

IREMM Study Update

Background JIPC Economic Studies

- Year 2013 interregional analysis
 - Conducted by the Joint ISO/RTO Planning Committee (JIPC)
 - Analyzing the effects of increasing the transfer capability between New York and New England
- Identify potential physical barriers to more efficient economic operation of the inter-regional system
- Quantify changes to economic and environmental metrics resulting from relaxing transmission constraints
- First cut analysis is a “high level” model of the three Northeast ISO/RTOs using IREMM
 - PJM
 - NYISO
 - ISO New England

Background JIPC Economic Studies

- Not intended to advocate for IREMM over other models, such as PROMOD, GridView, MAPS, etc.
 - Each model has its own place
 - Experience and comfort with an existing model is valuable
- Preliminary economic analyses to be followed by a more detailed analysis
- Transmission planning
 - Identification of conceptual solutions
- Detailed production cost analysis
 - Affirmation of economic analysis results
 - Including effects of conceptual solutions

Model Validation Framework

Modeling Validation Concepts

- Preliminary assessment of the data to be used
- Reasonableness of the results that are ultimately obtained through simulation
- Unexpected results can be investigated further
- The theoretical foundation of the model
 - The models that are used (including IREMM, PROMOD, MAPS and GridView) have a solid theoretical basis
- Statistical significance and economic significance
- Robustness of results
- Explanation
- Forecast

Validation Metrics

- Data verification
 - Generation
 - Load
 - Transmission
- Simulation verification (historical vs. simulated)
 - Average energy prices
 - Zonal average energy prices
 - Differences in average energy prices between zones
 - Interface flows
 - Time at limit (percent of time)
 - Volatility of flows (direction)
 - Congestion
 - Economic consequences of congestion
 - FTR / ARR approach used in other (New England) economic studies

Status

- Model development and verification has proceeded slower than anticipated in the preliminary schedule
 - Preliminary verification runs
 - Have indicated a desire to investigate refining the model
 - Investigate increasing scope of PJM beyond old “MAAC” boundaries
 - Enhance Central East and UPNY/SENY modeling to more accurately reflect participating transmission distributions on limiting interfaces
 - Desire to implement different interchange models with Quebec
 - Abandon the import-only assumption from Quebec
 - Implement a New England to Quebec interchange profile
 - Implement a New York to Quebec interchange profile
- This presentation will:
 - Discuss the revised Quebec modeling assumptions
 - Technique for analyzing effect of interface changes
 - Identify several additional PAR sink / source pairs

Interface Representations

Interface Limits (Partial)

Number	Interface Name	Forward	Reverse	Forward Direction
1	CE GRP	4550	3400	To the southeast
2	TOTAL-ES	6425	1999	From West to East
3	DSY49Y50	99999	99999	To NY City (Infinite for now)
4	EAST-WEST	2800	9999	Boston toward New York
5	NY-NE	1250	1250	New York to New England
6	N TO S	2700	9999	New Hampshire to Massachusetts
7	CT-IMPEX	2500	9999	Into Connecticut
8	PJM WEST-CENTRAL	4250	4250	From the west into central PJM
9	PJM CENTRAL-EAST	6450	6450	From the central into eastern PJM
10	DYSINGER	2550	1999	From Buffalo to the east
11	NB-BHE	1000	550	From New Brunswick
12	SUROWIEC SOUTH	1150	9999	From central Maine to southern Maine
13	ORRINGTON SOUTH	1200	9999	From Bangor Maine to central Maine
14	MAINE-NEW HAMPSHIRE	1525	9999	From southern Maine to New Ha
15	BOSTON IMPORT	4900	9999	Into Boston
16	ONTARIO TO NEW YORK	3000	3000	From Ontario into New York
17	TOTAL PJM TO NEW YORK	99999	99999	Total Flows are monitored
18	J-IMPORT	99999	99999	Import into NY City
19	EAST TO NY_G	1000	1000	East to NY_G (Ramapo net of "wheel")
20	LI SUM	1190	300	Into Long Island from New York

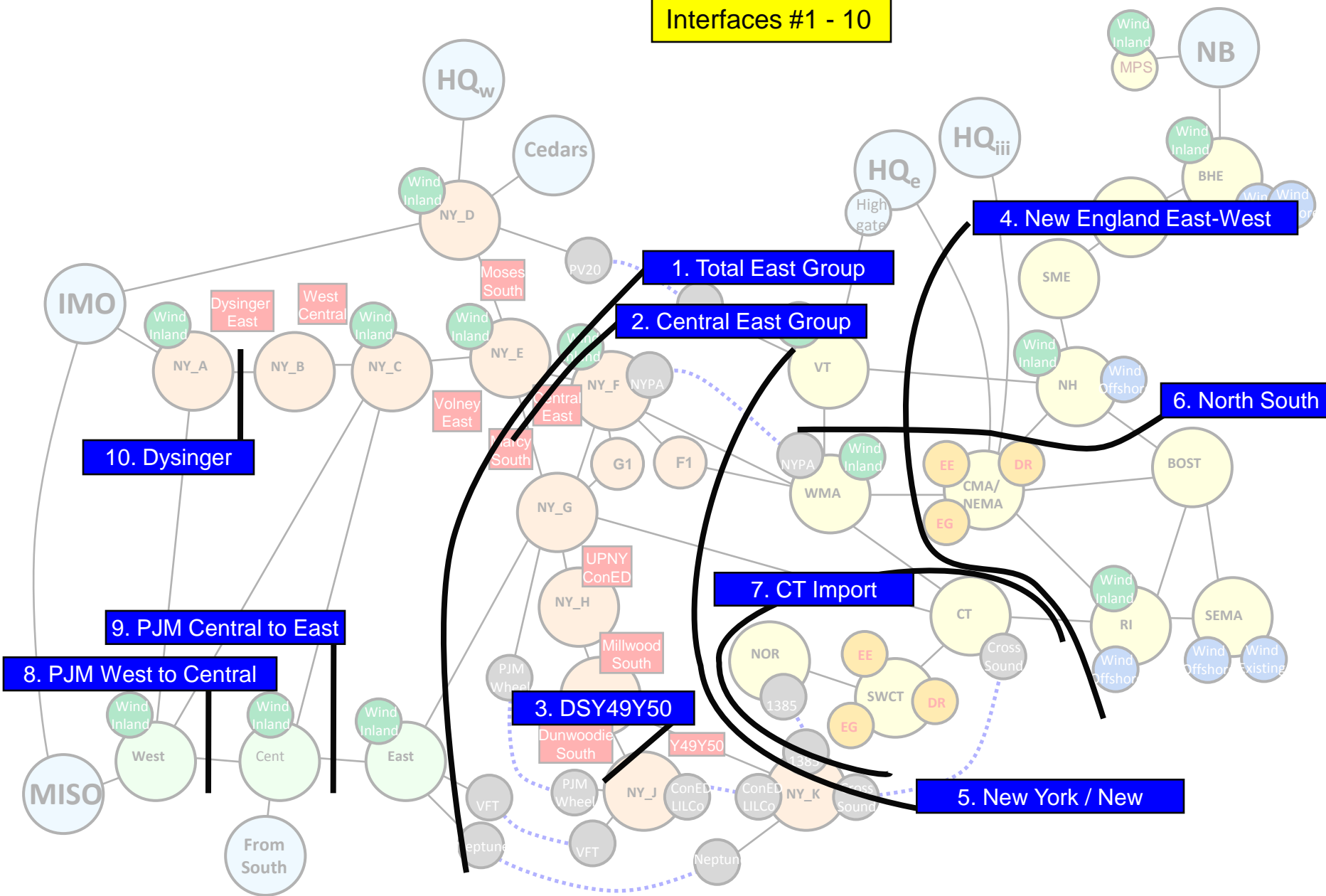
Color Codes

Value	Same as MARS Data
0	Economic Transfer Limit
99999	Unlimited

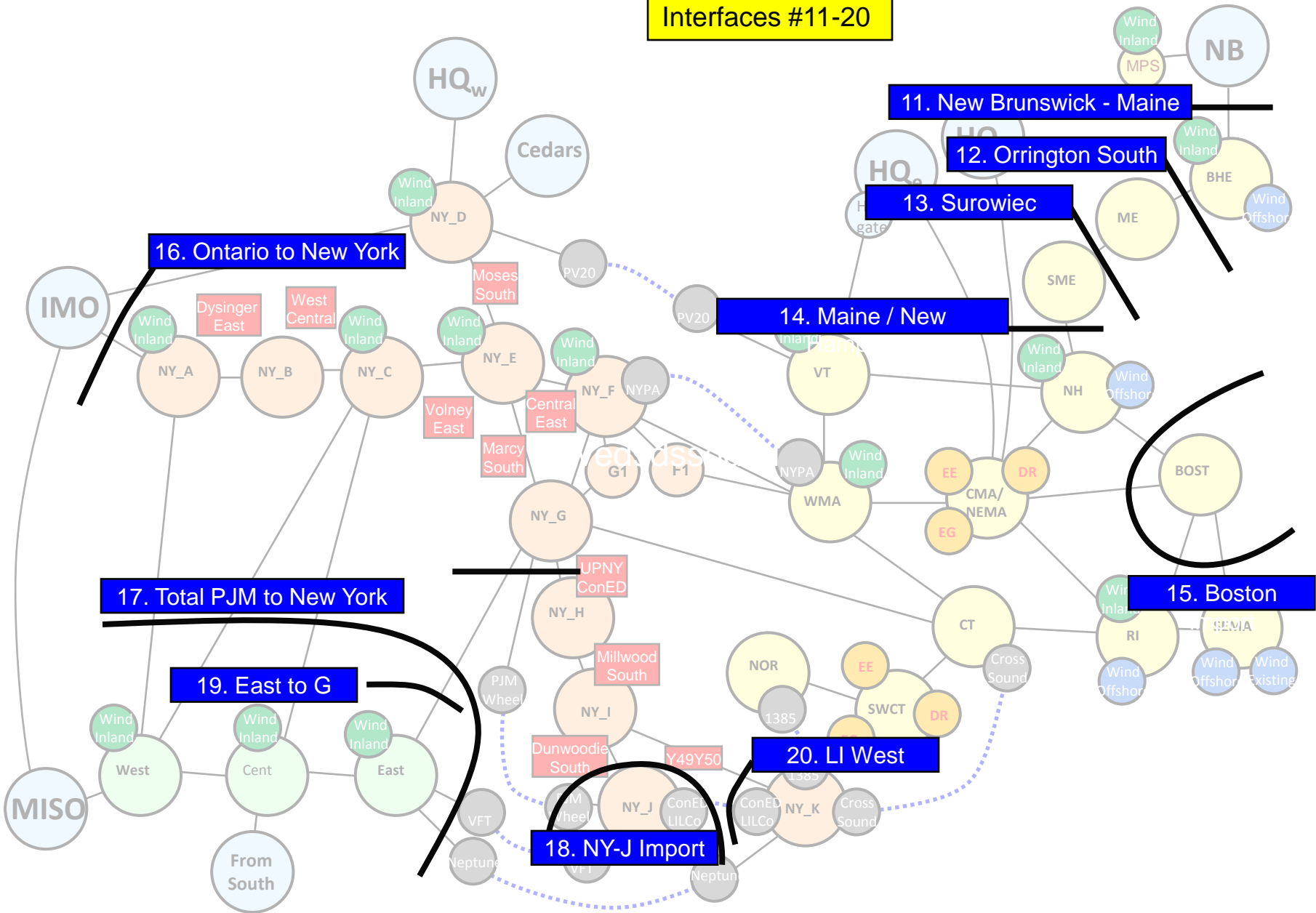
Sink / Source Pairs

- Sink / source pairs are used:
 - To represent expected flows on controllable interconnections
 - Phase Angle Regulator(PARs)/Variable Frequency Transformer(VFT)
 - PV20 (100 MW from NYISO to ISO-NE)
 - VFTs (300 MW from PJM to NYISO)
 - 1385 (100 MW from ISO-NE to NYISO)
 - NY_K to NY_J (275 MW Internal NYISO flow from Long Island to Zone J)
 - PJM Wheel (1000 MW Internal NYISO flow from Zone G to Zone J)
 - DC Interconnections
 - Cross Sound Cable (300 MW from ISO-NE to NYISO)
 - Neptune (600 MW from PJM to NYISO)
 - Firm Transactions
 - Recognize the long standing NYPA export to New England (85 MW)

