Congestion Cost Metrics DRAFT

One of the features of a locational marginal price (LMP) based market is the ability to identify grid locations that are difficult to serve with economic generation due to transmission bottlenecks (constraints) and quantify the cost of this congestion. The NYISO continuously calculates and publishes LMP's with three components:

Energy – This is the marginal electricity cost without the adjusted cost of congestion and losses

Congestion – This is the cost of out-of merit generation dispatch relative to an assumed unconstrained reference point at Marcy substation

Losses – This is the cost of supplying the losses from the accessible marginal generators to grid point in question

The cost of congestion commonly reported is the simple sum of the day ahead market LMP congestion component times the amount of load being affected (positively or negatively) by the congestion (later referred to as "congestion payments"). While this congestion cost is relatively simple to calculate, this value is generally felt to be an over-simplified and deceiving congestion impact metric because:

1. This calculation does not incorporate the effect of supply and demand response when the congestion is removed.
2. The congestion cost is relative to an assumed uncongested reference point. If this reference point is moved, the congestion cost is shifted to the LMP energy component. The congestion versus energy cost calculation becomes arbitrary depending on the reference point chosen.

To better measure the true cost of transmission congestion analysis tools and protocols were developed by the NYISO. The fundamental idea is to calculate what the day-ahead hourly clearing prices would be if there were no transmission constraints using the same data and calculation approach as the NYISO security constrained unit commitment software (SCUC). The congestion cost then is the difference between the actual SCUC transmission constrained LMP's, loads, and bids, and the same calculation with all transmission constraints ignored. Annual cost is the simple sum of daily cost.

The reported numbers are the result of a simulation of the NYCA market using the hourly bids and network status actually used by NYISO to clear the day-ahead market. The simulation performs a security constrained unit commitment for the market "as it was", then removes all transmission constraints (other constraints such as desired net interchange, DNI, generator ramp rates and minimum run times are enforced). The commitment and dispatch are then recalculated for this unconstrained scenario with no changes in bids from those actually submitted. The constrained and unconstrained results are compared to derive the cost of congestion. All calculations represent all market segments (e.g. fixed load, virtual load and generation, imports and exports), and actual hour-by-hour network status, but the unconstrained scenario fixes the amount of virtual load and generation MW.

The Congestion Metrics

To suit various needs for viewing the impact of congestion four congestion metrics were developed.

1. Change in Production Cost – This is the primary congestion impact metric chosen for use by the NYISO Operating Committee. The calculation compares the total production cost, based on mitigated bids, with and without transmission constraints limiting the unit commitment and dispatch. This measures the economic inefficiency introduced by the existence of transmission bottlenecks. In a sense, this is the *societal cost* of transmission congestion.

   A positive number means that transmission congestion increased electricity production cost.

   An advantage of this metric is that the production cost will always decrease when constraints are removed. Minimizing bid production cost is the objective of the SCUC; LMP's are the result of the commitment and dispatch that result from achieving this objective under generating unit and transmission constrained conditions. Since minimizing the LMP is not the SCUC action, relieving all or some of the constraints may or may not decrease the market based electricity cost to load. In LMP markets the load in a location pays the marginal price of the supply at that location, not the bid price. The result of constraint relief in an LMP market depends on how much load is affected, where the load is, and the response of supply and demand as constraints are relieved.

2. Change in Congestion Payments – This calculation, the sum of the LMP congestion component times the load affected, ignores the energy cost change as constraints are removed. With no simulation truly required to arrive at this congestion impact metric, this is the *accounting cost* of congestion. Congestion payments can be hedged with transmission congestion contracts (TCC's) resulting in the unhedged congestion numbers reported. For this analysis it was assumed that all TCC's are owned by load and are available for hedging congestion payments. See the attached glossary for more details of this calculation.

   A positive number means congestion increases load cost.

3. Change in Supply Payments – This metric is the opposite side of the demand payments calculation. In addition to the LMP payments to generation (or other supply sources such as virtual generation, or imports), generators are also paid a bid production cost guarantee (BPCG) and for ancillary services (AS). BPCG compensates generators that are committed despite the fact their bids are greater than the LMP at the generator location. This can happen if ramp rates, minimum run times or other limits force unit operation, which minimizes overall production cost even including BPCG payments.

