Carbon Pricing

Market Design Complete

Ethan D. Avallone

TECHNICAL SPECIALIST – ENERGY MARKET DESIGN

Business Issues Committee (BIC)

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*Please note that throughout this presentation, the word "carbon" will be used to refer to Carbon Dioxide (CO_2).

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Background

Background

- **The Integrating Public Policy Task Force (IPPTF) explored concepts and proposals for incorporating the social cost of carbon emissions in wholesale energy markets to better harmonize the state's energy policies and the operation of those wholesale markets.**
  - The IPPTF Carbon Pricing Proposal was published in December 2018*
- **The NYISO and stakeholders collaborated over the past few months to refine the proposal, discussing in further detail the market design and tariff language.**
  - Today's presentation presents the complete market design.
  - Proposed tariff language was discussed at the 6/11/2019 ICAPWG/MIWG meeting.^

*Link to the IPPTF Carbon Pricing Proposal: https://www.nyiso.com/documents/20142/3911819/Carbon-Pricing-Proposal%20December%202018.pdf/72fe5180-ef24-f700-87e5-fb6f300fb82c
^Link to the 6/11/2019 ICAPWG/MIWG presentation: https://www.nyiso.com/documents/20142/7007643/6.11.2019_MIWG_Carbon_Pricing_Tariff_Review_FINAL.pdf/4622a2c9-f7a1-ff00-8273-cc2abe988885

Background – Market Design Concept

- **The NYISO proposes to incorporate the Social Cost of Carbon into Wholesale energy markets using a price for carbon dioxide emissions that is charged to emitting resources.**
  - Carbon emitting resources would incorporate carbon charges into their energy offers, reflecting the carbon price in the NYISO's existing unit commitment, dispatch, and price formation.
  - Imports would be charged and exports would be paid the Carbon Impact to the LBMP (LBMPc) to prevent the carbon charges on internal generation from causing emissions leakage and scheduling distortions.

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Background – Market Design Concept

- **A carbon charge would raise the energy market clearing prices whenever carbon-emitting resources are on the margin. All suppliers, including clean energy resources, would receive the higher energy price, net of any carbon charges due on their emissions.**
  - Low carbon dioxide emitting New York resources, including efficient carbon-emitting units, renewables, hydropower, and nuclear generators, would benefit from higher net revenues.
  - A carbon charge would provide incentives for innovative low carbon technologies that may not yet be developed.
- **Load Serving Entities (LSEs) would continue to be charged the LBMP for wholesale energy purchases, which would account for the carbon adder of the marginal units.**
  - The NYISO would return the carbon charge residual collected from emitting suppliers and imports to LSEs after paying the LBMPc to exports.

Wholesale Suppliers Subject to the Carbon Charge

Wholesale Supplier Emissions

- **Carbon emissions tied directly to providing wholesale electric market services, including energy and ancillary services, will be subject to the NYISO's carbon charge.**
  - Eligible carbon emissions will include those associated with startups, no-load levels, and generation that receive wholesale market compensation
- **Carbon emissions subject to the charge will be "Burner tip" CO_2 emissions.**
  - Not covered: upstream/fugitive CO2 emissions, other greenhouse gas emissions (methane, nitrous oxide, etc.)
- **Emissions from Clean Energy Standard eligible wholesale suppliers will be exempt from the carbon charge.**
  - Resources listed in the Clean Energy Standard Order, Appendix A, will be exempt.*
- **Emissions associated with participation in the SCR and EDRP programs will not be subject to the carbon charge.**

*Link to the Clean Energy Standard Order: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7bB3777382-228F-4268-A674-6B5B93B8614B%7d

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Cogeneration Emissions

- Cogeneration resources produce both wholesale electricity market products and generation byproducts such as heat and/or steam.
- Emissions associated with heat and steam sales will not be subject to a wholesale electric sector carbon charge.
- Cogeneration resources should report emissions associated with the provision of wholesale energy and ancillary services (excluding emissions associated with heat and steam sales).
  - These resources should work with NYISO to establish a reference emissions allocation method.

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Behind-the-Meter Net Generation Resources

- Tariff defined BTM:NG Resources are eligible to concurrently serve Host Load and participate in the NYISO's wholesale markets.
- Emissions associated with serving Host Load will not be subject to a wholesale electric sector carbon charge.
- BTM:NG Resources should report emissions associated with the provision of wholesale electric energy and ancillary services (i.e., net generation).
  - Such resources should work with NYISO to establish a reference emissions allocation method.

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Distributed Energy Resources

- **DER aggregators should report emissions associated with the provision of wholesale energy and ancillary services (i.e., net generation).**
  - Such resources should work with NYISO to establish a reference emissions allocation method.

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SCR/EDRP Programs

- **Emissions produced during participation in these programs will not be subject to carbon charges.**
  - Resources in these programs infrequently produce energy using fossil fuels.
  - About 90% of all program MWs are pure load reduction with no local generation. Very few incremental emissions can be attributed to such resources.
    - There have been few SCR calls in recent years.
    - As a bounding analysis, we use the most recent NYCA-wide SCR/EDRP event, which occurred 8/12/2016. Average SCR response was 969.4 MW and average EDRP response was 12.6 MW for the 5 hour event, totaling 4,910 MWh. Assuming 10% local generation at a high heat rate unit (13 MMBtu/MWh, or 0.75 tons CO_2/ MWh on natural gas), there was the potential for 368 tons of CO_2 emissions, or ~$18,000 in carbon charges.
  - Collecting emissions data from these resources could create sizable new reporting requirements for the resources with few resultant carbon charges returned to loads.

Data from NYISO 2016 Annual Report on Demand Response Programs, page 19
http://www.nyiso.com/public/webdocs/markets_operations/market_data/demand_response/Demand_Response/Reports_to_FERC/2017/NYISO%202016%20Annual%20Report%20on%20Demand%20Response%20Programs_Final.pdf

Emissions Reporting & Billing

Emissions Reporting

- **Generators will report how much carbon they are emitting.**
  - CO_2 Emitting Resources would then true-up this data based on actual emissions.
  - Applicable charges and/or credits would be issued to adjust payments based on reported actual emissions.

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Emissions Billing

- CO_2 Emitting Resources would be able to provide the NYISO with weekly emissions data (with the ability to provide the data more often) or emissions estimates during the billing month. Emitting Resources will submit hourly emissions.
  - Initial emissions estimates will be automatically populated for the supplier, unless the supplier provides those data.
    - Automatically populated data will be based on the supplier's NYISO Reference Level.
  - Suppliers will be required to submit emissions true-ups within 60 days of the initial invoice (e.g., by mid-March for the January Billing Month)
    - This timeline will allow true-ups to appear on the 4 month invoice

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Emissions Billing (Continued)

- Suppliers will be able to provide additional true-ups by 170 days after the initial invoice.
  - No additional true-ups will occur after the final bill closeout (e.g., the October invoice for the January Billing Month)
- These emissions data submission and finalization timelines align with current final bill closeout timeline.*

*NYISO Invoicing Schedule is located at the following link: www.nyiso.com/public/webdocs/markets_operations/services/financial_services/billing_settlements/Processing_and_Invoice_Schedule/Monthly_Invoicing_Schedules/2018%20NYISO%20Monthly%20Invoicing%20Schedule.pdf

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Billing – Potential Penalties

- The billing deadline for emissions reporting is consistent with the current billing challenge period.
- Appendix V of this presentation includes examples of potential penalties.
  - If Carbon Emissions are not reported timely by day 60, then the Supplier will be charged 0.5 times the applicable Carbon Emissions.
    - This penalty is in addition to the charge for Carbon Emissions on the initial invoice.
  - If Carbon Emissions are not reported timely by day 170, then the Supplier will be charged 1.5 times the applicable Carbon Emissions.
    - This penalty is in addition to the charge for Carbon Emissions on the initial invoice.
    - This penalty is in addition to the charge if Carbon Emissions are not reported timely by day 60.