Interfaces #1 - 10



Interfaces #11-20



Historical Flows

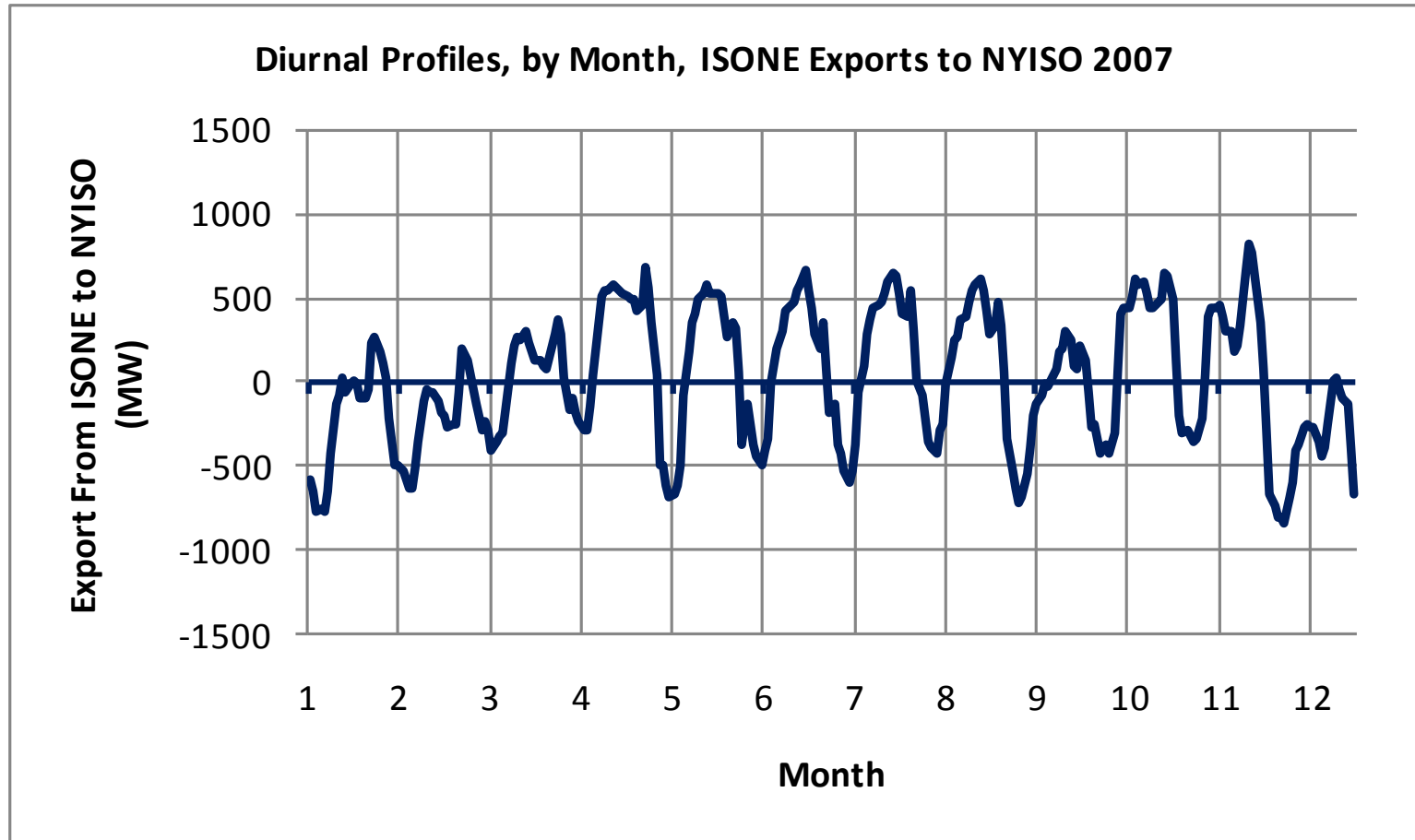
Validation of IPSAC modeling

Historical Interregional Transfers

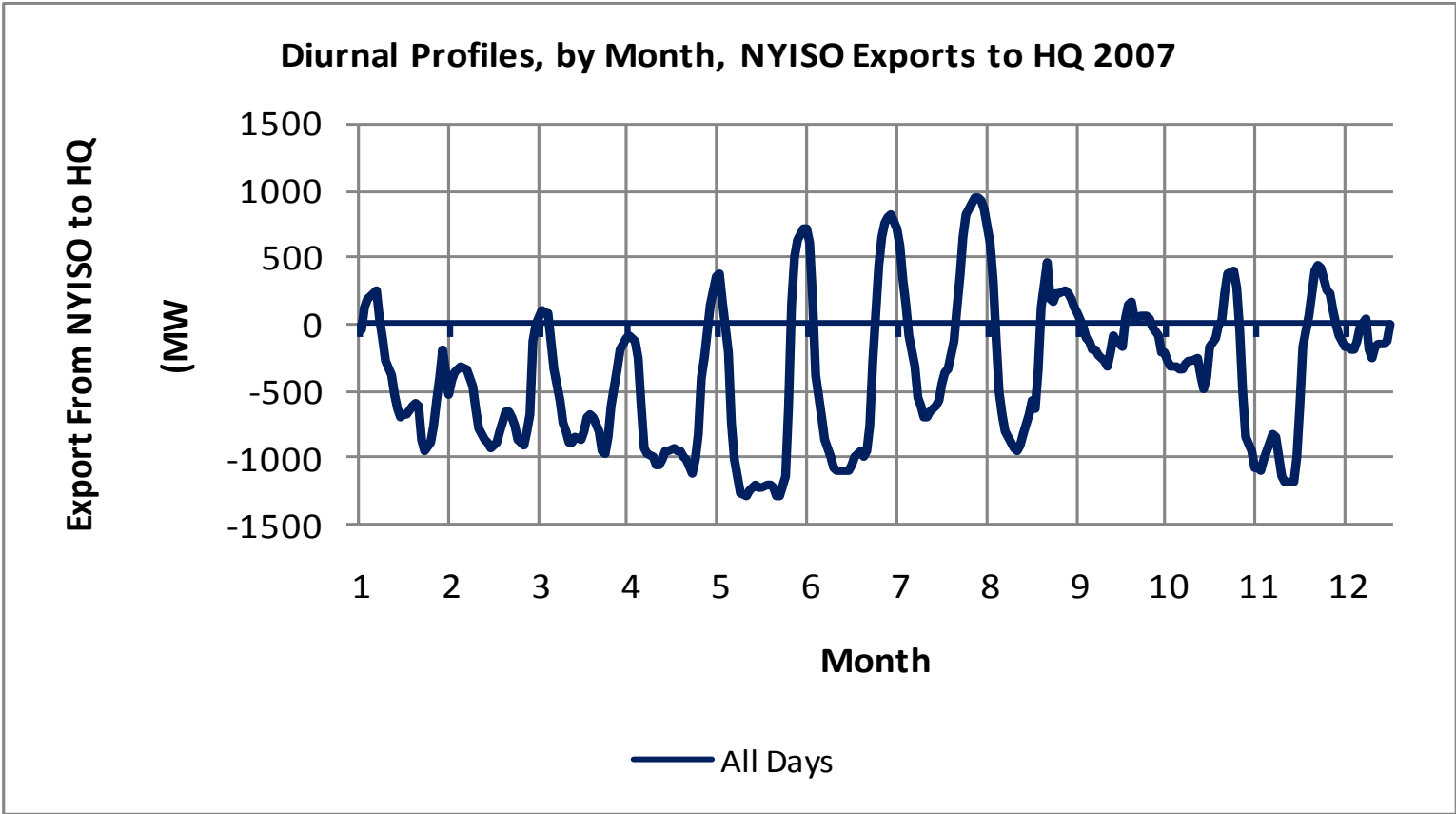
- To benchmark the IREMM interregional transfers
 - Historical diurnal power flows were obtained for calendar years
 - 2007
 - 2008
 - 2009
 - New York to/from Quebec
 - New England to/from Quebec
 - New England to/from New York
- Diurnal profiles provide trending information
 - Hourly data is too messy to compare
 - Monthly / seasonal trends can be observed

