New York ISO
Independent System Operator

Emissions Transparency: Implied Marginal Emission Rates Proposed Design

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Agenda

- Background
- Existing Methodologies in the Industry
- Existing ISO/RTO Methodologies
- Proposed Methodology for Implied Marginal Emission Rates
- Average Emission Rates
- Next Steps

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Background

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Background

- The Emissions Transparency project is a stakeholder requested project which requires NYISO to publish marginal and average zonal emissions rates along with the LBMPs on a DAM and RT basis.

- We are targeting a 2023 Functional Requirements Specification (FRS) by the end of Q4.

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Background

- **Marginal Emissions Rate (MER): the change in CO2 emissions resulting from increase in generation or consumption**
  - MER=dCO2/dMWh
  - Relevant for near-term consumption decisions
- **Average Emissions Rate (AER): total CO2 emissions divided by total MWh generated or consumed**
  - AER=total CO2/total MWh
  - Relevant for retrospective emissions accounting

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Existing Methodologies in the Industry

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Difference-Based Models

- Divide the change in emissions between two consecutive time steps by the corresponding change in load across those times
- Highly granular, but highly subject to bias since changing grid conditions confound the effect of varying load
- These models can often lead to extreme high or low values based on coincidence, especially in situations where load is changing more slowly

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Binning-Based Regression Models

- Fit with a linear model between emissions and load, creating a slope which represents the marginal emissions relationship
- Usings multiple bins of historical data for each hour, independent regression analyses produce different rates for different grid conditions
- These models can be inaccurate if grid conditions within a bin are not similar enough along a significant confounding dimension
  - The most common confounding bias is in marginal renewable energy

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Heat Rate Models

- Use LMP and fuel prices to determine what heat rate the LMP should correspond to for a given fuel type, and use this to calculate resulting MER
- Highly variable and highly granular
- These models perform best in grids where there is typically a clearly defined fuel type that could be marginal

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Experiment-Based Models

- Use experiments (i.e., RCTs or quasi-random natural experiments) to generate MERs
- Given enough experiments, these models have extremely low bias
  - Require very large high-quality datasets
- Low statistical power – very low variability and granularity
  - Difficulty producing wide range of treatment effects under various grid conditions

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Emissions of Marginal Unit

- **Estimation of MER as equal to annual AER of the current marginal unit**
- **Advantage is that grid operators may have access to data about the grid that is not readily available to the public**
  - Highly variable and highly granular
- **Weakness is in applicability**
  - Assumes that the marginal emissions of a shift of X megawatts is equal to the emissions rate of the MU times X, which is only true in special cases that apply to very small load changes
  - Marginal unit may not be a physical resource (e.g., virtual supply or transaction with another grid)
  - Difficult to apply when storage and other opportunity cost resources are marginal

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Existing ISO/RTO Methodologies

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PJM Methodology

- PJM calculates the marginal emission rate by summing up the product of the average emission rates of the marginal units with the corresponding percentage of the increase in demand.
- For a location representing a collection of different nodes, the rates are averaged together in the same way that LMPs are averaged together to form the LMP for the area. These rates can be load-weighted or simple averages.
- Publishes marginal emissions rates with a temporal resolution of 5 minutes and a data release lag of 5 minutes

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ISO-NE Methodology

- ISO-NE uses identities of marginal units from its dispatch, paired with unit-specific emissions rates derived using EPA's Clean Air Markets Division (CAMD) Continuous Emissions Monitoring System (CEMS) data
- Resulting MERs are aggregated to produce load-weighted MERs by fuel type for each 5-minute interval for the ISO-NE region as a whole
- Along with time interval, fuel type, and MER, ISO-NE reports the amount of load for which the fuel type was setting the LMP
- Publishes marginal emissions rates with 5-minute and hourly temporal resolution and a data release lag of 1-2 years

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Proposed Methodology for Implied Marginal Emission Rates (IMERs)

