



Locational Marginal Prices & Interface Flows

2016 Historical Market and Operational Data

Victoria Rojo

SYSTEM PLANNING

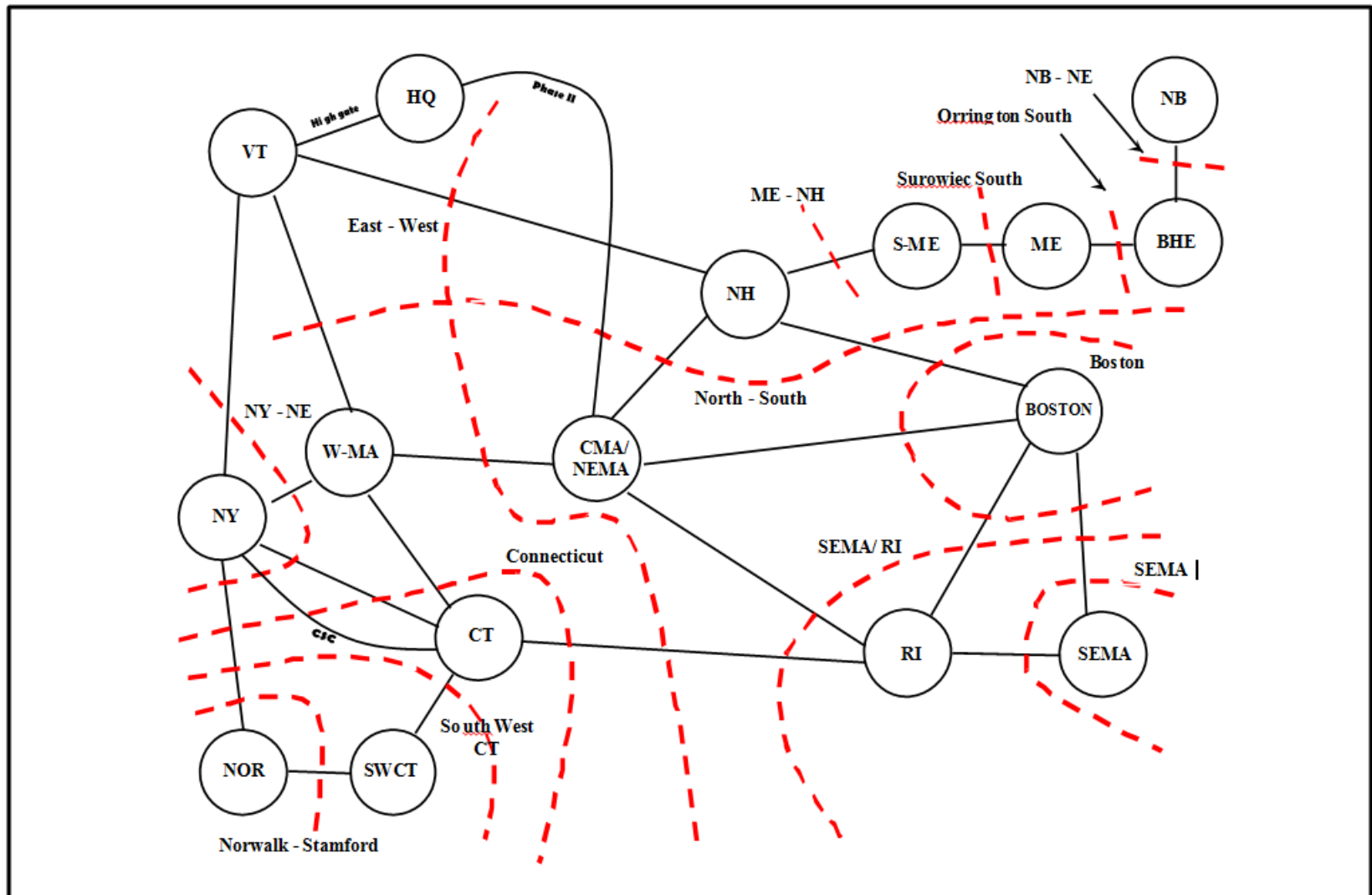


Overview

- Average Real-Time Locational Marginal Prices by RSP subarea
 - Hourly dollars per MWh
 - May contain differences from Market Reports due to rounding, precision, and definition
- Interfaces Flows
 - Monthly Box Plots
 - Duration Curves
- Market Information is summarized in other ISO-NE publications, such as the Annual Market Report
 - <https://www.iso-ne.com/markets-operations/market-monitoring-mitigation/internal-monitor>
- Presentation is intended to show general trends in real-time data
 - Anomalies within a trend are usually due to short-term events (e.g. a generator or line outage)
- Real-time data is subject to aberrations and missing data



New England Subarea Model



Box Plots & Duration Curves for Selected Interfaces

- Boston Import
- SEMA/Rhode Island Export
- Maine-New Hampshire
- Connecticut Import
- Western Connecticut Import
- Southwest Connecticut Import
- Norwalk-Stamford
- Orrington South
- Surowiec South
- East-West New England
- North-South New England
- HQ Phase II
- New Brunswick
- New England-New York Cross Sound Cable
- New England-New York Northport
- New England-New York Northern AC Ties



Interface Notes

- Metered Hourly Net Flows for HQ Phase II, New Brunswick, and the New York Northern AC Ties can be found on the ISO-NE website
 - <https://www.iso-ne.com/isoexpress/web/reports/grid/-/tree/external-interface-metered-data>
- Limits for interfaces are dynamic and are calculated in real time by the Interface Limit Calculator
- Flows and Limits for interfaces from 2010 – 2015 are available on the ISO-NE website. Data for 2016 will be posted soon.
 - <https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/historical-hourly-flows-and-limits>



REAL-TIME LOCATIONAL MARGINAL PRICES

Hub and RSP Subareas



Real-Time Locational Marginal Prices

2016 Summary (\$/MWh)

Region	Mean	Standard Deviation	Minimum	Maximum	Mean: Difference from Hub
Hub	28.94	34.05	-156.04	1438.97	0.00
BOSTON	29.72	35.00	-155.15	1447.10	0.78
CMA/NEMA	29.02	34.22	-155.69	1447.77	0.08
WMA	28.93	33.84	-157.58	1429.39	-0.01
SEMA	29.05	34.40	-155.76	1449.47	0.10
CT	28.97	34.05	-157.34	1443.39	0.03
SWCT	29.03	34.03	-159.12	1442.43	0.08
NOR	29.04	34.16	-159.72	1451.33	0.10
VT	28.64	33.53	-156.28	1427.78	-0.30
NH	28.53	33.17	-153.90	1418.07	-0.41
RI	28.88	34.07	-155.68	1439.23	-0.06
BHE	26.24	31.31	-150.66	1341.01	-2.70
SME	28.25	32.59	-153.47	1394.68	-0.69
ME	27.88	31.90	-151.52	1367.80	-1.06

Real-Time Locational Marginal Prices

2016 Summary of Congestion Component (\$/MWh)

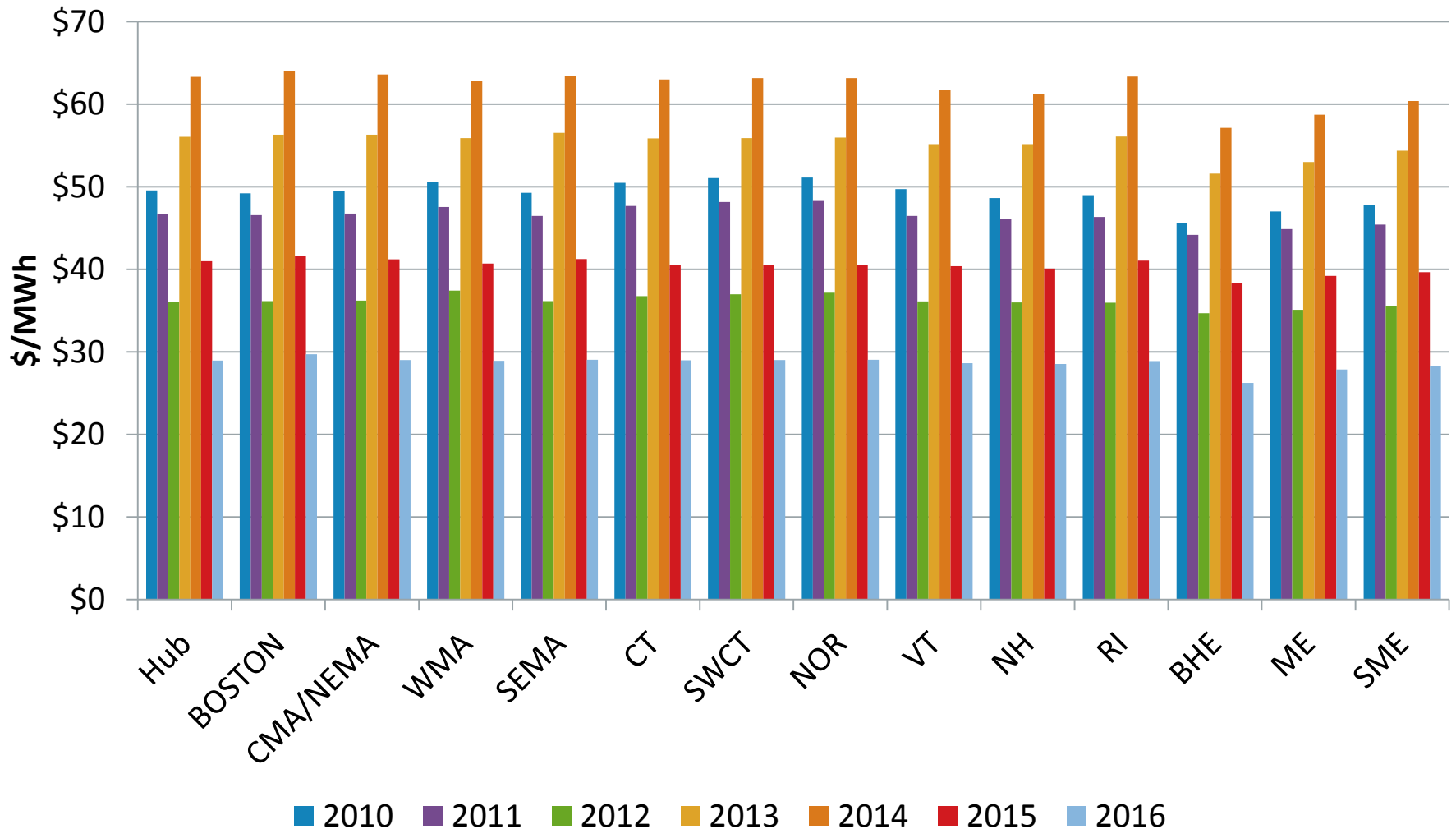
Region	Mean	Standard Deviation	Minimum	Maximum	Mean: Difference from Hub
Hub	-0.11	1.69	-68.00	23.42	0.00
BOSTON	0.58	4.77	-6.71	105.03	0.69
CMA/NEMA	-0.10	1.64	-72.50	27.85	0.01
WMA	-0.11	1.35	-28.66	10.21	0.00
SEMA	-0.07	1.96	-82.10	33.91	0.04
CT	-0.09	1.27	-20.22	13.95	0.03
SWCT	-0.07	1.56	-20.22	74.96	0.04
NOR	-0.07	1.59	-20.22	74.95	0.04
VT	-0.24	1.63	-40.33	43.72	-0.13
NH	-0.28	2.62	-119.46	4.44	-0.17
RI	-0.10	1.94	-89.96	29.08	0.02
BHE	-1.52	10.31	-200.46	5.18	-1.41
SME	-0.27	3.27	-151.90	5.20	-0.16
ME	-0.30	3.26	-151.10	5.12	-0.19

Real-Time Locational Marginal Prices

2016 Summary of Loss Component (\$/MWh)

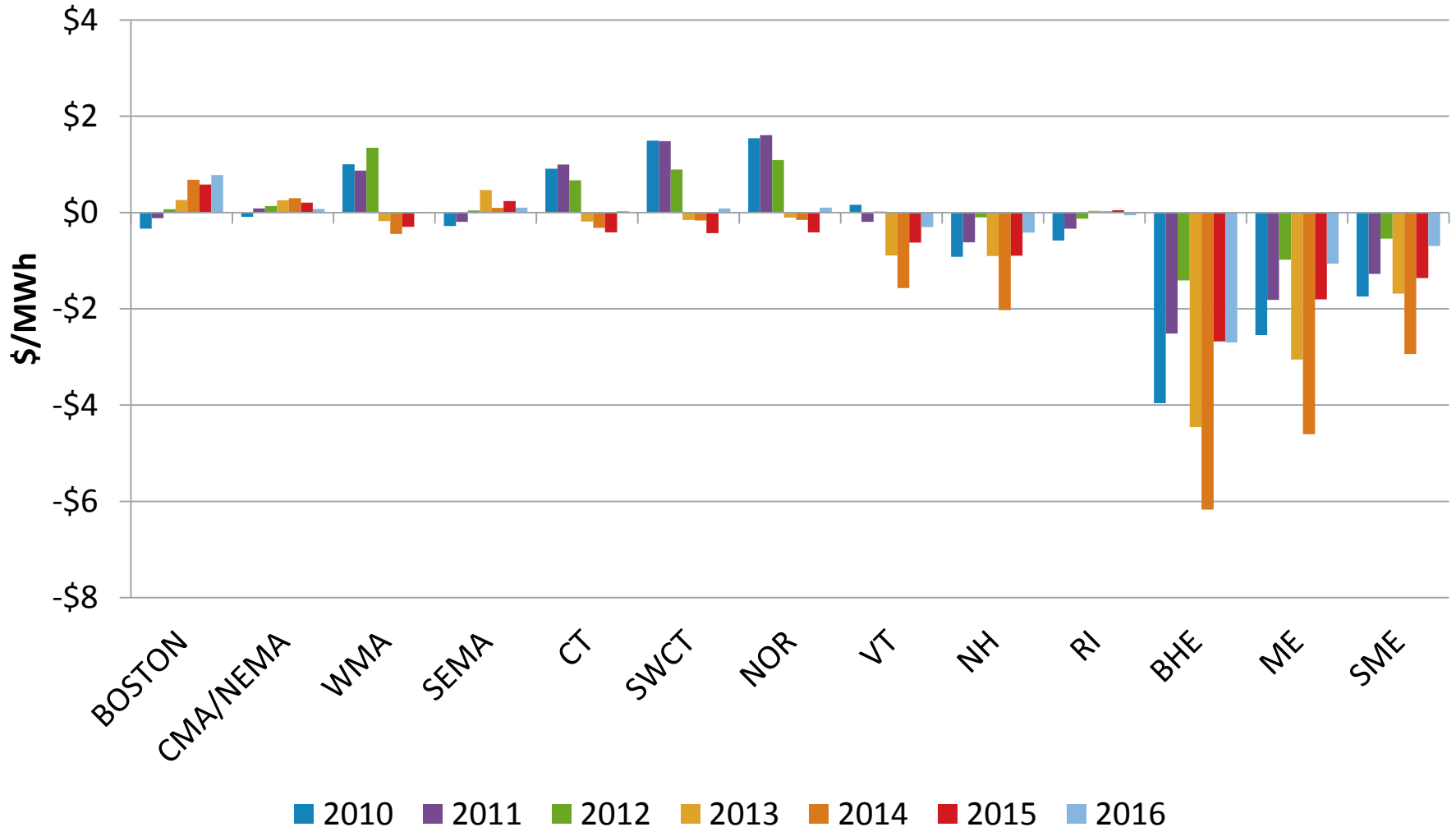
Region	Mean	Standard Deviation	Minimum	Maximum	Mean: Difference from Hub
Hub	0.08	0.20	-1.35	7.21	0.00
BOSTON	0.16	0.38	-0.96	14.67	0.09
CMA/NEMA	0.14	0.33	-0.85	15.07	0.07
WMA	0.06	0.28	-6.30	2.04	-0.02
SEMA	0.14	0.52	-1.24	21.66	0.07
CT	0.08	0.33	-3.78	7.73	0.00
SWCT	0.12	0.51	-5.59	6.77	0.04
NOR	0.13	0.64	-5.41	15.67	0.06
VT	-0.10	0.43	-12.74	2.12	-0.17
NH	-0.17	0.55	-21.75	3.48	-0.25
RI	0.00	0.26	-1.89	7.37	-0.07
BHE	-1.21	2.67	-126.72	12.57	-1.28
SME	-0.46	1.16	-52.59	5.04	-0.53
ME	-0.80	1.89	-88.14	7.72	-0.88

Average Real-Time Locational Marginal Prices



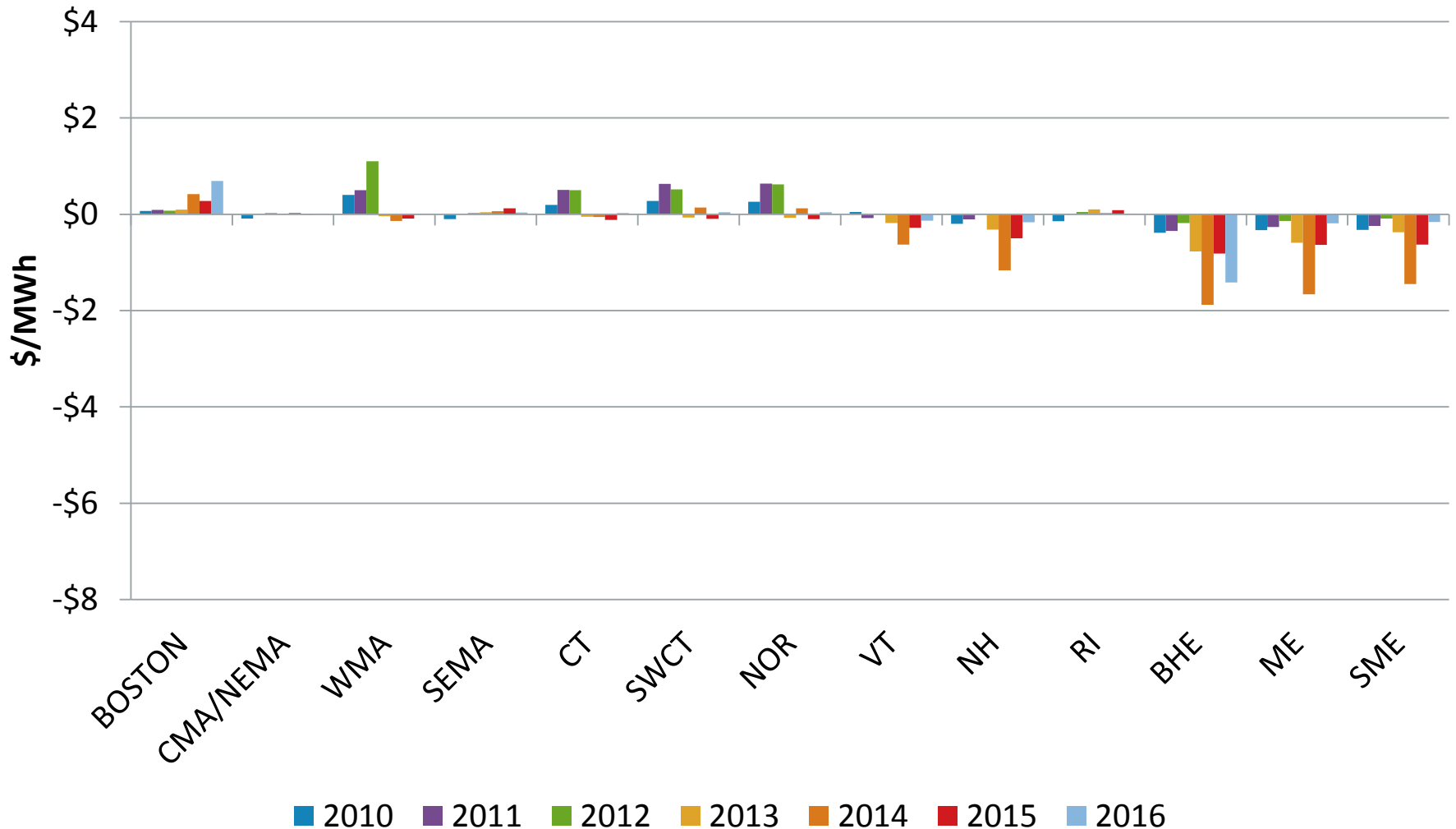
Average Real-Time Locational Marginal Prices