2007 Historical

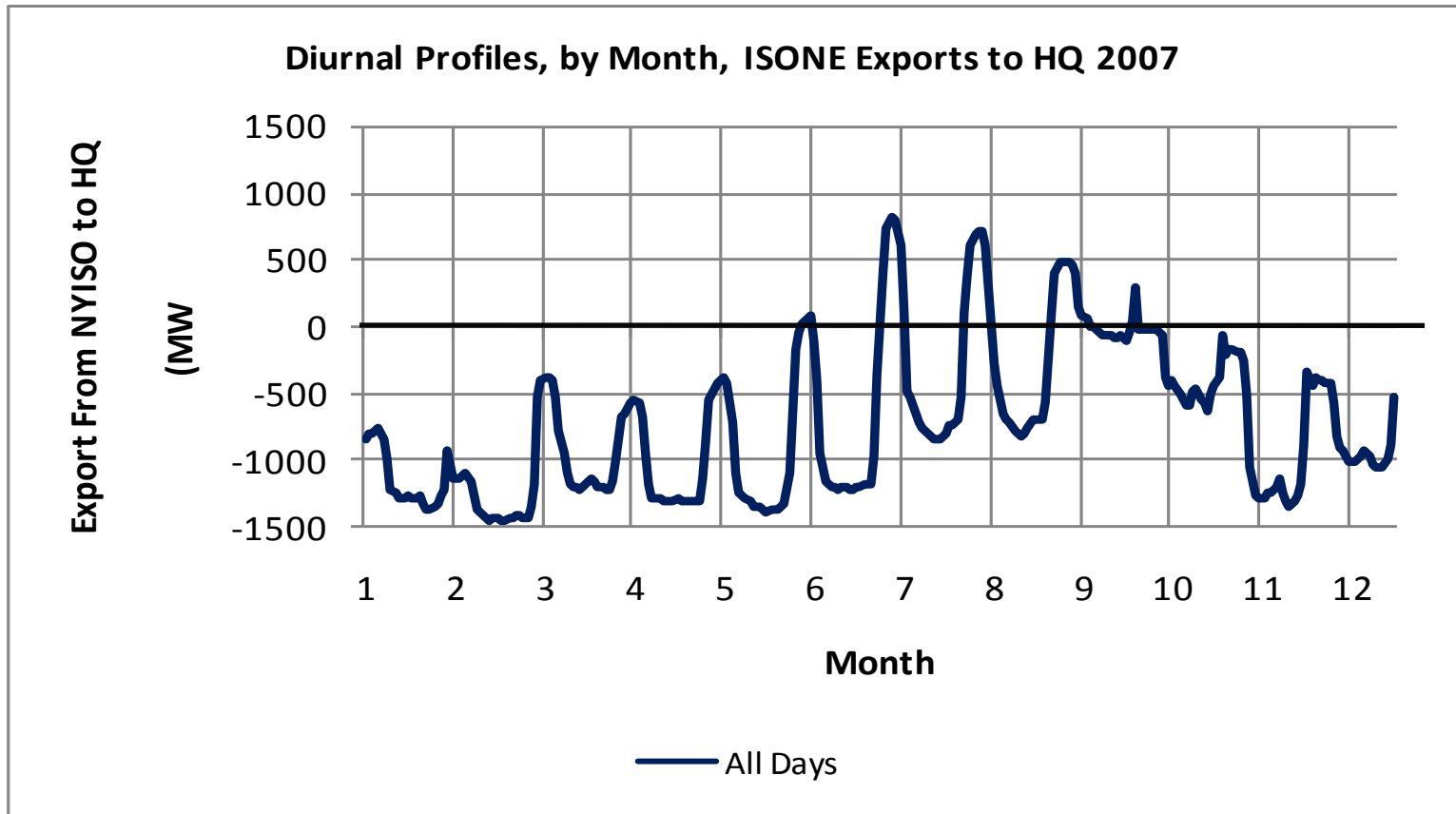
2007 Historical: ISO-NE to NYISO



2007 Historical: NYISO to HQ



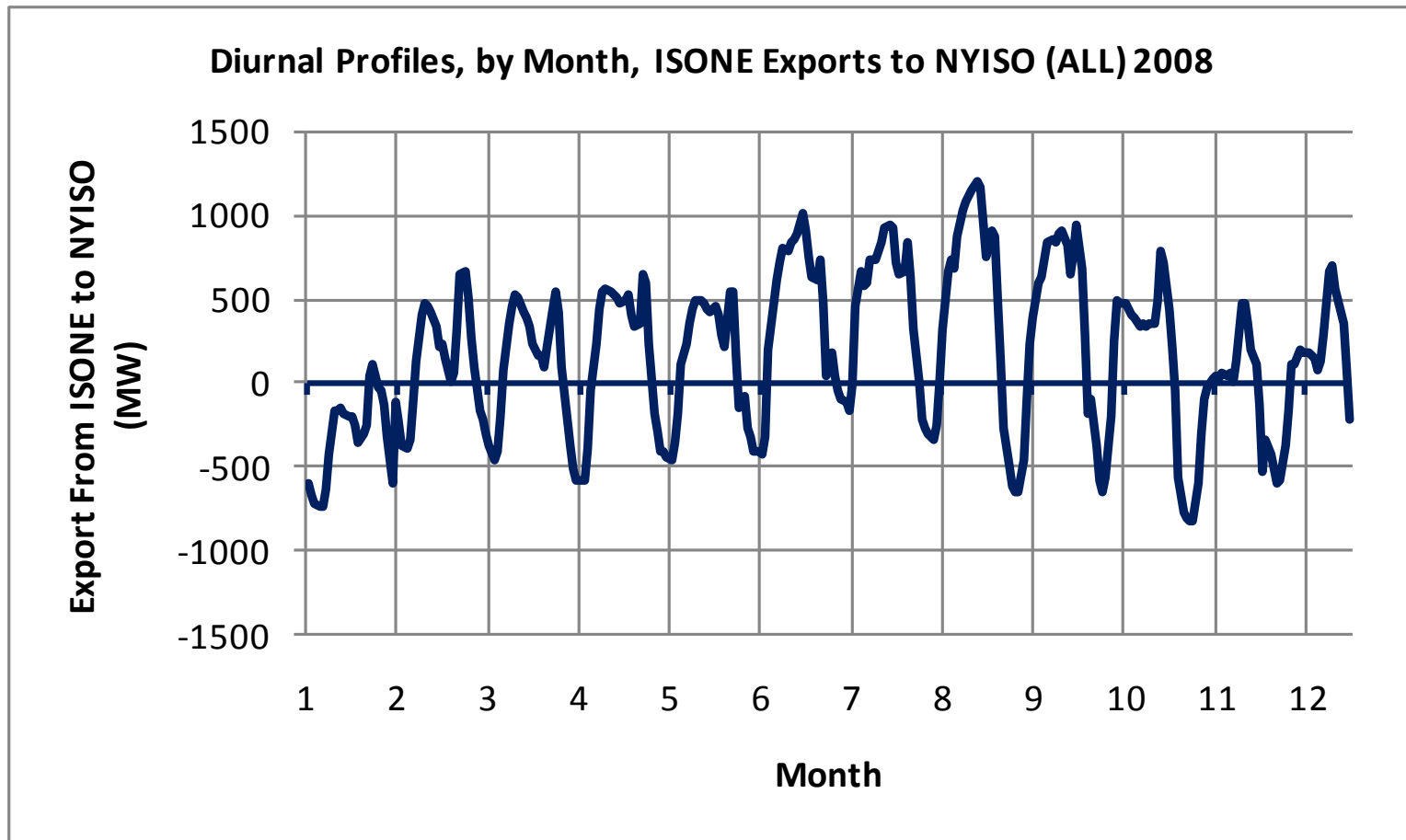
2007 Historical: ISO-NE to HQ



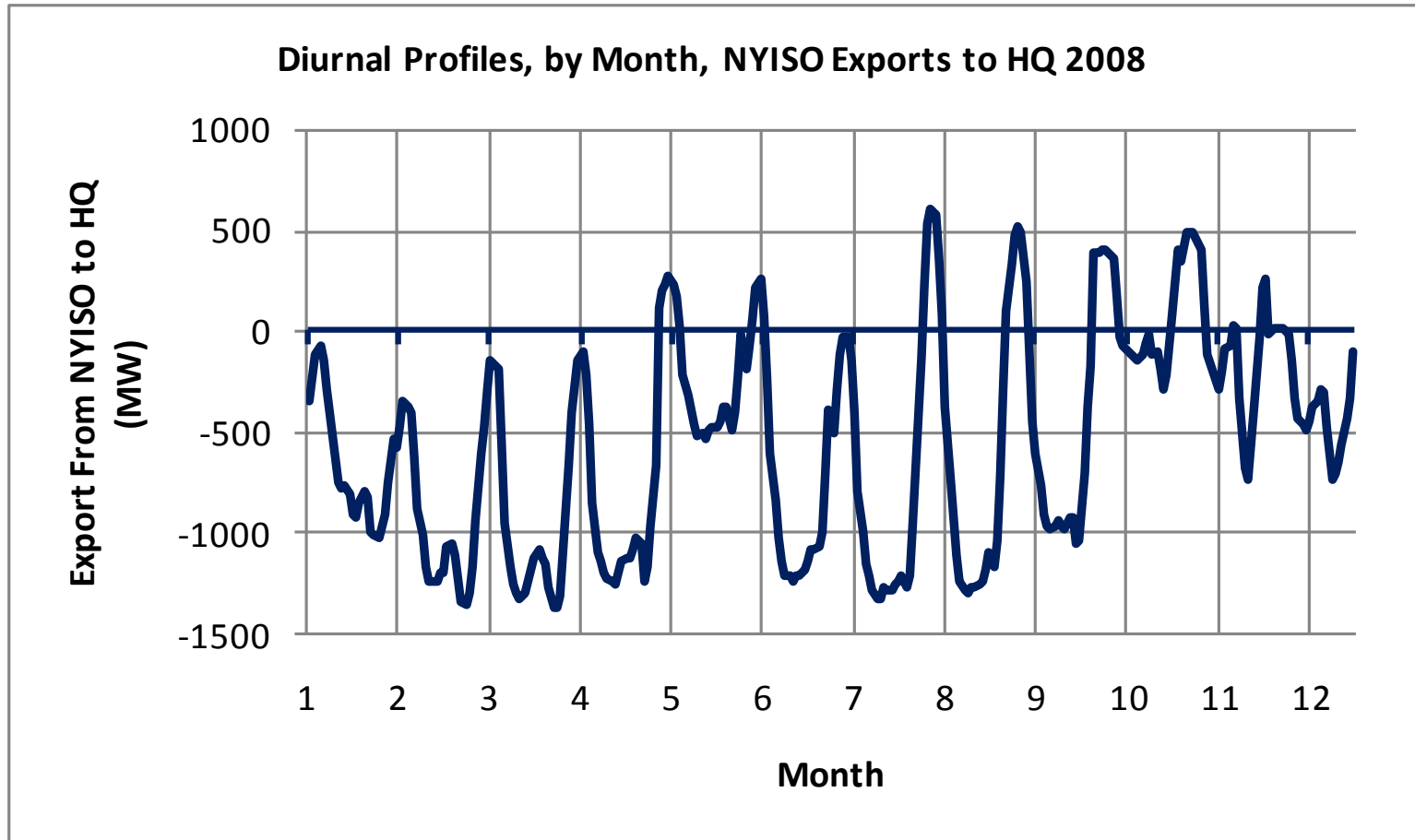
2008 Historical

2008 Historical: ISO-NE to NYISO

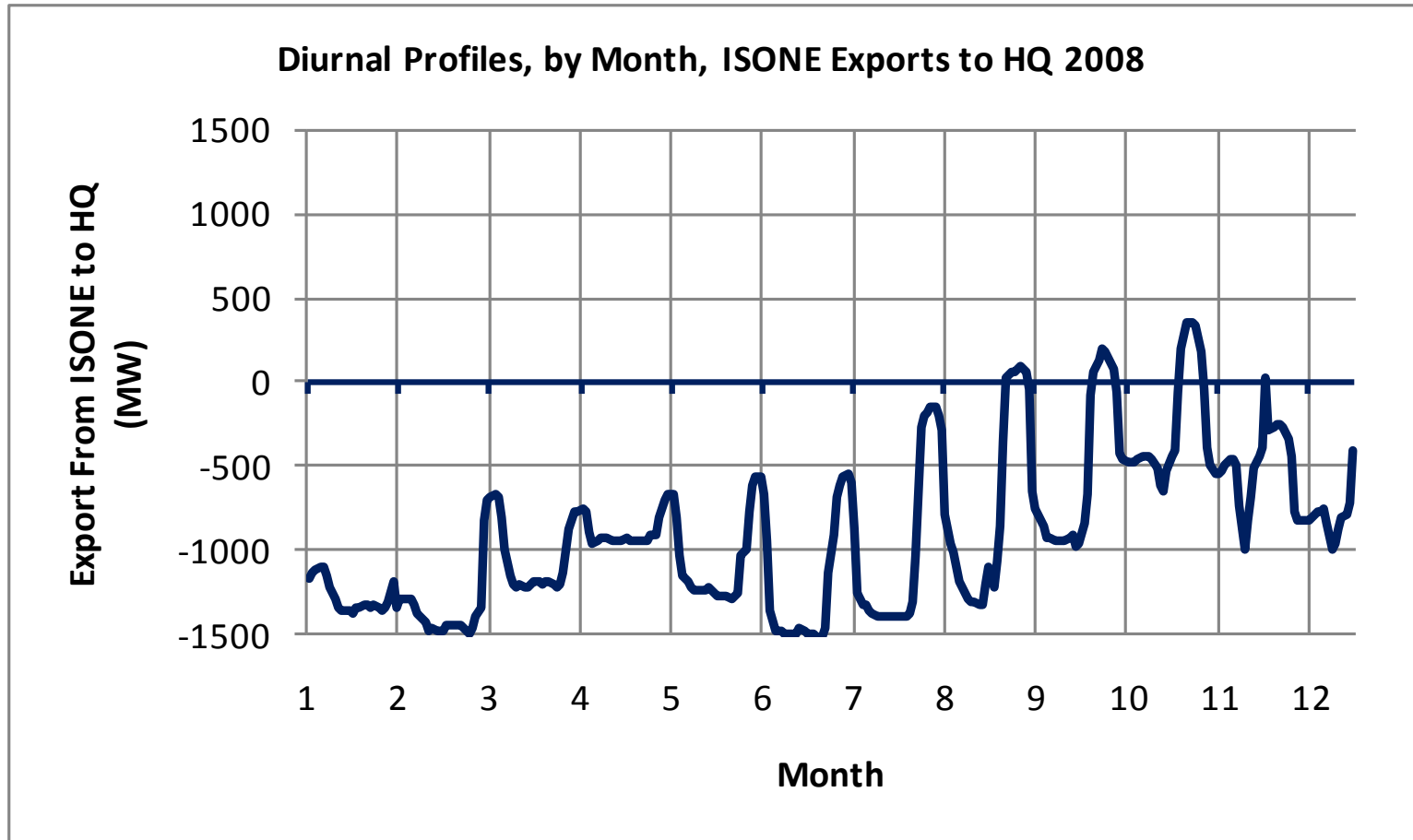
(All Resources including 1385 and CSC)