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Billing – Potential Penalties (Continued)

- **If Carbon Emissions are underreported, then the Supplier will be charged 2 times the applicable Carbon Emissions.**
  - This penalty is in addition to the charge for Carbon Emissions on the initial invoice.
  - This penalty is in addition to the failure to report by day 60 penalty, if applicable.

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Billing – Emissions Updates after the Billing Deadline for Emissions Reporting

- **If revised emissions data is supplied after the billing deadline for emissions reporting, then:**
  - If emissions are greater than the amount for which the CO_2 Emitting Resource was billed, then the resource would be subject to the underreporting penalty outlined on the prior slide.
  - If emissions are less than the amount for which the resource was billed, then the resource would <u>not</u> receive a credit.

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Billing - RGGI

- **In order for the NYISO to accurately apply the carbon charge, resources will have to report to the NYISO whether a given resource is subject to RGGI.**
  - This information will be essential for the NYISO to accurately calculate a carbon charge, as Suppliers covered by RGGI would be charged the Gross SCC *minus* the most recently posted daily RGGI price.*
    - Suppliers not covered by RGGI would incur a carbon price equal to the Gross SCC.

*The NYISO intends to use RGGI price data consistent with current MMA processes, please see the NYISO Reference Level Manual, Section 6: https://www.nyiso.com/documents/20142/2923301/rl_mnl.pdf/ae26885c-9f44-b0bb-11ab-e09ac2431c69

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Bilateral Transactions

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Bilateral Transactions

- **CO_2 Emitting Resources injecting into the grid would be subject to the carbon charge.**
  - CO_2 Emitting Resources operating to fulfill a bilateral transaction would thus also be subject to the carbon charge.
- **Transmission Customers purchasing energy through bilateral transactions would receive an allocation of the carbon residual.**
  - This treatment would be similar to how other billing residuals are allocated to Transmission Customers' Actual Energy Withdrawal.

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Carbon Impact to the LBMP (LBMPc)

LBMPc - Background

- **The NYISO envisions including carbon pricing within the wholesale energy market using the existing offer structure.**
  - When appropriate, Market Participants can include carbon emissions costs in their economic offers.
  - The NYISO market software will not automatically calculate a carbon component of LBMP.
- **The NYISO will use an *ex post* calculation to estimate the LBMP carbon impact (LBMPc).**

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How is the LBMPc used?

- **The $LBMP_C$ is needed to:**
  - Allocate the carbon credit to LSEs
    - Information on the proportional allocation methodology is included within this presentation.
  - Prevent leakage and distortion of regional flows by charging imports and crediting exports the LBMPc.
  - Provide market transparency
- **Note that internal generators are charged based on their actual emissions, not based on the $LBMP_C$.**

$LBMP_C$ Posting

- **The NYISO is targeting the following posting for $LBMP_C$; however, the ultimate implementation will depend on whether the posting is technologically possible and necessary for market information:**
  - Compute and post the zonal $LBMP_C$ for real-time market intervals, including look-ahead LBMPc values for RTC, to provide information for transactions.
  - Use the binding RTD interval (nominally 5-minutes) to determine the carbon residual allocation, import/export settlements, and provide further market transparency.
  - Post the zonal $LBMP_C$ at a 5 minute granularity*
    - When the posting occurs will depend on the time required to calculate $LBMP_C$.
    - The NYISO is targeting posting as soon as possible after the completion of each market run.

*The NYISO intends to provide a posting granularity similar to the current real-time zonal LBMP postings: http://www.nyiso.com/public/markets_operations/market_data/pricing_data/index.jsp

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Benefits

- The NYISO's proposed LBMPc calculation provides a number of benefits:
  - Transparent
  - Straightforward calculation of the LBMPc.
    - Marketers with imports/exports will be able to estimate their charge/credits, and LSEs will be able to estimate the carbon residual allocation.
  - Anticipate few intervals where LBMPc will need to be persisted.
  - Anticipate posting the LBMPc relatively soon after the RT LBMP posting.

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LBMPc Calculation

- The LBMPc calculation equation is shown on this slide.
  - A variable operations and maintenance (VOM) cost will be subtracted from the LBMP.
  - This value will then be divided by the estimated marginal fuel cost ($/mmBTU), plus the cost of emissions ($/mmBTU) to determine an implied heat rate.
- As previously discussed, the NYISO will set the LBMPc to zero when the calculated LBMPc is less than zero.

$$Emissions\ Cost_{ip} = (Emissions_{ip} * SCC_i)$$

$$\left(\frac{LBMP_{ip} - VOM_{ip}}{Fuel\ Cost_{ip} + Emissions\ Cost_{ip}}\right) = IHR_{ip}$$

$$LBMPc_{ip} = Max\left(\left(IHR_{ip} * Net\ SCC_i * Emissions_{ip}\right), 0\right)$$

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LBMPc Calculation – Implied Heat Rate

- **The implied heat rate produced by the calculation should be limited by a minimum and maximum value to maintain an appropriate LBMPc.**
  - Without a maximum limit, the impact of shortage pricing (for example) on the LBMP would result in an implied heat rate that is inappropriately high.
  - Without a minimum limit, the impact of renewable generation (for example) on the LBMP would result in an implied heat rate that is inappropriately low.
    - The implied heat rate should be set to zero when less than the minimum limit and set to the maximum when above the maximum limit.
    - A low implied heat rate indicates that zero emission energy, that does <u>not</u> bid opportunity cost, is likely marginal.
  - The minimum and maximum heat rates would be posted.

LBMPc Calculation - Inputs

- **The NYISO will post several inputs that will be used in the LBMPc calculation:**
  - Fuel indices
  - Variable Operations and Maintenance Cost (VOM)
  - Minimum implied heat rate
  - Maximum implied heat rate
  - Assumed tons of carbon per mmBTU
  - RGGI price source
  - Social Cost of Carbon
- **Stakeholders will be kept informed as to updates to these values.**

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Opportunity Cost Resources

- **Certain carbon free resources are able to store energy.**
  - These resources structure their bids to achieve schedules during the most economic periods of the day.
    - In periods of the day with lower prices, the bids of such resources therefore reflect the estimated opportunity cost of profit from periods of the day with higher prices.
- **The proposed LBMPc methodology will incorporate carbon adders that are the result of bidding opportunity costs.**
  - The LBMP used to calculate LBMPc will include the impact of resources bidding opportunity costs when such resources are marginal, so no additional adjustments are necessary.
  - Reminder: internal generators are charged based on their actual emissions, therefore carbon free resources bidding opportunity costs will <u>not</u> be charged for emissions.

