Carbon Pricing

Calculating the LBMPc

Reposted – Revisions in Green Font

Ethan D. Avallone

TECHNICAL SPECIALIST – ENERGY MARKET DESIGN

Market Issues Working Group (MIWG)

April 30, 2019 Rensselaer NY

Agenda

- Background

- LBMP Carbon Impact (LBMPc)*

- Examples

- Carbon Pricing Timeline

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

Background

Background

- **This presentation expands upon the April 8, 2019 LBMPc MIWG presentation.***

  - This presentation will provide further detail regarding the proposed LBMPc calculation.

Background

- **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 <u>not</u> automatically calculate a carbon component of LBMP.

- **The NYISO will use an *ex post* calculation to estimate the LBMP carbon impact (LBMPc).**

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

How is the LBMPc 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 LBMPc.[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

NEW YORK
INDEPENDENT
SYSTEM OPERATOR

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.

LBMPc

LBMPc Calculation – Estimated Marginal Fuel Cost

- The NYISO proposes that an estimated marginal fuel cost be used to determine the LBMPc for a given Load Zone or Proxy Generator Bus.
  - The NYISO proposes to use the RT LBMP divided by an estimated marginal fuel cost, then multiplied by a fuel conversion factor, to provide an implied heat rate.
- The NYISO will set the LBMPc to zero when the calculated LBMPc is less than zero.

$IHR = Implied\ Heat\ Rate$
$SCC = Social\ Cost\ of\ Carbon$

$$\left(\frac{LBMP}{Fuel\ Price} * Fuel\ Factor \right) = IHR$$

$$If\ IHR < Minimum\ IHR\ then\ IHR = 0\ ,\ and$$
$$If\ IHR > Maximum\ IHR\ then\ IHR = Maximum\ IHR$$

$$Max\big((IHR * Tons\ of\ Carbon\ per\ mmBTU * Net\ SCC), 0\big) = LBMPc$$

LBMPc Calculation – Fuel Prices

- **The NYISO will determine which fuel pricing point or blend of fuel pricing points is appropriate.**
  - A fuel price formed from a blend of fuel prices could consider different sources of natural gas and oil.
  - The NYISO intends to use one fuel price for the NYCA in the LBMPc calculation, though the fuel price used could vary each interval.
  - The fuel indices used will be posted.

LBMPc Calculation – Fuel Factor

- LBMP will be divided by the estimated marginal fuel cost.
  - The resulting value will then be multiplied by the fuel factor to convert to an implied heat rate.
  - The fuel factor is the percentage of the LBMP that is due to the cost of fuel.
    - The NYISO will estimate the fuel factor(s) used in the calculation, which will be posted to the NYISO website.

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.

  - The minimum and maximum heat rates would be posted.

  - The NYCA fleet ranges from a heat rate of roughly 5 mmBTU/MWh to roughly 21 mmBTU/MWh.

    - We expect that the minimum and maximum implied heat rates used in the calculation will be similar.*

*For example purposes only, may not reflect actual implementation

ISO NEW YORK INDEPENDENT SYSTEM OPERATOR

LBMPc Calculation – Carbon Emissions

- **The calculated implied heat rate will be multiplied by the tons of carbon per mmBTU to determine the tons of carbon per MWh for the applicable marginal fuel.**
  - The tons of carbon per mmBTU used will be posted for each fuel type.
    - For example, Natural Gas emissions are roughly .059 tons/mmBTU, whereas Fuel Oil emissions are roughly .081 tons/mmBTU*
- **The tons of Carbon emissions (tons/MWh) will be multiplied by the Net Social Cost of Carbon (in $/ton) to calculate the LBMPc (in $/MWh).**
  - The Social Cost of Carbon in effect would be posted.
  - The RGGI price source in effect would be posted.

For example purposes only, may not reflect actual implementation. Source: https://www.eia.gov/tools/faqs/faq.php?id=73&t=11

ISO NEW YORK INDEPENDENT SYSTEM OPERATOR

LBMPc Calculation - Inputs

- As mentioned in the previous slides, the NYISO will post several inputs that will be used in the LBMPc calculation:
  - Fuel indices
  - Fuel factor(s)
  - 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 changes to these values.

ISO NEW YORK INDEPENDENT SYSTEM OPERATOR

LBMPc Examples

NEW YORK
INDEPENDENT
SYSTEM OPERATOR

Examples

- At the 4/8/2019 MIWG meeting, stakeholders requested several examples of the LBMPc calculation.