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Proposed Methodology

- **The proposed methodology will be similar to the marginal emission rate calculation method discussed as part of the Carbon Pricing project in 2019.**
  - LBMP, fuel prices, emission costs and Variable Operating & Maintenance ("VOM") Costs will be used as inputs to estimate the implied heat rate. This implied heat rate will then be used to estimate the Implied MERs based on the implied marginal fuel.
  - The upper and lower boundaries for the implied heat rate will be set by using the minimum and maximum implied heat rates.
  - The implied marginal fuel will be estimated for zones based on limiting constraints mapped to reserve regions and historical analysis.
    - Limiting constraints identify persistent congestion patterns and thus enable IMERs to be calculated on a more granular level than NYCA-wide
  - Marginal fuel will be determined to be liquid fuel or natural gas based on which price is lower after the fuel index identification for a zone.
  - The Implied MERs will be estimated for RT on a zonal level.

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Proposed Methodology

- $$Implied\ Heat\ Rate\ (IHRi) = \frac{(LBMP\left(\frac{\$}{MWh}\right) - VOM\left(\frac{\$}{MWh}\right))}{Fuel\ Price\left(\frac{\$}{mmBTU}\right) + Emissions\ Cost\ (\frac{\$}{mmBTU})}$$

- $$Implied\ Heat\ Rate\ (IHRj) = 0\ if\ (IHRi < IHRmin)\ Else\ IHRmax\ if\ (IHRi > IHRmax)\ else\ IHRi$$

- $$Implied\ MER\ (Tons\ of\ Carbon\ per\ MWh) = Tons\ of\ Carbon\ per\ mmBTU * IHRj$$

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Implied MERs are Estimated Values

- IMERs are estimated emission values that will be calculated based on assumptions, as discussed in this presentation
  - NYISO expects these estimates to be reasonable but cannot and will not guarantee IMERs accuracy
- IMERs could inform those seeking to consider emissions associated with use, production, storage, or purchase of electricity
- IMERs will not:
  - Provide granular data for individuals or entities to demonstrate compliance with emission-related policies
  - Include upstream emissions or emissions from other sources

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Example

LBMP ($/MWh)	$50
Fuel Price ($/mmBTU) *(Marg. Fuel is NG)*	$4.5
Variable Operating and Maintenance Cost ("VOM") ($/MWh)	$4
Tons of Carbon per mmBTU *(for NG)*	0.059
Emissions Cost ($/mmBTU)	$2.36
Implied Heat Rate (mmBTU/MWh)	($50 - $4)/($4.5 + $2.36) = 6.71
MER (tons per MWh) *(Assuming the implied heat rate is within the bounds)*	6.71 * 0.059 = 0.40