Carbon Residual Allocation

Carbon Residual Allocation

- **The total carbon residuals are the total dollar amount of carbon charges collected by the NYISO from suppliers and allocated to Load Serving Entities (LSEs).**
  - Total Carbon Residual = carbon charges collected from generators + carbon charges collected from imports and wheels through – carbon payments to exports and wheels through.
- **Suppliers will receive the full LBMP (which includes the carbon pricing effect on LBMP (LBMPc)) and then pay the carbon price on their emissions.**
  - Import transactions will be charged the applicable LBMPc and export transactions will be paid the applicable LBMPc.
- **LSEs will pay the full LBMP, which includes the LBMPc.**
- **The NYISO will then allocate the carbon residual surplus to LSEs.**

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Carbon Residual Allocation

- The NYISO proposes a proportional allocation of a carbon residual surplus.
- The proportional carbon residual allocation will avoid major cost shifts among customers by providing an equal percentage of carbon charges back to each LSE.
  - In other words, it will equalize the (\$/MWh Residual Allocation)/LBMPc), and therefore compensate for zonal differences in the carbon component of the LBMP (*i.e.*, LBMPc).

$$Carbon\ Residual\ Credit_{ch} = \frac{\sum_z (WithdrawalUnits_{czh} * HourlyLBMPc_{zh})}{\sum_z (TotalWithdrawalUnits_{zh} * HourlyLBMPc_{zh})} * CarbonResidual_h$$

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Carbon Residual Allocation

- **The carbon residual will generally be positive resulting in carbon residual surplus allocation to LSEs.**
- **In the unlikely circumstance the carbon residual is negative, the proposed tariff language includes rules for allocating these carbon residual shortfalls to LSEs.**
  - A negative residual will occur when there are less carbon payments collected from internal generators, imports, and wheels through than paid to exports and wheels through.
    - This circumstance can arise when an emitting resource is on the margin while much of the energy is being provided by zero carbon resources.

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Carbon Residual Allocation

- **The NYISO proposes that a carbon residual shortfall be allocated according to load ratio share in a similar way to how other residual shortfalls are allocated.**
  - This method would avoid allocating additional carbon charges solely to load in zones with a higher LBMPc and avoids additional cost shifts.
    - Loads in zones with a higher LBMPc will bear a higher impact from the carbon charge as part of their energy payment.
      - If a proportional allocation were used these LSEs would also pay a higher proportion of the negative residual.

Mechanics of Carbon Residual Allocation

- **The carbon residual allocation will use the LBMPc from the binding real-time interval (nominally 5-minutes) to calculate the time-weighted integrated (TWI) LBMPc.**
  - Supplier emissions will be reported on an hourly basis; the carbon residual will therefore be on an hourly basis.
  - TWI LBMPc, the hourly carbon residual, and RT actual internal load, will be used to determine the allocation.

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Social Cost of Carbon

Social Cost of Carbon

- **Social Cost of Carbon ("SCC") will be defined as:**
  - A value, in dollars per short ton of carbon dioxide, established by the PSC in accordance with the New York State Administrative Procedure Act.
- **The ISO shall utilize the Social Cost of Carbon in the ISO Administered Markets.**
- **The ISO Services Tariff will reference the PSC order setting the initial Social Cost of Carbon.**
- **The ISO shall maintain a posting on its website that sets forth the effective Social Cost of Carbon.**
  - To the extent revised Social Cost of Carbon value(s) are established by the PSC, such revised values will be utilized.
  - The revised Social Cost of Carbon will become effective on the first day of a calendar month following the posting of such revised values to the ISO's website.
- **In the event the PSC establishes Social Cost of Carbon value(s) through only a specified date and has not established a revised value(s) beyond such specified date, the ISO shall continue using the last value set by the PSC.**

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The Effect of Carbon Pricing on the ICAP Market

The Effect of Carbon Pricing on the ICAP Market

- **The NYISO analyzed the impacts of carbon pricing on the ICAP demand curves to illustrate how the annual update process could affect future Capacity market clearing prices. The analysis was presented to stakeholders on October 11, 2018.***
- **Net EAS Revenue will be impacted by carbon pricing.**
  - Both cost and revenue are impacted as emissions cost and LBMPs are expected to increase.
- **The resulting impacts of implementing carbon pricing in the wholesale market should be rolled into Net EAS Revenue estimates through the annual update process.**
  - Adjustments to the Net EAS Model to allow for incorporation of carbon pricing once implemented will be evaluated and discussed as part of the upcoming demand curve reset process.

*Link to the October 11, 2018 IPPTF meeting materials: https://www.nyiso.com/documents/20142/3715284/IPPTF%20-%20Net%20EAS%20Carbon%20Impact.pdf/4a757498-836d-1edf-2ed7-76cc59da452c

External Transactions

External Transactions

- **Import transactions into the NYISO market are paid the Proxy Generator Bus price for the applicable external control area.**
  - For example, an import with costs of $40/MWh in the PJM market could sell at the $50 PJM Keystone Proxy Generator Bus price in the NYISO market for a potential net revenue of $10/MWh.
- **Export transactions out of the NYCA pay the Proxy Generator Bus price for the applicable external control area.**
  - For example, an export expecting a $50/MWh price in NE could buy at the $40/MWh NE NPX Proxy Generator Bus price in the NYISO market for a potential net revenue of $10/MWh.

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External Transactions

- **The NYISO proposes to apply carbon charges or credits to external transactions such that they compete with internal resources (and each other) as if the NYISO were not applying a carbon charge to internal suppliers (i.e., on a status quo basis).***
  - Imports will be paid the LBMP and pay a carbon charge equal to the carbon impact to the LBMP (LBMPc), at the relevant border.
  - Exports will pay the LBMP and receive a carbon payment equal to the LBMPc at the relevant border.
  - Wheel-through transactions will incur a two part carbon charge; they will pay the LBMPc at the import interface and will be paid the LBMPc at the export interface.
  - Carbon charges will only apply to transactions that flow in real-time.
- **The real-time LBMPc, based on the real-time system dispatch, will be used to determine charges and credits.**

*For further information, please see the IPPTF Carbon Pricing Proposal at the following link:
https://www.nyiso.com/documents/20142/2244202/IPPTF%20Carbon%20Pricing%20Proposal/60889852-2eaf-6157-796f-0b73333847e8https://www.nyiso.com/documents/20142/2244202/IPPTF%20Carbon%20Pricing%20Proposal/60889852-2eaf-6157-796f-0b73333847e8

External Transactions

- Import and export schedules will be determined as they are determined today, via the system optimization software, based on import and export bids.
- Traders will be able to incorporate expected payments/charges into their bids.
  - Traders that do not do so face the prospect of receiving an undesired schedule.
- The NYISO will create a new billing code for carbon charge settlements (i.e., the carbon charge will be a separate line item on bills and invoices).
  - For example, an import will see both a payment equal to the full LBMP (as they do now) and, under a separate billing code, a charge equal to the carbon impact on LBMP on its bill.

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External Transactions

- **A carbon charge or credit will only apply to transactions that actually flow in real time.**
  - Thus, a DA scheduled transaction that does not flow in RT will buy out of its position at the RT LBMP consistent with the NYISO's current settlement rules.
    - An import transaction that does not flow in RT will not be charged LBMPc.
    - An export transaction that does not flow in RT will not be credited LBMPc.
- **Proxy Generator Bus LBMPs are currently published on the NYISO web site. The LBMPc will also be available on the NYISO web site.**

Other Items

Other Items

- The NYISO recognizes that open items remain, which require NYS PSC action:
  - Establishing a SCC for use in the wholesale market,
  - Returning carbon emissions costs to retail customers.
- The NYISO has brought these items to the attention of NYS DPS staff.