2008 Historical: NYISO to HQ

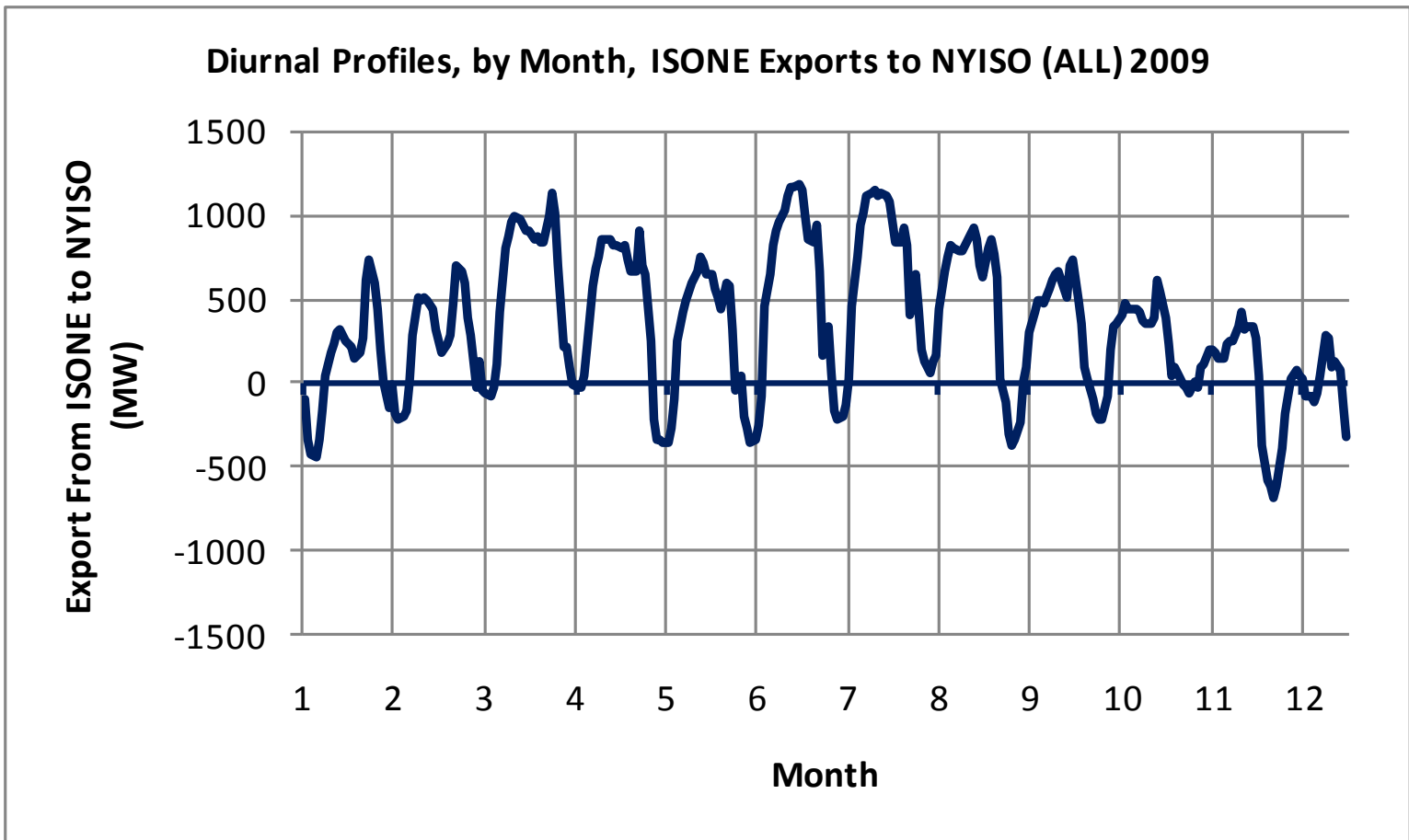


2008 Historical: ISO-NE to HQ

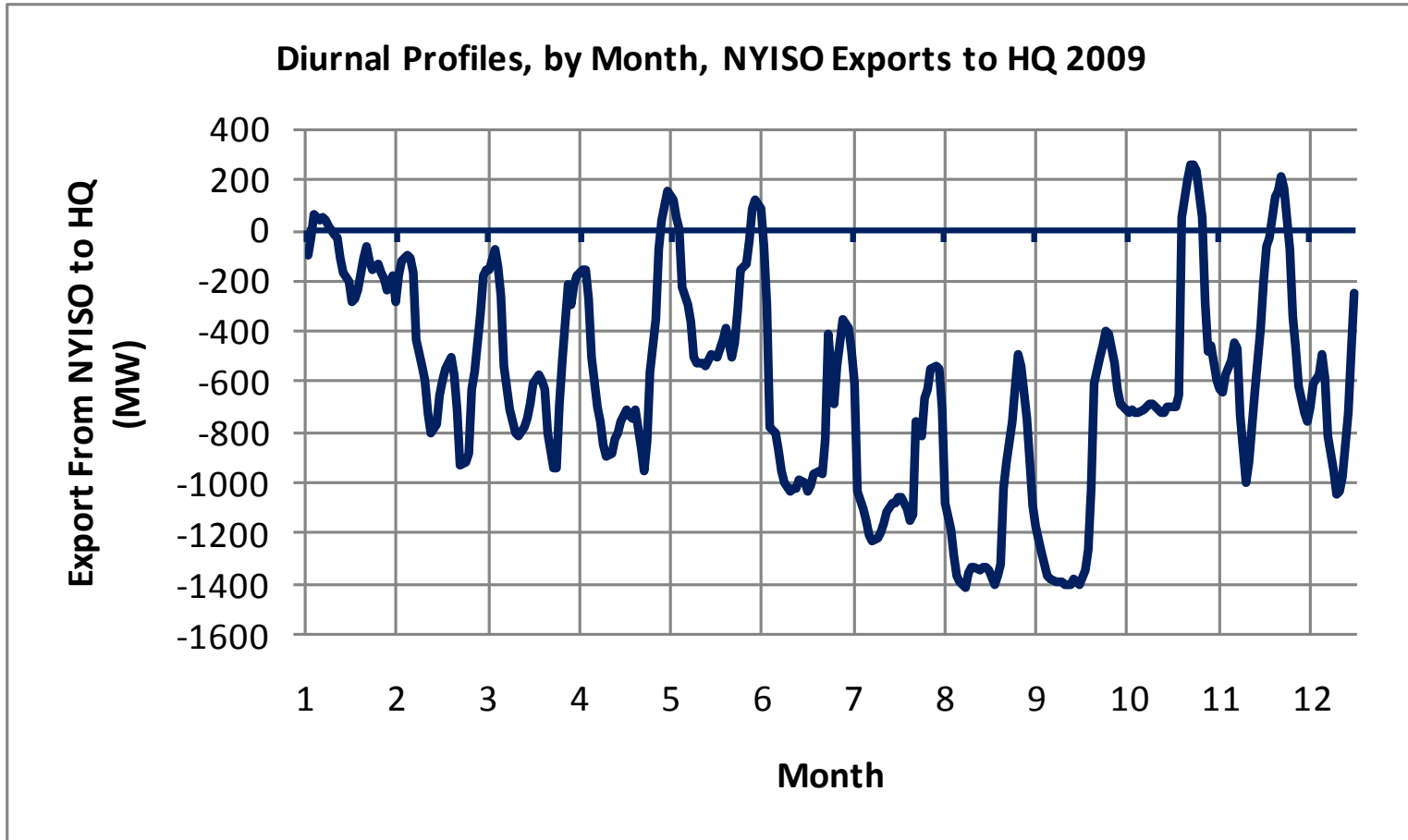


2009 Historical

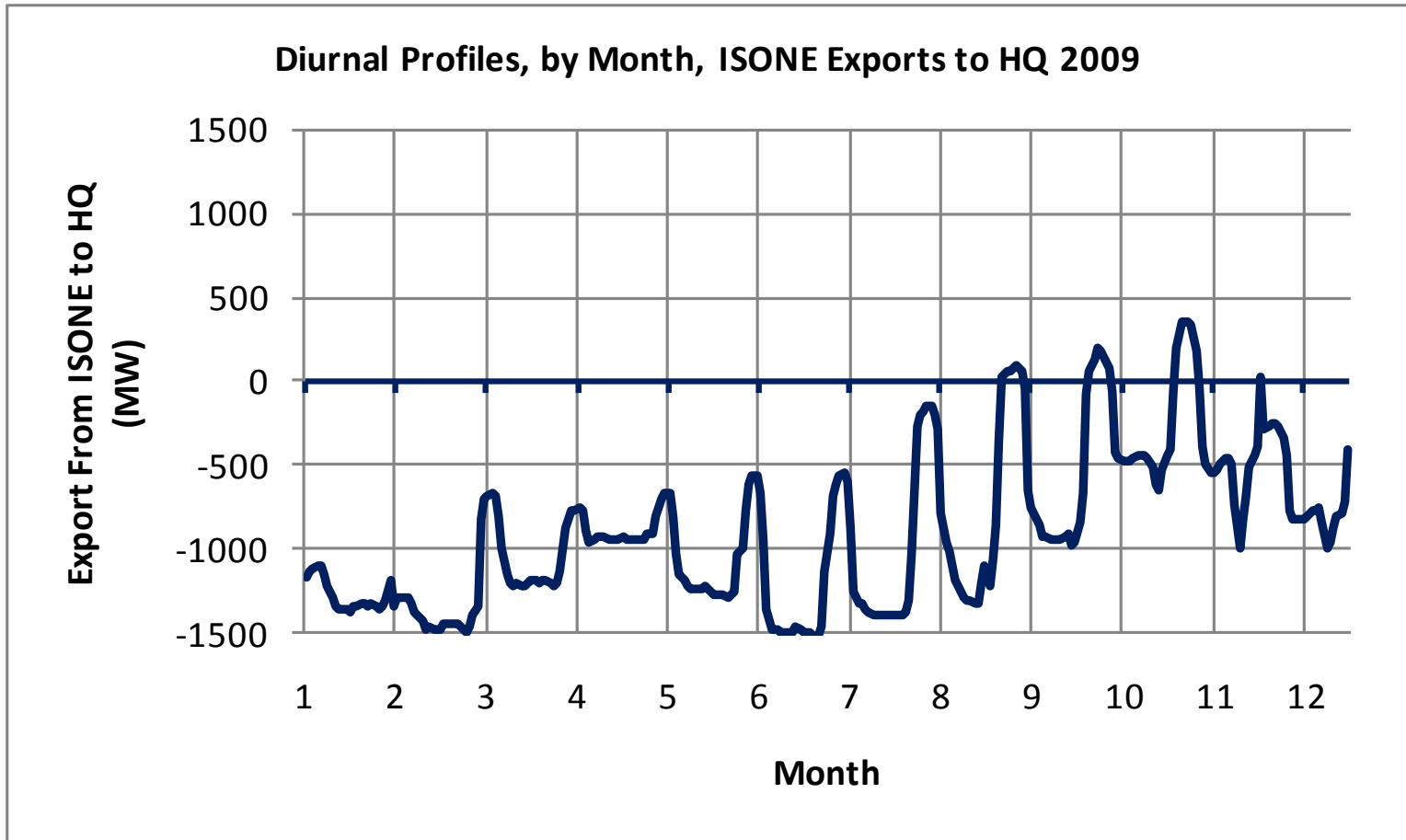
2009 Historical: ISO-NE to NYISO



2009 Historical: NYISO to HQ



2009 Historical: ISO-NE to HQ



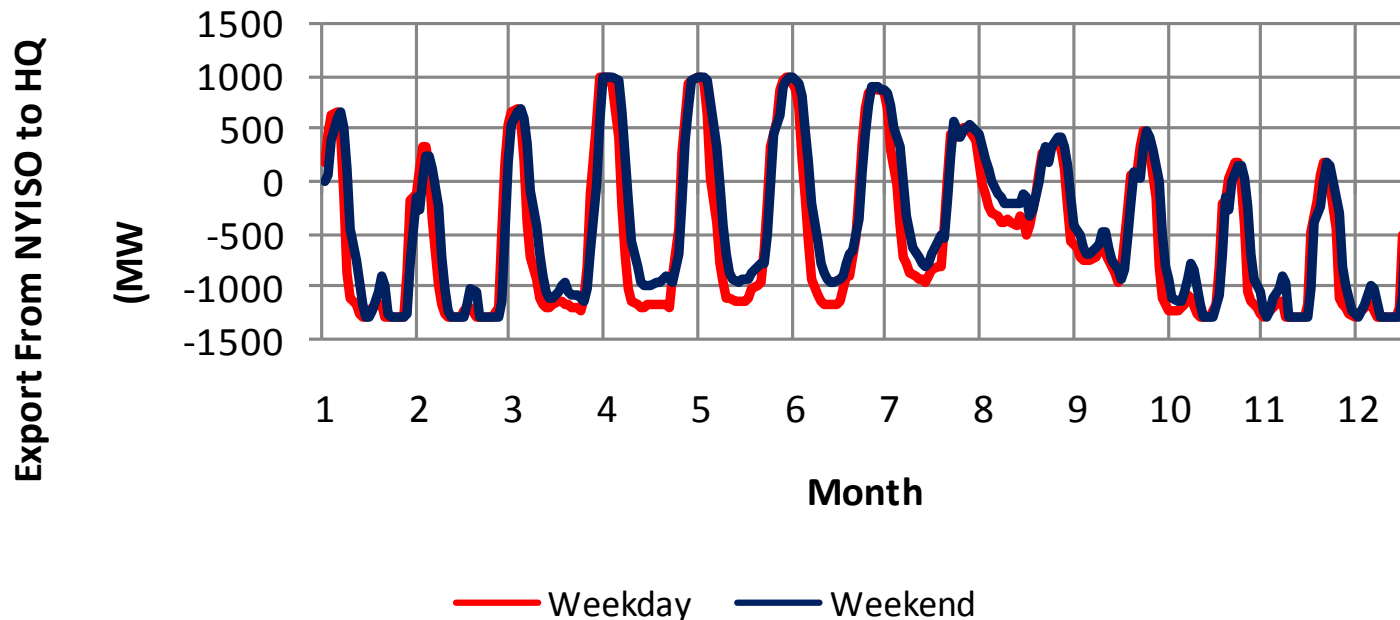
NY CARIS Representation for 2013

NY CARIS Representation for Chateauguay

- For the New York “Congestion Assessment and Resource Integration Study” (CARIS) study, NYISO developed a model for interchange with Quebec
 - Based on historical flows
 - Explicitly reflects imports and exports
- Hourly resolution “over-specified” the interchange flows
 - i.e. events that caused “a 506 MW flow at 10 AM on October 12” may not be consistent with assumptions for 2013
 - Representative trend could be appropriate
 - Use of diurnal shape appears to be a reasonable approximation
- Monthly trends can be captured
- Week-day and week-end appear similar