Difference from Hub



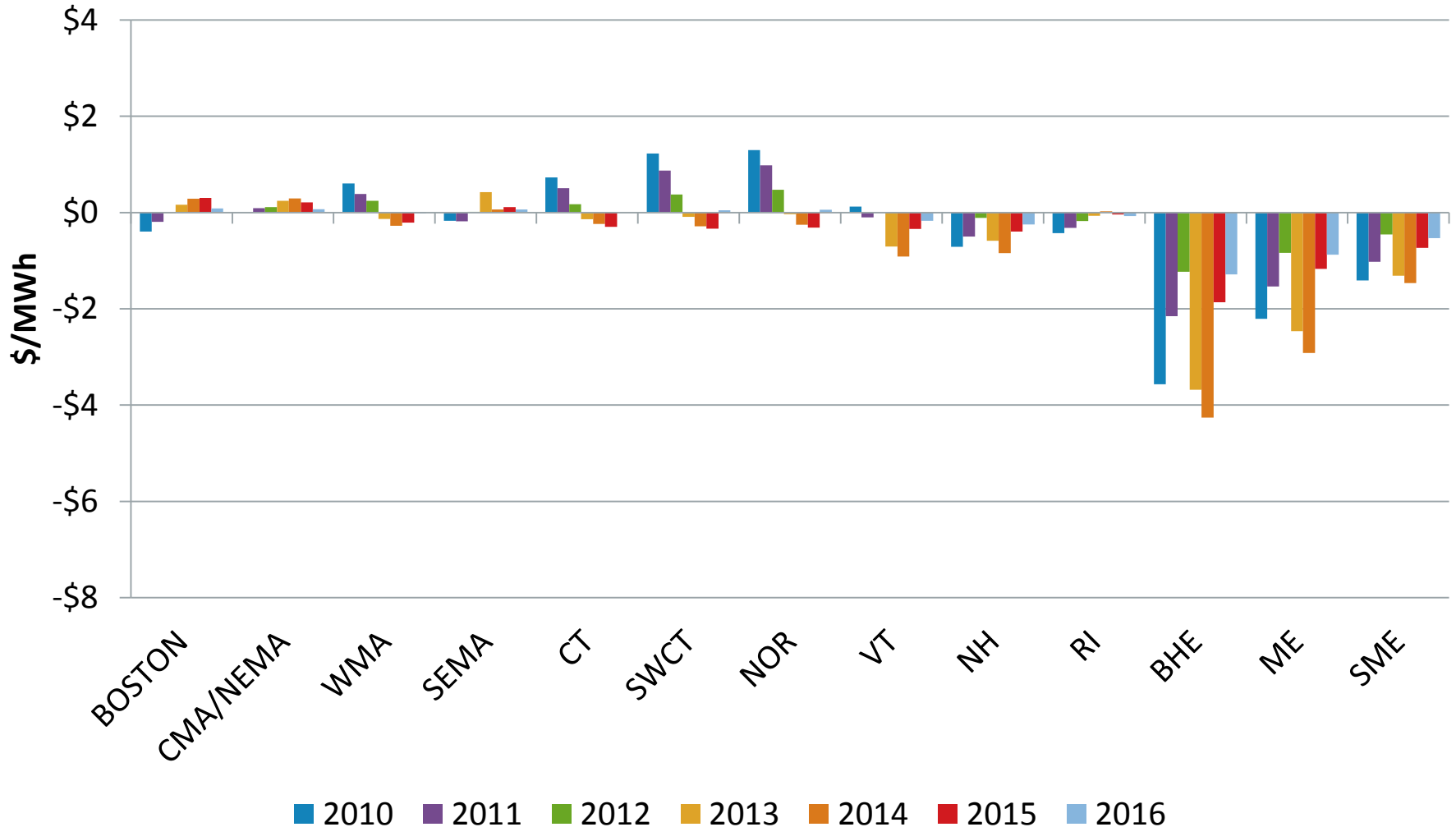
Average Real-Time Locational Marginal Prices

Difference from Hub: Congestion Component

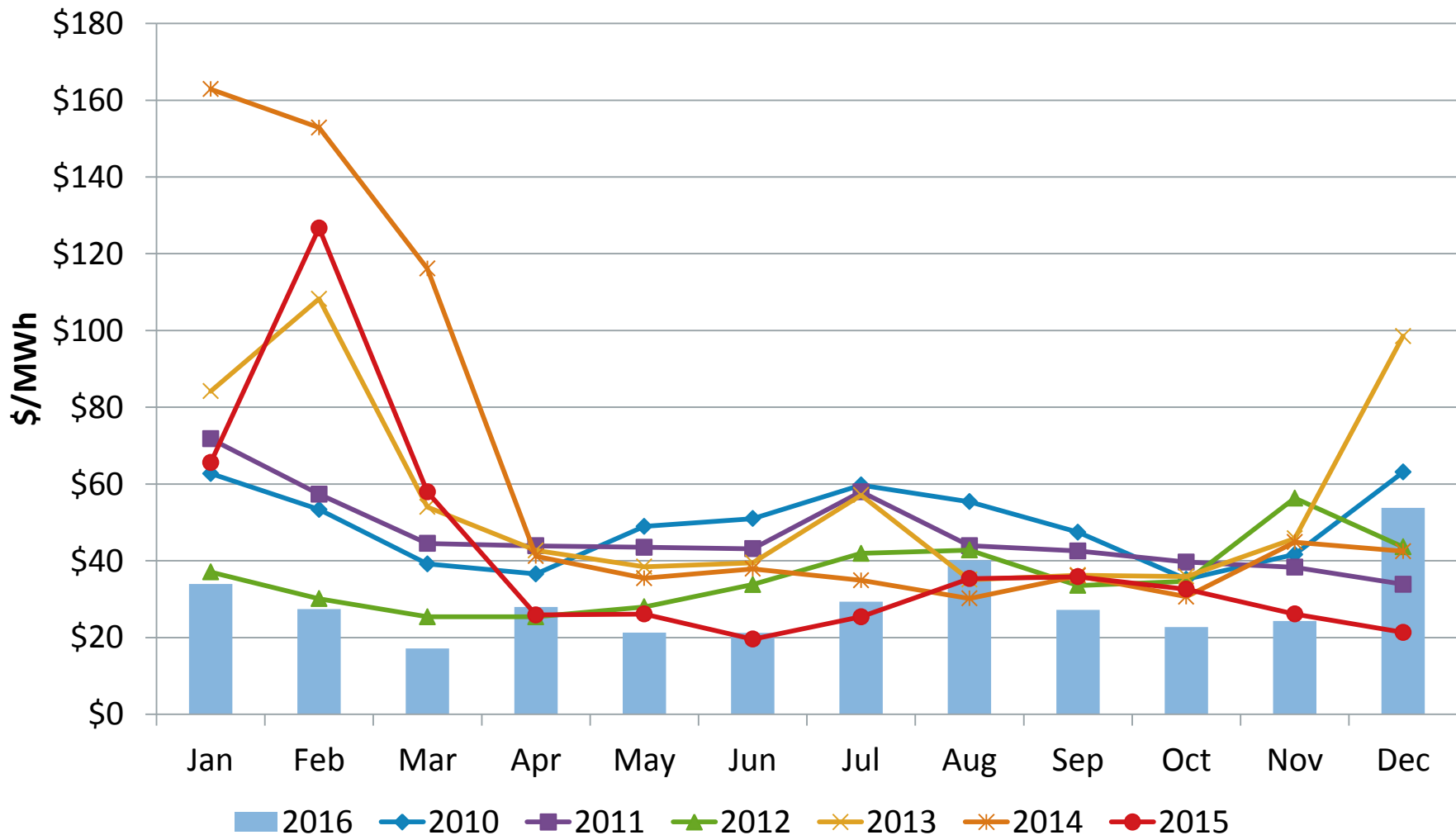


Average Real-Time Locational Marginal Prices

Difference from Hub: Loss Component



Monthly Average Real-Time Locational Marginal Prices at Hub



INTERFACE DESCRIPTIONS



Interface Descriptions

Internal Interfaces

- The Boston Import interface surrounds the northeastern area of Massachusetts, from the New Hampshire/Massachusetts border to just south of Boston. A positive sign indicates power flow into Northeastern Massachusetts/Boston from the rest of New England.
- The Southeastern Massachusetts/Rhode Island (SEMA/RI) export interface surrounds Massachusetts south of Boston and all of the state of Rhode Island. The western edge of the interface is the same as parts of the East-West and Boston Import interfaces. A positive sign indicates power flow into the rest of New England from SEMA/RI.
- The Maine-New Hampshire interface runs across part of southern Maine. A positive sign on the data indicates power flow from Maine to New Hampshire.



Interface Descriptions

Internal Interfaces

- The Connecticut Import interface surrounds most of the state of Connecticut. A positive sign indicates power flow into Connecticut from the rest of New England.
- The Western Connecticut Import interface is generally west of the Connecticut river, excluding the Hartford area. A positive sign on the data indicates power flow from East to West.
- The Southwest Connecticut Import interface surrounds the southwestern corner of Connecticut. A positive sign indicates power flow into southwest Connecticut.



Interface Descriptions

Internal Interfaces

- The Norwalk-Stamford interface surrounds the extreme southwestern portion of southwest Connecticut, and lies within the Southwest Connecticut Import interface. A positive sign indicates power flow into the region.
- The Orrington South interface separates the areas north and east of Bangor from the rest of Maine. A positive sign indicates a southwest power flow towards Portland.
- The Surowiec South interface is just northeast of Portland, and lies across the lines going southwest from Maine Yankee, roughly separating southern Maine from the rest of the state. A positive sign indicates power flow into the Southern-Maine subarea.



Interface Descriptions

Internal Interfaces

- The East-West interface runs south from northern Vermont, through central Massachusetts, and through Connecticut just west of the Rhode Island border. A positive sign on the data indicates power flow from East to West.
- The North-South interface runs across the southern borders of New Hampshire and Vermont, dividing the ISO-NE area into two separate three-state regions. A positive sign on the data indicates power flow from North to South.



Interface Descriptions

External Interfaces

- The New Brunswick interface connects New England to the Maritimes. A positive sign indicates power flow from New England to the Maritimes.
- The HQ Phase II interface connects New England to the Hydro Quebec System. A positive sign indicates power flow from New England to HQ.
- The New York-New England interface runs along the border between the New England Control Area and the New York Control Area. This interface is shown as (1) the Cross Sound Cable-central CT to Long Island, (2) Norwalk CT-Northport Long Island, and (3) the NY-Northern AC ties. A positive sign on the data indicates power flow from New England to New York.



Interface Details

- On-peak hours are defined as non-holiday weekdays from hours ending 8 AM to 11 PM.
- For a technical description of the interfaces see the “Generic Interface Constraints” spreadsheet:
 - http://isoweb.iso-ne.com/transmission_system_information/Generic%20Interface%20Constraints/