   A positive number means generation payments went up due to congestion.

4. Change in Demand Payments – This congestion impact calculation uses simulation to include the local energy cost response when transmission constraints are removed. Where the first congestion metric measures efficiency, this metric determines how much more New York load pays due to congestion and the design of an LMP based market; that is, the *bills impact*.

   The load payments congestion impact necessarily includes the effect of all market segments that can change when transmission constraints are relieved. These segments are:

   - LMP Components: While the LMP congestion component will be pushed to zero when no transmission constraints exist, the unbottled generation will sell more energy at a slightly higher price (in accordance with the bid curves), albeit at a lower bid than the units put on out-of-merit in the transmission limited case. This results in an increase in the LMP energy component as the LMP congestion component decreases. The LMP loss component will also change depending on the location and prices of the generation unbottled when constraints are relieved. Ancillary service costs (e.g. reserves) also affect LMP's as this is a trade-off of selling ancillary services or energy.

   - The change in load payments due to congestion are also hedged with TCC's, leading to the reported unhedged demand payment.

   - TCC shortfall – In the event of a TCC shortfall (or surplus) the load pays for this imbalance, which necessarily changes as transmission constraints are relieved or removed. While this shortfall may be compensated for elsewhere in the Transmission Service Charge (TSC) from a congestion impact perspective this is considered a load cost. While the NYISO OATT describes details of the allocation of shortfall by transmission owner, for this analysis shortfall is stated for the NYCA only.

   - Schedule 1 Imbalances – In accordance with the NYSIO OATT imbalances of energy and loss payments are a component of the OATT defined Schedule 1 payment. Relieving or eliminating transmission constraints affects these Schedule 1 payments, and is thus considered a congestion impact in this analysis. Like shortfall, this analysis states Schedule 1 effect for the NYCA only.

In this analysis it was assumed that all TCC's were credited to load. The TCC auction cost is ignored, as it is part of the TSC. See the attached glossary for more details of this calculation.

A positive number means congestion increases load payments.

Congestion by Constraints

The congestion payment metric is the only one available for allocating congestion impact to individual causative constraints. Congestion payments, either total or unhedged, is not a useful number in the absolute, but the relative payments are felt to be of value in identifying transmission constraint location and severity. Therefore, to prevent confusion and misinterpretation of absolute numbers, the unhedged congestion payments by constraint are reported as the percentage of the total for the period reported.

As discussed above, the use of congestion payments (either total or unhedged after subtraction of TCC hedging payments) does not consider the change in energy payments when the constraint is relieved (or in the case of the congestion metrics calculation, when all transmission constraints are relieved). Moreover, and very importantly, if a constraint is relieved another existing or "just below the surface" constraint will almost certainly become constraining, limiting the congestion reducing benefit of the constraint relief.

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Glossary of Posted Results

The definition of the posted congestion results as listed in the column headings are:

For the Metrics Reports

All quantities are the congested minus the uncongested values, representing the congestion impact according to the established definitions.

Zone – This is the zone designation as defined by the NYISO. Zone designations were added for external connected regions New England, Hydro Quebec, Ontario, and PJM.

BPC – Bid Production Cost. This is the total cost of electricity supply based on the bid amounts at the clearing commitment and dispatch. It is the optimized quantity in the unit commitment and dispatch process. Other quantities such as the LMP are the result of the commitment and dispatch determined from minimizing bid production cost. See text for interpretation of the metric.

Cong_Unh – This is the Congestion Payments (congestion component times the load affected) minus the TCC hedge.

Sup_Pay – Supply Payments. This sum of the energy, congestion, losses, bid production cost guarantee, and ancillary services payments made to electricity suppliers. It is the sum of these payments to generators, virtual generators, and imports. See text for interpretive information.

Dem_Pay – Demand Payments. This sum of the energy, congestion and losses payments paid by electricity demand (fixed load, virtual load, price capped load, exports, and wheeling). See text for interpretive information.

TCC – Transmission Congestion Contracts. This is the congestion hedging derived from multiplying the TCC MW owned times the LMP difference between the TCC contract point of withdrawl (POW) minus point of injection (POI). There is no adjustment in this calculation for different TCC owner types (i.e. all TCC revenue is attributed to demand), nor for the variety of grandfathered TCC contracts. For zonal TCC attributions the TCC is credited to that zone if the POI is within that zone.