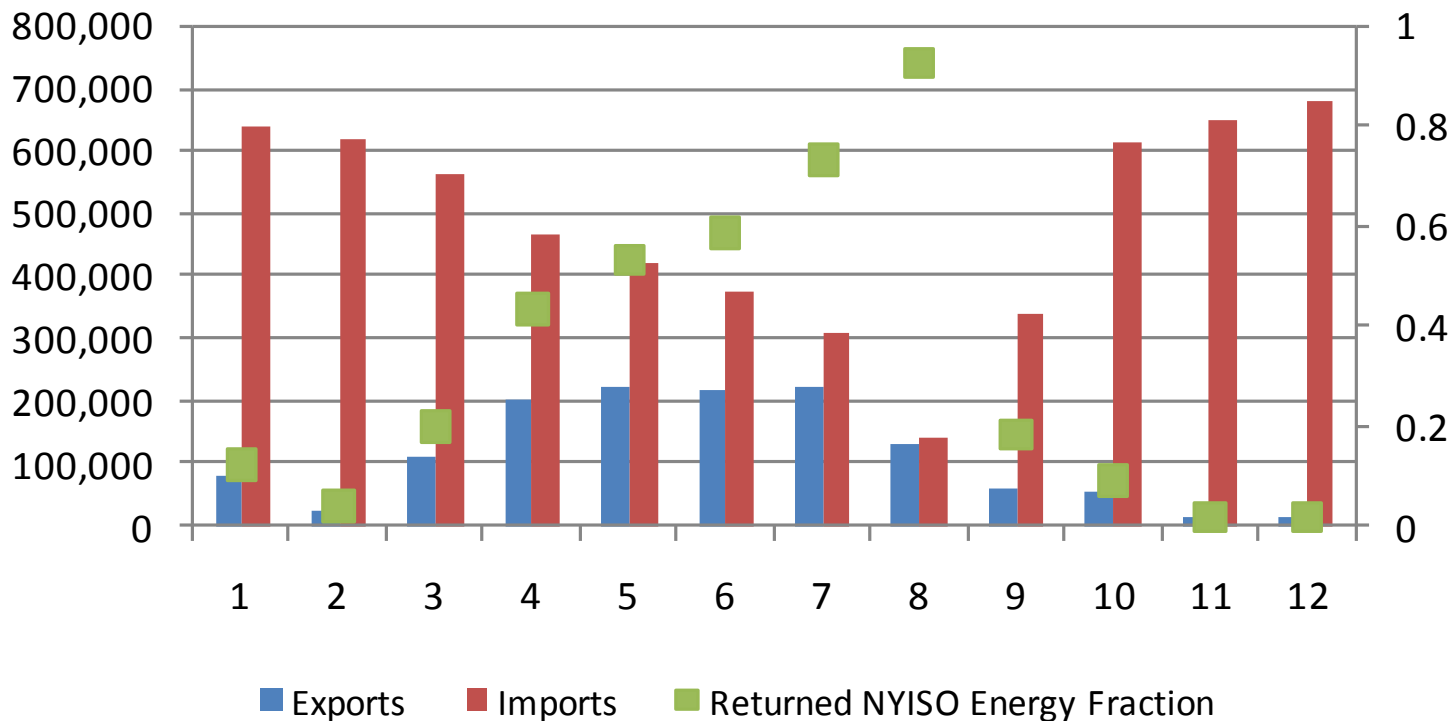
NYISO's CARIS Interchange with HQ

Diurnal Profiles, by Month, NYISO Exports to HQ



NYISO's CARIS Interchange with HQ

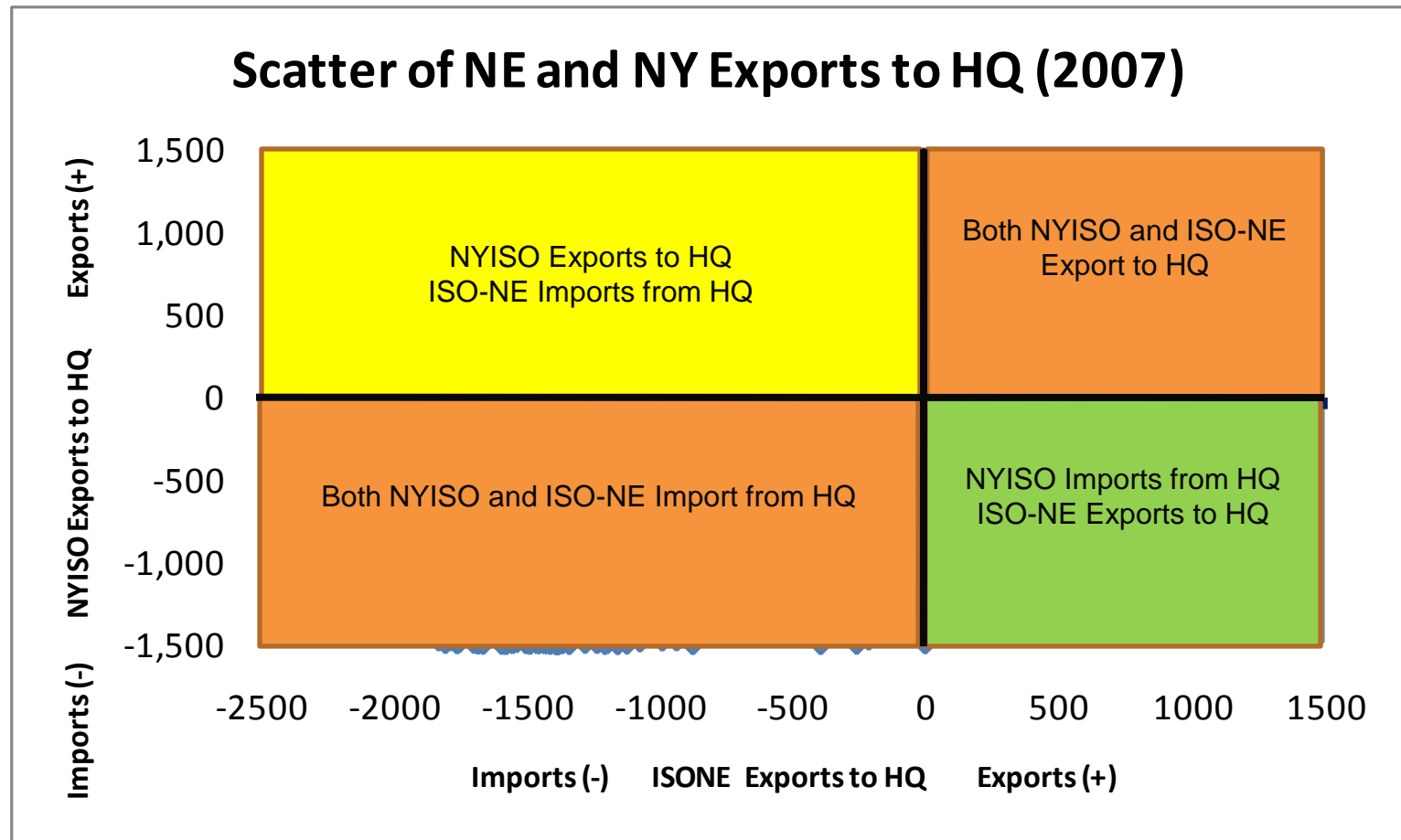
Imports and Export MWh by Month



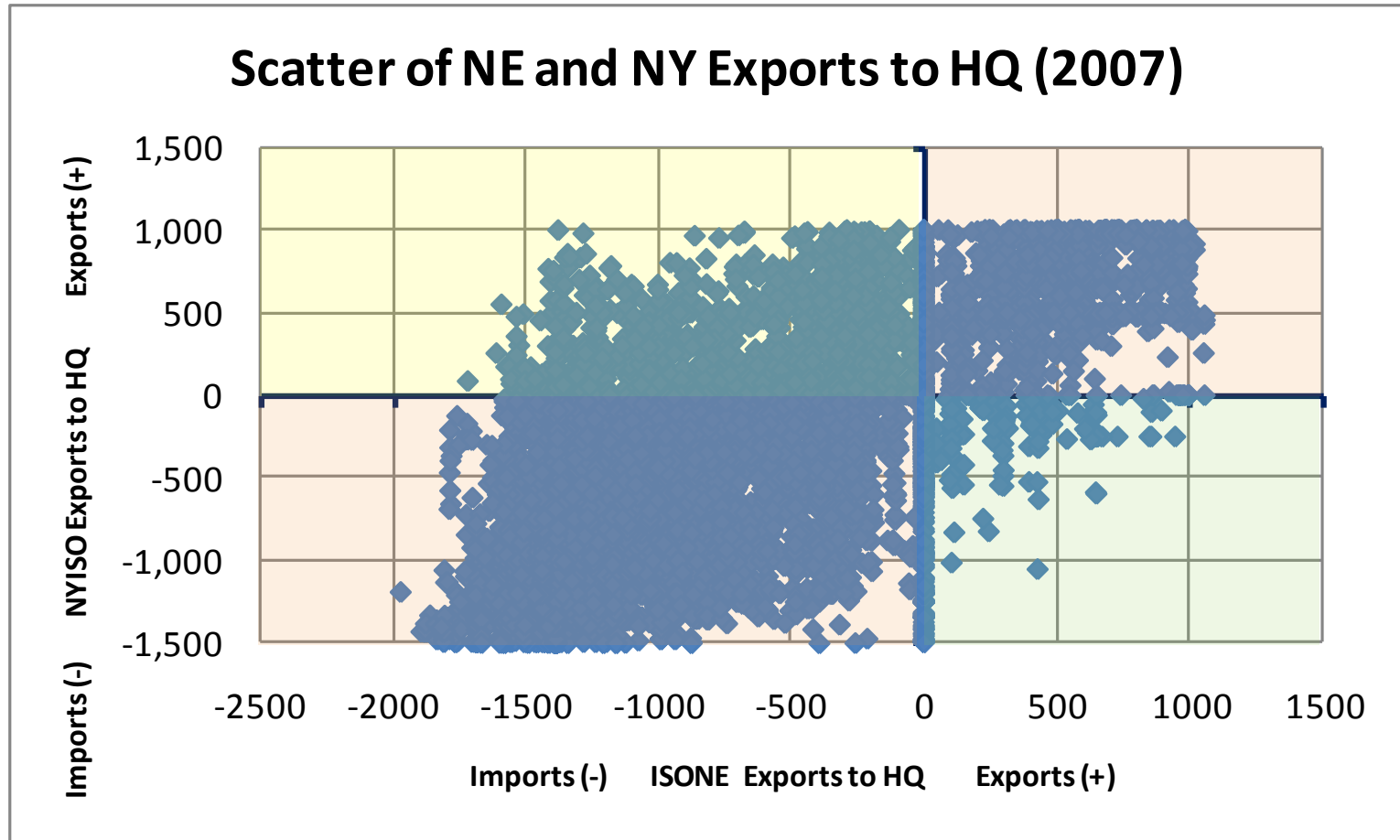
NY / NE / Quebec Flow: Analysis by Quadrant

Validation of IPSAC modeling

NY / NE / Quebec: Flow by Quadrants

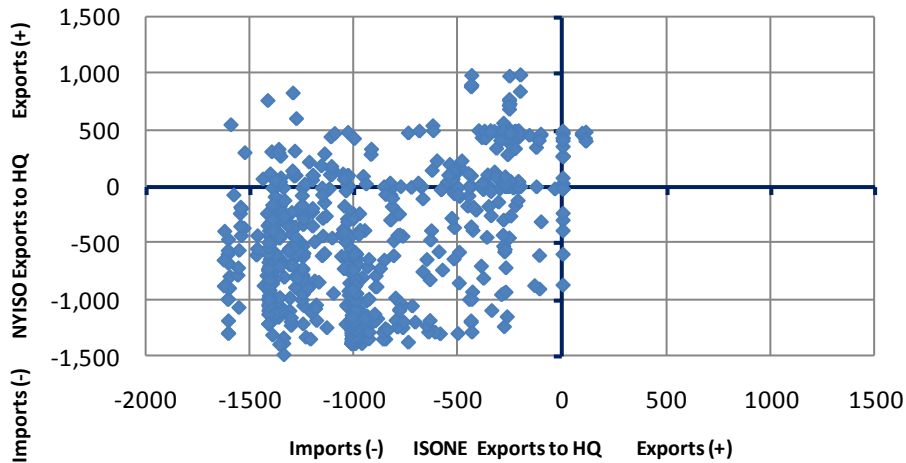


