Applying Carbon Charge Border Adjustments to NYISO External Transactions

PRESENTED TO

IPPTF

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Note: An updated version of the slides are being released on April 19, 2018 to correct slides 13 and 29 which previously stated that Quebec provides a credit for emissions avoided due to exports. Gray font on these slides indicates portions of the text that have changed.

Agenda

Problem Statement to Avoid Distorting Trade

Two Options to Re-Level the Playing Field

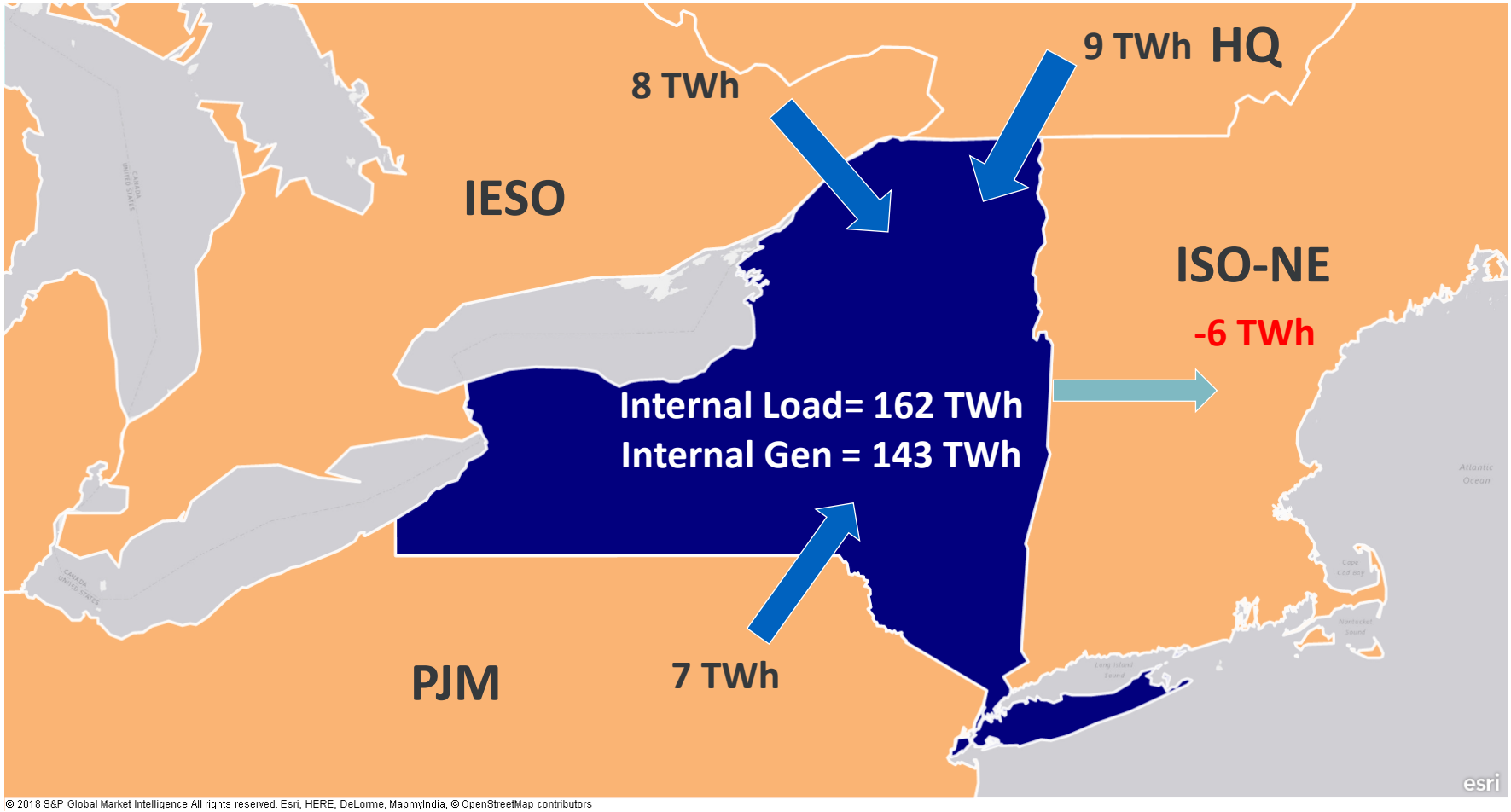
Implementation Challenges with Each

Comparison of Options

Special Treatment of New Clean Imports

New York Context

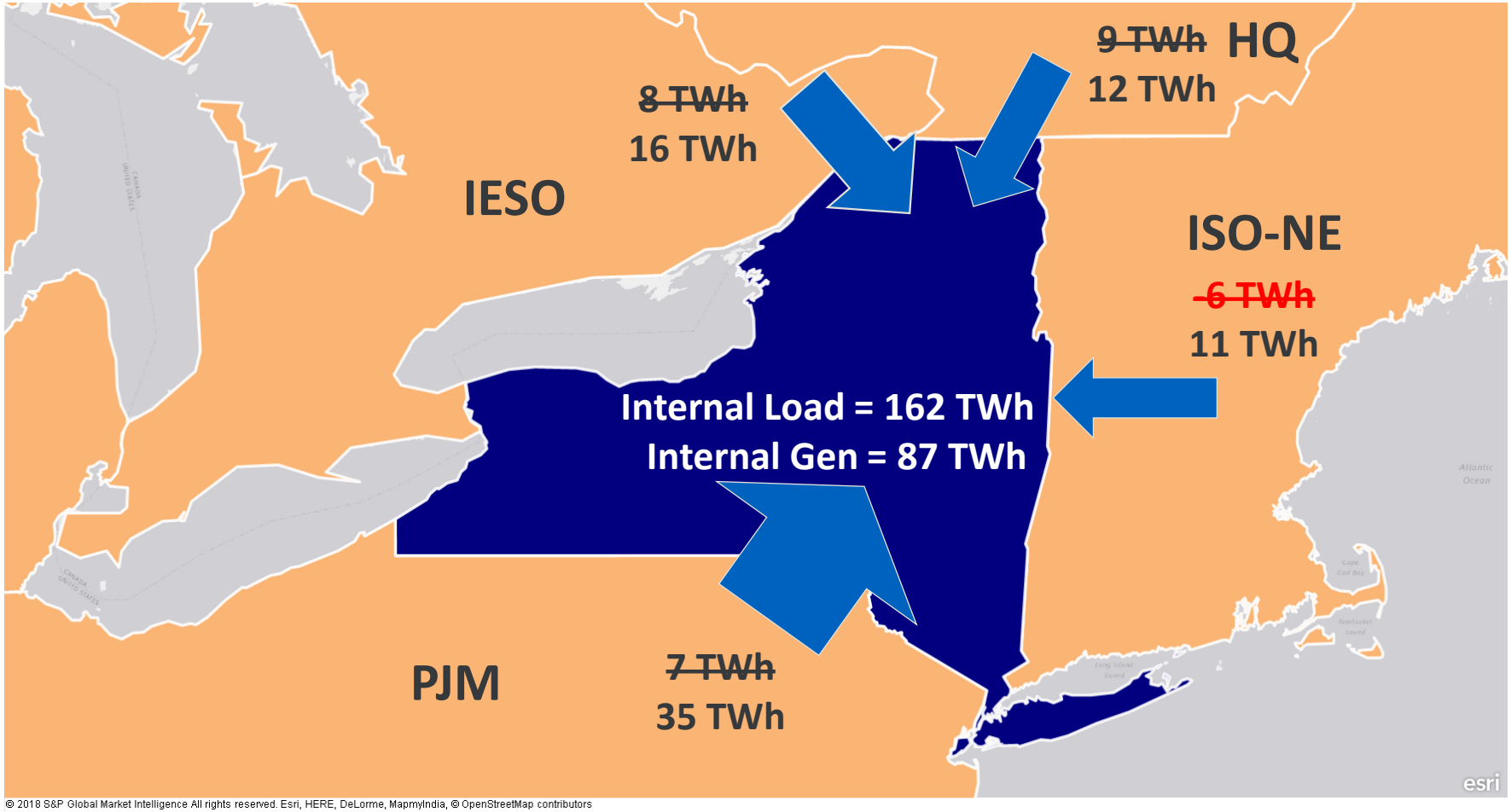
NYCA had net imports of 19 TWh in 2015, serving 12% of NYCA load