Next Steps

Next Steps

- **The BIC vote on the Carbon Pricing proposal is currently planned for a later date.**
- **Market Participants will be provided advanced notice of the vote.**
  - Stakeholder discussions regarding the Carbon Pricing Supplemental Analysis will continue at ICAPWG/MIWG.
  - The Carbon Pricing Supplemental Analysis is targeted for discussion in June and July ICAPWG/MIWG meetings.

Appendix I: Proportional Carbon Residual Allocation Example*

*Please note that the following example are for illustrative purposes only.

Proportional Carbon Residual Allocation Example

i	ii	iii	iv
Total Carbon Residual ($)	Location	Load (MWh)	TWI LBMPc ($/MWh)
200,000	A	3,000	21
	B	800	10
	C	1,600	15
	D	700	0
	E	1,000	16
	F	2,000	20
	G	500	17
	H	700	18
	I	1,000	18
	J	7,000	21
	K	3,500	21
	Total	21,800	

- **Assume that the total carbon residual for a given hour is $200,000.**
  - The Time-Weighted Integrated (TWI) LBMPc is calculated from 5-minute level LBMPc values.

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Proportional Carbon Residual Allocation Example

i	ii	iii	iv	v (iii*iv)	vi (v/(sum(v))
Total Carbon Residual ($)	Location	Load (MWh)	TWI LBMPc ($/MWh)	Gross LSE Carbon Impact ($)	Share of Gross Carbon Payments by Zone (%)
200,000	A	3,000	21.00	63,000	15.34%
	B	800	10.00	8,000	1.95%
	C	1,600	15.00	24,000	5.85%
	D	700	0.00	-	-
	E	1,000	16.00	16,000	3.90%
	F	2,000	20.00	40,000	9.74%
	G	500	17.00	8,500	2.07%
	H	700	18.00	12,600	3.07%
	I	1,000	18.00	18,000	4.38%
	J	7,000	21.00	147,000	35.80%
	K	3,500	21.00	73,500	17.90%
	Total	21,800		410,600	

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Proportional Carbon Residual Allocation Example

i	ii	iii	iv	v (iii*iv)	vi (v/(sum(v))	vii (vi*(i))	viii (vii/iii)	ix viii/iv
Total Carbon Residual ($)	Location	Load (MWh)	TWI LBMPc ($/MWh)	Gross LSE Carbon Impact ($)	Share of Gross Carbon Payments by Zone (%)	Carbon Residual Allocation ($)	Carbon Residual Rate ($/MWh)	Proportion
200,000	A	3,000	21.00	63,000	15.34%	30,686.80	10.23	0.49
	B	800	10.00	8,000	1.95%	3,896.74	4.87	0.49
	C	1,600	15.00	24,000	5.85%	11,690.21	7.31	0.49
	D	700	0.00	-	-	-	0.00	-
	E	1,000	16.00	16,000	3.90%	7,793.47	7.79	0.49
	F	2,000	20.00	40,000	9.74%	19,483.68	9.74	0.49
	G	500	17.00	8,500	2.07%	4,140.28	8.28	0.49
	H	700	18.00	12,600	3.07%	6,137.36	8.77	0.49
	I	1,000	18.00	18,000	4.38%	8,767.66	8.77	0.49
	J	7,000	21.00	147,000	35.80%	71,602.53	10.23	0.49
	K	3,500	21.00	73,500	17.90%	35,801.27	10.23	0.49
	Total	21,800		410,600		200,000.00		

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Proportional Carbon Residual Allocation Example

Zone	Load	TWI LBMPc ($/MWh)	Allocation Rate ($/MWh)
A	3,000.00	21.00	10.23
B	800.00	10.00	4.87
C	1,600.00	15.00	7.31
D	700.00	0.00	0.00
E	1,000.00	16.00	7.79
F	2,000.00	20.00	9.74
G	500.00	17.00	8.28
H	700.00	18.00	8.77
I	1,000.00	18.00	8.77
J	7,000.00	21.00	10.23
K	3,500.00	21.00	10.23

- The zonal allocation rate ($/MWh) is used to allocate the carbon residual to each LSE.
  - The NYISO will post the zonal allocation rate for each load zone.

Proportional Carbon Residual Surplus Allocation Example

			i
LSE	Zone	Zone Load (MWh)	LSE Load (MWh)
LSE1	A	3,000.00	1,000.00
LSE2	A		1,000.00
LSE3	A		1,000.00
LSE1	B	800.00	800.00
LSE1	C	1,600.00	1,600.00
LSE3	D	700.00	525.00
LSE3	D		175.00
LSE1	E	1,000.00	1,000.00
LSE2	F	2,000.00	1,200.00
LSE3	F		800.00
LSE1	G	500.00	500.00
LSE1	H	700.00	350.00
LSE3	H		350.00
LSE3	I	1,000.00	500.00
LSE2	I		500.00
LSE2	J	7,000.00	2,100.00
LSE1	J		1,400.00
LSE3	J		3,500.00
LSE2	K	3,500.00	875.00
LSE3	K		2,625.00

- A single LSE may serve load in many different zones.

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Proportional Carbon Residual Surplus Allocation Example

			i	ii	(i*ii)
LSE	Zone	Zone Load (MWh)	LSE Load (MWh)	Allocation Rate ($/MWh)	LSE Allocation Revenue ($)
LSE1	A	3,000.00	1,000.00	10.23	10,228.93
LSE2	A		1,000.00	10.23	10,228.93
LSE3	A		1,000.00	10.23	10,228.93
LSE1	B	800.00	800.00	4.87	3,896.74
LSE1	C	1,600.00	1,600.00	7.31	11,690.21
LSE3	D	700.00	525.00	0.00	-
LSE3	D		175.00	0.00	-
LSE1	E	1,000.00	1,000.00	7.79	7,793.47
LSE2	F	2,000.00	1,200.00	9.74	11,690.21
LSE3	F		800.00	9.74	7,793.47
LSE1	G	500.00	500.00	8.28	4,140.28
LSE1	H	700.00	350.00	8.77	3,068.68
LSE3	H		350.00	8.77	3,068.68
LSE3	I	1,000.00	500.00	8.77	4,383.83
LSE2	I		500.00	8.77	4,383.83
LSE2	J	7,000.00	2,100.00	10.23	21,480.76
LSE1	J		1,400.00	10.23	14,320.51
LSE3	J		3,500.00	10.23	35,801.27
LSE2	K	3,500.00	875.00	10.23	8,950.32
LSE3	K		2,625.00	10.23	26,850.95
					200,000.00

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Appendix II: Carbon Residual Analysis

Carbon Residual Analysis

- At the February 4, 2019 MIWG meeting, the NYISO reviewed the proposed proportional Carbon Residual allocation. The presentation also explained that in the unlikely circumstance the carbon residual is negative, the tariff will include rules for allocating these carbon residual shortfalls to LSEs. The NYISO proposed that carbon residual shortfalls be allocated according to load ratio share in a similar way to how other residual shortfalls are allocated.
  - Using the same load ratio share allocation for both would allocate more of the shortfall to zones that have already borne a higher impact of the carbon charge in their prices (i.e., have a higher LBMPc) which is not consistent with the design objective of avoiding major cost shifts among customers.
- Stakeholders requested that the NYISO provide more information about the likelihood of a carbon residual shortfall in the future.
  - A carbon residual shortfall will occur when there are less carbon charges collected from internal generators, imports, and wheels through than carbon payments to exports and wheels through. This circumstance can arise when an emitting resource is on the margin while much of the energy is being provided by zero carbon resources.
- Stakeholders suggested leveraging the GE MAPS runs used in the carbon pricing consumer impact analysis to estimate the frequency of a carbon residual shortfall.