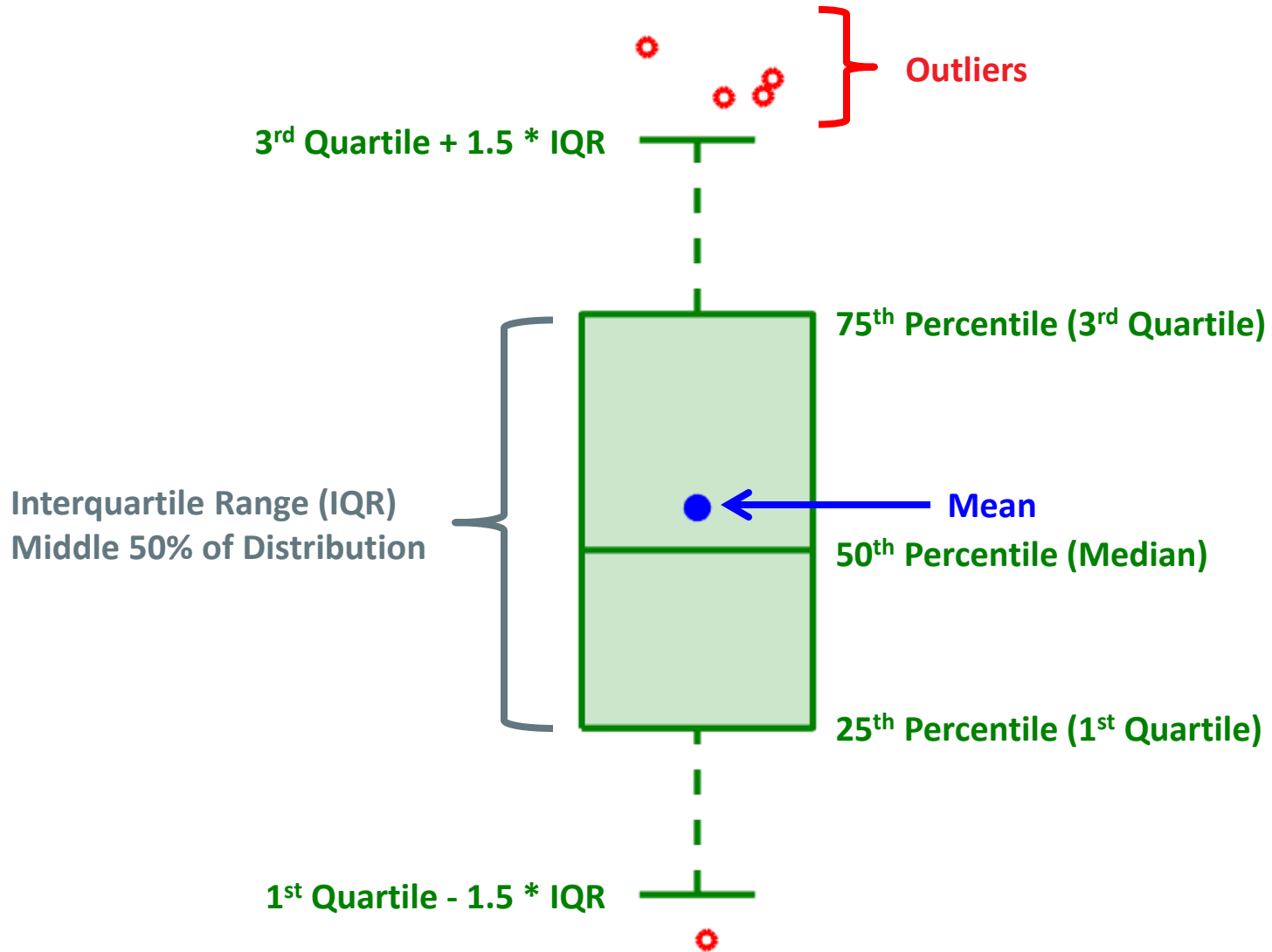


2016 INTERFACE FLOWS

Monthly Boxplots

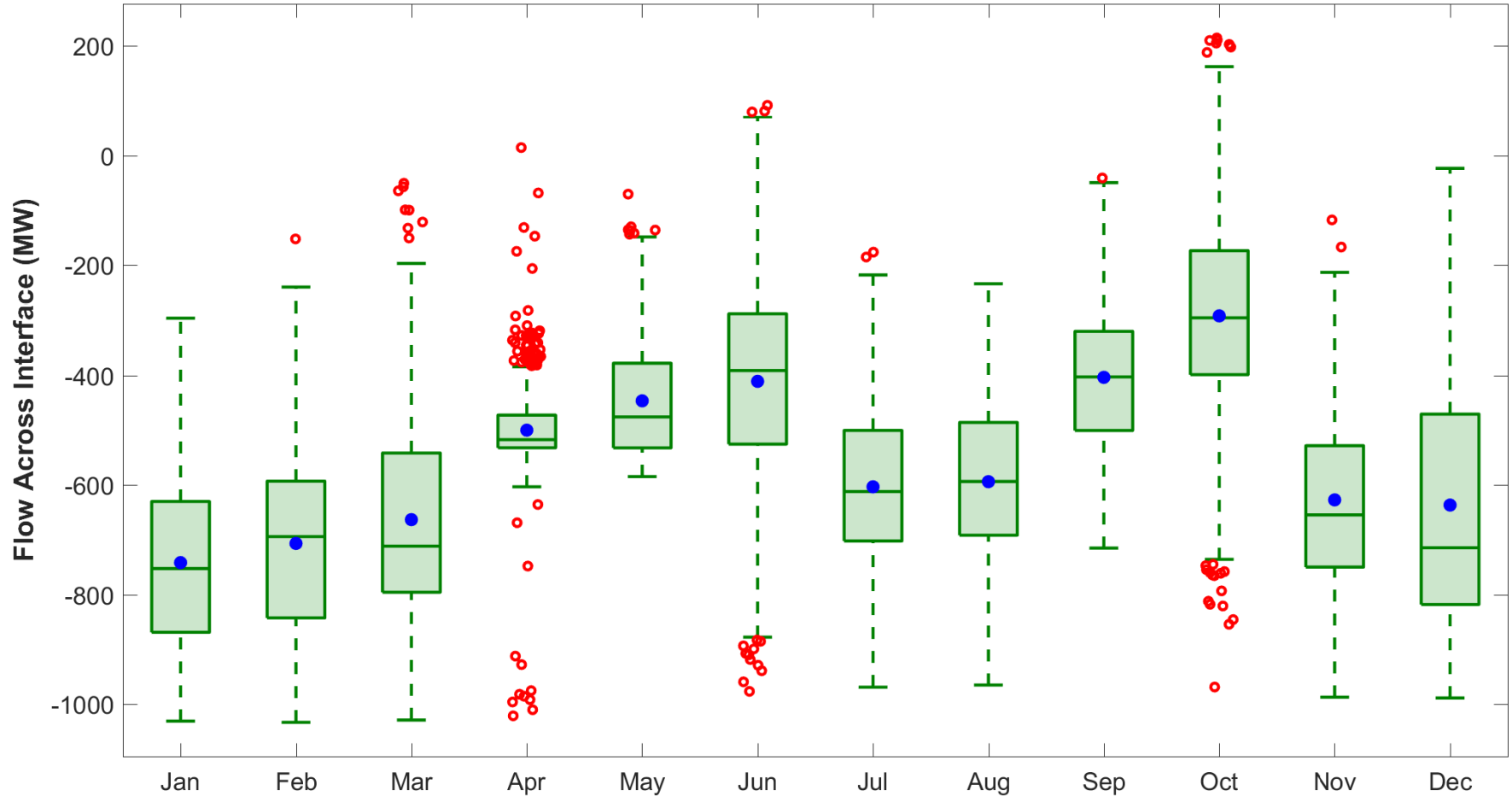


Boxplot Key



New Brunswick

Summary Flow Statistics by Month

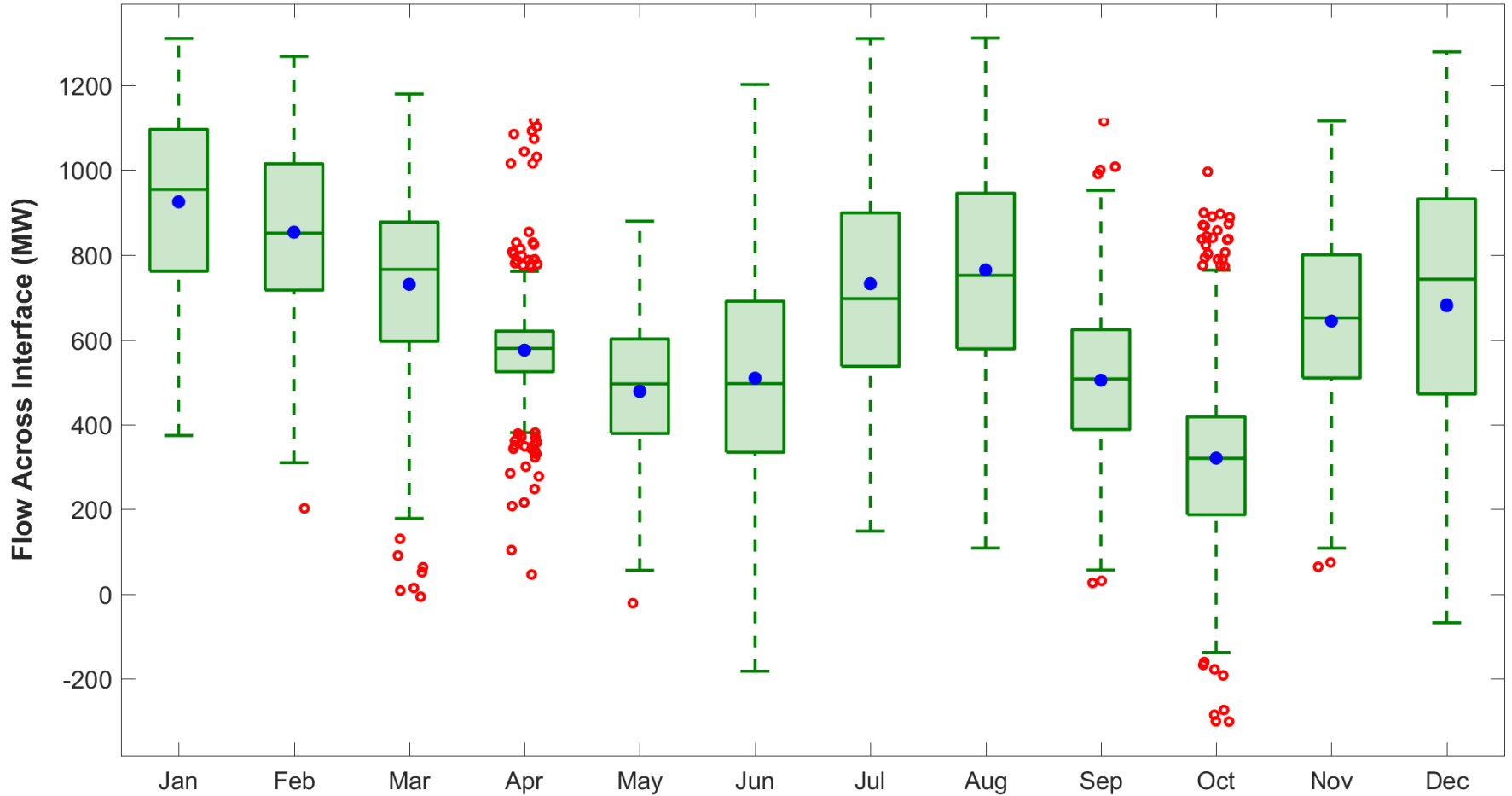


*Positive values indicate power flowing out of New England



Orrington South

Summary Flow Statistics by Month

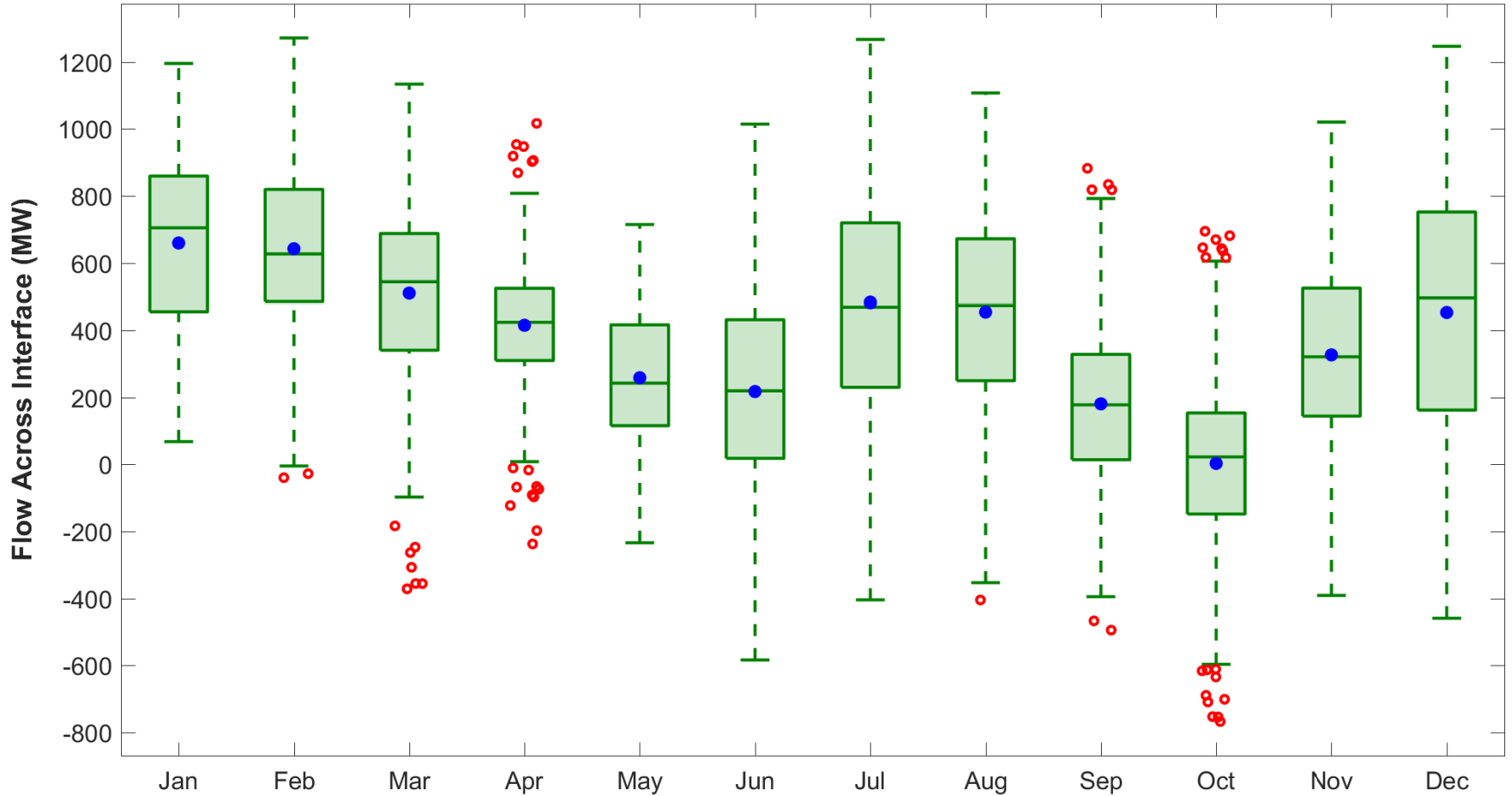


*Positive values indicate power flowing into the Maine subarea



Surowiec South

Summary Flow Statistics by Month

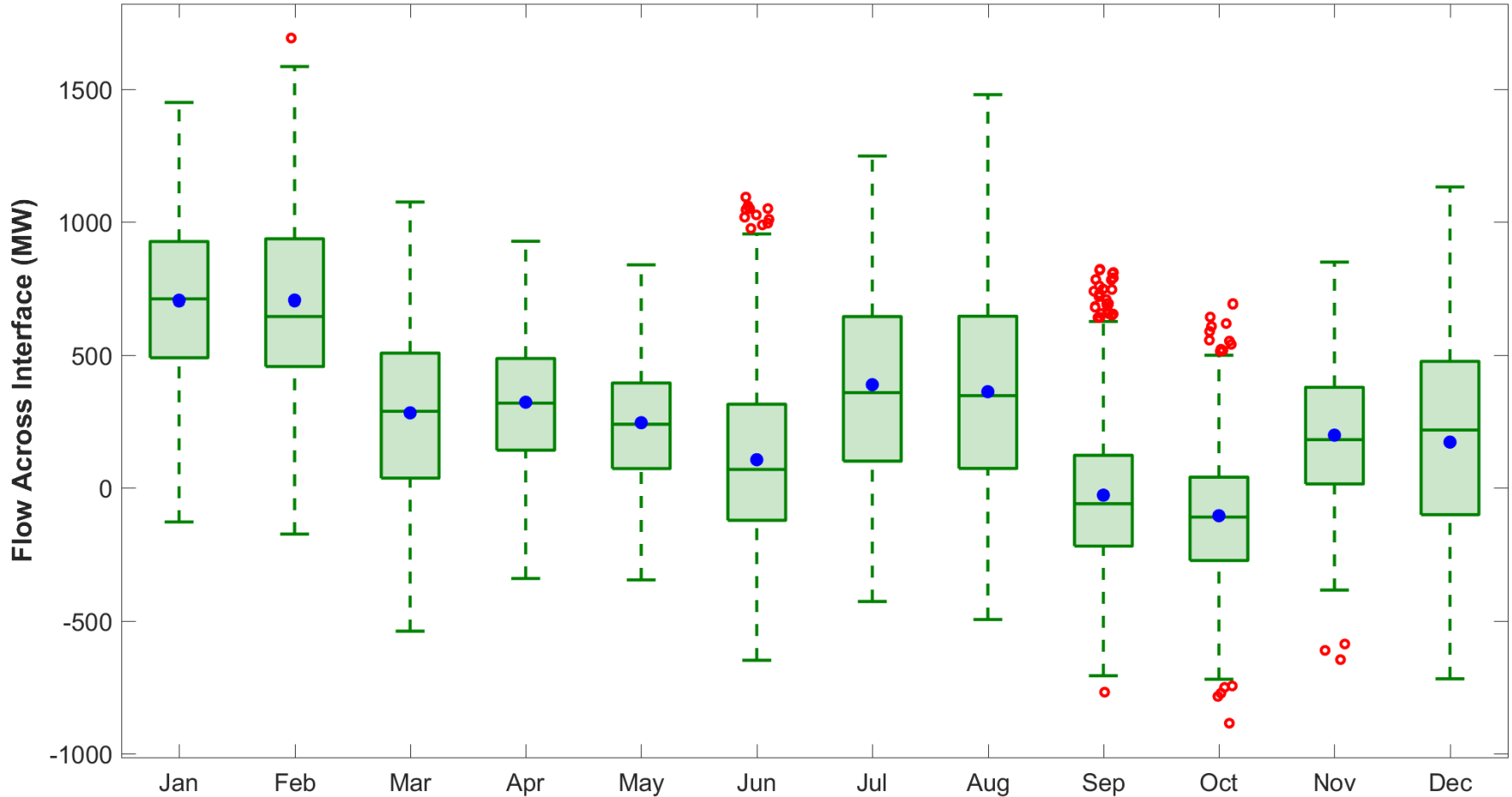


*Positive values indicate power flowing into the Southern Maine subarea



Maine to New Hampshire

Summary Flow Statistics by Month

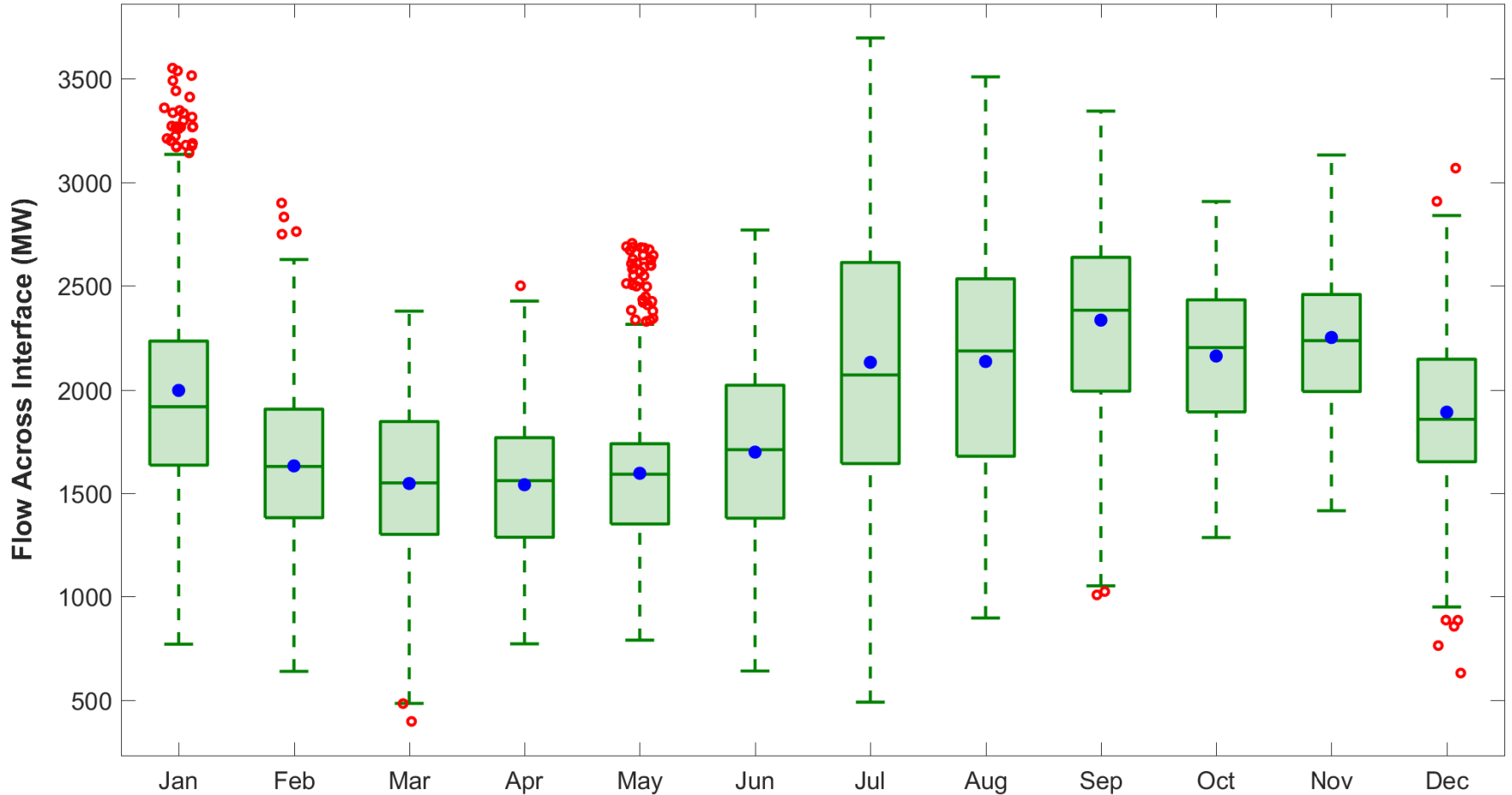


*Positive values indicate power flowing into New Hampshire



Boston Import

Summary Flow Statistics by Month

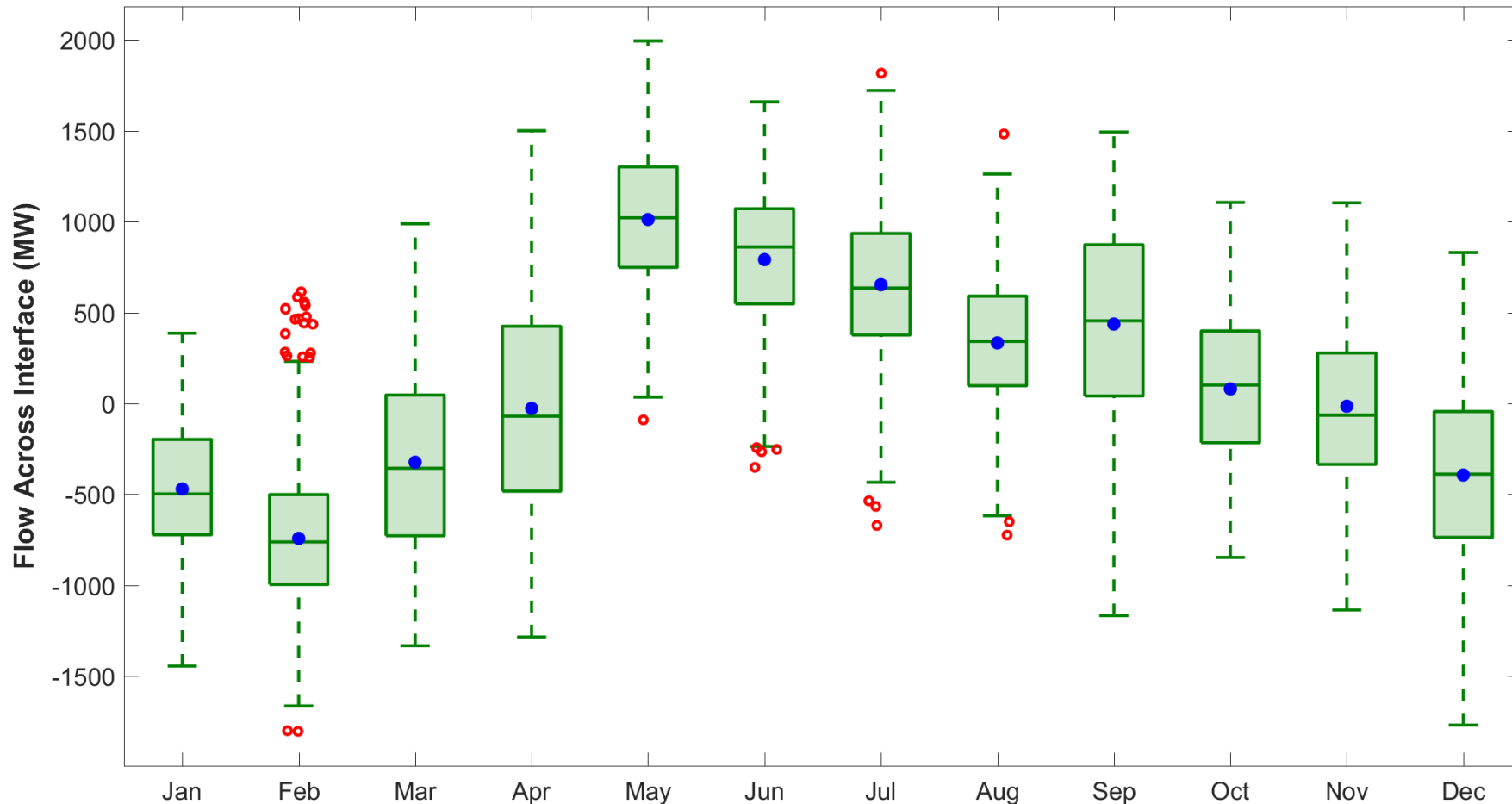