Sources: Brattle analysis of NYISO Interface Flows and Limit data from various sources (see appendix).

Effects of Carbon Pricing w/o Border Adjustment

Absent border adjustments, internal carbon pricing could dramatically increase imports to serve almost half of New York load



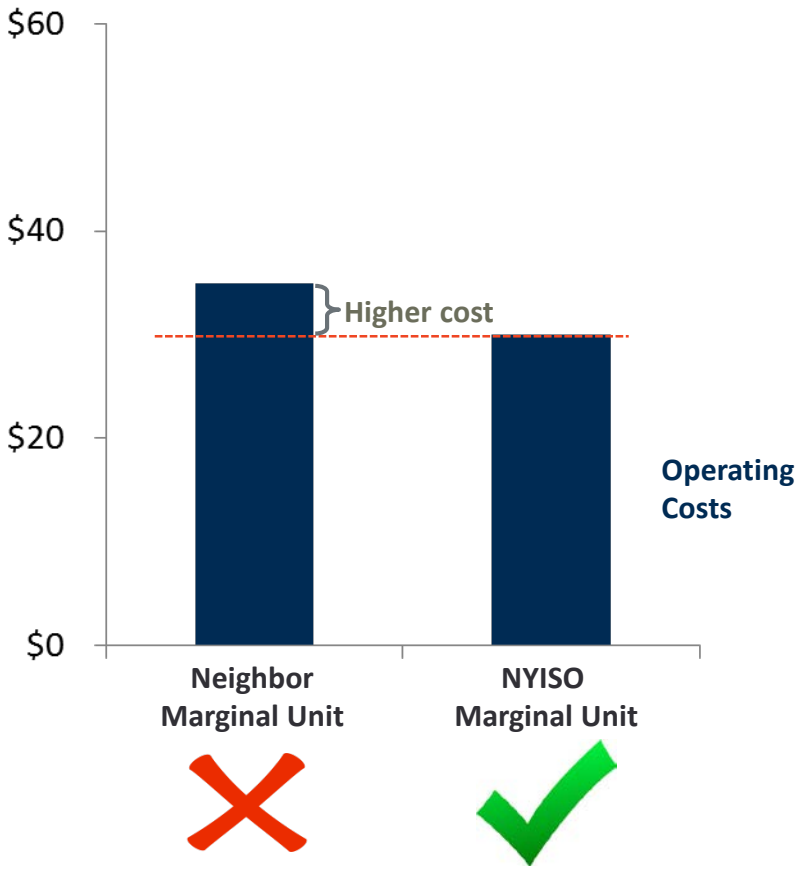
Sources: Brattle analysis of NYISO Interface Flows and Limit data from various sources (see appendix).

Carbon Pricing without Border Adjustments

Charging only internal resources disfavors them; shifts production outside NY (imports ↑, exports ↓), increases production costs, and leaks emissions (possibly increasing overall)

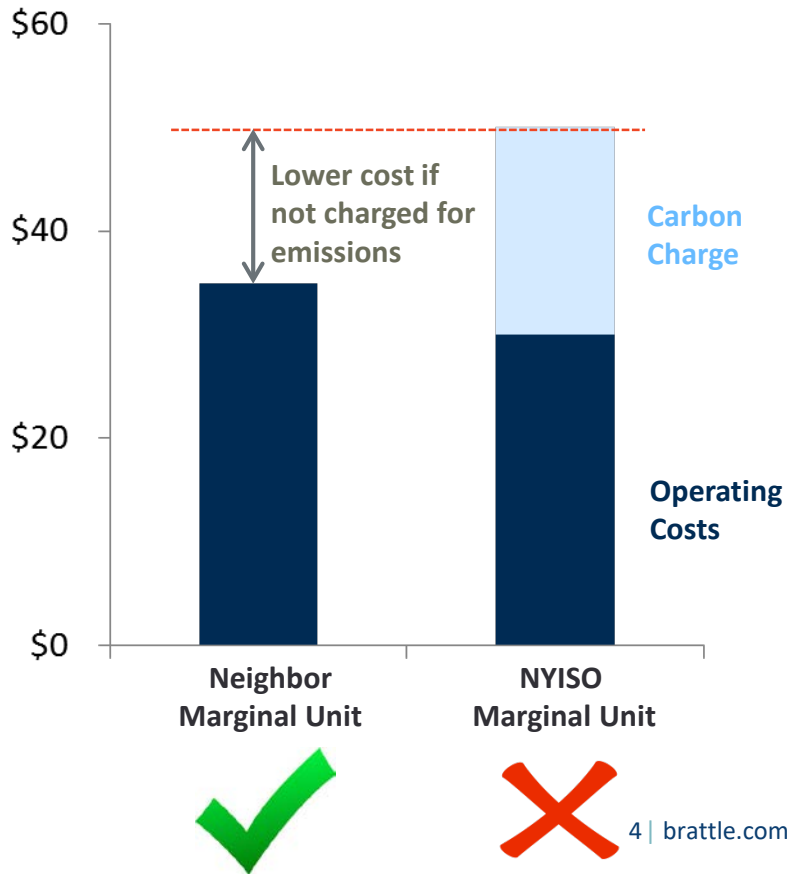
Status Quo

No Carbon Charges



NYISO Carbon Pricing

No Charges on Imports or Credits on Exports



Two Approaches to Preventing Distortions

Need to re-level the playing field to prevent distortions, in one of two ways

Option 1: External transactions compete on a status-quo basis

- Avoids distortions by making all effects of carbon charges invisible to imports and exports
  - Imports earn the NY LBMP w/o the carbon effect
  - Exports pay the NY LBMP w/o the carbon effect
- Imports/exports would remain unchanged
- Consistent with an objective to reduce internal emissions without trying to change imports/exports; that is, not imposing NY's view of externalities as far as trade is concerned

Option 2: External transactions compete on a green power basis, accounting for all emissions and NY's view of their externalities