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Carbon Residual Analysis

- **The NYISO was able to confirm, using the GE MAPS runs from the consumer impact analysis, that even in the 2030 cases, a carbon residual shortfall is unlikely: the review of the two 2030 MAPS cases most likely to have carbon residual shortfalls found <u>no hours</u> where a carbon residual shortfall would have occurred.**
  - A carbon residual shortfall requires that in the same hour there be both 1) low levels of internal NYCA carbon emitting generation and 2) net exports from the NYCA
  - The two 2030 consumer impact cases analyzed were D10fs and D12fspv*
    - These scenarios retired two nuclear units, added renewables including approximately 1,300MW of offshore wind, shifted 2.9TWh of renewable generation downstate and, in the D12fspv scenario, also added 500MW of behind the meter solar in zone G.
  - The NYISO found no hours during which a carbon residual shortfall would have occurred.
    - In other words, even with the renewables expected in 2030, including offshore wind and additional behind the meter solar, there were no hours with a carbon residual shortfall.

*See Brattle Memo "Summary of GE MAPS Cases Used in Issue Track 5 Analysis at the following link: https://www.nyiso.com/documents/20142/3715785/2018.10.12%20MAPS%20Memo.pdf/d9f5bc46-1f76-42f2-ae32-1a1e8b25de66

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Appendix III: LBMPc Examples

For further information regarding the LBMPc calculation, please refer to the following presentation: https://www.nyiso.com/documents/20142/6785167/5.30.2019_MIWG_Carbon_Pricing_LBMPc_FINAL.pdf/e1ce07eb-84b3-5c31-1026-17a513cba2fe

Marginal Fuel Used is Natural Gas

Variable		Interval 1
I	LBMP ($/MWh)	$50.00
II	Variable O&M (VOM) Cost	$3.00
III	Natural Gas Price ($/mmBtu)	$2.50
IV	Tons of Carbon per mmBTU	0.059
V	Social Cost of Carbon ($/ton)	$48.30
VI	Estimated Emissions Cost ($/mmBTU) [IV*V]	$2.85
VII	(LBMP-VOM)/(Fuel Price+Emissions Cost) (mmBtu/MWh) [(I-II)/(III+VI)]	8.8
VIII	Implied Heat Rate (mmBtu/MWh) [If VII < 5, then 0; If VII>21, then 21, Else VII]	8.8
IX	Estimated RGGI Cost ($/ton)	$4.00
X	Net Social Cost of Carbon ($/ton) [V-IX]	$44.30
XI	Tons of Carbon per MWh [IV*VIII]	0.518
XII	LBMPc ($/MWh) [X*XI]	$22.96

*Variables and calculations on this slide are for example purposes only

^For this example, Maximum Implied Heat Rate = 21, Minimum Implied Heat Rate = 5

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Marginal Fuel used is Fuel Oil

Variable		Interval 1
I	LBMP ($/MWh)	$80.00
II	Variable O&M (VOM) Cost	$3.00
III	Fuel Oil Price ($/mmBtu)	$6.00
IV	Tons of Carbon per mmBTU	0.081
V	Social Cost of Carbon ($/ton)	$48.30
VI	Estimated Emissions Cost ($/mmBTU) [IV*V]	$3.91
VII	(LBMP-VOM)/(Fuel Price+Emissions Cost) (mmBtu/MWh) [(I-II)/(III+VI)]	7.8
VIII	Implied Heat Rate (mmBtu/MWh) [If VII < 5, then 0; If VII>21, then 21, Else VII]	7.8
IX	Estimated RGGI Cost ($/ton)	$4.00
X	Net Social Cost of Carbon ($/ton) [V-IX]	$44.30
XI	Tons of Carbon per MWh [IV*VIII]	0.629
XII	LBMPc ($/MWh) [X*XI]	$27.87

*Variables and calculations on this slide are for example purposes only
^For this example, Maximum Implied Heat Rate = 21, Minimum Implied Heat Rate = 5

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Minimum Heat Rate Effective

- Assume the minimum heat rate in effect is 5.0.
  - In the following example, the implied heat rate calculated at row VIII would have been 1.3, but this is below the minimum value, thus the implied heat rate is set to 0.

Variable		Interval 1
I	LBMP ($/MWh)	$10.00
II	Variable O&M (VOM) Cost	$3.00
III	Natural Gas Price ($/mmBtu)	$2.50
IV	Tons of Carbon per mmBTU	0.059
V	Social Cost of Carbon ($/ton)	$48.30
VI	Estimated Emissions Cost ($/mmBTU) [IV*V]	$2.85
VII	(LBMP-VOM)/(Fuel Price+Emissions Cost) (mmBtu/MWh) [(I-II)/(III+VI)]	1.3
VIII	Implied Heat Rate (mmBtu/MWh) [If VII < 5, then 0; If VII>21, then 21, Else VII]	0.0
IX	Estimated RGGI Cost ($/ton)	$4.00
X	Net Social Cost of Carbon ($/ton) [V-IX]	$44.30
XI	Tons of Carbon per MWh [IV*VIII]	0.000
XII	LBMPc ($/MWh) [X*XI]	$0.00

*Variables and calculations on this slide are for example purposes only

^For this example, Maximum Implied Heat Rate = 21, Minimum Implied Heat Rate = 5

Maximum Heat Rate Effective

- Assume the maximum heat rate in effect is 21.0.
  - In the following example, the implied heat rate calculated at row VIII would have been 92.9, but this is above the maximum value, thus the implied heat rate is set to 21.0.

Variable		Interval 1
I	LBMP ($/MWh)	$500.00
II	Variable O&M (VOM) Cost	$3.00
III	Natural Gas Price ($/mmBtu)	$2.50
IV	Tons of Carbon per mmBTU	0.059
V	Social Cost of Carbon ($/ton)	$48.30
VI	Estimated Emissions Cost ($/mmBTU) [IV*V]	$2.85
VII	(LBMP-VOM)/(Fuel Price+Emissions Cost) (mmBtu/MWh) [(I-II)/(III+VI)]	92.9
VIII	Implied Heat Rate (mmBtu/MWh) [If VII < 5, then 0; If VII>21, then 21, Else VII]	21.0
IX	Estimated RGGI Cost ($/ton)	$4.00
X	Net Social Cost of Carbon ($/ton) [V-IX]	$44.30
XI	Tons of Carbon per MWh [IV*VIII]	1.239
XII	LBMPc ($/MWh) [X*XI]	$54.89