*Positive values indicate power flowing into Boston



SEMA/Rhode Island

Summary Flow Statistics by Month

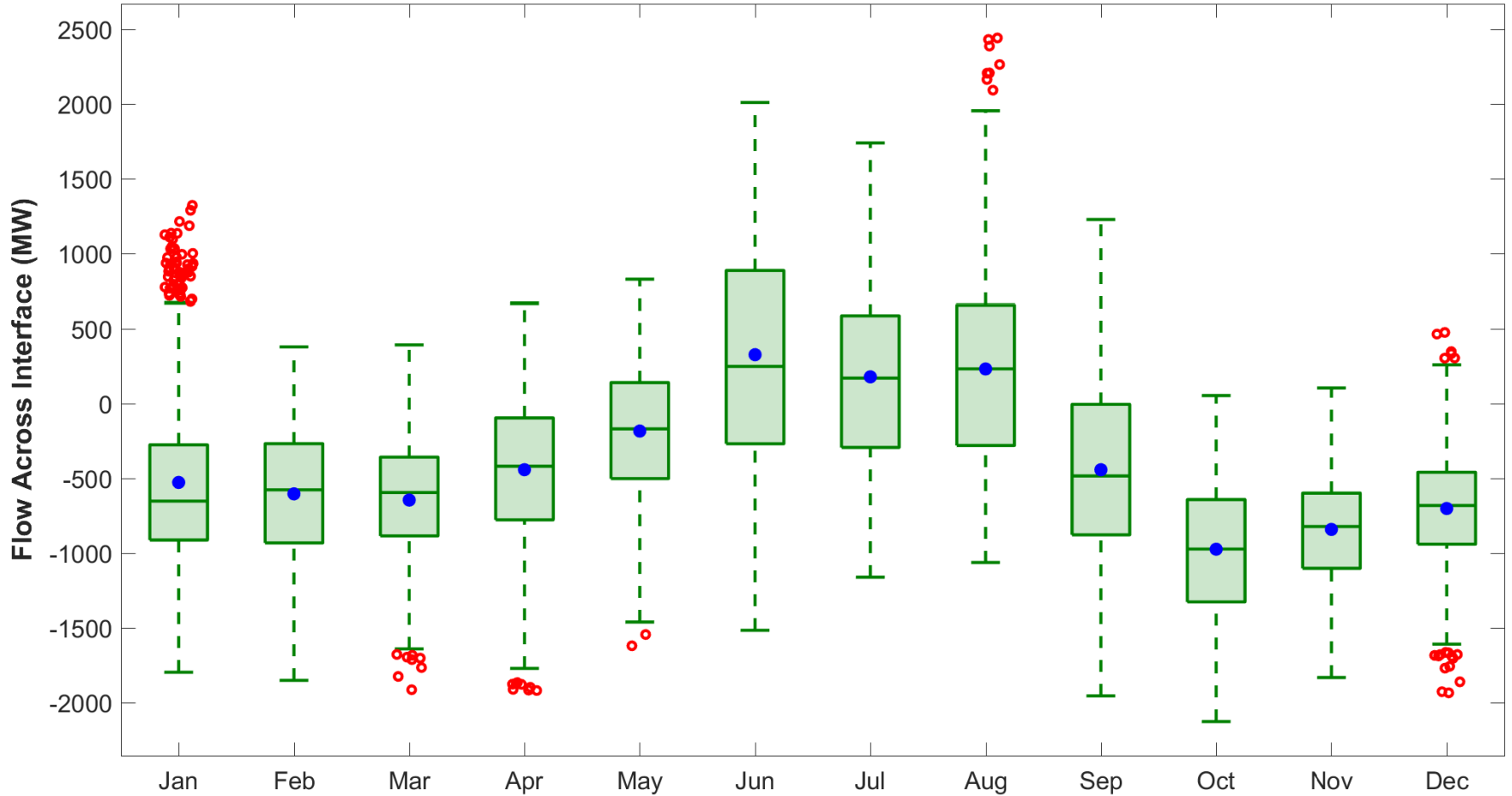


*Positive values indicate power flowing out of SEMA/Rhode Island



Connecticut Import

Summary Flow Statistics by Month

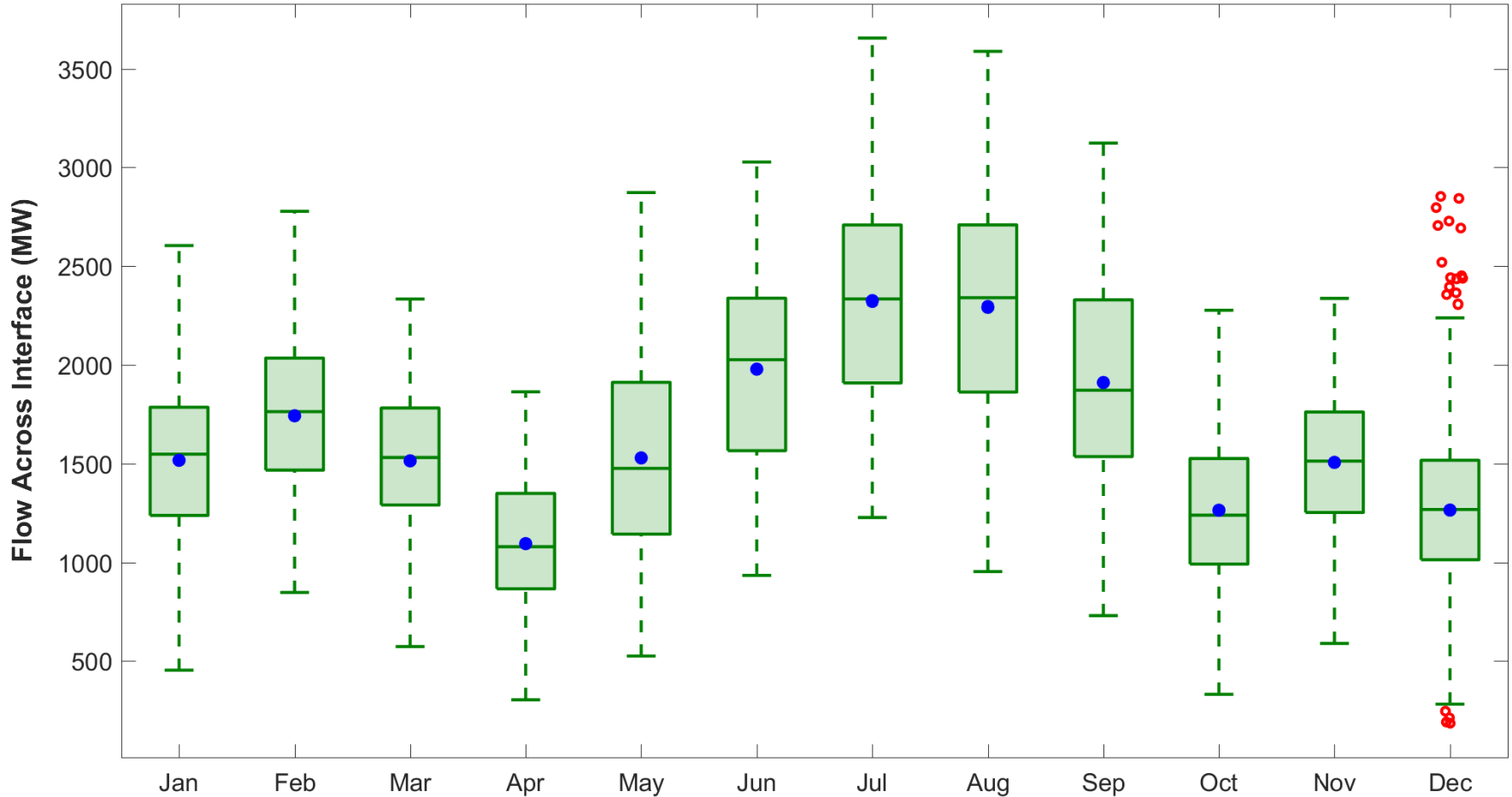


*Positive values indicate power flowing into Connecticut



Western Connecticut Import

Summary Flow Statistics by Month

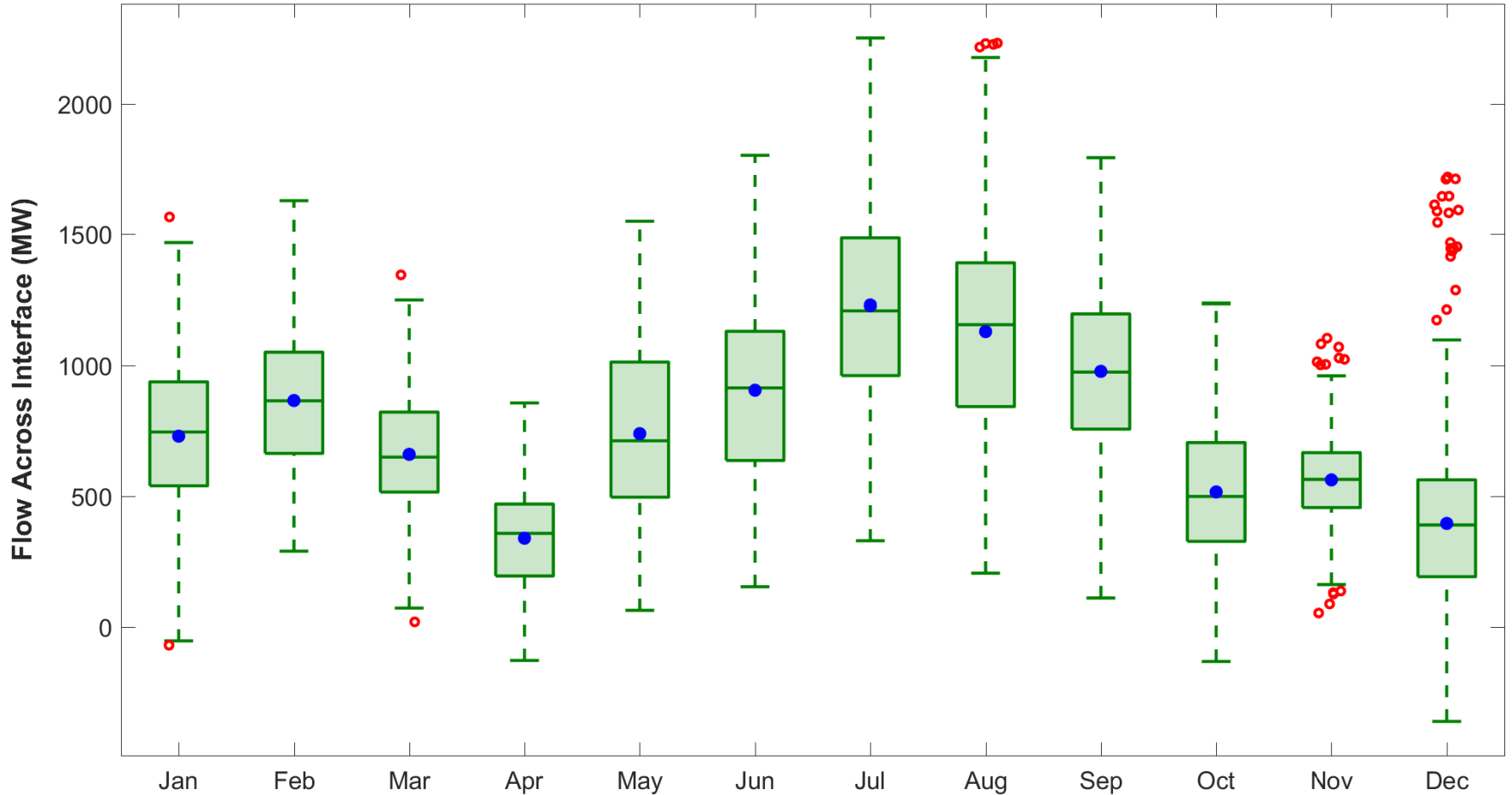


*Positive values indicate power flowing into Western Connecticut



Southwest Connecticut

Summary Flow Statistics by Month

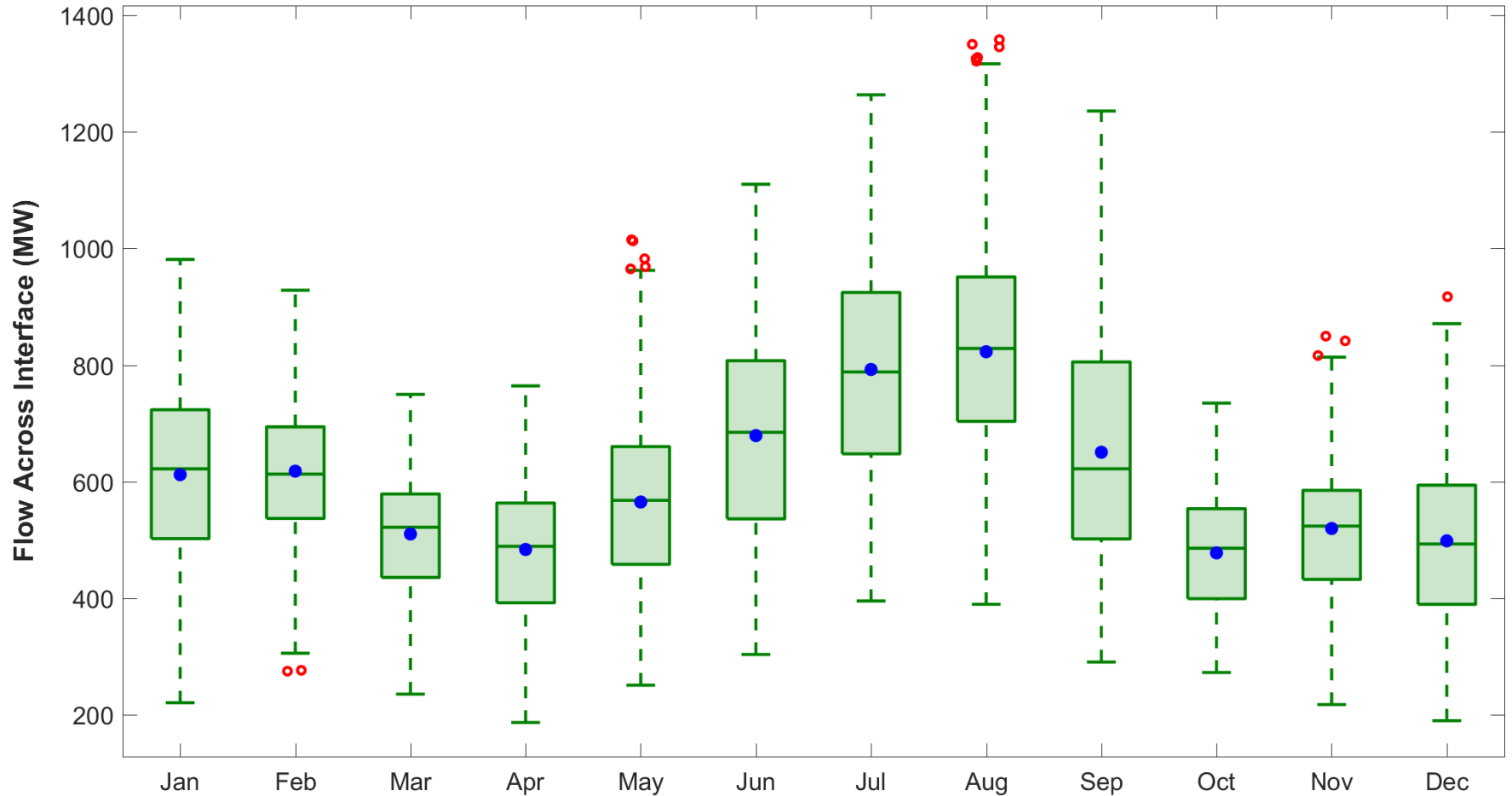


*Positive values indicate power flowing into Southwest Connecticut



Norwalk-Stamford

Summary Flow Statistics by Month

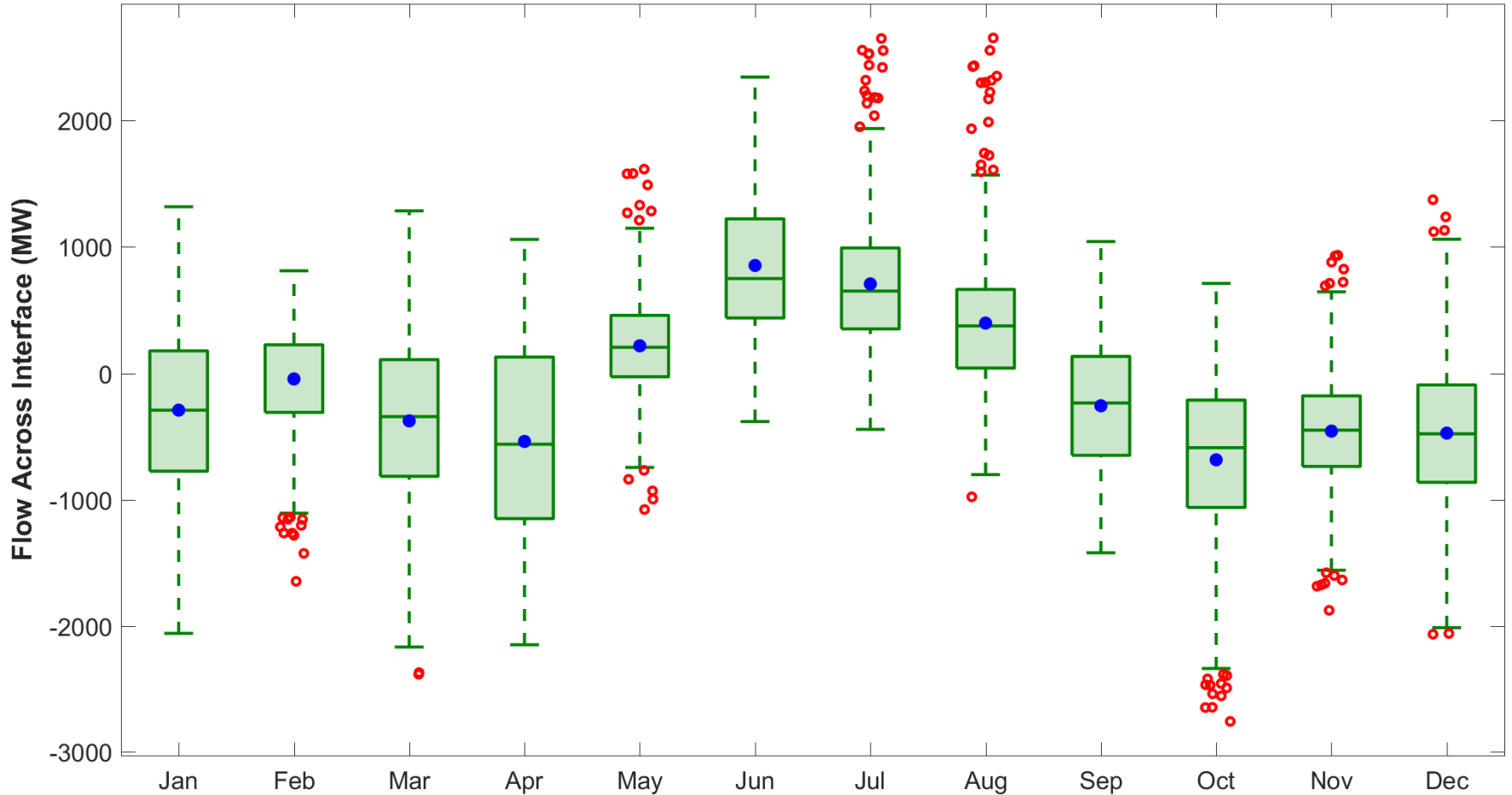


*Positive values indicate power flowing into Norwalk-Stamford