- Avoids distortions by levying charges on imports (or crediting exports) based on their emissions
  - Imports charged based on their marginal emissions
  - Exports credited based marginal emissions avoided
- Extends the market's environmental-economic optimization to transactions, favoring clean imports and exports when they provide cost-effective abatement
- Consistent with an objective to reduce global emissions associated with serving NY load (and utilizing NY generators), when cost effective given NY's view of externalities
- Consistent with approaches used in other carbon regimes (California, Ontario, Quebec)

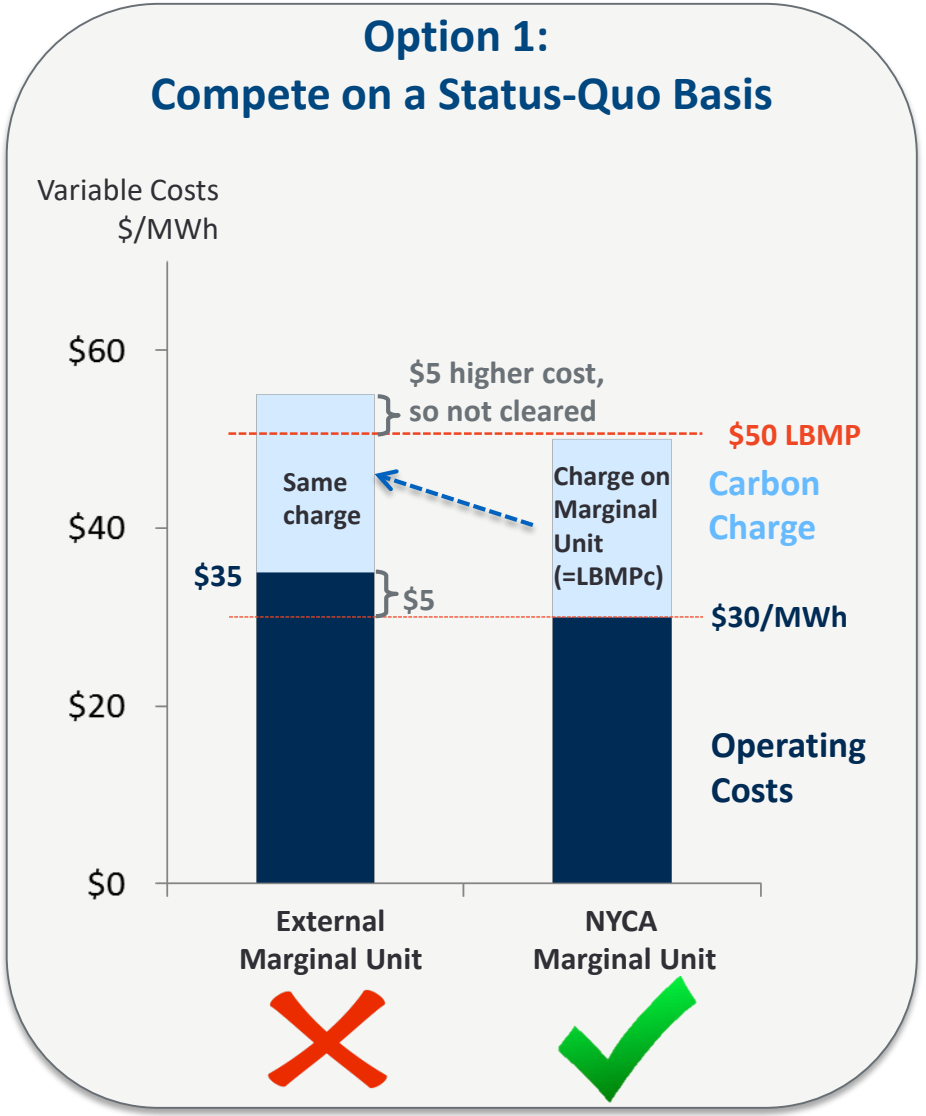
Option 1: Approach

Approach

- Charge imports the same amount as the marginal NYCA resource, *i.e.*, *the carbon effect on NY LBMP* (LBMPc)
- Imports will add the charge to their offers; in effect, they compete with internal resources on a "status quo basis" with the same relative costs as if no carbon charges applied to anyone
- Exports are similar, but with a credit

Pros and Cons

- Relatively simple and transparent way to avoid distortions
- Misses opportunities for cost-effective abatement via transactions



Option 1: Implementation

NYISO Posts Charges and Credits

NYISO would post applicable charge/credit at each border based on a forecast of the carbon effect on the NY LBMP (LBMPc), before the DA & RT offer deadlines

Importers and Exporters Submit Offers

Importers would presumably offer into NY at the neighboring system price plus the NY border charge
Exporters would presumably bid to buy at the NY LBMP and offer to sell at the NY LBMP minus the border credit

NYISO Clears DA and RT Auctions

NYISO and neighboring systems would clear the DA and RT markets based on bids and offers, just like today

NYISO Settles Transactions

Imports and Exports would settle at applicable NY LBMP (inflated by carbon adder) minus NY border charge/credit

Option 1: Forecasts to Determine Charges/Credits

- To forecast the NY LBMPc at each border (for posting applicable charges/credits), NYISO would have to develop a reasonable forecasting methodology.
- Candidate forecast methodologies could be developed and tested using historical data of marginal emissions rates (which, when multiplied by carbon charges, indicates what LBMPc would have been).
- For example, one could test whether the corresponding hour of the prior day provides a good forecast for each hour the following day, versus more sophisticated alternatives.
- The Joint Staff team plans to present the results of such a study to stakeholders as a part of Issue Track 2 of the IPPTF work plan.