*Variables and calculations on this slide are for example purposes only

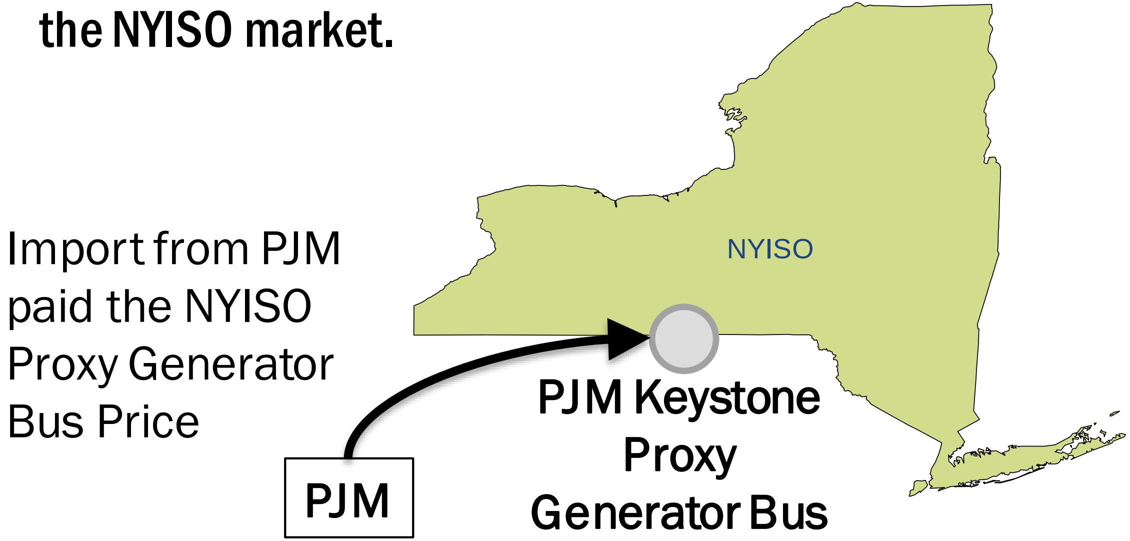
^For this example, Maximum Implied Heat Rate = 21, Minimum Implied Heat Rate = 5

Appendix IV: Import and Export Transaction Examples

Note: The examples in this presentation will focus on the Proxy Generator Bus price in the NYISO market.

Import Transaction Examples - Overview

- A Market Participant (MP) intending to import into the New York Control Area (NYCA) will sell power at the proxy generator bus for the applicable control area in the NYISO market.



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Import Example – Accurate Prediction

- **In the example at right, the importer bids to sell at a proxy generator bus.**
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$52.59	$52.59
LBMP	$53.18	$53.18

Import Example – Accurate Prediction

- In the example at right, the importer bids to sell at a proxy generator bus.
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.
- The importer's bid is scheduled in the DA market.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$52.59	$52.59
LBMP	$53.18	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	$531.80	0

Import Example – Accurate Prediction

- In the example at right, the importer bids to sell at a proxy generator bus.
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.
- The importer's bid is scheduled in the DA market.
  - The resource flows and has net revenue of $5.90.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$52.59	$52.59
LBMP	$53.18	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	$531.80	0
LBMPc Charge/ Credit	0	-$225.90
Net Settlement	$531.80	-$225.90
Bid Cost	-$300.00	$0.00
Net Revenue	N/A	$5.90

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Import Example – Under-Predict LBMPc

- **In the example at right, the importer bids to sell at a proxy generator bus.**
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$30.00	$30.00
LBMP	$31.00	$53.18

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Import Example – Under-Predict LBMPc

- In the example at right, the importer bids to sell at a proxy generator bus.
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.
- The importer's bid is scheduled in the DA market.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$30.00	$30.00
LBMP	$31.00	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	$310.00	0

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Import Example – Under-Predict LBMPc

- In the example at right, the importer bids to sell at a proxy generator bus.
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.
- The importer's bid is scheduled in the DA market.
  - The resource flows and has net revenue of -$215.90.
  - This is due to the fact that an emitting resource was on the margin in RT, whereas the import expected a non-emitting resource to be marginal.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$30.00	$30.00
LBMP	$31.00	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	$310.00	0
LBMPc Charge/ Credit	0	-$225.90
Net Settlement	$310.00	-$225.90
Bid Cost	-$300.00	$0.00
Net Revenue	N/A	-$215.90

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Import Example – DA LBMPc Higher

- **In the example at right, the importer bids to sell at a proxy generator bus.**
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$52.59	$52.59
LBMP	$75.00	$53.18

Import Example – DA LBMPc Higher

- In the example at right, the importer bids to sell at a proxy generator bus.
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.
- The importer's bid is scheduled in the DA market.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$52.59	$52.59
LBMP	$75.00	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	$750.00	0

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Import Example – DA LBMPc Higher

- **In the example at right, the importer bids to sell at a proxy generator bus.**
  - Under carbon pricing, imports would forecast LBMPc when bidding into the DA and RT Market.
- **The importer's bid is scheduled in the DA market.**
  - A different resource, likely with lower emissions cost, is marginal in RT.
  - The resource flows and has net revenue of $224.10.

Market	Day-Ahead	Real Time
Import Cost	$30.00	$30.00
Import Bid for Proxy LBMP	$52.59	$52.59
LBMP	$75.00	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	$750.00	0
LBMPc Charge/ Credit	0	-$225.90
Net Settlement	$750.00	-$225.90
Bid Cost	-$300.00	$0.00
Net Revenue	N/A	$224.10

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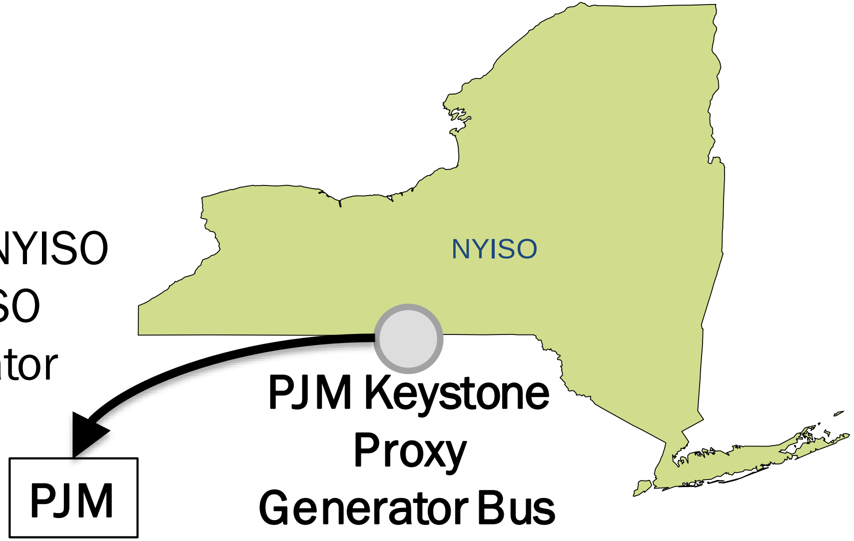
Export Transaction Examples - Overview

- An MP intending to export from the New York Control Area (NYCA) will purchase power at the proxy generator bus for the applicable control area in the NYISO market.

Export from NYISO pays the NYISO Proxy Generator Bus Price



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Export Example – Accurate Prediction

- **In the example at right, the exporter bids to buy at a proxy generator bus.**
  - Under carbon pricing, exports would forecast LBMPc when bidding into the DA and RT Market.

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$53.59	$53.59
LBMP	$53.18	$53.18

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Export Example – Accurate Prediction

- In the example at right, the exporter bids to buy at a proxy generator bus.
  - Under carbon pricing, exports would forecast LBMPc when bidding into the DA and RT Market.
- The exporter's bid is scheduled in the DA market.

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$53.59	$53.59
LBMP	$53.18	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	$531.80	0

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Export Example – Accurate Prediction

- **In the example at right, the exporter bids to buy at a proxy generator bus.**
  - Under carbon pricing, exports would forecast LBMPc when bidding into the DA and RT Market.
- **The exporter's bid is scheduled in the DA market.**
  - The resource flows and has net revenue of $4.10.