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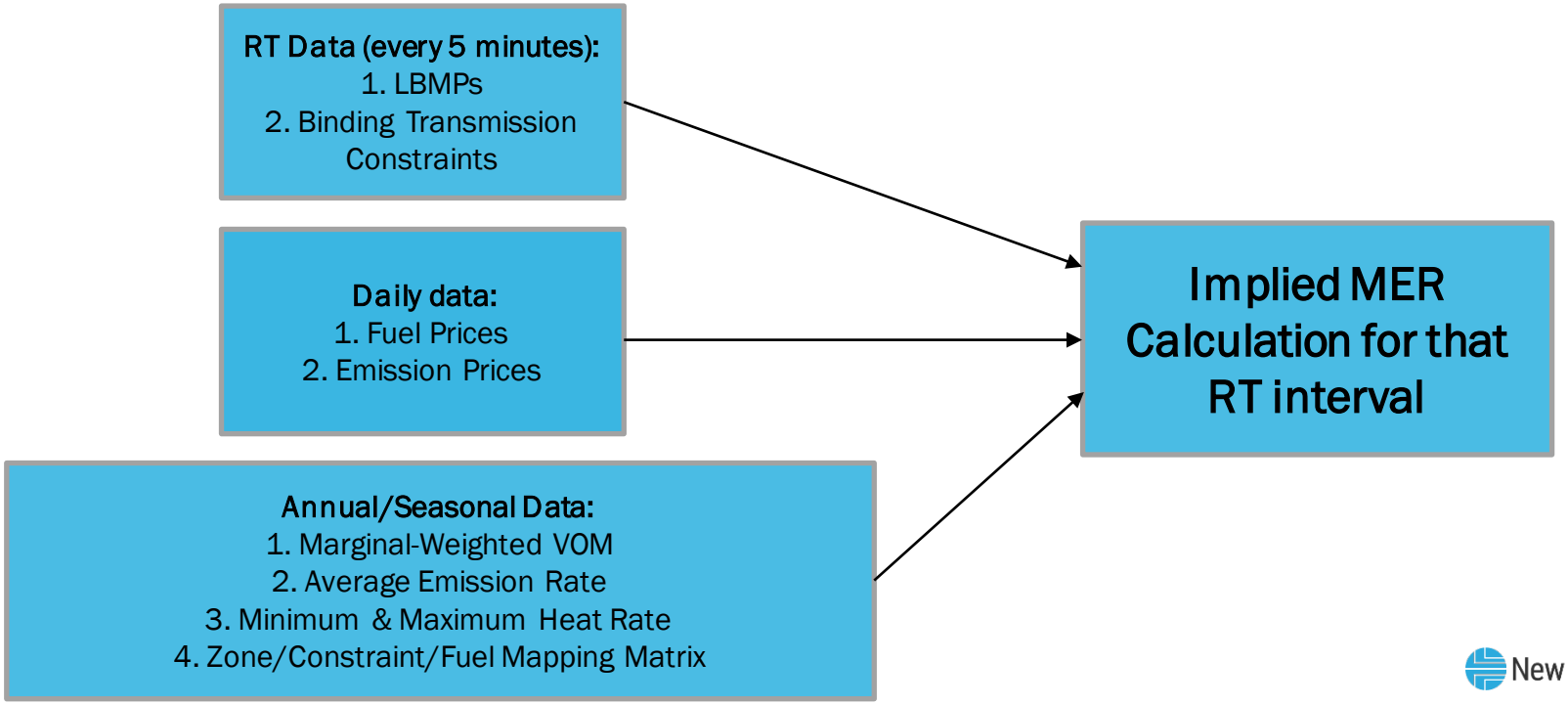
Proposed Methodology



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On-going efforts

- Limiting constraints identify persistent congestion patterns and thus enable IMERs to be calculated on a more granular level than NYCA-wide
  - Validate the set of pre-identified limiting constraints from the Carbon Pricing project and check if any new limiting constraints would need to be added.
  - NYISO is considering the appropriate validation and updating procedures and periodicity.
- Validate the associated fuel types with the limiting constraints in the Zonal/Fuel/Constraint Mapping matrix through an updated historical analysis.
  - NYISO is considering the appropriate validation and updating procedures and periodicity.
- Internal software and processes needed to post the Implied MERs.
- Identify the appropriate Manual location to memorialize the calculation and posting process

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Average Emission Rates

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Average Emission Rates

- NYISO proposes to not publish average emission rates.
- Implied MERs have more value compared to average emission rates for near term consumption decisions.
- It is very difficult to calculate Zonal Average Emission Rates from a consumption level since the load served in a certain zone can be met by generation sources from a different zone which are very difficult to identify.
  - For e.g., The load in NYC isn't served by the generation only in NYC but also from other zones. The generation sources are not known in real time to estimate the emission rate from these sources.
- There are various sources of existing public information for average emission rates if market participants would like to use this information.

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Next Steps

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Next Steps

- **May/June**
  - Return to ICAPWG/MIWG with additional information on the inputs.

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Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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