IHR= Implied Heat Rate
SCC = Social Cost of Carbon

$$\left(\frac{LBMP}{Fuel\ Price} * Fuel\ Factor \right) = IHR$$

$$If\ IHR < Minimum\ IHR\ then\ IHR = 0\ ,\ and$$
$$If\ IHR > Maximum\ IHR\ then\ IHR = Maximum\ IHR$$

$$Max\big((IHR * Tons\ of\ Carbon\ per\ mmBTU * Net\ SCC), 0\big) = LBMPc$$

Marginal Fuel Used is Natural Gas

	Variable*	Interval 1
I	LBMP ($/MWh)	$30.00
II	Natural Gas Price ($/mmBTU)	$2.00
III	LBMP/Fuel Price (mmBTU/MWh) [I/II]	15.00
IV	Fuel Factor	0.5
V	Implied Heat Rate^ (mmBTU/MWh) [III*IV]	7.5
VI	Tons of Carbon per mmBTU	0.059
VII	Tons of Carbon per MWh [V*VI]	0.443
VIII	Social Cost of Carbon ($/ton)	$48.30
IX	Estimated RGGI Cost ($/ton)	$4.00
X	Net Social Cost of Carbon ($/ton)	$44.30
XI	LBMPc ($/MWh) [VII*X]	$19.60

*Variables and calculations on this slide are for example purposes only
^For this example, Maximum Implied Heat Rate = 20, Minimum Implied Heat Rate = 5 (see slide 12 for further information)

DRAFT – FOR DISCUSSION PURPOSES ONLY

ISO NEW YORK INDEPENDENT SYSTEM OPERATOR

Marginal Fuel used is Fuel Oil

	Variable*	Interval 1
I	LBMP ($/MWh)	$80.00
II	Fuel Oil Price ($/mmBTU)	$4.00
III	LBMP/Fuel Price (mmBTU/MWh) [I/II]	20.00
IV	Fuel Factor	0.5
V	Implied Heat Rate ^ (mmBTU/MWh) [III*IV]	10.0
VI	Tons of Carbon per mmBTU	0.081
VII	Tons of Carbon per MWh [V*VI]	0.810
VIII	Social Cost of Carbon ($/ton)	$48.30
IX	Estimated RGGI Cost ($/ton)	$4.00
X	Net Social Cost of Carbon ($/ton)	$44.30
XI	LBMPc ($/MWh) [VII*X]	$35.88

*Variables and calculations on this slide are for example purposes only
^For this example, Maximum Implied Heat Rate = 20, Minimum Implied Heat Rate = 5 (see slide 12 for further information)

NEW YORK INDEPENDENT SYSTEM OPERATOR

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 V would have been 3.8, but this is below the minimum value, thus the implied heat rate is set to 0.

	Variable	Interval 1
I	LBMP ($/MWh)	$15.00
II	Natural Gas Price ($/mmBtu)	$2.00
III	LBMP/Fuel Price (mmBtu/MWh) [I/II]	7.50
IV	Fuel Factor	0.5
V	Implied Heat Rate^ (mmBtu/MWh) [III*IV]	0.0
VI	Tons of Carbon per mmBTU	0.059
VII	Tons of Carbon per MWh [V*VI]	0.000
VIII	Social Cost of Carbon ($/ton)	$48.30
IX	Estimated RGGI Cost ($/ton)	$4.00
X	Net Social Cost of Carbon ($/ton)	$44.30
XI	LBMPc ($/MWh) [VII*X]	$0.00

*Variables and calculations on this slide are for example purposes only
^For this example, Maximum Implied Heat Rate = 20, Minimum Implied Heat Rate = 5 (see slide 12 for further information)

ISO NEW YORK INDEPENDENT SYSTEM OPERATOR

Maximum Heat Rate Effective

- Assume the maximum heat rate in effect is 20.0.

  - In the following example, the implied heat rate calculated at row V would have been 25, but this is above the maximum value, thus the implied heat rate is set to 20.0.

	Variable*	Interval 1
I	LBMP ($/MWh)	$500.00
II	Natural Gas Price ($/mmBTU)	$10.00
III	LBMP/Fuel Price (mmBTU/MWh) [I/II]	50.00
IV	Fuel Factor	0.5
V	Implied Heat Rate^ (mmBTU/MWh) [III*IV]	20.0
VI	Tons of Carbon per mmBTU	0.059
VII	Tons of Carbon per MWh [V*VI]	1.180
VIII	Social Cost of Carbon ($/ton)	$48.30
IX	Estimated RGGI Cost ($/ton)	$4.00
X	Net Social Cost of Carbon ($/ton)	$44.30
XI	LBMPc ($/MWh) [VII*X]	$52.27

*Variables and calculations on this slide are for example purposes only
^For this example, Maximum Implied Heat Rate = 20, Minimum Implied Heat Rate = 5 (see slide 12 for further information)

DRAFT – FOR DISCUSSION PURPOSES ONLY

ISO NEW YORK INDEPENDENT SYSTEM OPERATOR

Carbon Pricing Timeline

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	Additional Design Topics as Necessary (LBMPc)
Tuesday, May 14, 2019	Tariff Revisions Discussion
Thursday, May 30, 2019	Additional LBMPc Discussion & Tariff Revisions Review

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

www.nyiso.com