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$53.59	$53.59
LBMP	$53.18	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	$531.80	0
LBMPc Charge/ Credit	0	$225.90
Net Settlement	-$531.80	$225.90
Export Revenue	$310.00	$0.00
Net Revenue	N/A	$4.10

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Export Example – Under-Predict LBMPc

- In the example at right, the exporter bids to buy at a proxy generator bus.

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$30.00	$30.00
LBMP	$25.00	$53.18

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Export Example – Under-Predict LBMPc

- In the example at right, the exporter bids to buy at a proxy generator bus.
  - Under carbon pricing, exports would forecast LBMPc when bidding into the DA and RT Market.
- The exporter's bid is scheduled in the DA market.

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$30.00	$30.00
LBMP	$25.00	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	-$250.00	0

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Export Example – Under-Predict LBMPc

- **In the example at right, the exporter bids to buy at a proxy generator bus.**
  - Under carbon pricing, exports would forecast LBMPc when bidding into the DA and RT Market.
- **The exporter's bid is scheduled in the DA market.**
  - The export bid has not included an adjustment to account for the LBMPc.
  - The resource flows and has net revenue of $285.90

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$30.00	$30.00
LBMP	$25.00	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	-$250.00	0
LBMPc Charge/ Credit	0	$225.90
Net Settlement	-$250.00	$225.90
Export Revenue	$310.00	$0.00
Net Revenue	N/A	$285.90

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Export Example – DA LBMPc Higher

- In the example at right, the exporter's bid is scheduled in the DA market.

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$80.00	$80.00
LBMP	$75.00	$53.18

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Export Example – DA LBMPc Higher

- **In the example at right, the exporter's bid is scheduled in the DA market.**
  - A resource with lower emissions cost is marginal in RT.

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$80.00	$80.00
LBMP	$75.00	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	-$750.00	0

Export Example – DA LBMPc Higher

- **In the example at right, the exporter's bid is scheduled in the DA market.**
  - A resource with lower emissions cost is marginal in RT.
  - The resource flows with net revenue of -$214.10.

Market	Day-Ahead	Real Time
Export Price (External Energy Price)	$31.00	$31.00
Export Bid for Proxy LBMP	$80.00	$80.00
LBMP	$75.00	$53.18
LBMPc	N/A	$22.59
LBMP minus LBMPc	N/A	$30.59
Schedule	10	10
LBMP Settlement	-$750.00	0
LBMPc Charge/ Credit	0	$225.90
Net Settlement	-$750.00	$225.90
Export Revenue	$310.00	$0.00
Net Revenue	N/A	-$214.10

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Appendix V: Example - Potential Penalties during Emissions Data Submission

Please Note: This example expands upon tariff revisions in MST 15.9.

Example 1 Assumptions

- **Assume for purposes of example 1:**
  - The NYISO estimates for the initial invoice that the generator's emissions are 9 tons.
  - The cost of carbon emissions is $40/ton.
  - The generator has 10 tons of actual carbon emissions.
  - The generator does not report emissions by the 60 day deadline.
  - The generator does not report emissions by the 170 day deadline.
- **Invoice charges in this example show the generator's final position as of the invoice version.**
  - No addition or subtraction between invoice versions are necessary in this example

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Example 1

- **Initial Invoice Version 1 (before 60 day deadline)**
  - Supplier Carbon Charge = $360
  - Failure to report by 60 day deadline penalty = Not Applicable
  - Failure to report by 170 day deadline penalty = Not Applicable
  - Failure to report accurate final carbon emissions penalty = Not Applicable
- **Total = $360**

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Example 1

- **Settlement Adjustment Invoice Version 2 (after 60 day deadline, before 170 day deadline)**
  - Supplier Carbon Charge = $360
  - Failure to report by 60 day deadline penalty = $180
  - Failure to report by 170 day deadline penalty = Not Applicable
  - Failure to report accurate final carbon emissions penalty = Not Applicable
- **Total = $540**

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Example 1

- **Final Invoice (after 170 day deadline)**
  - Supplier Carbon Charge = $360
  - Failure to report by 60 day deadline penalty = $180
  - Failure to report by 170 day deadline penalty = $540
  - Failure to report accurate final carbon emissions penalty = Not Applicable
- **Total = $1,080**

Example 2 Assumptions

- **Assume that at day 165, the generator in example 1 reports emissions of 6 tons, when the generator emissions are actually 10 tons.**
- **Assume for purposes of example 2:**
  - The NYISO estimates for the initial invoice that the generator's emissions are 9 tons.
  - The cost of carbon emissions is $40/ton.
  - The generator does not report emissions by the 60 day deadline.
  - The generator reports emissions of 6 tons at day 165.
  - The generator has 10 tons of actual carbon emissions.

Example 2

- **Initial Invoice Version 1 and Settlement Adjustment Invoice Version 2 would be the same as in example 1.**
- **Final Invoice**
  - Supplier Carbon Charge = $240
  - Failure to report by 60 day deadline penalty = $180
  - Failure to report by 170 day deadline penalty = Not Applicable
- **Invoice issued after final bill closeout**
  - Failure to report accurate final carbon emissions penalty = $320
- **Total = $740**

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Appendix VI: Tariff Revisions

Select Definitions

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Select Definitions

- **New defined tariff terms are necessary to effectuate carbon pricing.**
  - Carbon Emissions: Point-of-production carbon dioxide (“CO2”) emissions, in short tons, that result from Energy injected, or start-up to inject Energy, in connection with participation in the ISO Administered Markets.
  - Cost of Carbon Emissions: For purposes of the ISO Administered Markets, a dollar per short ton value of Carbon Emissions equal to the Social Cost of Carbon minus the value of any other state, multi-state, or federal charges for Carbon Emissions that the Supplier is required to pay, as set forth in ISO Procedures, including but not limited to carbon dioxide emission allowance costs. If the calculated Cost of Carbon Emissions is negative, the ISO shall set the value to zero.
  - Social Cost of Carbon (“SCC”): A value, in dollars per short ton of carbon dioxide, established by the PSC in accordance with the New York State Administrative Procedure Act.

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Annual Updates for Net Energy and Ancillary Revenue Offset (MST 5.14.1.2.2.2)

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Annual Updates for Net Energy and Ancillary Revenue Offset

- For purposes of the annual updates to the ICAP Demand Curves, the NYISO determines updated values for the net Energy and Ancillary Services revenue offset associated with each peaking plant.
- The Cost of Carbon Emissions under the carbon pricing proposal is included within the variable cost of the applicable peaking plant.
  - The NYISO has also noted that this cost shall be zero prior to the effective date of the carbon pricing proposal.

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Carbon Charges for Suppliers – MST Rate Schedule 9, Section 15.9.1 & 15.9.2

Carbon Charges for Suppliers

- All Suppliers, electrically located in the NYCA, with Carbon Emissions shall be subject to the Supplier Carbon Charge except Demand Side Resources participating as an SCR or EDRP and Suppliers that came into operation after January 1, 2015 and meet the eligibility criteria set forth in Appendix A to the NYPSC Order Adopting a Clean Energy Standard.*
- The ISO shall calculate a Supplier Carbon Charge based on the Supplier's reported Carbon Emissions data; however, if the Supplier has not provided hourly Carbon Emissions data to the ISO, the ISO shall calculate the Supplier Carbon Charge based on its estimate of the Carbon Emissions.