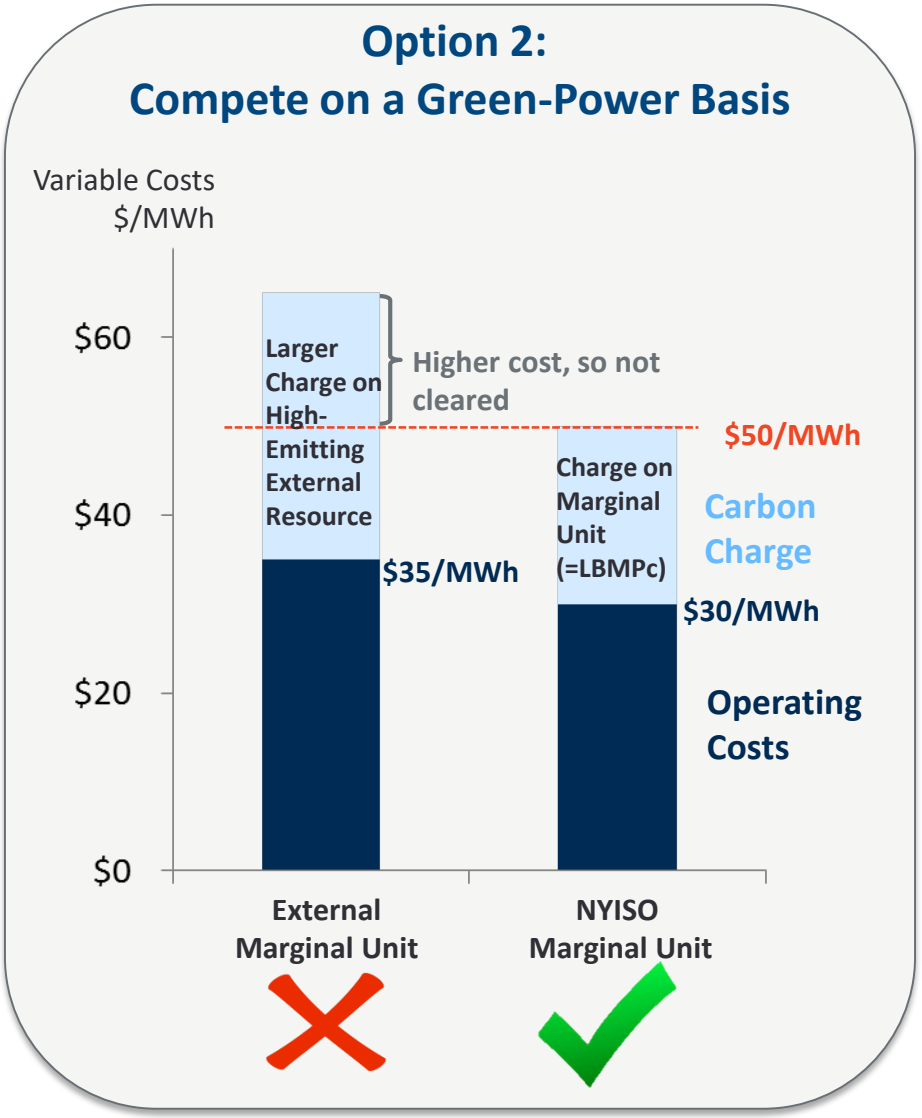
Option 2: Approach

Approach

- Implementation same as Option 1, but with different charges/credits
- Charges/credits based on the marginal emissions rate for transactions with neighboring system
- Have to account for carbon prices neighbors already apply in order for all transactions to be evaluated based on New York's view of externalities

Pros and Cons

- Incentivizes cost-effective abatement beyond NY
- Challenging to implement w/o unintended effects



Option 2: Opportunities and Challenges

Opportunities

- May best suit NY's recognition of CO_2 as a global pollutant and its GHG inventory that accounts for the emissions consequences of net imports; Other carbon regimes do it this way for the same reason
- Recognizes the emissions implications of transactions so the market can environmental-economically optimize and find the most cost-effective ways to reduce emissions and serve NY load (and utilize NY generation)
- NY's particular context, with its neighbors' diverse resource bases, seems to present good opportunity to optimize

Challenges

- Benefits are smaller than may seem since marginal differs from average
- What's marginal may be more uniform across neighbors than it seems: with HQ/ON's energy-limited resources, fossil or external transactions are more likely to be marginal
- Difficult to get the right rates accounting for all of these effects (but there are ways to estimate)
- Wrong rates can cause distortions and wealth transfers for paper reductions

Option 2 Context

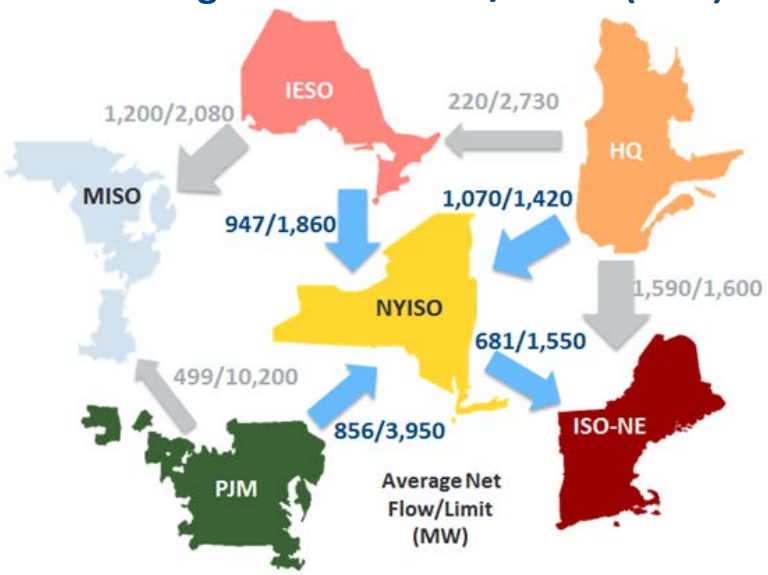
NYISO has historically been a net importer of energy (Net imports = 19 TWh in 2015)

- NYISO generally imports energy from HQ, IESO, and PJM and exports to ISO-NE
- Imports accounted for 19% of electric sector emissions in 2014 (most recent year)
- There is significant headroom for additional imports after the addition of a carbon charge

Each market has a unique resource mix and significant transactions across markets

- Canadian markets are >90% zero-emitting resources; PJM and ISO-NE are majority fossil
- HQ and IESO tend to export to U.S. markets and sell to each other on a seasonal basis
- PJM is net exporter to both MISO and NYISO; ISO-NE is net importer

2015 Regional Net Flows/Limits (MW)



NYISO Net Imports from Neighboring Markets

Market	Net Imports (GWh)	Import Utilization (%)	Import Headroom (GWh)
HQ	9,400	78%	3,100
IESO	8,300	48%	8,000*
PJM	7,500	23%	27,100
ISO-NE	-6,000	-65%	17,400

Option 2: Opportunity May be Less than it Seems

The opportunity may seem large based on neighbors' fleet compositions

- Quebec and Ontario have clean fleets (2015 HQ generation was 99% zero-emitting and IESO generation was 90% zero-emitting) and could provide up to 11 TWh more to NY with current transmission.
- PJM has more coal-intensive fleet; NY could import ~4 TWh less (some import is flow-thru to NE).
- If Canadian imports had a zero emissions rate and PJM had a 0.7 ton/MWh emissions rate vs. a 0.47 ton/MWh NY-internal rate, total emissions could fall up to 6 million tons/year (a 20% reduction in NYCA carbon footprint).

But marginal emissions matter, not average

- In order for markets to optimize, price signals must reflect *marginal* costs (incl. externalities), not average costs.
- Transactions are usually not unit specific, and even if they were, marginal emissions impacts would reflect incs/decs from the marginal resource (as it backfills for the transaction).
- The marginal resource could be internal or external to a neighbor. For example, importing energy from Ontario could cause Ontario to sell less to MISO.

NY's neighbors' marginal emissions rates are likely less distinguishable than it may seem

- Quebec and Ontario's clean resources are energy-limited hydro (and wind), so it is unclear how a price signal increases their output (except on an investment horizon, discussed separately below). The marginal resource might be an internal fossil resource or transactions with other neighbors, *e.g.*, ultimately gas in New England or coal/gas in MISO.
- PJM has some coal on the margin, which has higher burner-tip emissions, but the difference from gas-fired generation in NY would be smaller if lifecycle emissions were considered, not just burner-tip.

Option 2: Potential Determination of Rates

Advanced production cost modeling

- Like MAPS/CARIS but need model with "contract path" capability; need to add MISO and HQ integrated commitment and dispatch, with good modeling of hydro operations in ON and HQ
- Hourly marginal rate = change in global emissions in change case vs. base case, where change case forces 1 MW greater contract path transaction from a given neighbor than observed in the base case (with 1 MW greater load in NY); repeat for each interface
- Analyze patterns to see how to assign rates to transaction on each interface, *e.g.*, on-peak vs. off-peak by season

Or ask neighbors to demonstrate somehow…

Also have to account for carbon pricing already applied by neighbors

- Assume a separate process would address the RGGI seam, so ignore RGGI
- Simplest treatment is where neighbors do not price carbon, then NY's full carbon charge applies to the marginal emissions
- Ontario and Québec have a price of about USD $16/ton and do not credit exports; would have to charge imports NY's Net SCC minus $16 (but charge the full Net SCC if the marginal resource is in MISO)

Option 2: What if Rates are Wrong?