2007 Historical: Flow by Quadrants

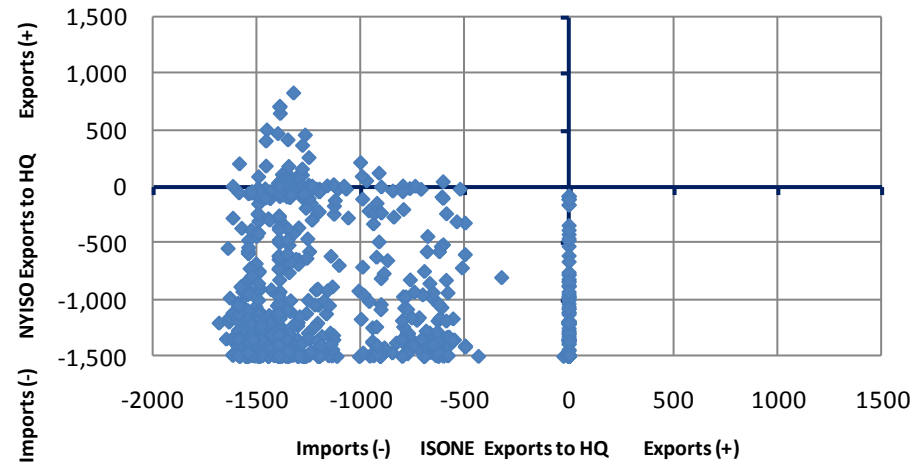


March: 2007 and 2008: Flow by Quadrants

Scatter of NE and NY Exports to HQ (2007)

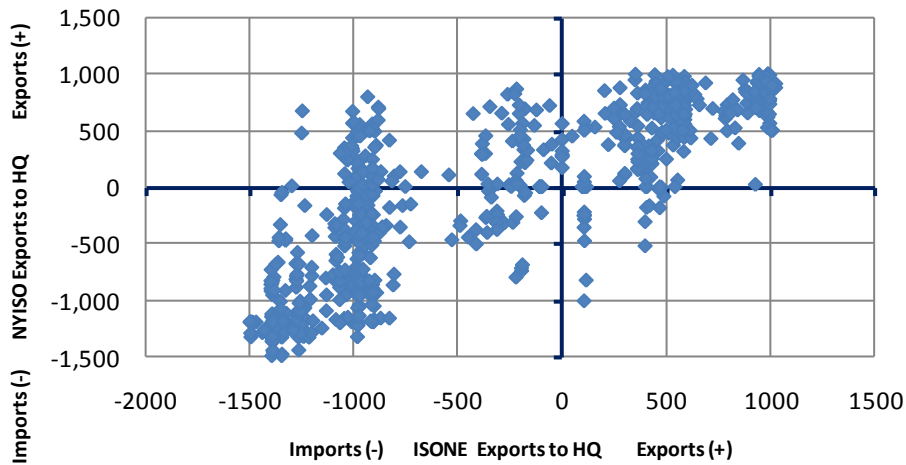


Scatter of NE and NY Exports to HQ (2008)

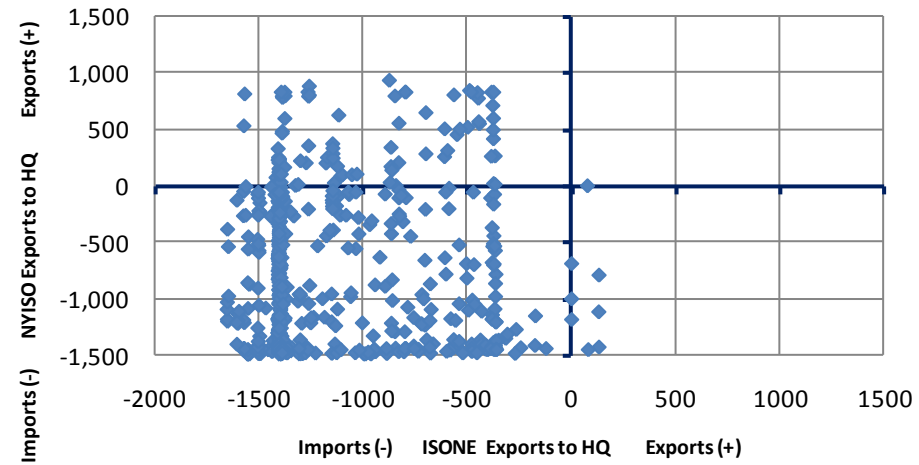


July: 2007 and 2008: Flow by Quadrants

Scatter of NE and NY Exports to HQ (2007)

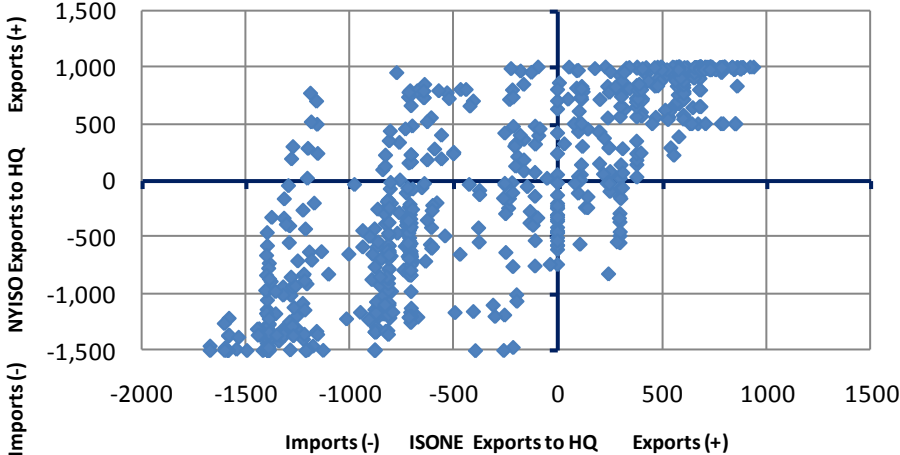


Scatter of NE and NY Exports to HQ (2008)