East to West New England

Summary Flow Statistics by Month

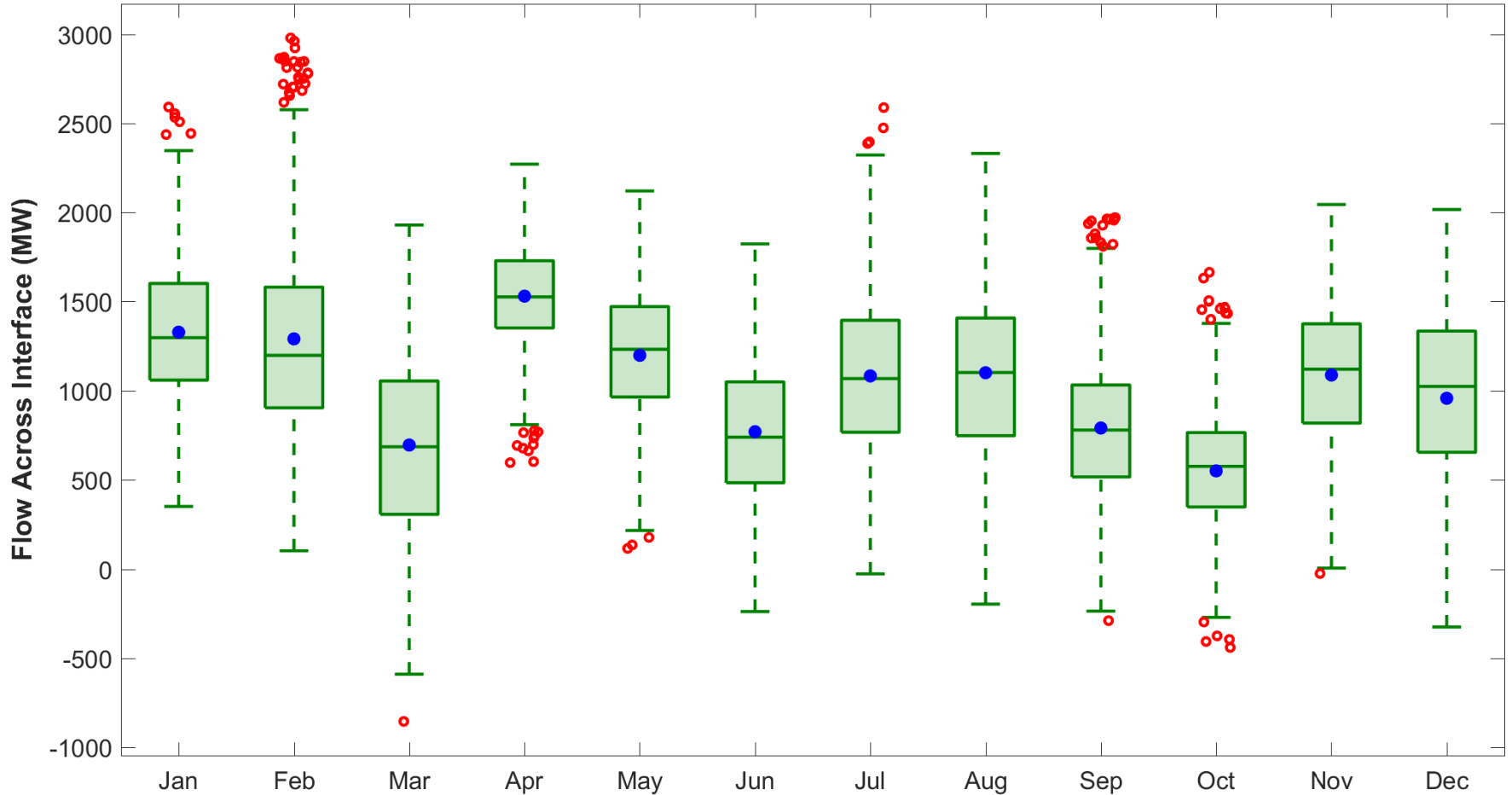


*Positive values indicate power flowing West



North to South New England

Summary Flow Statistics by Month

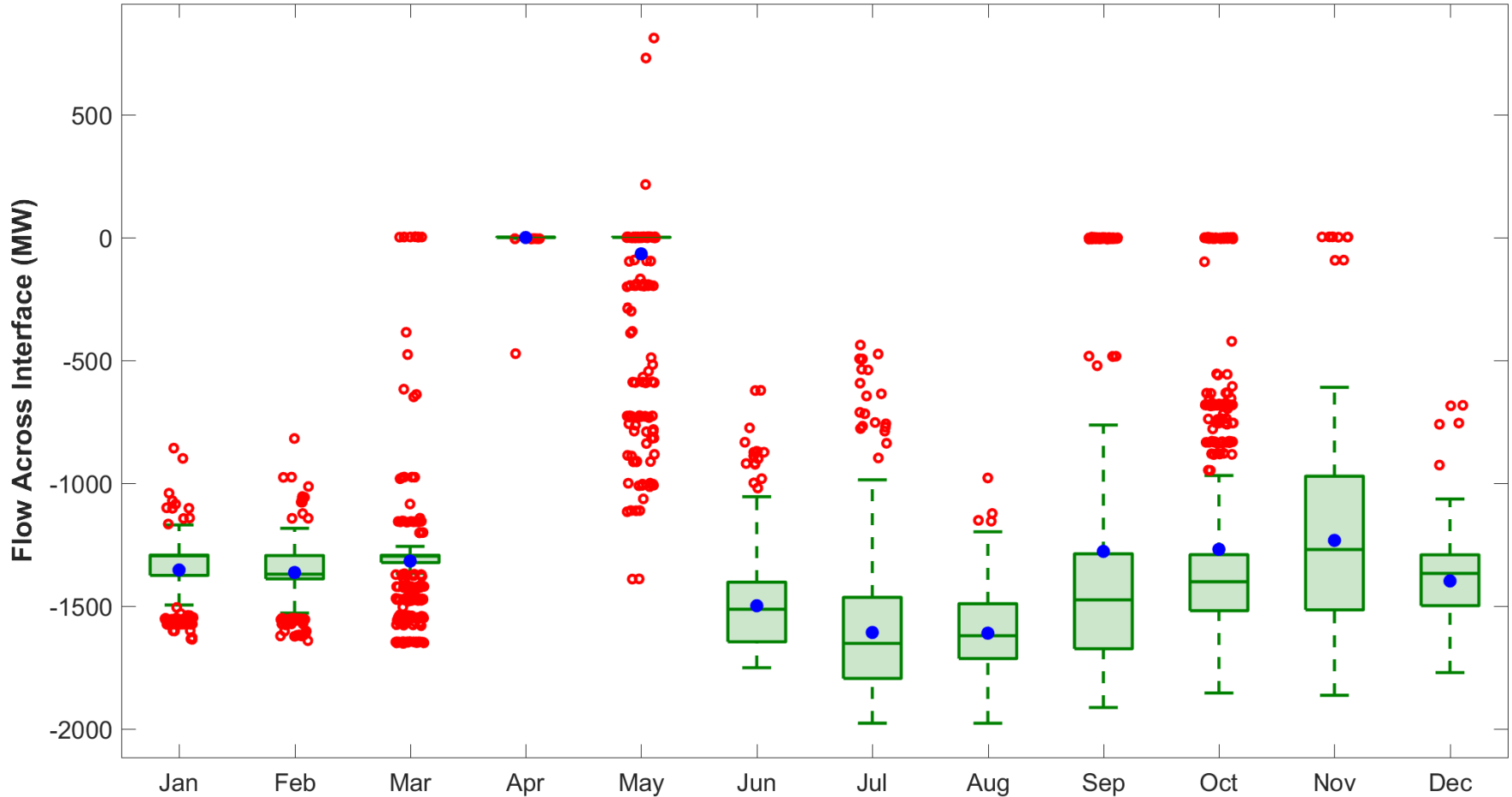


*Positive values indicate power flowing South



HQ Phase II

Summary Flow Statistics by Month

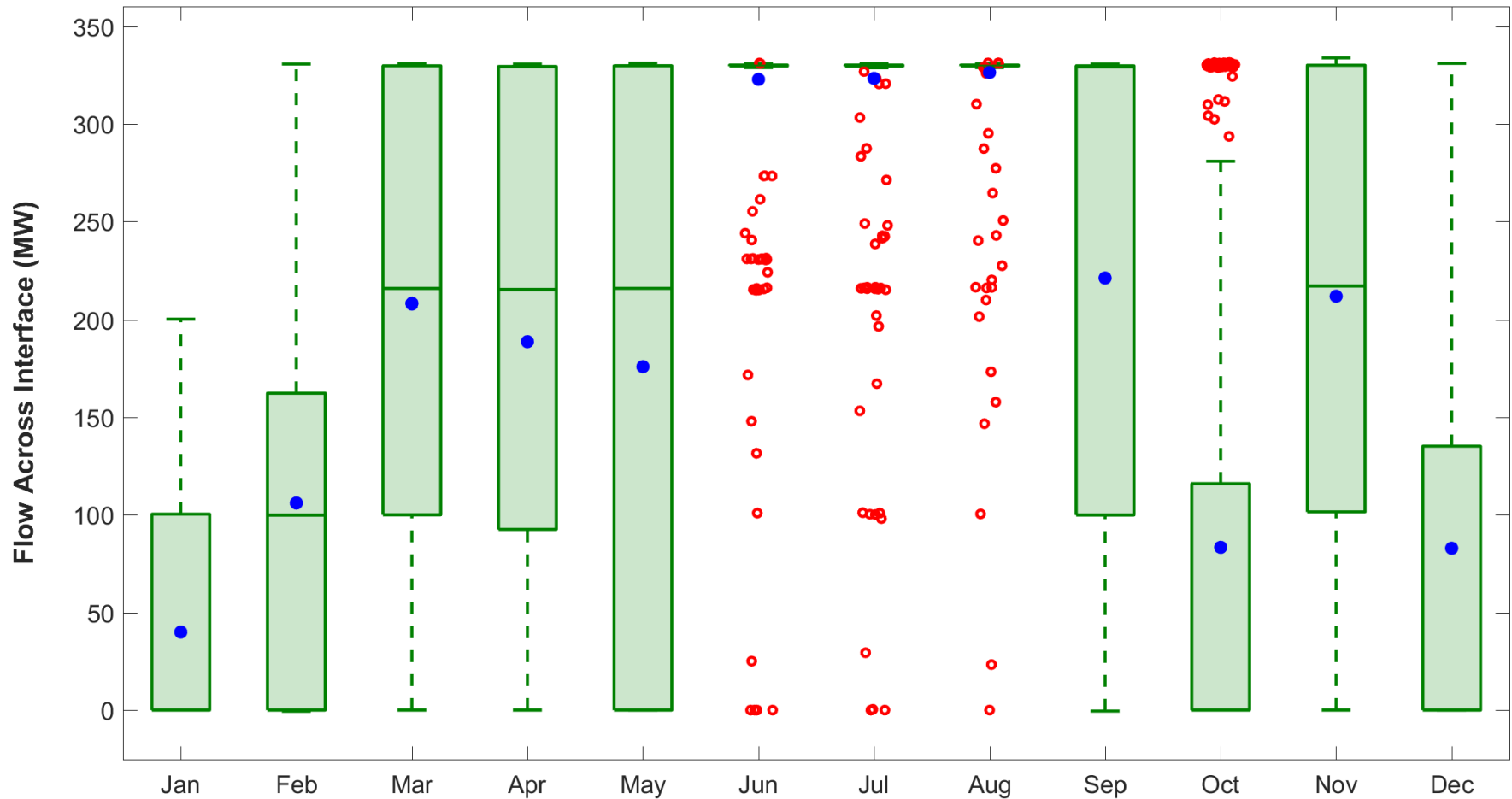


*Positive values indicate power flowing out of New England



New York: Cross Sound Cable

Summary Flow Statistics by Month

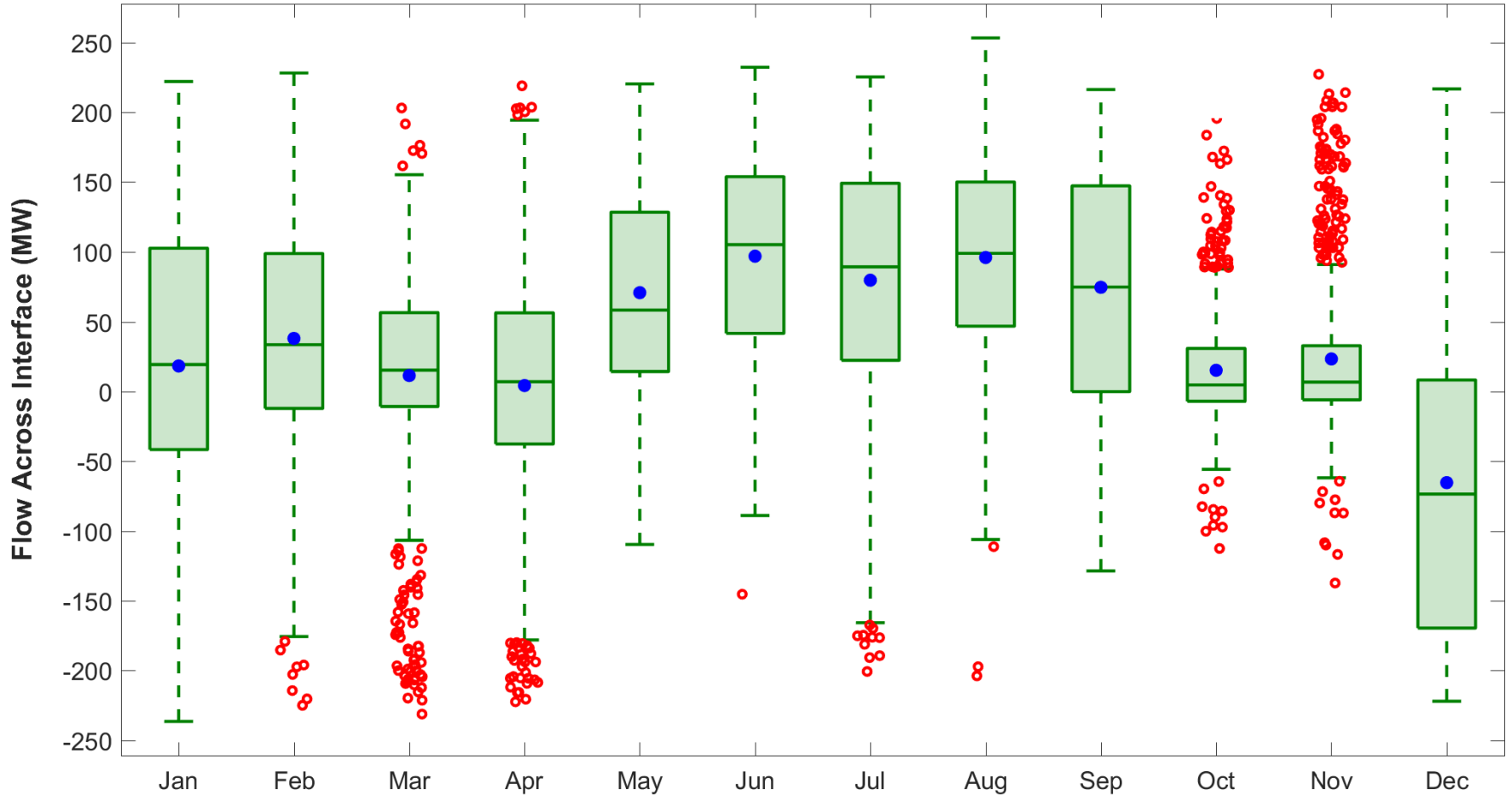


*Positive values indicate power flowing out of New England



New York: Northport

Summary Flow Statistics by Month

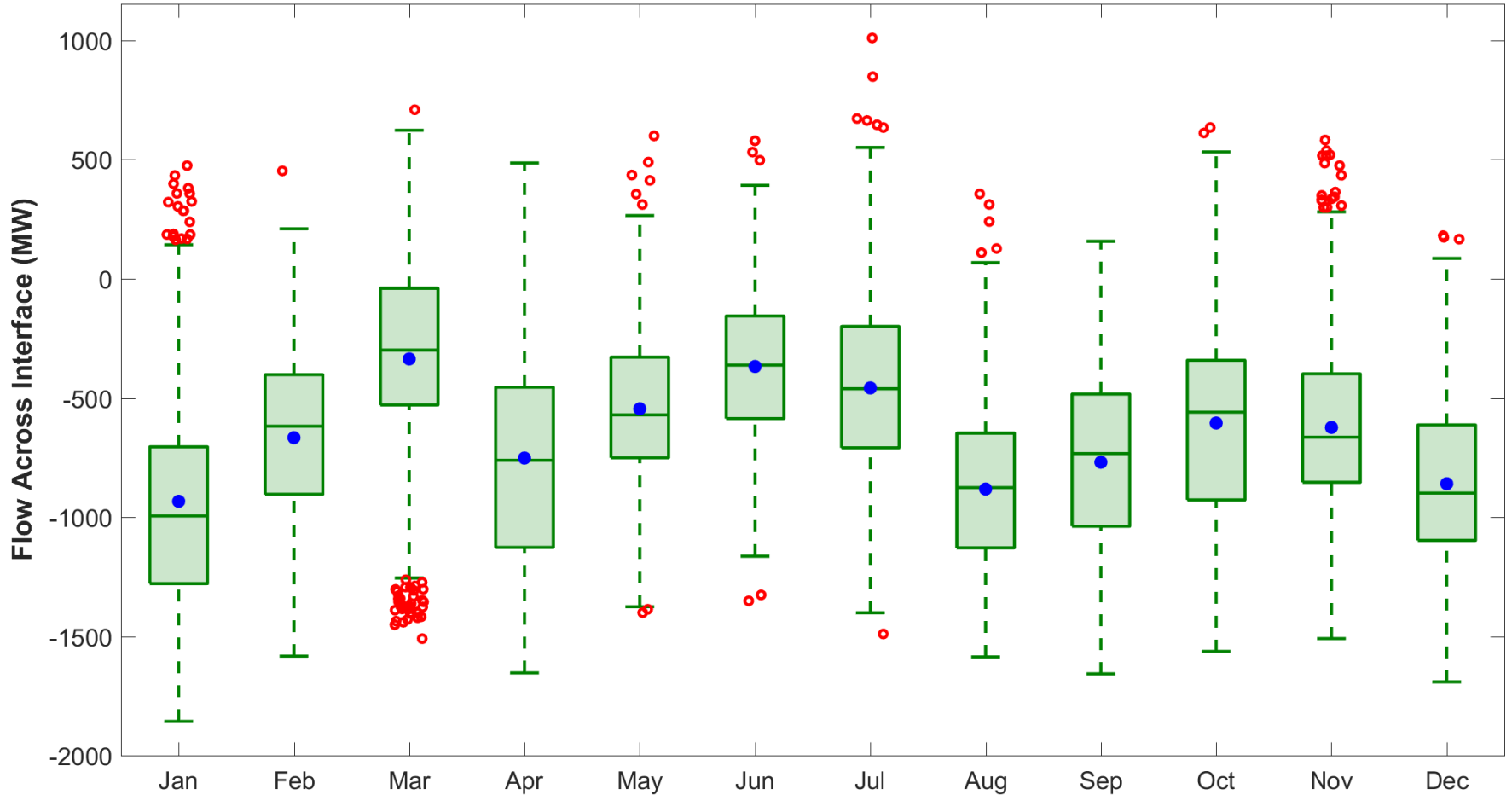


*Positive values indicate power flowing out of New England



New York: Northern AC Ties

Summary Flow Statistics by Month



