicable intertie zone prices;
- ~200 k\$ to make changes to the Commercial Reconciliation System (CRS) to effect the proposed settlements;
- ~160 k\$ to make changes to other IESO market systems affected by the proposed change.

There is also a possible additional implementation cost of ~90 k\$ to develop and use an interim settlement tool if the CRS changes cannot be made at the same time as the other system changes. In addition, given the lack of design detail regarding the proposed change, it is prudent to add a 30% contingency to the cost estimate. As a result, the IESO estimates a total implementation cost of between 1 M\$ to 1.3 M\$.

8. Benefits Analysis – Increased Linked Wheels Volumes and Market Payments

A stakeholder member of the Working Group developed the following quantification of the expected benefits of the proposed design. The calculated benefits of the proposed design are from increased linked wheel transaction volumes and the increase in associated IESO administration fees and export transmission fees that would be paid by these transactions. Payment of these fees by participants conducting linked wheel transactions would contribute to paying the fixed costs of the IESO and Ontario transmitters and therefore these fixed costs would not be borne by Ontario consumers.

⁵ Constellation Energy submitted a market rule amendment request MR-00347 that proposed that linked wheels not pay the market uplift charges such transactions currently pay. Constellation subsequently withdrew this request. Information related to MR-00347 can be found on the IESO web site by searching for MR-00347 documents at the following link:
http://www.ieso.ca/imoweb/amendments/tp_meetings.asp

Specifications:

- Time Period: 2007
- Filtered on all wheeling opportunities that were greater than \$10 CDN gross.

Assumptions:

- When the difference between MISO and Ont is greater than \$10 (including congestion through Ontario), a market participant will capture this opportunity 15% of the time flowing 100MW in either the real time or day ahead markets.
- The IESO charges a \$0.87/MWh administration fee
- The IESO charges a \$1.00/MWh transmission fee.
- This analysis does not evaluate historical wheeling opportunities from POHZ to MISO or NYISO or vice versa
- This analysis does not evaluate historical wheeling opportunities from Manitoba to MISO or NYISO or vice versa

Conclusions:

- In the realtime market, there were 5810 hours in which there was a \$10 wheeling opportunity (including IESO congestion) between MISO and NYISO in either direction.
- In the day ahead markets, there were 4087 hours in which there was a \$10 opportunity (including IESO congestion) between MISO and NYISO in either direction.
- 15% X (5810 hours + 4087 hours) X (\$1.00/MWh + \$0.87/MWh) X 100MW = \$277,610

Therefore, before considering the incremental volume wheeling to and from Quebec as well as wheeling to and from Manitoba, the estimated incremental revenue to the IESO in one year due to implementing the requested Linked Wheel rule amendment is \$277,610.

Given the estimated costs of 1 M\$ to 1.3 M\$ to implement the change and the above estimated annual benefits, the pay-back period for the change would be between 3.6 and 4.6 years. If the identified benefits also materialize for linked wheels on other interfaces, the payback period would be shorter.

9. Benefits Analysis – Impact on Intertie Zone Shadow Prices

The IESO conducted analysis to test the stakeholder assertion that the current requirement to bid the export of a linked wheel at \$2000/MW was resulting in higher sink intertie zone shadow prices and economically inefficient scheduling of intertie transactions at the sink intertie.

The IESO believes that when there is no congestion on the sink intertie, the presence of the \$2000/MWh export leg of a linked wheel has no impact on the intertie zone shadow price. In other words, if all bid exports to Michigan can be scheduled on the Michigan tie, the zone shadow price will equal the Ontario price. The presence of a linked wheel will only affect the intertie zone price when there is congestion on the tie.

For this analysis, the IESO looked at the months of August and September of 2008 and all linked wheels that had Michigan as the sink. A summary of the analysis follows:

Total Hours with Linked Wheel: 437 or 29.8% of total hours

Total Peak Hours with Linked Wheel: 335 or 51.1% of total peak hours

Total Off-Peak Hours with Linked Wheel: 102 or 12.6% of total off-peak hours

Total Hours with Export Congestion on Michigan Tie: 171 or 11.7% of total hours

Total Peak Hours with Export Congestion on Michigan Tie: 121 or 36.1% of total peak hours

Total Off-Peak Hours with Export Congestion on Michigan Tie: 50 or 6.2% of total off-peak hours

Total Hours with LW & Export Congestion: 121 or 8.3% of total hours and 27.7% of total hours with LW

Total Peak Hours with LW & Export Congestion: 99 or 15.1% of total peak hours and 29.6% of total peak hours with LW

Total Off-Peak Hours with LW & Export Congestion: 22 or 2.7% of total off-peak hours and 21.6% of total off-peak hours with LW

Average MISI Price Total Hours with Congestion: 74.76 \$/MWh

Average MISI Price Peak Hours with Congestion: 74.72 \$/MWh

Average MISI Price Off-Peak Hours with Congestion: 74.85 \$/MWh

Average MISI Price Total Hours with Congestion and LW: 77.56 \$/MWh

Average MISI Price Peak Hours with Congestion and LW: 76.24 \$/MWh

Average MISI Price Off-Peak Hours with Congestion and LW: 83.50 \$/MWh

From this analysis it appears that the presence of a linked wheel in times of export congestion on the sink intertie results in higher intertie zonal prices than would be the case if there was no linked wheel.

Further analysis would be required to determine the market efficiency impacts of these apparent higher prices. This analysis would require looking at individual hours from the sample when there was export congestion and a linked wheel and estimate the impact if the linked wheel was offered in under the proposed design i.e. congestion pricing. The IESO does not have resources available at the current time to conduct such an analysis.

10. Outstanding Issues

IESO staff has identified three potential issues regarding the proposed design. These issues, and their status, are outlined below.

a. Congestion Rents for Transmission Rights (TR) Market

Ontario TR market is a real-time market. Intertie congestion rents collected from intertie transactions in real-time fund, in part, TR market payouts. If linked wheels are settled on basis of pre-dispatch constrained prices, what is the impact on TR market funding?

Some preliminary analysis conducted by a stakeholder member of the Working Group indicates that there is potential for reduced collection of real-time intertie congestion rents under the proposed design i.e. linked wheels under the proposed design may contribute to real-time intertie congestion but may not pay the corresponding real-time congestion rents as the linked wheels are settled on the basis of pre-dispatch prices. This outcome could result in under-funding of the transmission rights market.

Stakeholder members on the Working Group acknowledge the potential under-funding of the transmission rights market, but assert that there is already an under-funding issue with respect to the transmission rights market. The proposed change to linked wheels would only exacerbate the under-funding problem. While solving the under-funding issue is necessary, it should not prevent the proposed change to linked wheels.

b. Potential Unintended Adverse Outcomes

With only linked wheels settled on basis of pre-dispatch constrained prices and all other intertie transactions settled on basis of real-time unconstrained prices, are there any potential unintended adverse outcomes or incentives created for imports, exports or linked wheels?

The Working Group has not examined this issue.

c. Changes from Pre-Dispatch to Real-Time

If there are significant changes in congestion (internal or intertie) from the hour-ahead pre-dispatch to real-time, is it 'fair' that imports and exports may be subject to additional cost risk but linked wheels are not?

Under the proposal, a linked wheel would be paying for internal congestion and transmission losses through the difference in intertie zonal prices determined in pre-dispatch constrained schedule. Everyone else pays for real-time congestion and transmission losses. What are the implications of this different treatment?

The Working Group has not examined these issues.