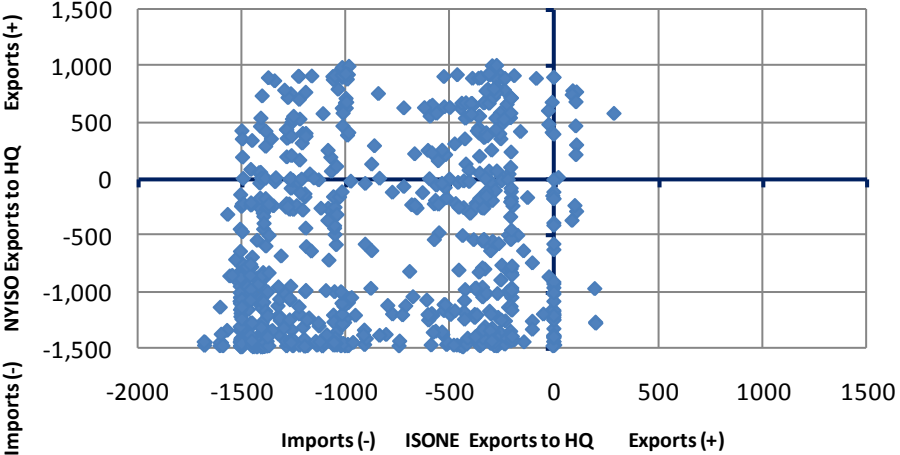


August: 2007 and 2008: Flow by Quadrants

Scatter of NE and NY Exports to HQ (2007)

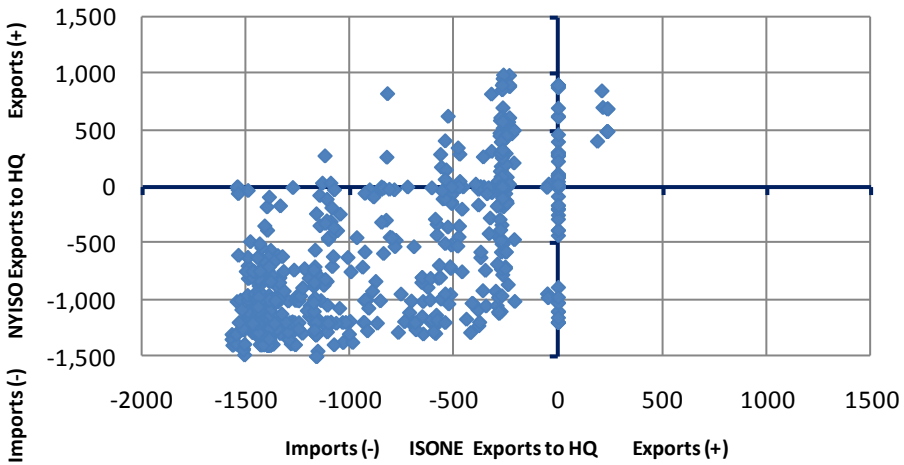


Scatter of NE and NY Exports to HQ (2008)

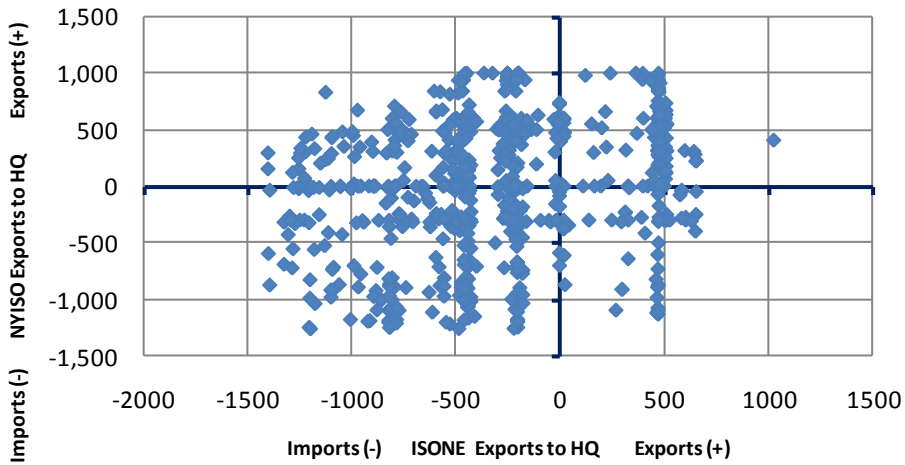


November: 2007 and 2008: Flow by Quadrants

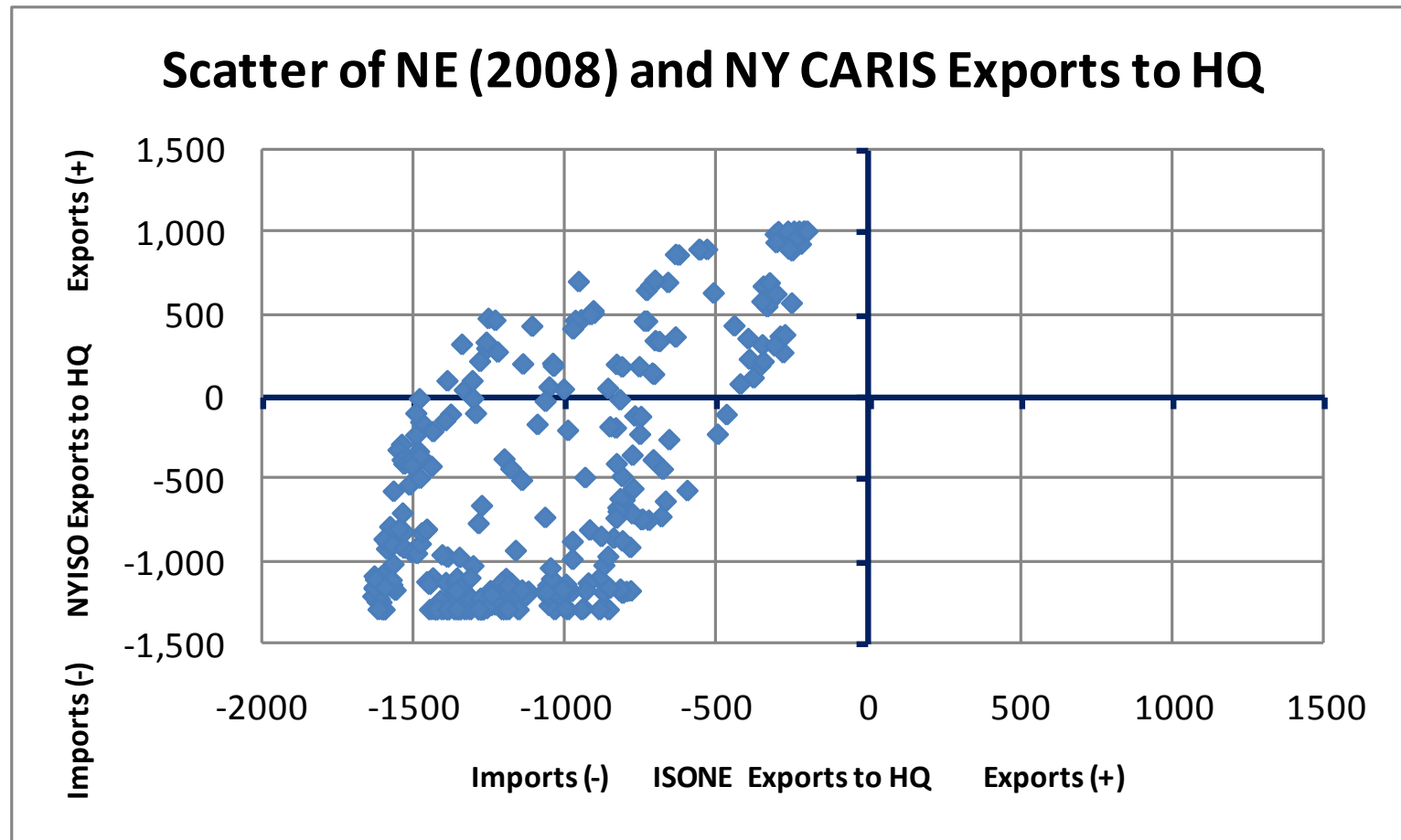
Scatter of NE and NY Exports to HQ (2007)



Scatter of NE and NY Exports to HQ (2008)



Input to IREMM Model: Flow by Quadrants



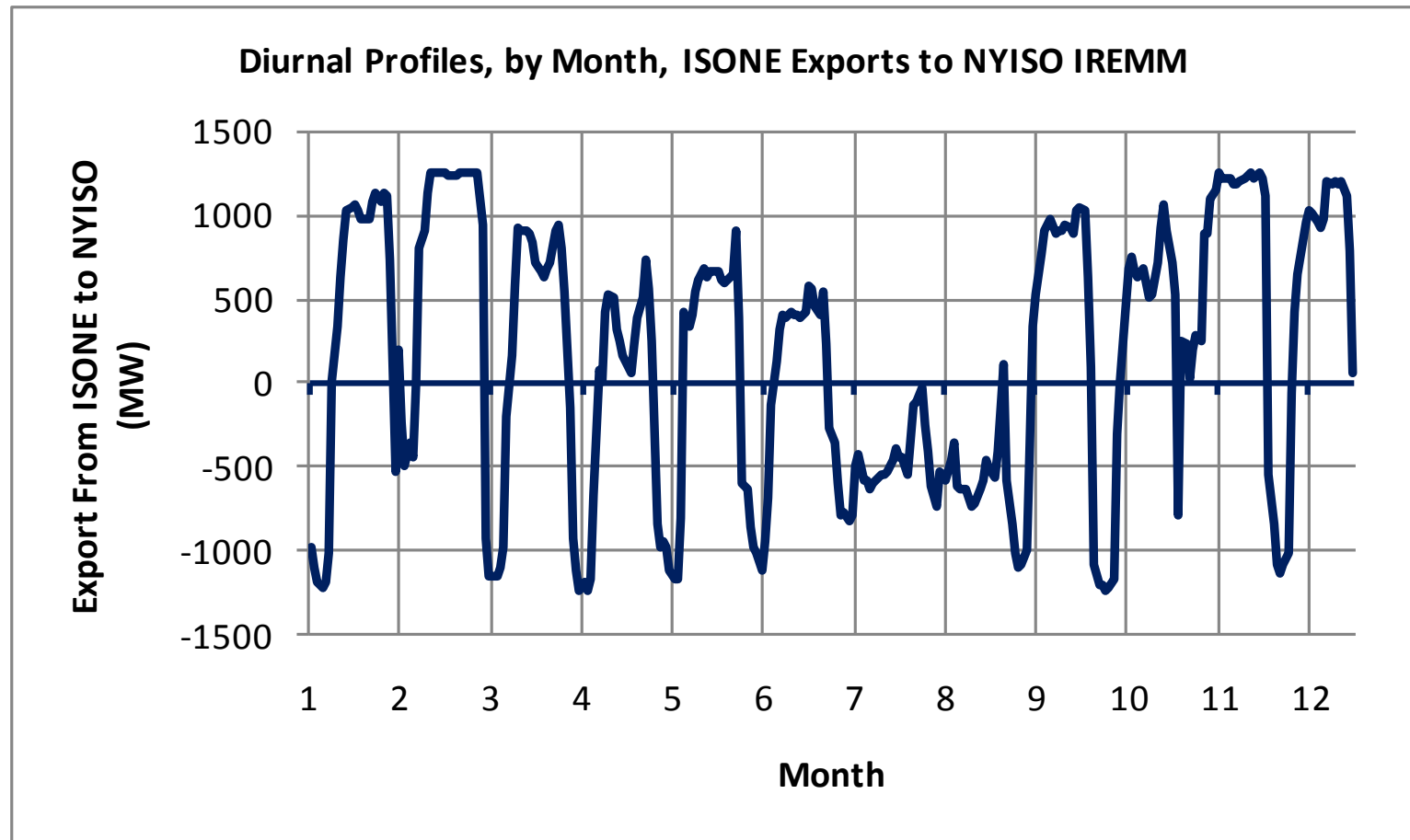
IREMM Simulation Results

Validation of IPSAC modeling

Simulation Results

- The following slide represents the trend of flows across the New York / New England interface
- Diurnal trends are observed that are consistent with historical data
 - Flows from New York to New England in the night
 - Flows from New England to New York during the day
 - Amplitude of IREMM diurnal flows seems greater than seen in historical diurnal flows
- Summer flows seem to be different than in historical years