*Positive values indicate power flowing out of New England



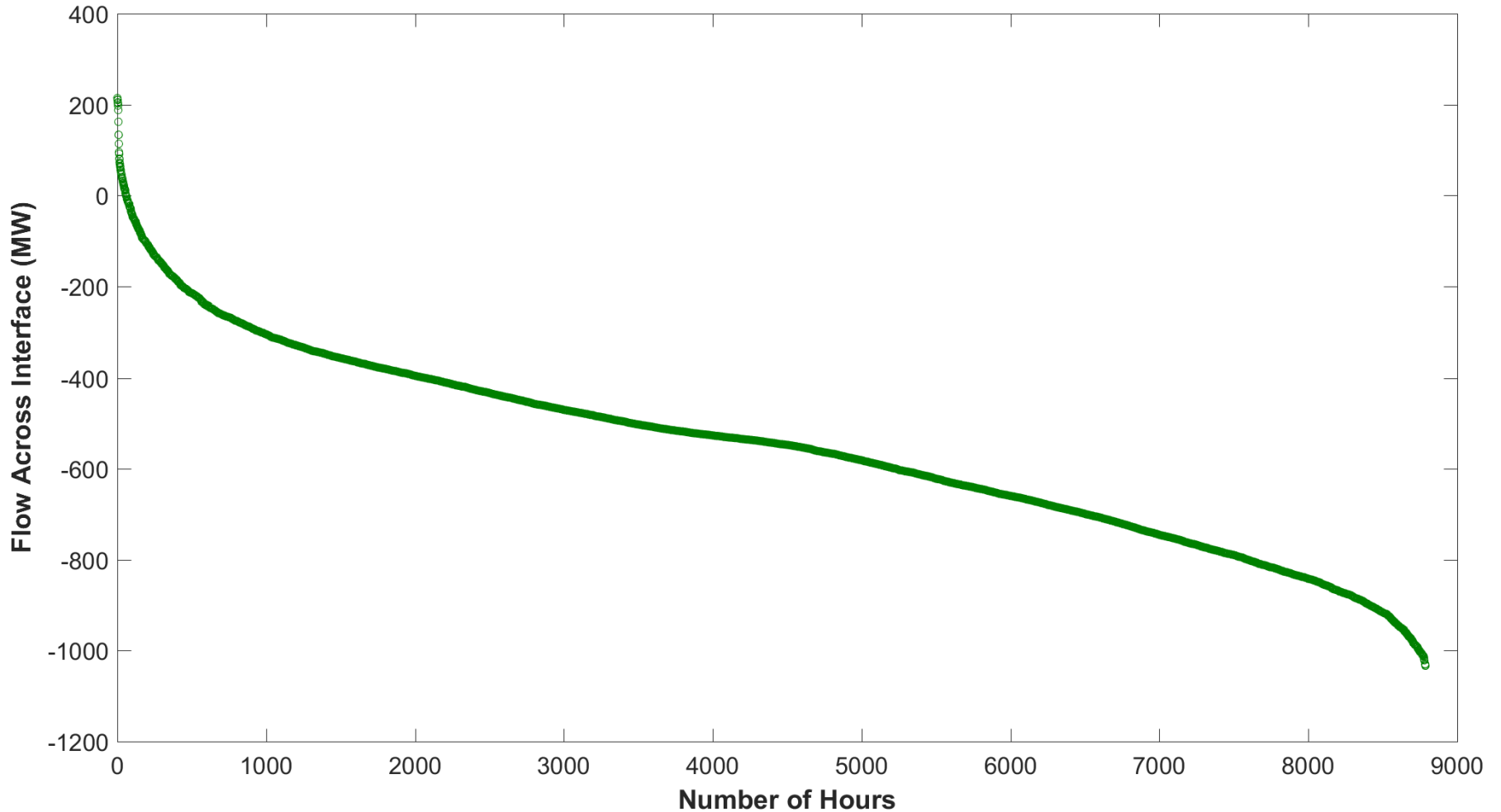
2016 INTERFACE FLOWS

Annual Duration Curves



New Brunswick Duration Curve

All Hours

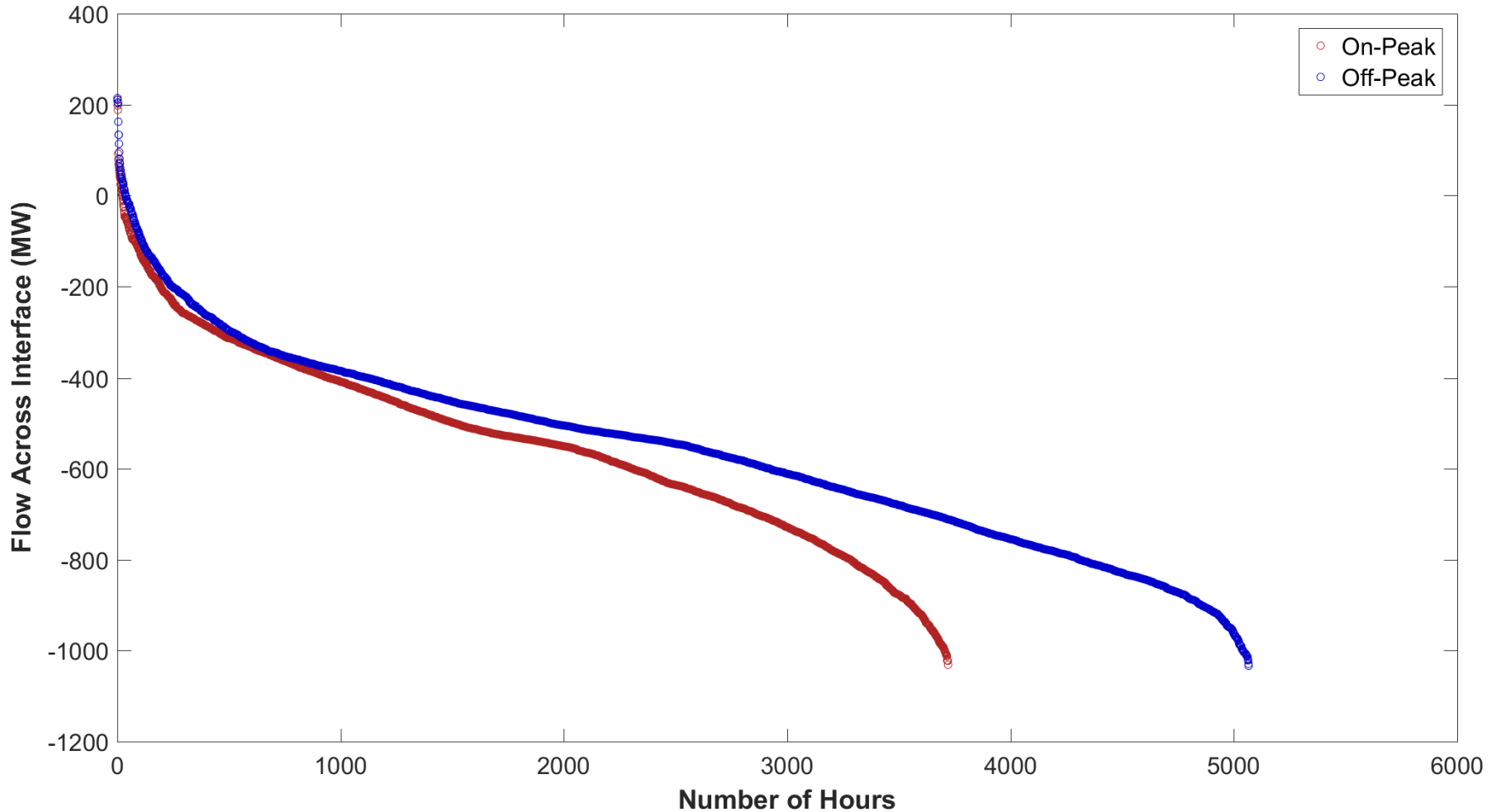


*Positive values indicate power flowing out of New England



New Brunswick Duration Curve

On/Off Peak Hours

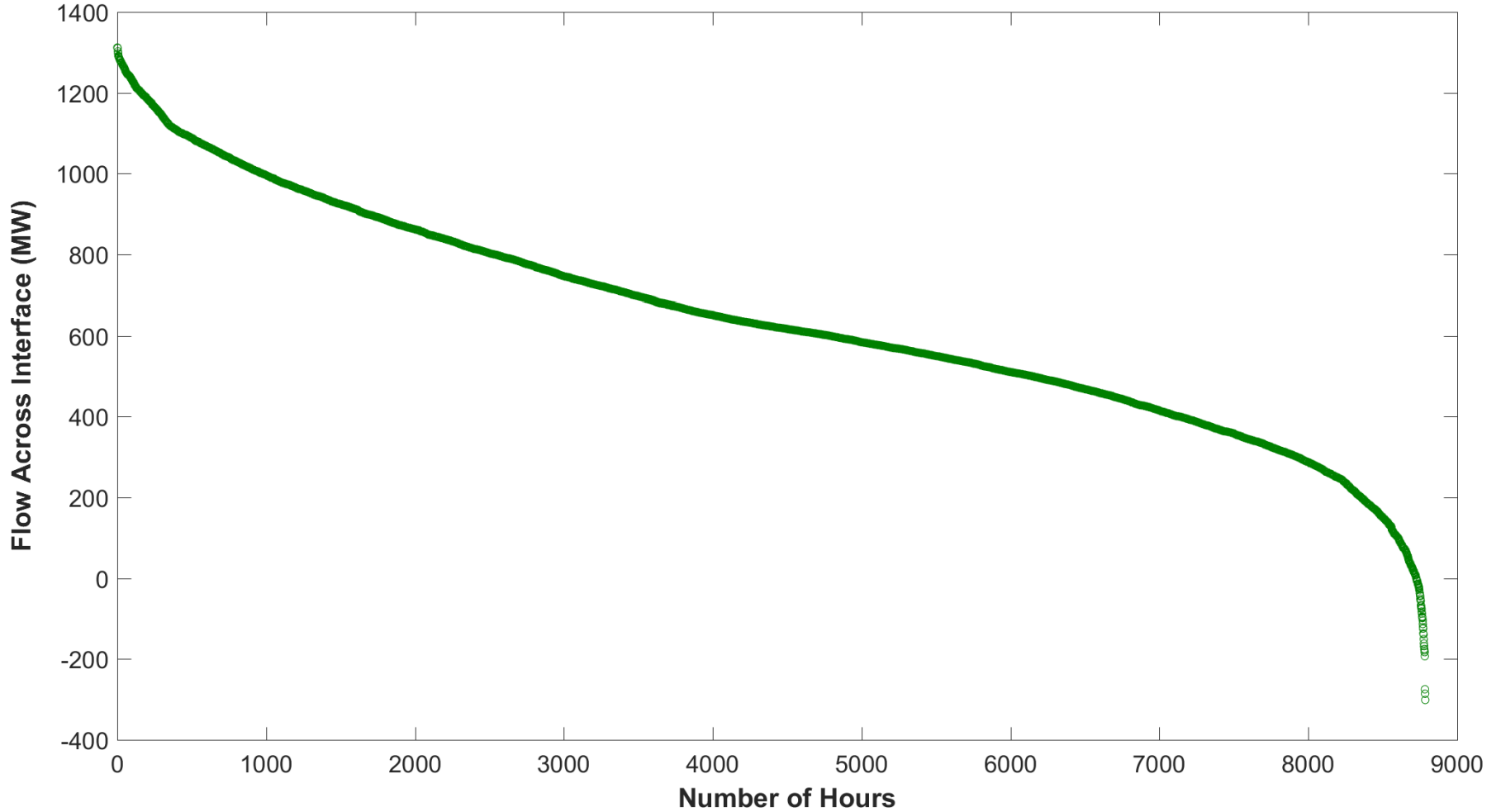


*Positive values indicate power flowing out of New England



Orrington South Duration Curve

All Hours

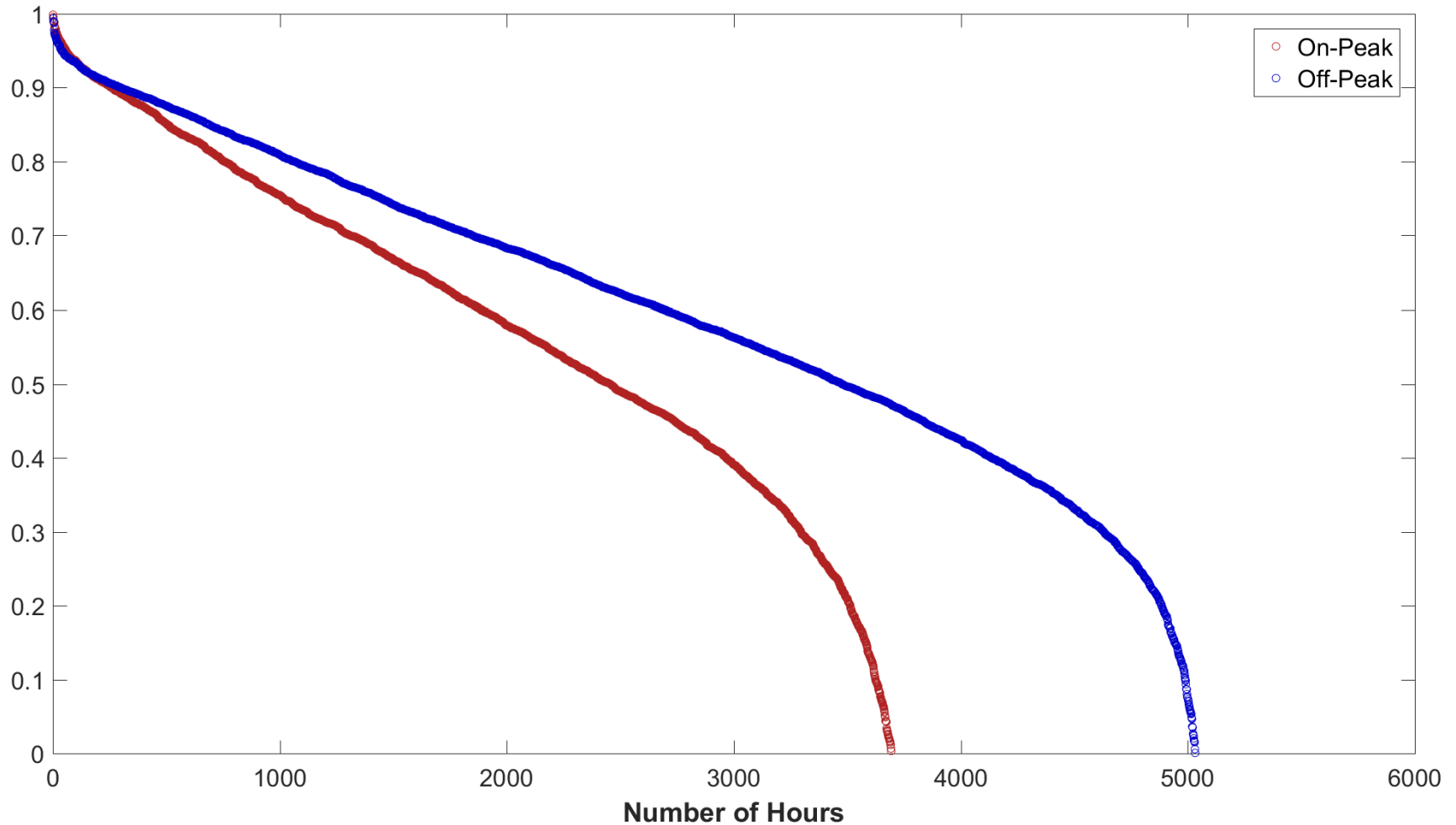


*Positive values indicate power flowing into the Maine subarea



Orrington South Duration Curve

Net Flow as a % of Interface Limit

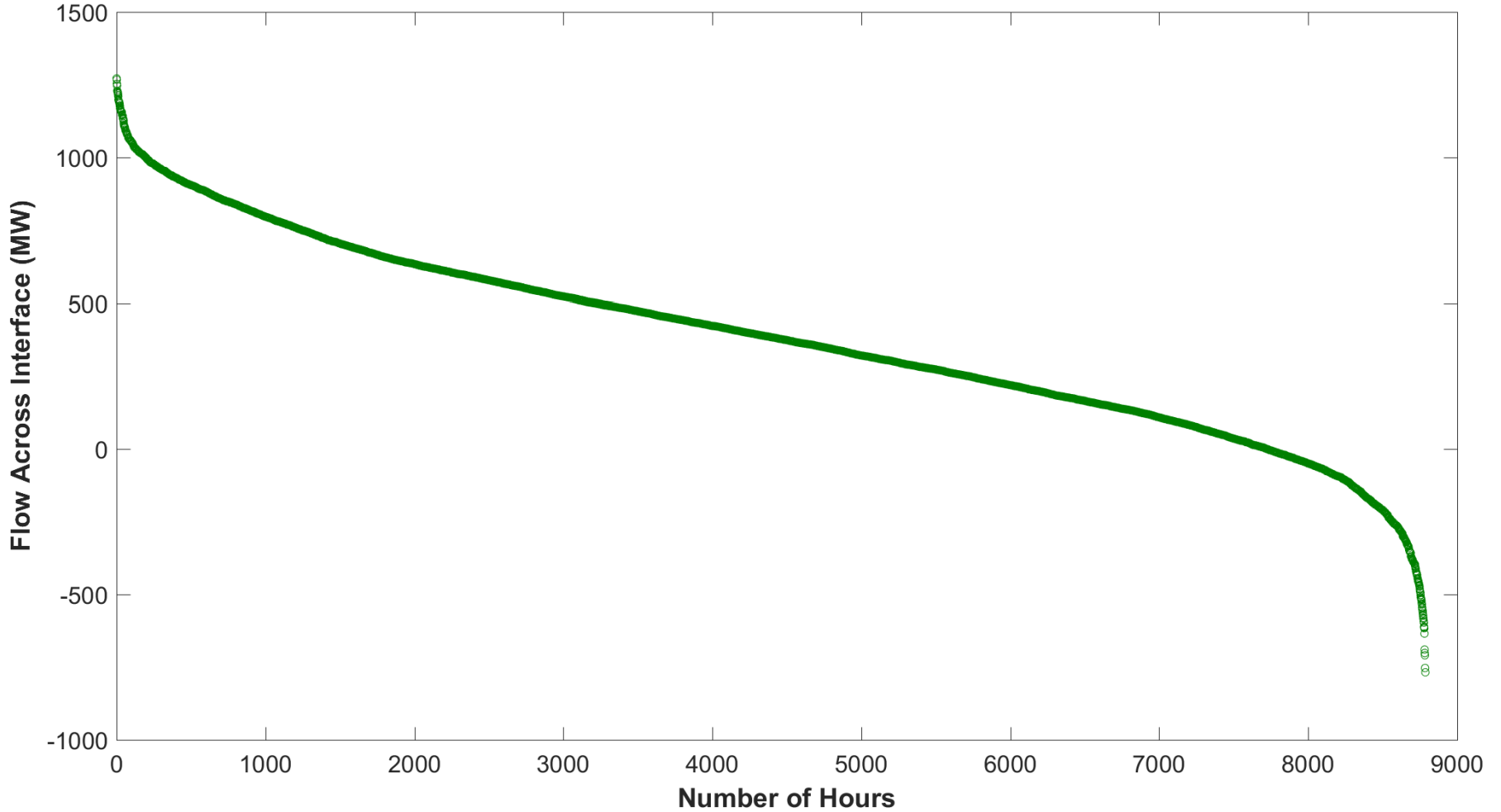


*Positive values indicate power flowing into the Maine subarea



Surowiec South Duration Curve

All Hours

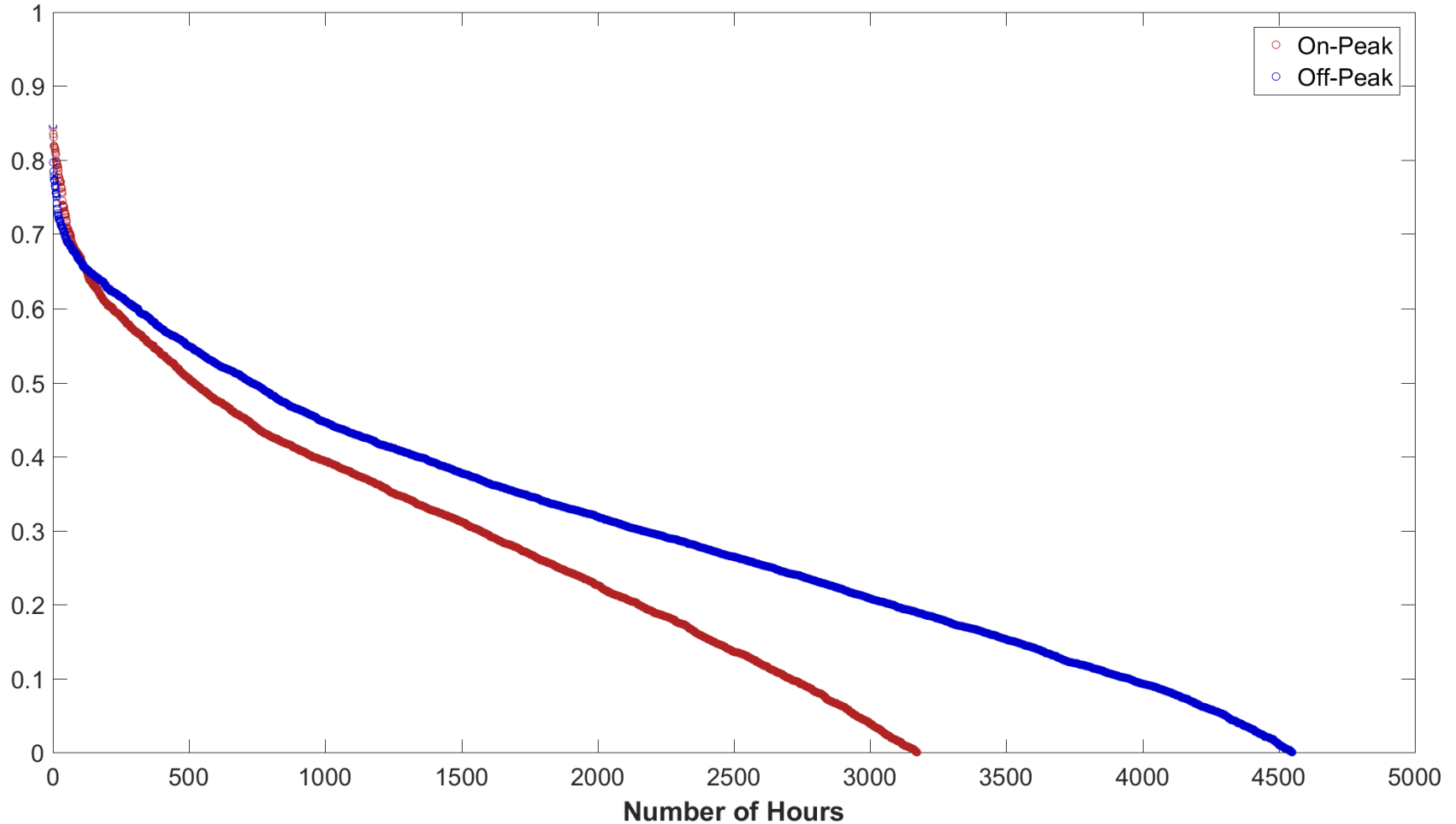