Under Option 2, one might be able to identify rates that more nearly approximate marginal emissions than Option 1

But being significantly off can create distortions, for example:

- NYISO applies a $6.5/MWh charge to IESO imports (assuming 0.16 tons/MWh emissions rate)
- But actual emissions rate is 0.70 tons/MWh (due to diverted flows from MISO increasing MISO coal and gas generation)
- IESO imports outcompete the NYISO marginal generator (paying $18/MWh), causing 6 TWh (700 MW hourly flows) to divert from IESO → MISO to IESO → NY
- Total emissions rise by 1.5 million tons (MISO emissions ↑ ↑, NYISO emissions ↓)
- For the high-emitting incremental imports, NY customers pay ($18/MWh − $6.5/MWh) × 6 TWh = $70M/yr (on top of $95M/yr premium for 8.3 TWh existing IESO imports)

Comparison of Options in New York Context

Option 2 has much appeal but only if the marginal rates can be identified reasonably accurately

	Option 1: Transactions Compete on a Status-Quo Basis	Option 2: Transactions Compete on a Green-Power Basis
Advantages	• Prevents distortions from "status quo" • Relatively simple and transparent	• If the rates applied to transactions are reasonably accurate, prevents distortions *and* incentivizes cost-effective abatement • Approach used by other carbon regimes (California, Ontario, Quebec)
Disadvantages	• Misses opportunities for cost-effective abatement	• Distinctions among neighbors re marginal impacts are less than average rates suggest • Difficult to identify marginal emissions impacts (especially for networked neighbors w/energy-limited clean resources) • Risk of distortions if charges/credits set incorrectly • Potential for large wealth transfers from NYISO customers to assumed-clean importers

Treatment of External Transactions in the Investment Timeframe

The two options discussed so far focus on marginal emissions in the operating timeframe, but may not reflect marginal emissions in the investment timeframe, if a new resource serving NY had lower emissions rate

NYISO and DPS could consider special treatment of new resources either through contracts or a special border rate

- Contracts could adjust through the price, and NYSERDA might be willing to pay a higher price for external RECs whose associated energy is delivered based on a higher nominal emissions rate (and higher charges) than internal resources
- Or a special border rate could apply to resources that may not have a contract but pass an "incrementality test"; difficult to develop, but some potential elements:
  - *Online date*: after the official announcement of the NYISO carbon pricing mechanism
  - *Deliverability*: Demonstrate there is sufficient capacity to deliver incremental power to NYISO without displacing existing low-carbon resource
  - *Clean Energy Attributes*: Ensure that the clean energy attributes for the resource are not being used elsewhere to satisfy an RPS or a long-term contract
  - *Incented by NYISO Carbon Charge*: Demonstrate that new resources would not have entered the market absent the higher prices due to the NYISO carbon price (may be too high of a bar and/or deter projects that have not yet been developed for other reasons)

Treatment of Longstanding Clean Imports

As a variant of Option 2, NYISO could reward existing long-term, inframarginal, low-emitting imports for continuing to help meet clean energy goals

- Could be allowed to sell inframarginal energy into New York at the full LBMP while being charged at low unit-specific or portfolio-specific emission rates

Additional imports above historic threshold levels could be charged at a marginal emission rate per Option 2

Likely most applicable to HQ, which has provided about 10 TWh/yr over past 5 years

- HQ imported >800 MW in 90% of hours the interface flowed power in 2015 and 2016
- NYISO could allow HQ to sell up to 800 MW in any given hour at a hydro rate (while earning the full LBMP) without interfering with signals at the margin
  - *See* NYISO Services Tariff Section 17.1.6.3 for existing pricing rules associated with the Non-Competitive Proxy Generator Buses at the HQ interface
- Would provide ~$110 million to HQ—approximately 2/3 as much as if HQ were charged a generic rate of zero on all sales—at a cost to New York customers
- Imports beyond the 800 MW limit could be charged at the marginal emission per Option 2

Appendix A: The Need for Export Credits

Setup

Carbon Regime (CR)

Carbon Price	*$/ton*	$50
Gas Price	*$/MMBtu*	$5
Load	*MW*	0
Generator		
Capacity	*MW*	1
Heat Rate	*MMBtu/MWh*	7
Emissions Rate	*tons/MWh*	0.4
Dispatch Costs		
No carbon price	*$/MWh*	$35
Carbon price	*$/MWh*	$55

Non-Carbon Regime (NCR)

Carbon Price	*$/ton*	$0
Gas Price	*$/MMBtu*	$5
Load	*MW*	1
Generator		
Capacity	*MW*	1
Heat Rate	*MMBtu/MWh*	9
Emissions Rate	*tons/MWh*	0.53
Dispatch Costs		
No carbon price	*$/MWh*	$45
Carbon price	*$/MWh*	N/A

This example could describe the last, marginal MW in large systems with plenty of other generation and load in both regions

Effect of Carbon Charge and Export Credit

Status Quo (No Carbon Charge)

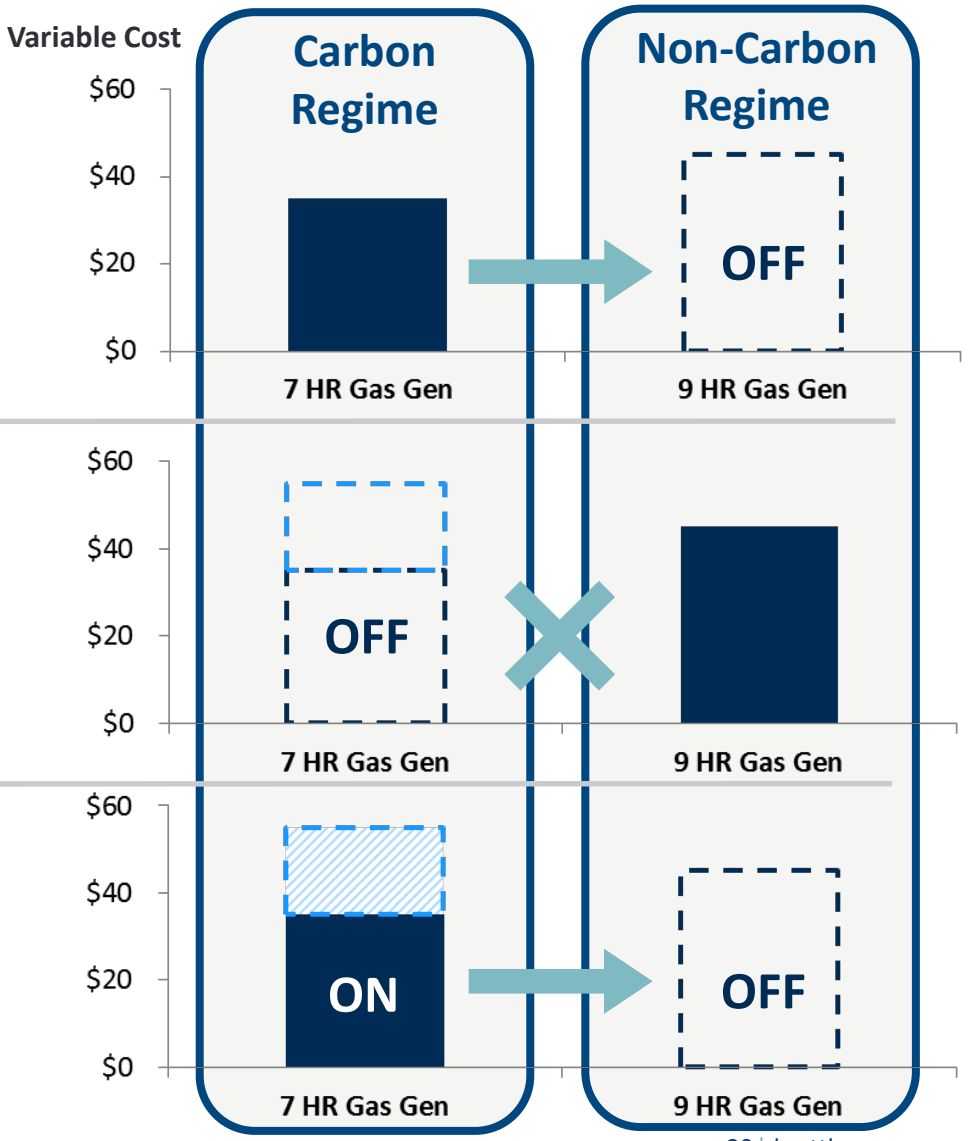
- CR's 7 HR gen costs less than NCR's 9 HR gen so it exports to NCR
- Emissions are 0.40 tons