Dem_Pay_Unh – Demand Payments Unhedged. This is the demand payments minus the TCC hedge. See the above TCC description for the zonal TCC assignment assumption. Note that the total NYCA demand payments may not match the NYCA generation payments due to the lack of inclusion of Schedule 1 and TCC shortfall (see following items).

Sch1 – Schedule 1 Adjustments. Imbalances between the demand energy and losses payments and the supply energy and losses receipts are considered to be a charge to the demand as defined in the NYISO OATT Schedule 1. Because the simple allocation of this charge to the individual zones is not defined by the OATT (it is defined through transmission owners, not zones) this charge to demand is not allocated to the zones in the congestion impact reporting.

Shortfall - Imbalances between the demand congestion payments, the supply congestion receipts, and TCC payments are considered to be a charge to the demand as defined in the NYISO OATT. Because the simple allocation of this charge to the individual zones is not defined by the OATT (it is defined through transmission owners, not zones) this charge to demand is not allocated to the zones in the congestion impact reporting.

Demand Unhedged – This is the demand payments plus schedule 1 and shortfall adjustments, minus the TCC. It is defined for the NYCA only due to the difficulty in allocation of schedule 1 and shortfall allocation by zone as noted in the description of those elements.

For the Calculation Components

All quantities are the actual values for the transmission constrained and unconstrained conditions. The difference between the two is the established definition of congestion impact.

Zone – This is the zone designation as defined by the NYISO. Zone designations were added for external connected regions New England, Hydro Quebec, Ontario, and PJM.

Dem_MWHrs – Total demand for all demand types (fixed load, virtual load, price capped load, exports, and wheeling).

Supp_ MWHr – Supply MWHRs. Total supply for all supply types (generation, virtual generation, imports). Any difference in total supply and demand is due to loss handling and roundoff.

BPC – Bid Production Cost. This is the total cost of electricity supply based on the bid amounts at the clearing commitment and dispatch. It is the optimized quantity in the unit commitment and dispatch process. Other quantities such as the LMP are the result of the commitment and dispatch determined from minimizing bid production cost.

BPCG – Bid Production Cost Guarantee. In the course of the production cost minimization the lowest overall cost may occur by committing and dispatching a unit even if the bid at an hour is greater than the LMP for that hour. This could occur if the startup time, ramp rates, or other unit characteristics reduce the overall daily production cost. The difference between the LMP paid for the particular hours and the bid price is paid as BPCG.

Dem_ Energy$ - Demand Energy Payments. This energy component payments paid by fixed load, virtual load, price capped load, exports, and wheeling.

Dem_Congest$ - Demand Congestion Payments. This congestion component payments paid by fixed load, virtual load, price capped load, exports, and wheeling.

Dem_Losses$ - Demand Loss Payments. This loss component payments paid by fixed load, virtual load, price capped load, exports, and wheeling.

Sup_ Energy$ - Supply Energy Payments. This energy component payments paid to generation, virtual generation, and imports.

Sup_Congest$ - Supply Congestion Payments. This congestion component payments paid to generation, virtual generation, and imports.

Sup_Losses$ - Supply Loss Payments. This loss component payments paid to generation, virtual generation, and imports.

AS_rev – Ancillary Service Revenue. This is the payments to generators for regulating, total, 10 minute, and spinning reserves.

TCC – Transmission Congestion Contracts. This is the congestion hedging derived from multiplying the TCC MW owned times the LMP difference between the TCC contract point of withdrawl (POW) minus point of injection (POI). There is no adjustment in this calculation for different owner types (i.e. all TCC revenue is attributed to load), nor for the variety of grandfathered TCC contracts. For zonal TCC attributions the TCC is credited to that zone is the POI is within that zone.

For the Constraint Congestion Payments

This is the congestion payments (accounting cost) of the individual constraints as measured by the percent of the total period unhedged congestion component of the LMP. See text for interpretation of this metric.

Monitored Facility – This is the NYISO name of the electric facility that was limiting during a particular hour. The to and from name does not indicate the direction of the congestion, only the standard naming convention of this facility.

Contingency – The contingency under which the monitored facility was limiting during a particular hour. If the monitored facility was limiting under a no contingency condition this is listed as “base case”.