*Positive values indicate power flowing into the Southern Maine subarea



Surowiec South Duration Curve

Net Flow as a % of Interface Limit

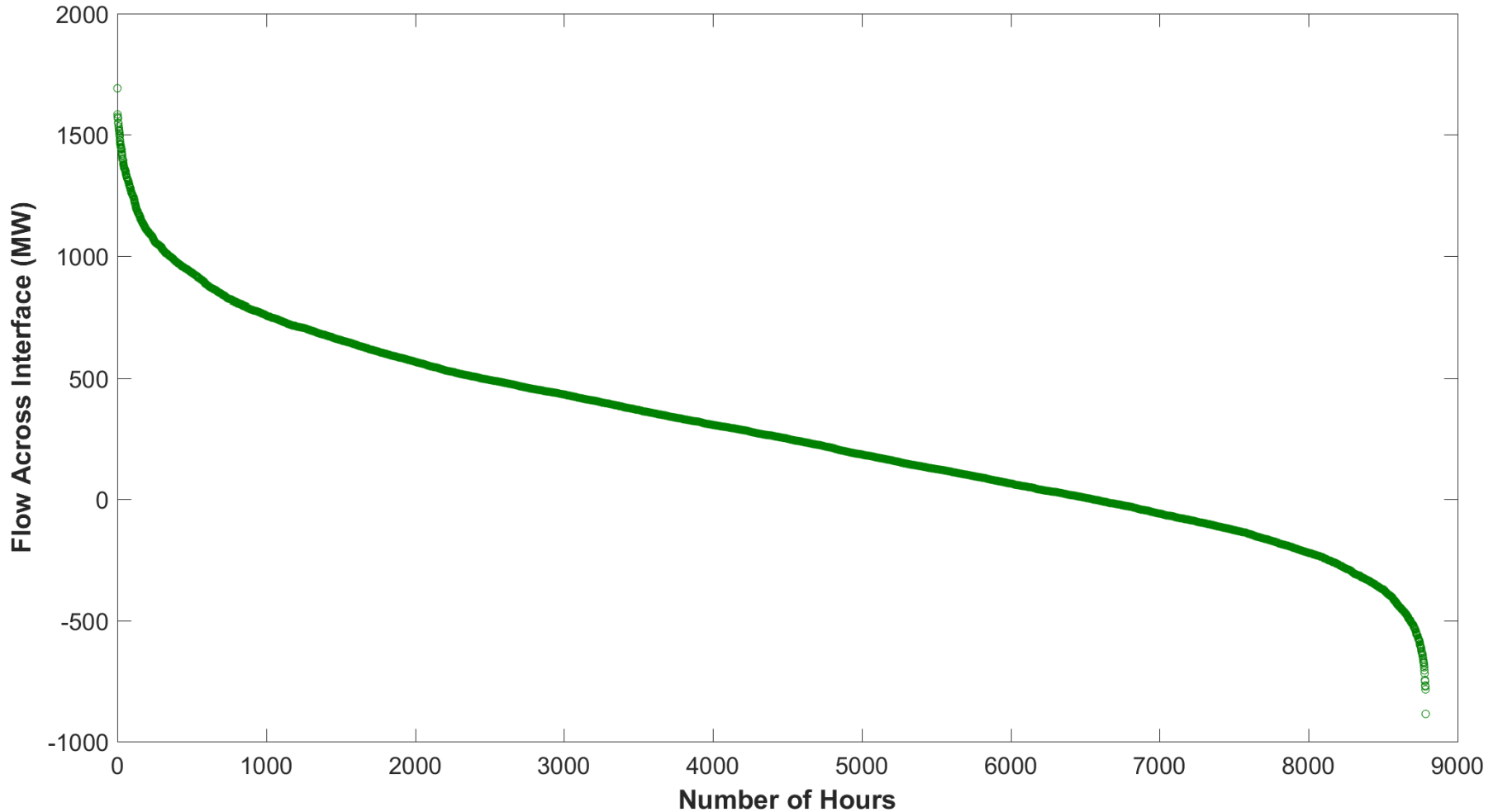


*Positive values indicate power flowing into the Southern Maine subarea



Maine to New Hampshire Duration Curve

All Hours

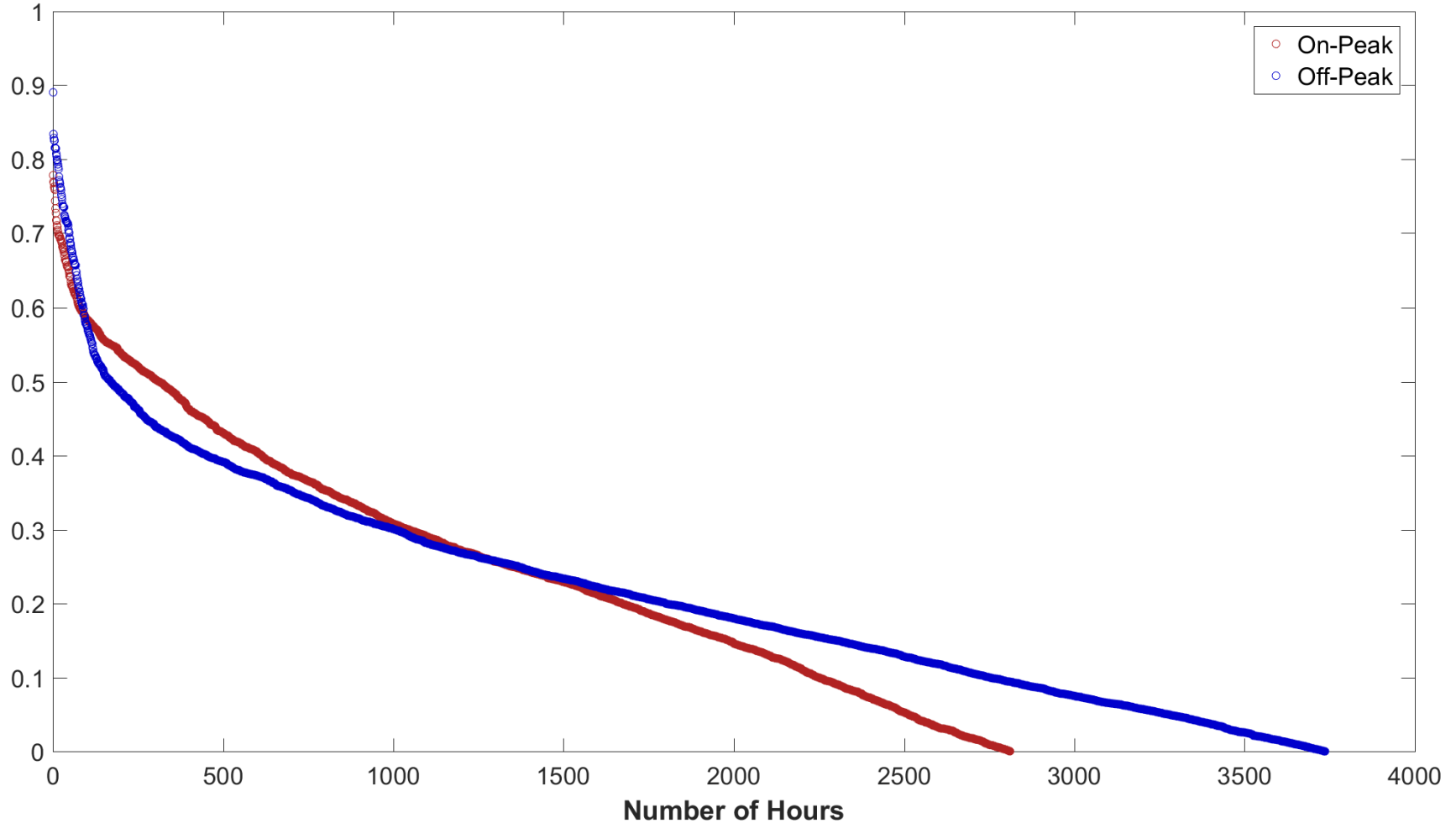


*Positive values indicate power flowing into New Hampshire



Maine to New Hampshire Duration Curve

Net Flow as a % of Interface Limit

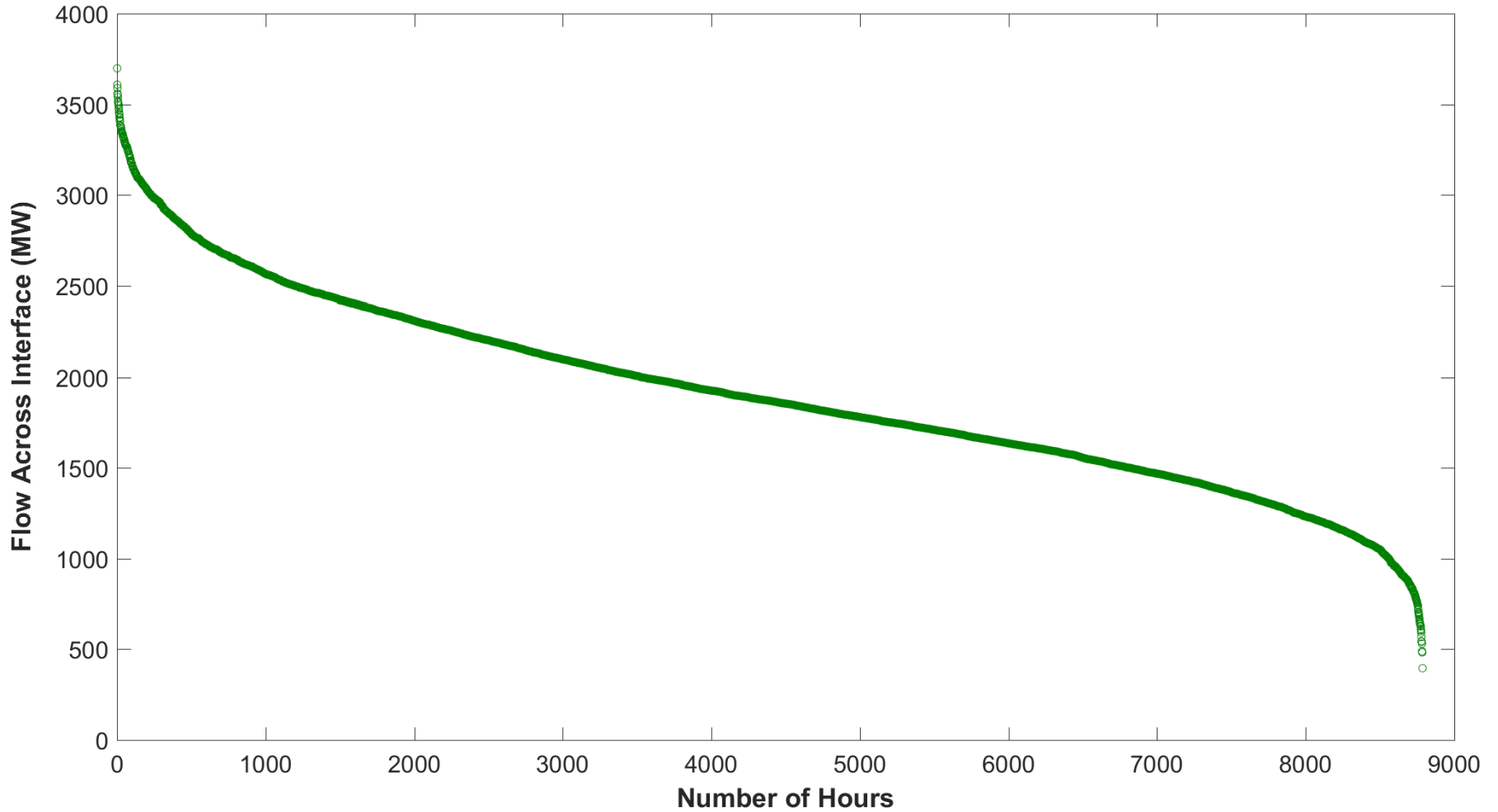


*Positive values indicate power flowing into New Hampshire



Boston Import Duration Curve

All Hours

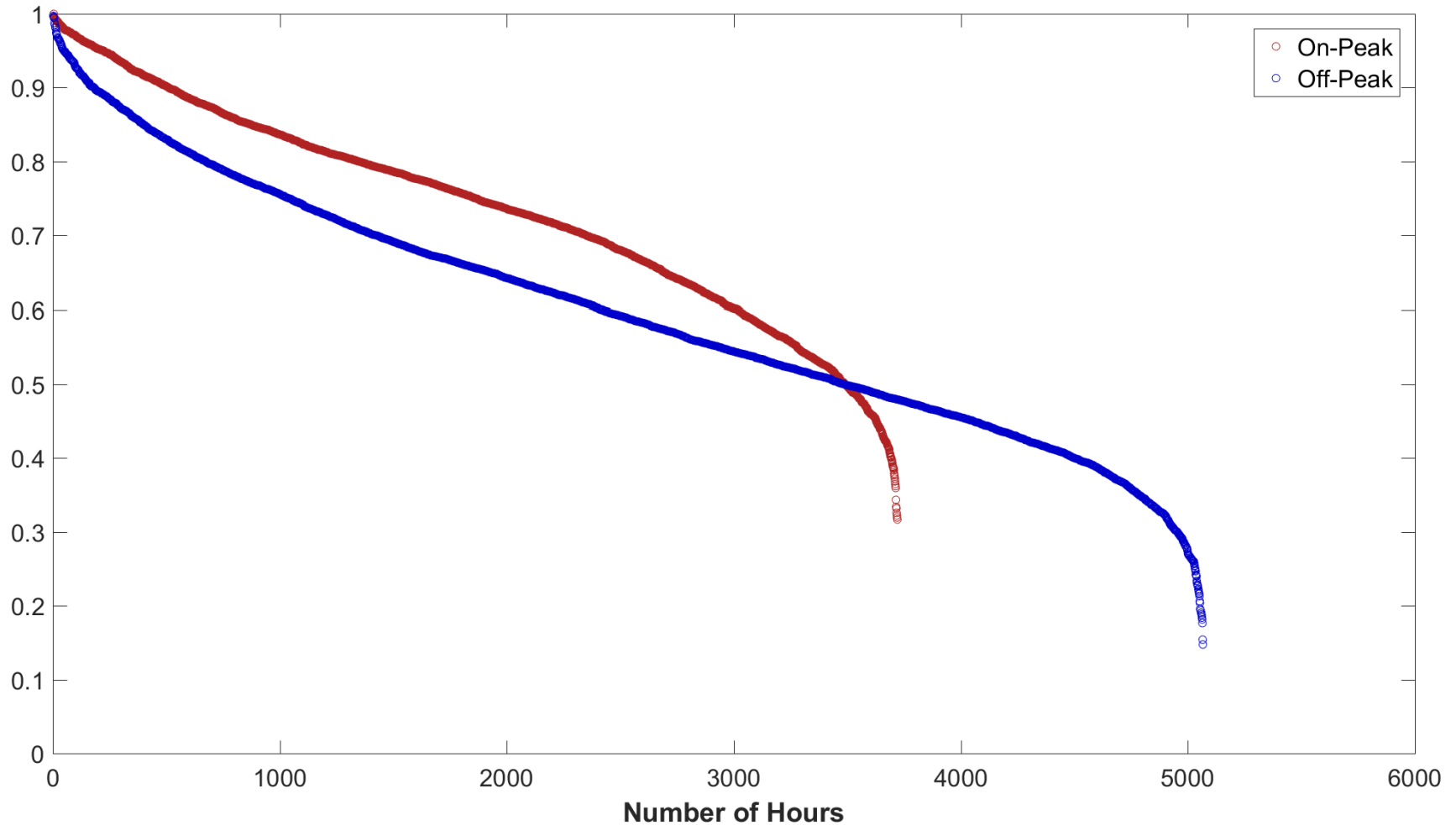


*Positive values indicate power flowing into Boston



Boston Import Duration Curve

Net Flow as a % of Interface Limit

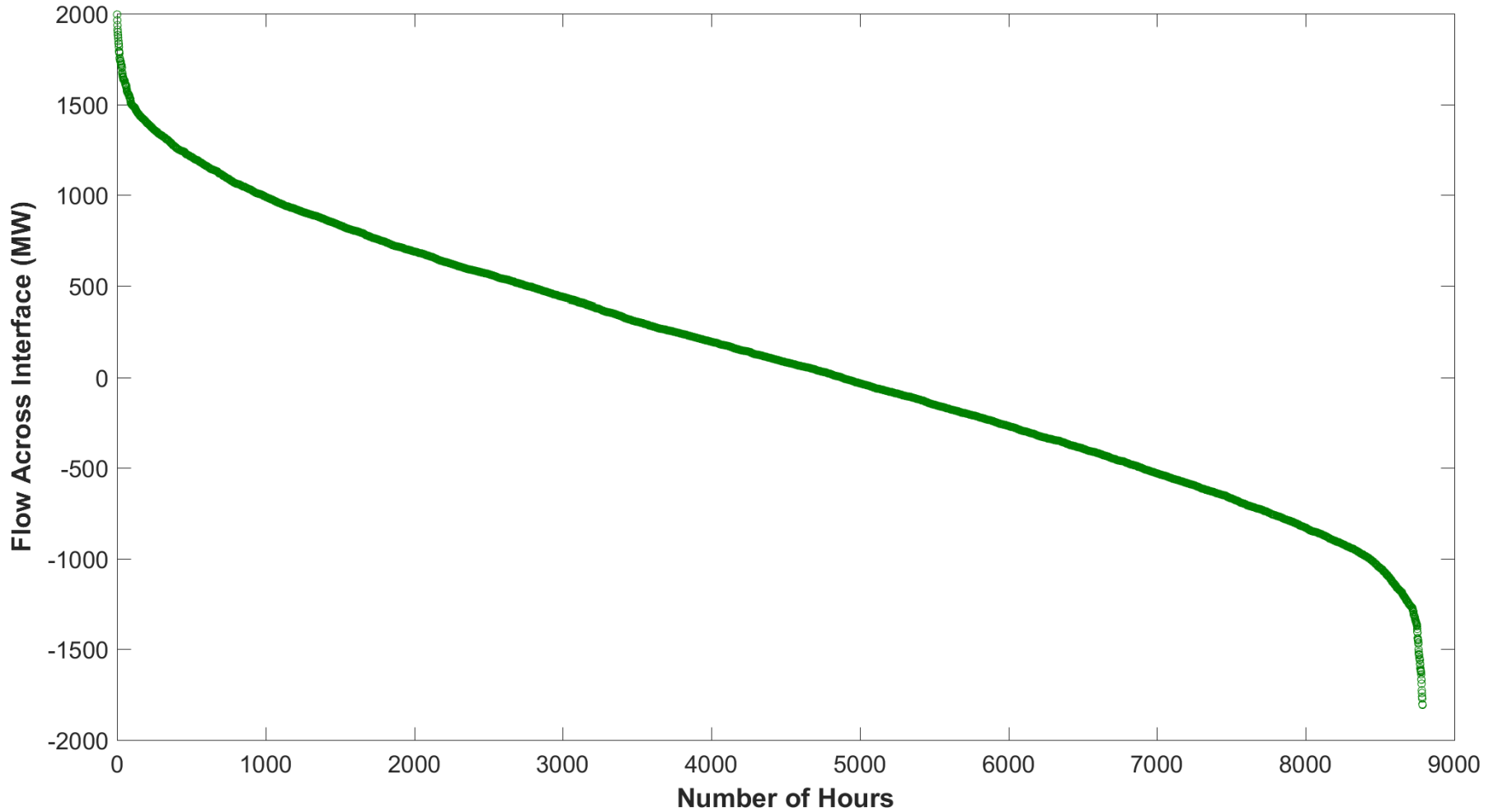


*Positive values indicate power flowing into Boston