*NYPSC Case No. 15-E-0302 – Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard – *Order Adopting a Clean Energy Standard* (August 1, 2016).

Carbon Charges for Suppliers

- **Section 15.9.1 Carbon Charges**
  - The NYISO shall charge each applicable Supplier for Carbon Emissions ("Supplier Carbon Charge").

Supplier Carbon Charge for Supplier *u* in hour *h* = $CE_{uh} * CC_{uh}$

Where:

CE_{uh} = Carbon Emissions by Supplier u in hour h

CC_{uh} = The Cost of Carbon Emissions for Supplier u in hour h

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Carbon Charges for Suppliers

- **Section 15.9.2 Reporting Carbon Emissions**
  - This section refers to the timeframes for emissions reporting outlined in MST Section 7.4.1.1, as well as discusses penalties. Appendix V of this presentation includes examples of potential penalties.
    - Section 15.9.2.1 notes that if Carbon Emissions are not reported timely by day 60, then the Supplier will be charged 0.5 times the applicable Carbon Emissions.
      - This penalty is in addition to the charge for Carbon Emissions on the initial invoice.
    - Section 15.9.2.1 further notes that if Carbon Emissions are not reported timely by day 170, then the Supplier will be charged 1.5 times the applicable Carbon Emissions.
      - This penalty is in addition to the charge for Carbon Emissions on the initial invoice.
      - This penalty is in addition to the charge if Carbon Emissions are not reported timely by day 60.
    - Section 15.9.2.2 notes that if Carbon Emissions are underreported, then the Supplier will be charged 2 times the applicable Carbon Emissions
      - This penalty is in addition to the charge for Carbon Emissions on the initial invoice.
      - This penalty is in addition to the failure to report by day 60 penalty outlined in section 15.9.2.1, if applicable.

Social Cost of Carbon – MST Section 15.9.3

Social Cost of Carbon – MST Section 15.9.3

- The ISO shall utilize the Social Cost of Carbon in the ISO Administered Markets.
- The ISO Services Tariff will reference the PSC order setting the initial Social Cost of Carbon.
- The ISO shall maintain a posting on its website that sets forth the effective Social Cost of Carbon.
  - To the extent revised Social Cost of Carbon value(s) are established by the PSC, such revised values will be utilized.
  - The revised Social Cost of Carbon will become effective on the first day of a calendar month following the posting of such revised values to the ISO's website.
- In the event the PSC establishes Social Cost of Carbon value(s) through only a specified date and has not established a revised value(s) beyond such specified date, the ISO shall continue using the last value set by the PSC.

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Carbon Charges, Carbon Payments, and the Allocation of the Carbon Residual - OATT Rate Schedule 18

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Carbon Charges, Carbon Payments and Allocation of the Carbon Residual

- **Section 6.18.1 Carbon Charges for Import Transactions and Wheels Through**
  - The ISO will charge each Transmission Customer scheduling Imports and Wheels Through the LBMPc at the relevant Proxy Generator Bus ("Transmission Customer Carbon Charge").

$$\text{Transmission Customer Carbon Charge}_{icp} = \text{InjectionUnits}_{icp} * LBMPc_{ip}$$

Carbon Charges, Carbon Payments and Allocation of the Carbon Residual

- **Section 6.18.2 Carbon Charges for Export Transactions and Wheels Through**
  - The ISO will pay each Transmission Customer scheduling Exports and Wheels Through the LBMPc at the relevant Proxy Generator Bus (“Transmission Customer Carbon Payment”).

Transmission Customer Carbon Payment$_{icp}$ = $\text{WithdrawalUnits}_{icp}$ * $LBMPc_{ip}$

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Carbon Charges, Carbon Payments and Allocation of the Carbon Residual

- **Section 6.18.3 Calculation of Carbon Residual Payments/ Charges**
  - Calculation of the Carbon Residual:
    - Transmission Customer Carbon Payments for Export Transactions and Wheels Through subtracted from the sum of all Supplier Carbon Charges and Transmission Customer Carbon Charges for Import Transactions and Wheels Through
  - This section defines the calculation of the Carbon Residual credit for each Transmission Customer through the proportional allocation methodology.

$$Carbon\ Residual\ Credit_{ch} = \frac{\sum_z (WithdrawalUnits_{czh} * HourlyLBMPc_{zh})}{\sum_z (TotalWithdrawalUnits_{zh} * HourlyLBMPc_{zh})} * CarbonResidual_h$$

  - This section also defines the Carbon Residual charge if there is a Carbon Residual Shortfall as allocated through load ratio share.

$$Carbon\ Residual\ Charge_{ch} = (-1) * CarbonResidual_h * \frac{WithdrawalUnits_{ch}}{TotalWithdrawalUnits_h}$$

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LBMPc – OATT Section 6.18.4

LBMPc – OATT Section 6.18.4

- The NYISO shall calculate the LBMPc for each Load Zone and Proxy Generator Bus in Real-Time for each RTC and RTD interval, as well as look-ahead intervals using the formula shown on this slide.
- The following values shall be set in accordance with ISO procedures:
  - Variable operations and maintenance cost ($/MWh)
  - Fuel indices ($/mmBTU)
  - Emissions (tons/mmBTU)
  - Minimum Implied Heat Rate (mmBTU/MWh)
  - Maximum Implied Heat Rate (mmBTU/MWh)
- If the LBMP is corrected, then the LBMPc shall be recalculated based on the applicable revised LBMP and updated if necessary.

$$Emissions\ Cost_{ip} = (Emissions_{ip} * SCC_i)$$

$$\left(\frac{LBMP_{ip} - VOM_{ip}}{Fuel\ Cost_{ip} + Emissions\ Cost_{ip}}\right) = IHR_{ip}$$

$$LBMPc_{ip} = Max\left(\left(IHR_{ip} * Net\ SCC_i * Emissions_{ip}\right), 0\right)$$

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Revisions to MST section 7.4.1.1 ISO Corrections or Adjustments and Customer Challenges to the Accuracy of Settlement Information

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Emissions Data Submission

- **New MST Section 7.4.1.1.2**
  - A Supplier shall provide the NYISO with all Carbon Emissions data within 60 days from the date of the initial invoice for the month in which service is rendered.
    - The ISO shall post Carbon Emissions data to the Supplier's account for review as soon as practicable after it is received.
- **New MST Section 7.4.1.1.6**
  - A Supplier shall provide to the ISO any final updates or corrections to Carbon Emissions data within 170 days from the date of the initial invoice.
    - The ISO shall process final updates or corrections to Carbon Emissions data as soon as practicable after it is received, after which time it shall be finalized.
- **Revision to MST Section 7.4.1.1.7**
  - Add a reference to Carbon Emissions data in order to treat Carbon Emissions data like metering data throughout the review periods.

Mitigation & Reference Level Language (MST 23.3.1.4, 23.3.3.3.2, 30.4.5.3.2, 30.6.2.2)

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Mitigation & Reference Level Language

- Emissions rates and emissions costs are included within the data that the NYISO may request from Market Parties.
- The Cost of Carbon Emissions may be included within Supplier reference levels.

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Additional OATT Tariff Revisions

OATT Tariff Revisions

- Certain OATT tariff revisions mirror the previously discussed MST tariff language:
  - OATT Sections 1.3 and 1.19 reflect the new MST definitions
  - OATT Section 2.7.4.2.1 incorporates the same revisions as those proposed in MST Section 7.4.1.1

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The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system

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