Carbon Charge Without Export Credits

- Carbon charge makes CR's 7 HR gen uncompetitive, so NCR's 9 HR gen runs instead; no exports
- Emissions are 0.53 tons

Carbon Charge With Export Credit

- CR's 7 HR gen is charged but then export-credited the same, so its competitiveness is restored, and it exports to NCR
- Emissions are 0.40 tons
- No cost vs. status quo

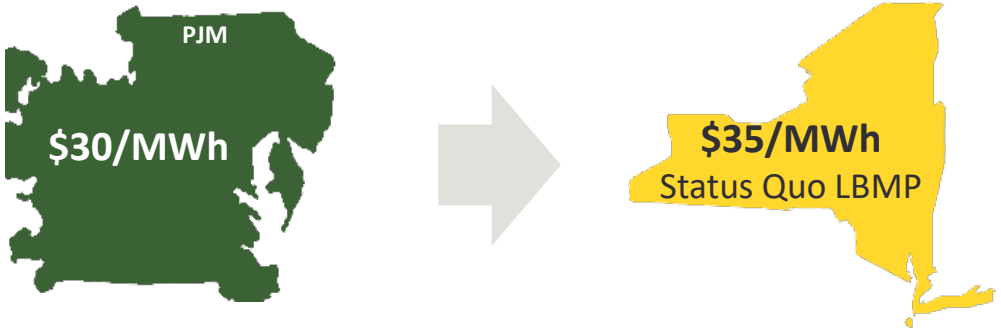


Appendix B: Examples of Options 1 and 2

Option 1 Example: Imports to NYISO

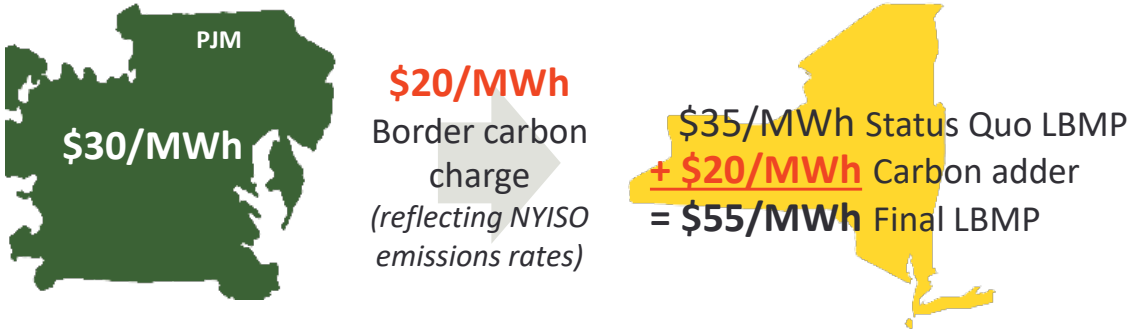
Carbon charges with NYISO-based border rates would not change import flows, as the economics of imports would remain unchanged

Example Transaction under Status Quo (No Carbon Charge)



- $30/MWh	Cost in PJM
+ $35/MWh	Revenue at NY LBMP
= $5/MWh	**Net Revenue**

Impacts of NY Carbon Charge w/Option 1

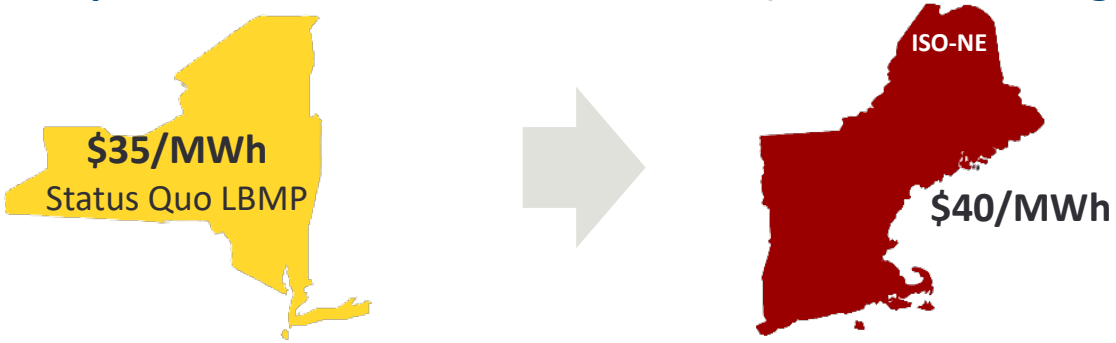


- $30/MWh	Cost in PJM
$55/MWh	Revenue at NY LBMP
- $20/MWh	Border carbon charge
= $5/MWh	**Net Revenue**

Option 1 Example: Exports from NYISO

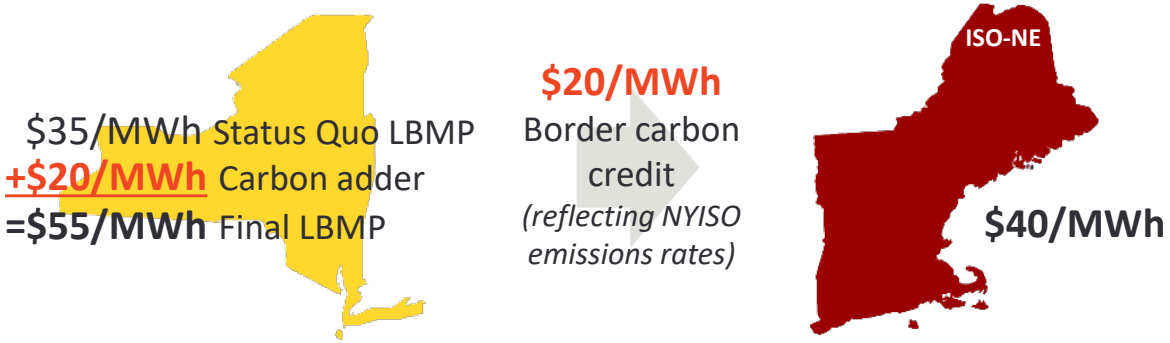
Carbon charges with NYISO-based border rates would not change export flows, as the economics of exports would remain unchanged

