

Carbon Pricing

Calculating the LBMPc

The Treatment of Opportunity Cost Resources

Ethan D. Avallone

TECHNICAL SPECIALIST – ENERGY MARKET DESIGN

Market Issues Working Group (MIWG)

April 8, 2019 Rensselaer NY

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Agenda

- Background
- Calculating the LBMPc
- The Treatment of Opportunity Cost Resources
- Carbon Pricing Timeline

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Background

Background

- This presentation will discuss the LBMP carbon impact (LBMPc) calculation, as well as the treatment of opportunity cost resources.
 - LBMPc was discussed at the IPPTF meetings in 2018.*
 - The treatment of resources bidding opportunity costs into the NYISO markets was also discussed at the IPPTF in 2018.^

*Link to the 7/9/2018 IPPTF meeting LBMPc presentation: <https://www.nyiso.com/documents/20142/1406035/IT%202%20LBMP%20Carbon%20Impact%20FINAL.pdf/0cf758f2-8320-125d-1e4d-0e992965bfb3>

Link to the 8/27/2018 IPPTF meeting LBMPc presentation: <https://www.nyiso.com/documents/20142/3716686/10.29.2018%20LBMPc%20Formulation%20DRAFT.pdf/180e88ba-eb70-c55a-9b69-95e6ba1a285a>

^Link to the 11/26/2018 Opportunity Cost Resources presentation:

<https://www.nyiso.com/documents/20142/3738019/11.26.2018%20IPPTF%20Additional%20Updates%20to%20Carbon%20Pricing%20Proposal%20FINAL.pdf/ca2d53f4-b7bb-f049-0223-273fc54785ac>

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LBMP_c

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LBMPc Calculation

- The IPPTF Carbon Pricing Proposal 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.

*Link to IPPTF Carbon Pricing Proposal: <https://www.nyiso.com/documents/20142/3911819/Carbon-Pricing-Proposal%20December%202018.pdf/72fe5180-ef24-f700-87e5-fb6f300fb82c>

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How is the LBMP_C used?

- The LBMP_C is needed to:
 - Allocate the carbon credit to LSEs
 - Information on the proportional allocation methodology can be found in the February 4, 2019 MIWG materials.¹
 - Prevent leakage and distortion of regional flows by charging imports and crediting exports the LBMP_C.²
 - Provide market transparency
- Note that internal generators are charged based on their actual emissions, not based on the LBMP_C.³

1. Link to Carbon Residual Allocation presentation: <https://www.nyiso.com/documents/20142/4815989/Carbon%20Pricing%20Residual%20Allocation%20FINAL.pdf/16101736-138a-e7ed-ad77-cbbef3141f16>

2. Link to Carbon Pricing Import/Export presentation: <https://www.nyiso.com/documents/20142/4461032/1152019%20MIWG%20Carbon%20Pricing%20Transactions.pdf/d5b918ce-27e2-caf3-9935-138104168cde>

3. Link to IPPTF Carbon Pricing Proposal: <https://www.nyiso.com/documents/20142/2244202/IPPTF-Carbon-Pricing-Proposal.pdf/60889852-2eaf-6157-796f-0b73333847e8>

LBMPc Calculation

- The NYISO initially proposed to perform the LBMPc calculation using a system of equations that account for binding transmission constraints and the characteristics of marginal resources.
 - NYISO staff have been unable to successfully prototype the proposed method.
 - In many cases it is not possible to solve the system of equations or determine a system of equations for a given market interval.
 - Such instances would require the NYISO market software to “persist” the LBMPc from prior intervals, potentially for long periods of time.
 - The inability to solve the system of equations can happen for different reasons, for example, due to the congestion pattern (including when Phase Angle Regulators are being optimized and impacting constraints), or because the set of marginal units identified by inspection is sometimes incomplete.

LBMPc Calculation (Continued)

- The NYISO proposes that an estimated fuel cost be used to determine the LBMPc for a Load Zone.
 - The NYISO proposes to use the RT LBMP divided by an estimated marginal fuel cost to provide an approximate heat rate.
 - The NYISO proposes to use the cost of natural gas and oil, utilizing the lowest cost fuel on an mmBTU basis.
 - The fuel indices used will be posted.
 - The NYISO will determine the conversion factor from mmBTU to tons of Carbon emissions.
 - The conversion factor will be posted.
 - The tons of Carbon emissions (tons/MWh) will be multiplied by the Social Cost of Carbon (in \$/ton) to calculate the LBMPc (in \$/MWh).

LBMPc Calculation (Continued)

- **The NYISO anticipates a number of benefits:**
 - The new calculation is more transparent than the method initially proposed.
 - Stakeholders will be better able to estimate the LBMPc and therefore it will be easier for marketers with imports/exports to estimate their charge/credits and for LSEs to estimate the carbon residual allocation
 - Fewer intervals will require the LBMPc to be persisted due to the lack of ability to solve for LBMPc in that interval
 - The NYISO also anticipates a faster solve time, enabling posting the LBMPc closer to the RT LBMP posting

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Example*

$$\left(\frac{\text{Load Zone LBMP}}{\text{Fuel Price}} * \text{Conversion Factor} \right) * \text{Social Cost of Carbon} = \text{Load Zone LBMPc}$$

	Variable	Interval 1
i	Zone LBMP (\$/MWh)	\$30.00
ii	Natural Gas Price (\$/mmBtu)	\$2.75
iii	Fuel Oil Price (\$/mmBTU)	\$6.00
iv	Heat Rate (mmBtu/MWh) (i/ii)	10.91
v	Conversion Factor (Tons of Carbon/ mmBtu)	0.025
vi	Tons of Carbon per MWh (iv*v)	0.273
vii	Social Cost of Carbon (\$/ton)	\$48.30
viii	LBMPc (vi*vii)	\$13.17

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

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Opportunity Cost Resources

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.
- **When the marginal unit emits carbon, the LBMP is expected to increase slightly under carbon pricing to reflect the emissions of the marginal unit.**
 - Carbon free opportunity cost resource bids are also likely to increase as a result of carbon pricing in some hours.

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Opportunity Cost Resources

- **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 not be charged for emissions.

Carbon Pricing Timeline

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Anticipated MIWG Meeting Schedule

MIWG Meeting Date	Topic/ Deliverable
Tuesday, January 15, 2019	Import/ Export Transaction Examples
Tuesday, January 22, 2019	Overview of Impacted Tariff Sections
Thursday, January 31, 2019	Credit Overview
	Tariff Revisions Discussion
Monday, February 4, 2019	Carbon Residual Allocation
Thursday, February 28, 2019	Tariff Revisions Discussion
Thursday, March 28, 2019	Analysis Group: Carbon Pricing Supplemental Analysis
Monday, April 8, 2019	LBMPc Calculation & Opportunity Cost Resources
Tuesday, April 30, 2019	Tariff Revisions Discussion & Additional Design Topics as Necessary
Tuesday, May 14, 2019	Tariff Revisions Discussion
Thursday, May 30, 2019	Tariff Revisions Review (If Necessary)

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- 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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