IREMM simulation of ISO-NE to NYISO



Conceptual Example – Based on preliminary, unrefined data and assumptions

Effect of NE/NY Interface Relaxation

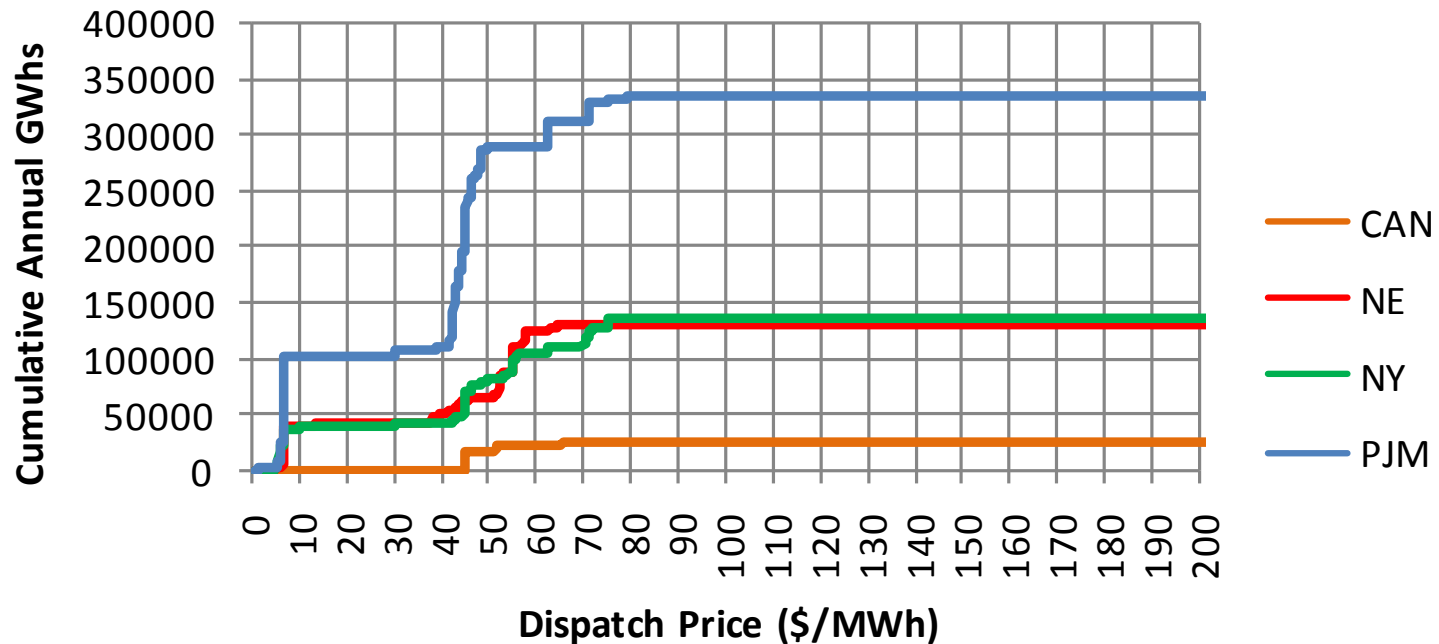
Conceptual Validation of IPSAC modeling

Evaluating the Effect of Interface Relaxation

- The following slides are conceptual for illustration
- Show the cumulative dispatch curve
 - MWs dispatched at what price level
 - By area (ISO-NE, NYISO, PJM, Quebec)
 - Total dispatched at maximum dispatch price is total net generation
- Comparing two curves can show differences
 - Which resources are displacing which other resources
 - Illustrated using only dispatch prices, not actual resources
- Incremental resources from interface relaxation can be determined
 - Annually
 - Monthly

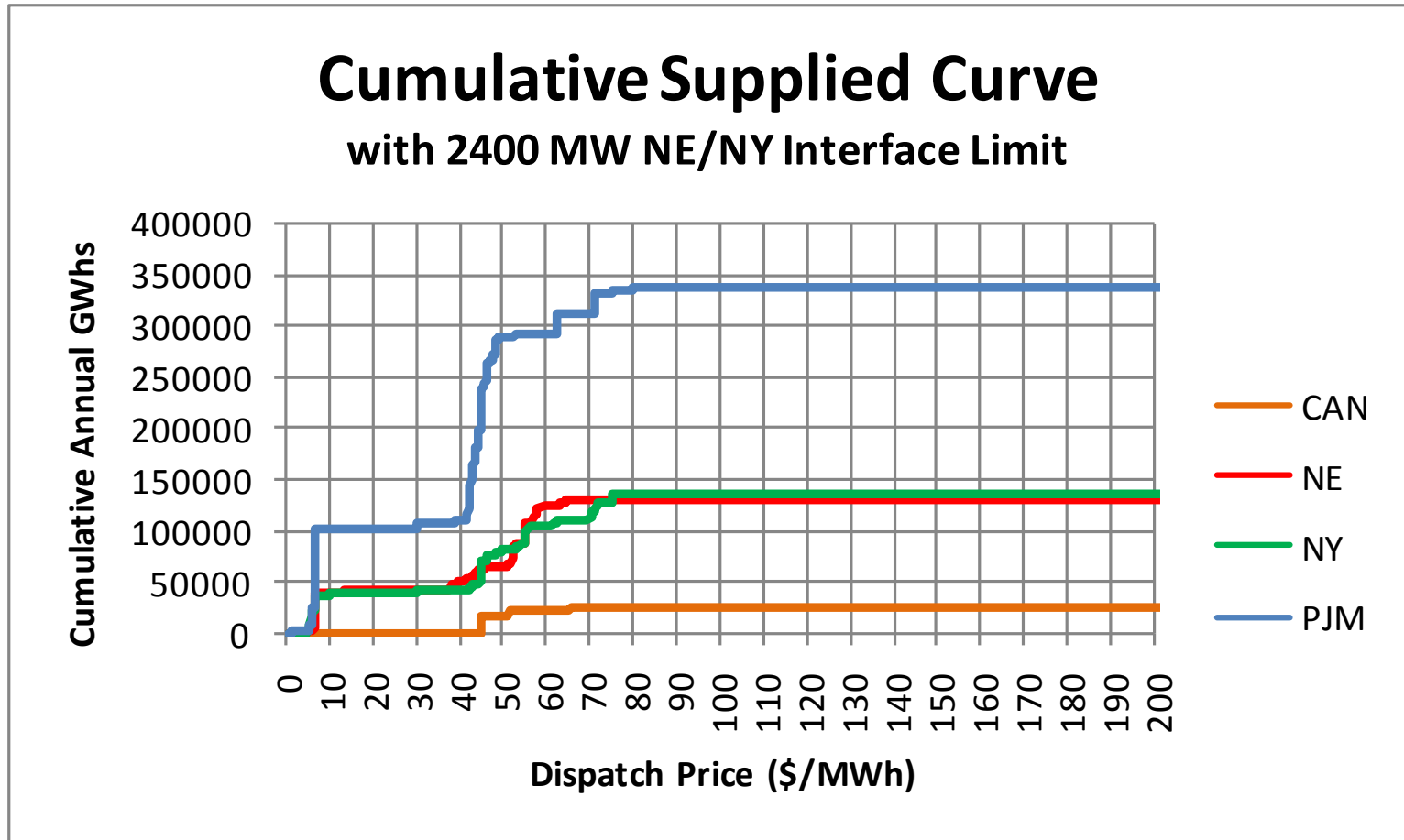
Supply Curve – A Reference Case

Cumulative Supplied Curve with 1400 MW NE/NY Interface Limit



Conceptual Example – Based on preliminary, unrefined data and assumptions

Supply Curve – A Relaxed Interface Case

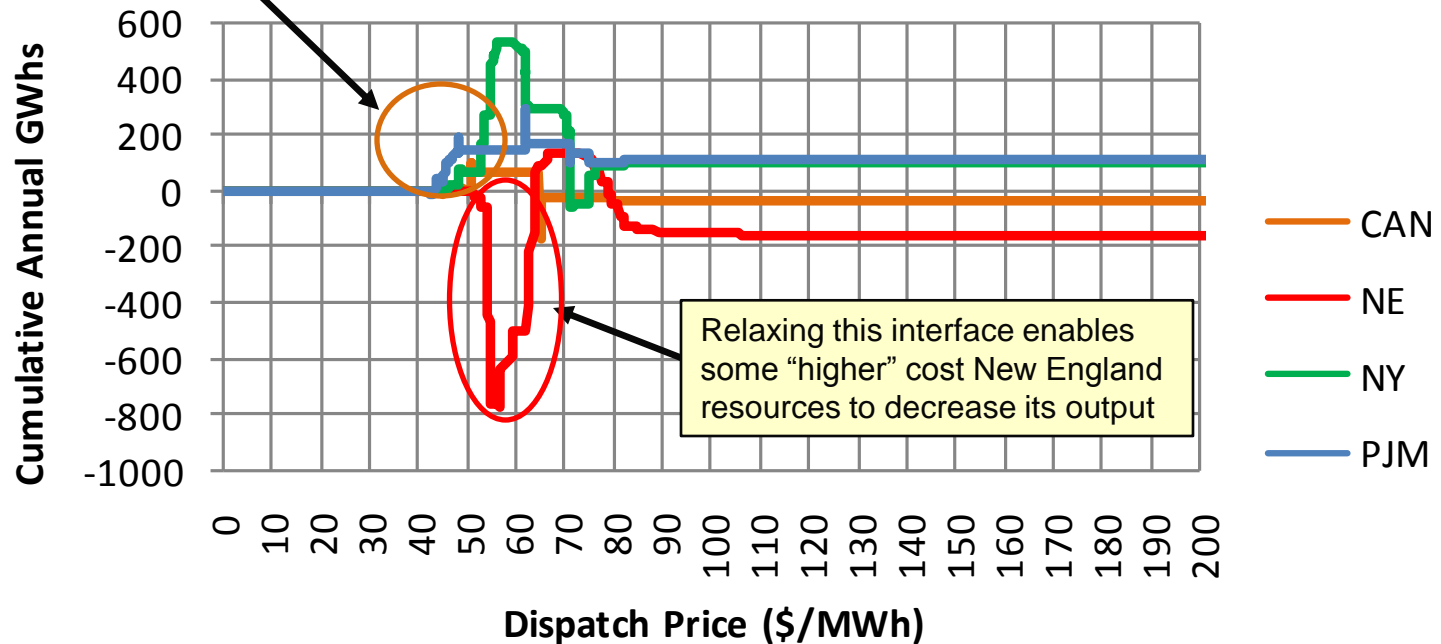


Conceptual Example – Based on preliminary, unrefined data and assumptions

Effect of Increased Transfer Capability

Relaxing this interface enables some "lower" cost PJM and NY resources to increase output

Cumulative Supply Curve with 2400 MW NE/NY Interface Limit



Conceptual Example – Based on preliminary, unrefined data and assumptions