Example Transaction under Status Quo (No Carbon Charge)



- $35/MWh	Cost in NYISO
+ $40/MWh	Revenue at ISO-NE LMP
= $5/MWh	**Net Revenue**

Impacts of NY Carbon Charge w/Option 1

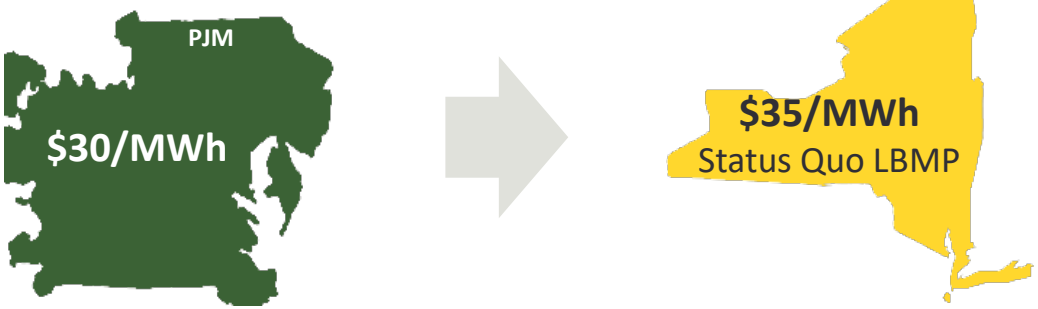


- $55/MWh	Cost in NYISO
+ $20/MWh	Border carbon credit
+ $40/MWh	Revenue at ISO-NE LMP
= $5/MWh	**Net Revenue**

Option 2 Example: Imports to NYISO

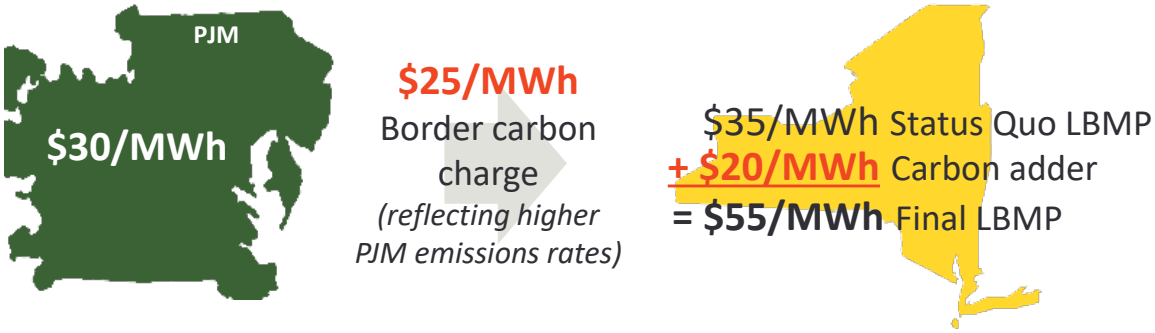
Carbon charges with neighbor-specific border rates could reduce imports from higher-emitting regions

Example Transaction under Status Quo (No Carbon Charge)



- $30/MWh	Cost in PJM
+ $35/MWh	Revenue at NY LBMP
= $5/MWh	**Net Revenue**

Impacts of NY Carbon Charge w/Option 2

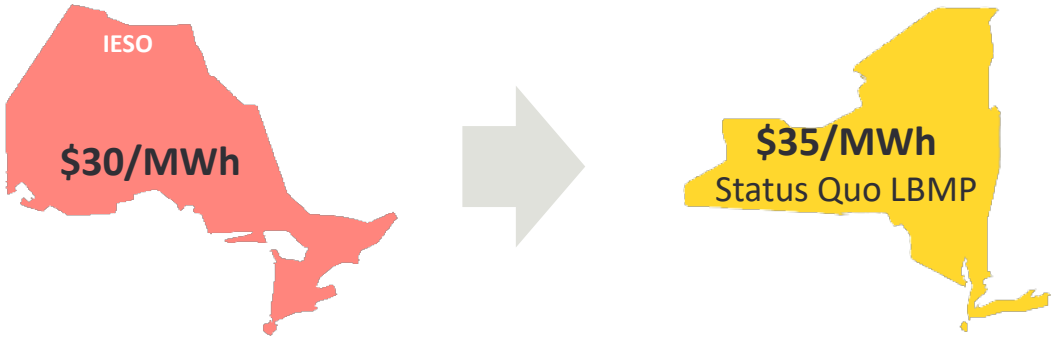


- $30/MWh	Cost in PJM
- $25/MWh	Border carbon charge
+ $55/MWh	Revenue at NY LBMP
= $0/MWh	**Net Revenue**

Option 2 Example: Imports to NYISO, Cont'd

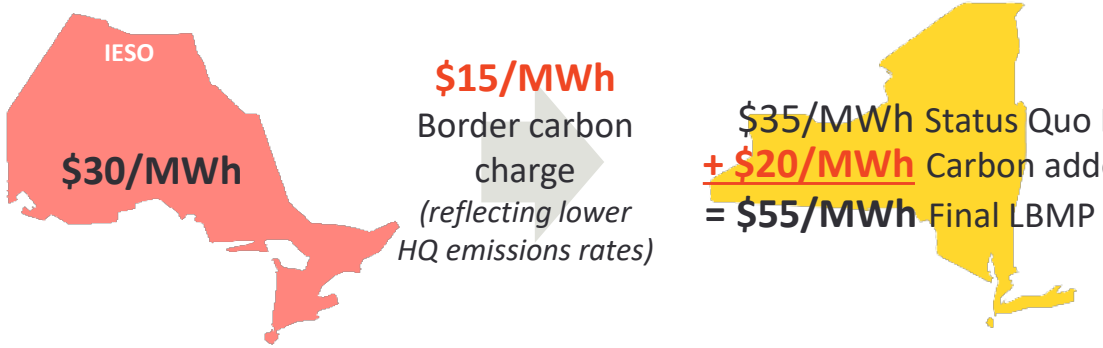
Carbon charges with neighbor-specific border rates could attract clean imports by enhancing the economics of imports from lower-emitting region

Example Transaction under Status Quo (No Carbon Charge)



- $30/MWh	Cost in ON
+ $35/MWh	Revenue at NY LBMP
= $5/MWh	**Net Revenue**

Impacts of NY Carbon Charge w/Option 2

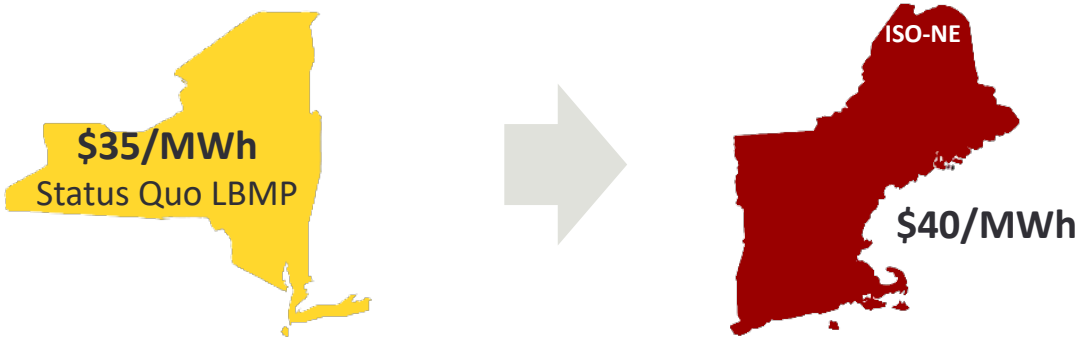


- $30/MWh	Cost in ON
- $15/MWh	Border carbon charge
+ $55/MWh	Revenue at NY LBMP
= $10/MWh	**Net Revenue**

Option 2 Example: Exports from NYISO

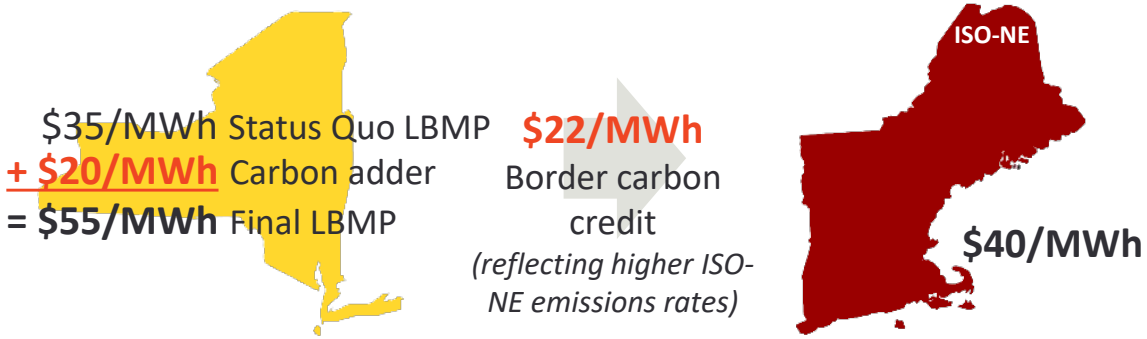
Carbon charges with neighbor-specific border rates could increase exports to higher-emitting regions

Example Transaction under Status Quo (No Carbon Charge)



- $35/MWh	Cost in NYISO
+ $40/MWh	Revenue at ISO-NE LMP
= $5/MWh	**Net Revenue**

Impacts of NY Carbon Charge w/Option 2



- $55/MWh	Cost in NYISO
+ $22/MWh	Border carbon credit
+ $40/MWh	Revenue at ISO-NE LMP
= $7/MWh	**Net Revenue**

Appendix C:
Lessons Learned from Other Jurisdictions

California ISO

- As a large importer of electricity (28% of 2016 energy mix), California's carbon policies are vulnerable to emissions leakage risks
- California Air Resources Board (CARB) assesses compliance obligations on three types of imports under its Cap and Trade Program:
  - **Unspecified Sources:** generic imports into California must obtain GHG allowances based on a *single default emissions factor* (0.428 $mTCO_2e/MWh$) that reflects the historical average marginal emissions rates in WECC
  - **Specified Source:** qualified units that are under contract to or owned by California entities and are "directly delivered" to the California grid use their *unit-specific* emissions rates.
    - *E.g.*, Palo Verde Nuclear Station, contracted coal (Intermountain Power Plant), contracted renewables for CA-RPS
  - **Asset-Controlling Supplier (ACS):** entities that apply and qualify receive a *portfolio-specific average emissions factor* for all imports from its system
    - *E.g.*, Bonneville (0.0120 $mTCO_2e/MWh$), Powerex (0.0254 $mTCO_2e/MWh$), Tacoma Power (0.0155 $mTCO_2e/MWh$)
- No export credits as California has historically had limited exports
- **Western EIM:** even with perfect visibility of generation sources, it is challenging to design a market that reduces leakage and prevents resource shuffling without introducing unintended consequences or opportunities to game the system

Ontario and Québec

- **Import Charges**: Ontario and Québec both apply market-specific rates to electricity imports
  - Ontario uses ***forecasted on-peak and off-peak marginal rates*** estimated from production cost modeling
  - Québec uses ***historical average emissions rates*** estimated from public sources
  - Emissions rates updated annually
  - No charges for imports between their markets
  - Allowance obligations for imports from RGGI jurisdictions are reduced by the ratio of RGGI allowance prices to WCI allowance prices
- As net exporters, Ontario and Québec are less dependent on imports than New York
  - Hence import charges have smaller impacts on energy flows than if New York adopted the same approach
- **Export Credits**:
  - Québec and Ontario do not credit exports for avoided emissions in neighboring markets

2018 Ontario Default Emissions Rates (mtCO2e/MWh)

Market	On Peak	Off Peak
ISO-NE	0.414	0.297
NYISO	0.434	0.311
PJM	0.754	0.607
MISO	0.768	0.730
Unspecified	0.750	0.600

Source: Ontario Ministry of Energy, "Default Emission Factors for 2018 for Ontario's Cap & Trade Program", December 15, 2017.

Québec Default Emissions Rates (mtCO2e/MWh)

Market	All Hours
Vermont	0.006
NYISO	0.236
ISO-NE	0.290
PJM	0.554
SPP	0.566
MISO	0.596
Non-Identifiable	0.999

Source: Table 17-1, Amendment to Québec Environment Quality Act, chapter Q-2, December 18, 2017.

Presenter Information

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Dr. Samuel A. Newell, a Principal of The Brattle Group, is an economist and engineer with experience in electricity wholesale markets, the transmission system, and RTO/ISO rules. He supports clients throughout the U.S. in regulatory, litigation, and business strategy matters involving wholesale market design, generation asset valuation, transmission development, integrated resource planning, demand response programs, and contract disputes. He has provided testimony before the FERC, state regulatory commissions, and the American Arbitration Association.

Dr. Newell earned a Ph.D. in Technology Management and Policy from MIT, and a M.S. in Materials Science and Engineering from Stanford University. Prior to joining Brattle, Dr. Newell was Director of the Transmission Service at Cambridge Energy Research Associates.

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LITIGATION

- Accounting
- Analysis of Market Manipulation
- Antitrust/Competition
- Bankruptcy & Restructuring
- Big Data & Document Analytics
- Commercial Damages
- Environmental Litigation & Regulation
- Intellectual Property
- International Arbitration
- International Trade
- Labor & Employment
- Mergers & Acquisitions Litigation
- Product Liability
- Securities & Finance
- Tax Controversy & Transfer Pricing
- Valuation
- White Collar Investigations & Litigation

INDUSTRIES

- Electric Power
- Financial Institutions
- Natural Gas & Petroleum
- Pharmaceuticals & Medical Devices
- Telecommunications, Internet, and Media
- Transportation
- Water

Offices

BOSTON

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