SEMA/Rhode Island Duration Curve

All Hours

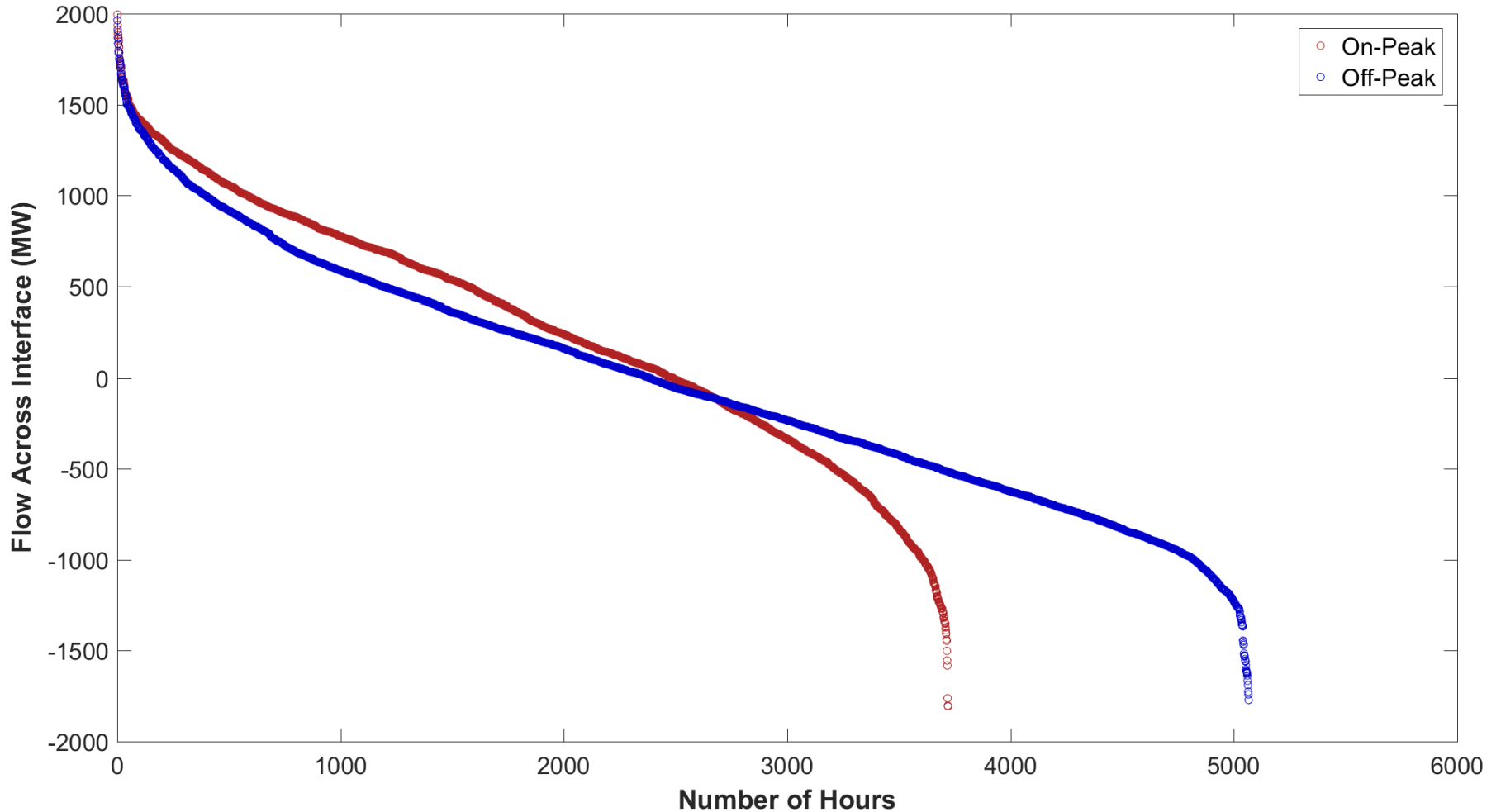


*Positive values indicate power flowing out of SEMA/Rhode Island



SEMA/Rhode Island Duration Curve

On/Off Peak Hours

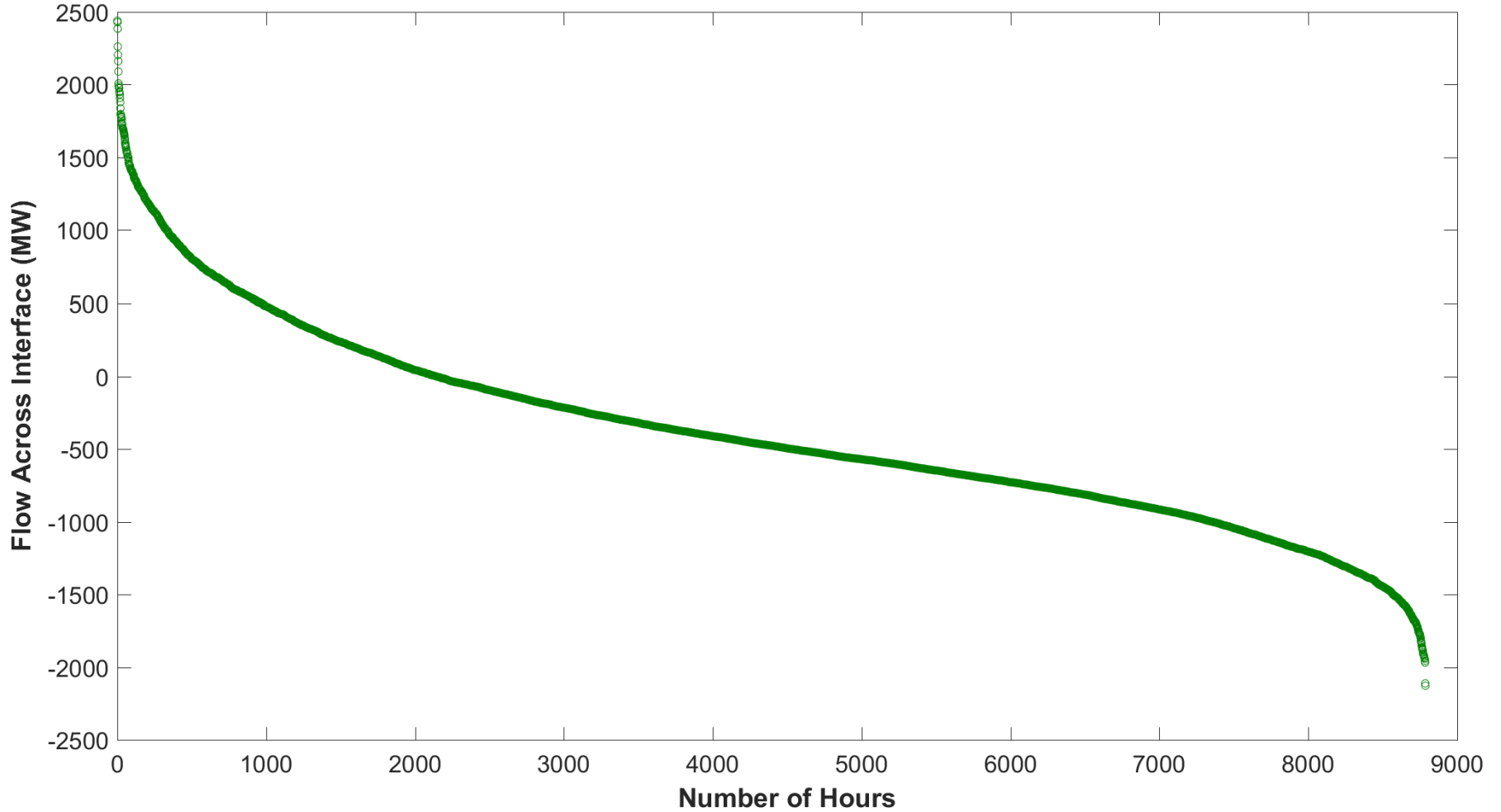


*Positive values indicate power flowing out of SEMA/Rhode Island



Connecticut Import Duration Curve

All Hours

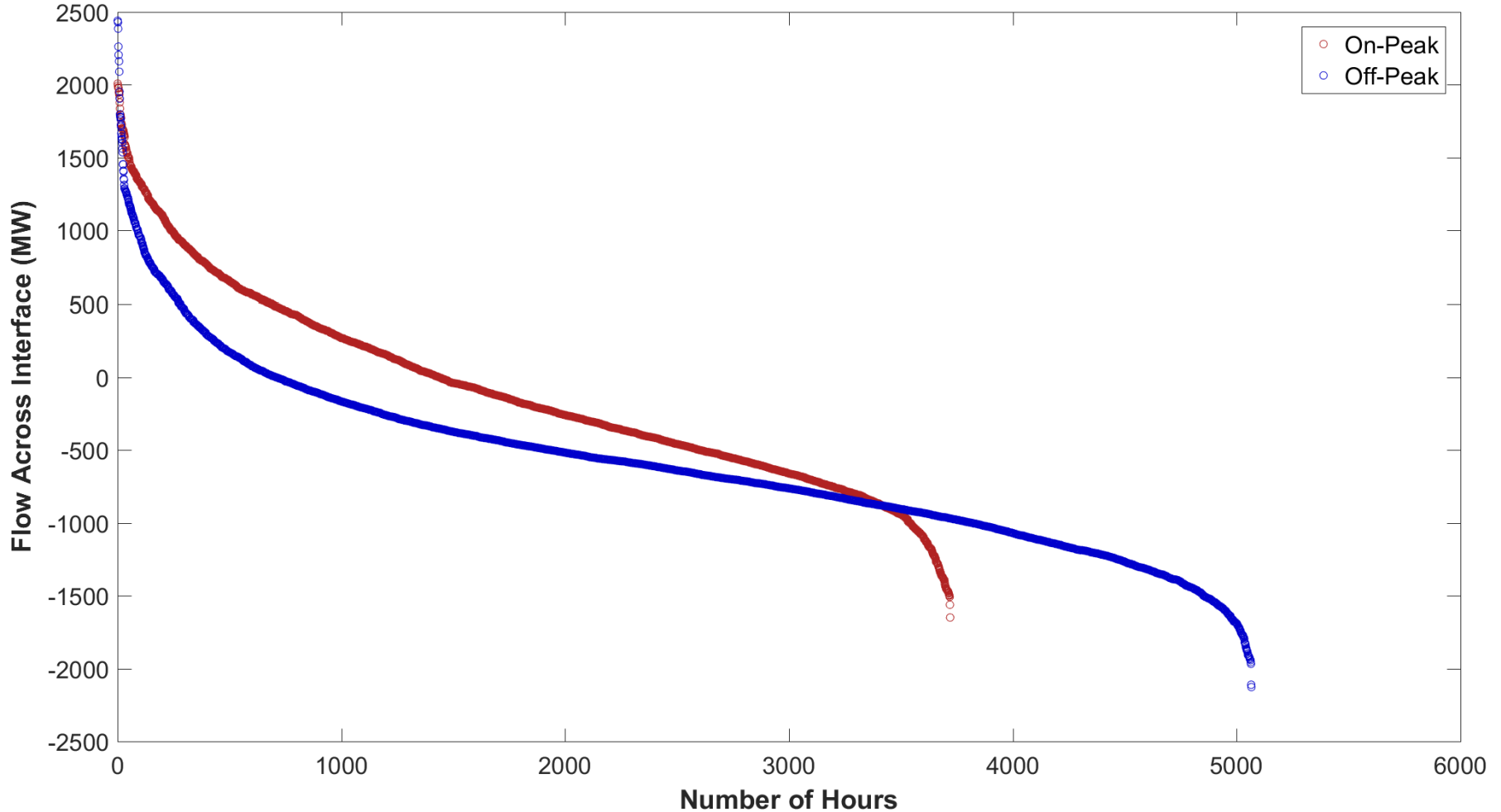


*Positive values indicate power flowing into Connecticut



Connecticut Import Duration Curve

On/Off Peak Hours

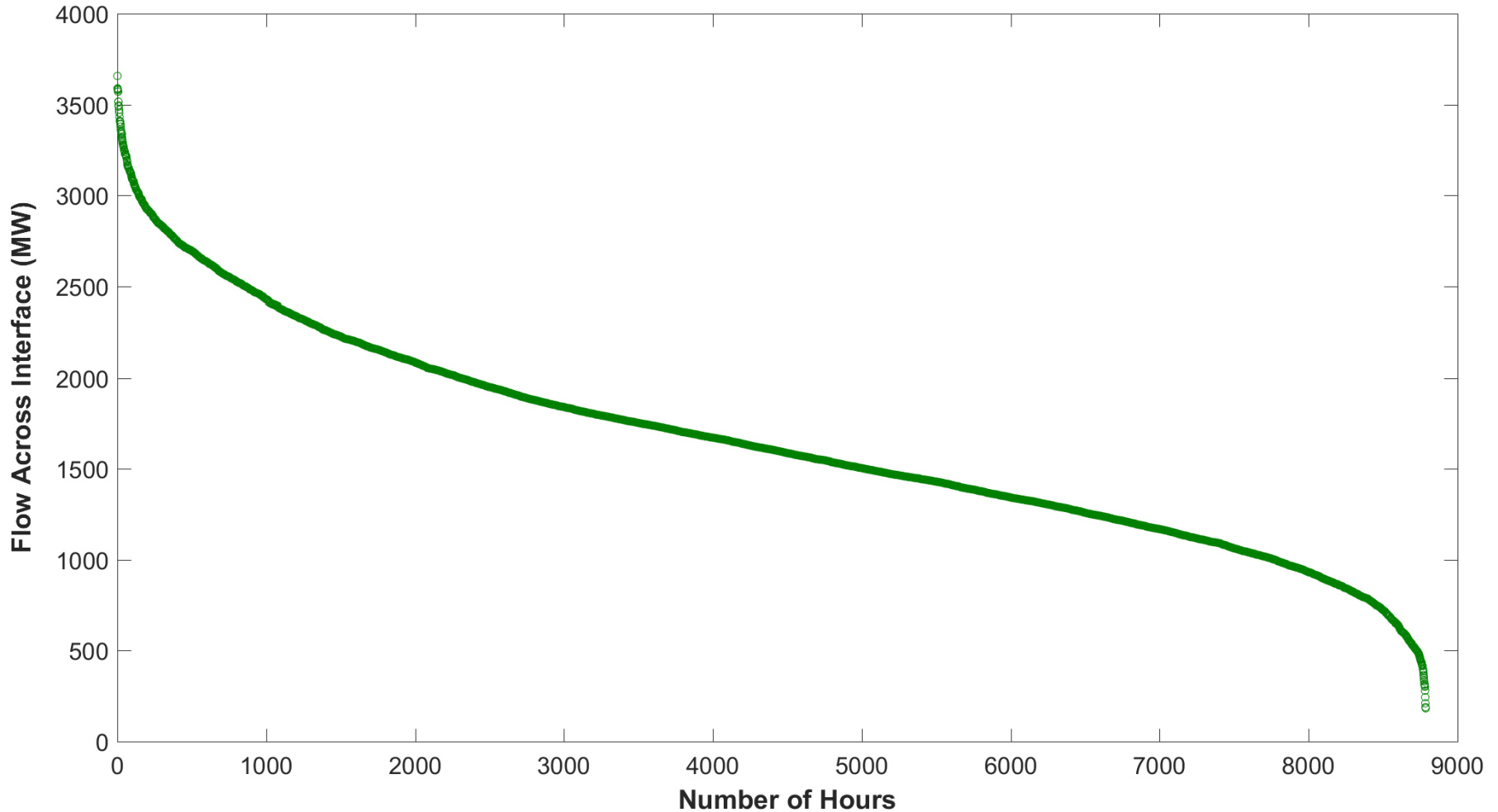


*Positive values indicate power flowing into Connecticut



Western Connecticut Import Duration Curve

All Hours

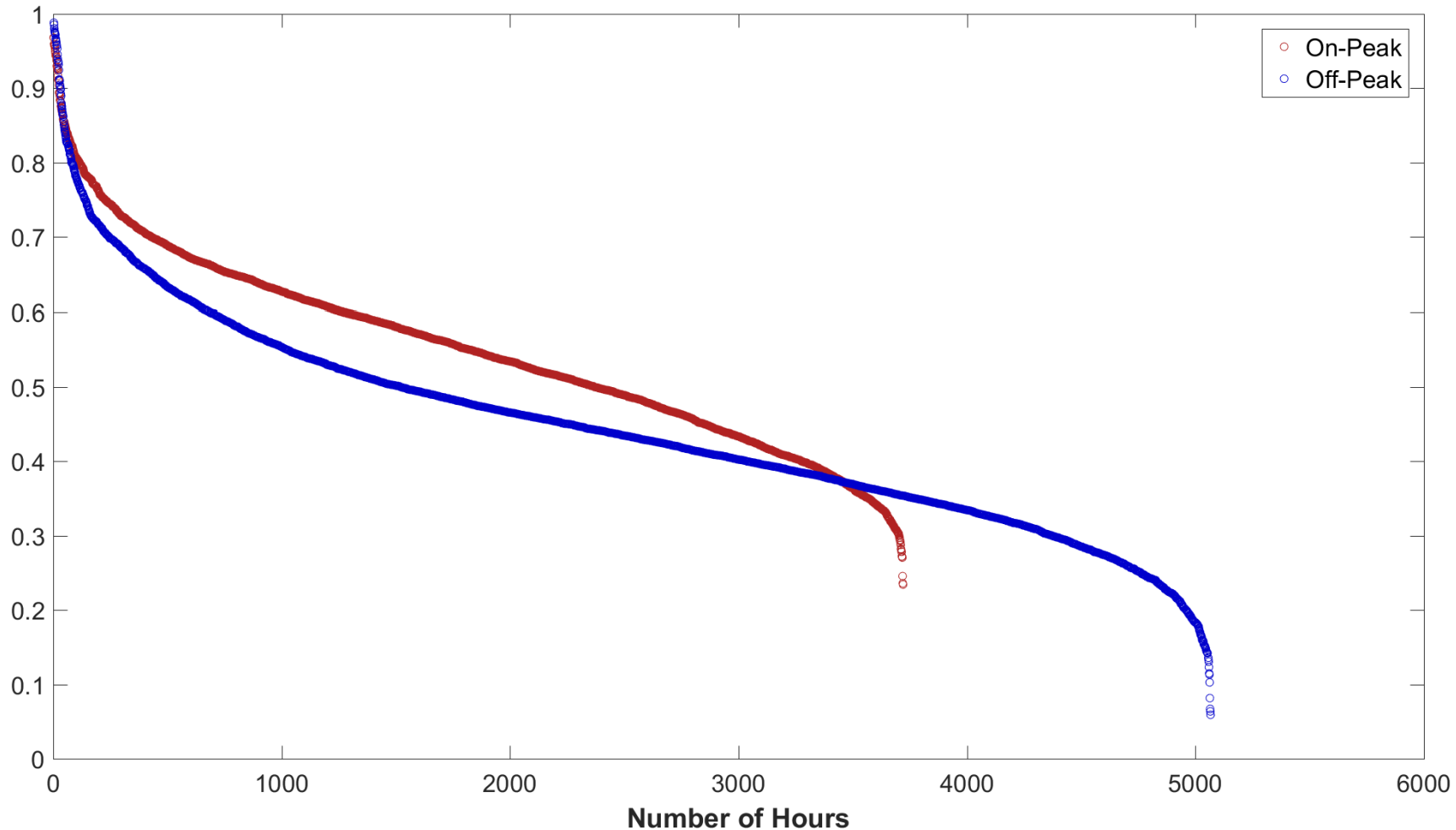


*Positive values indicate power flowing into Western Connecticut



Western Connecticut Import Duration Curve

Net Flow as a % of Interface Limit

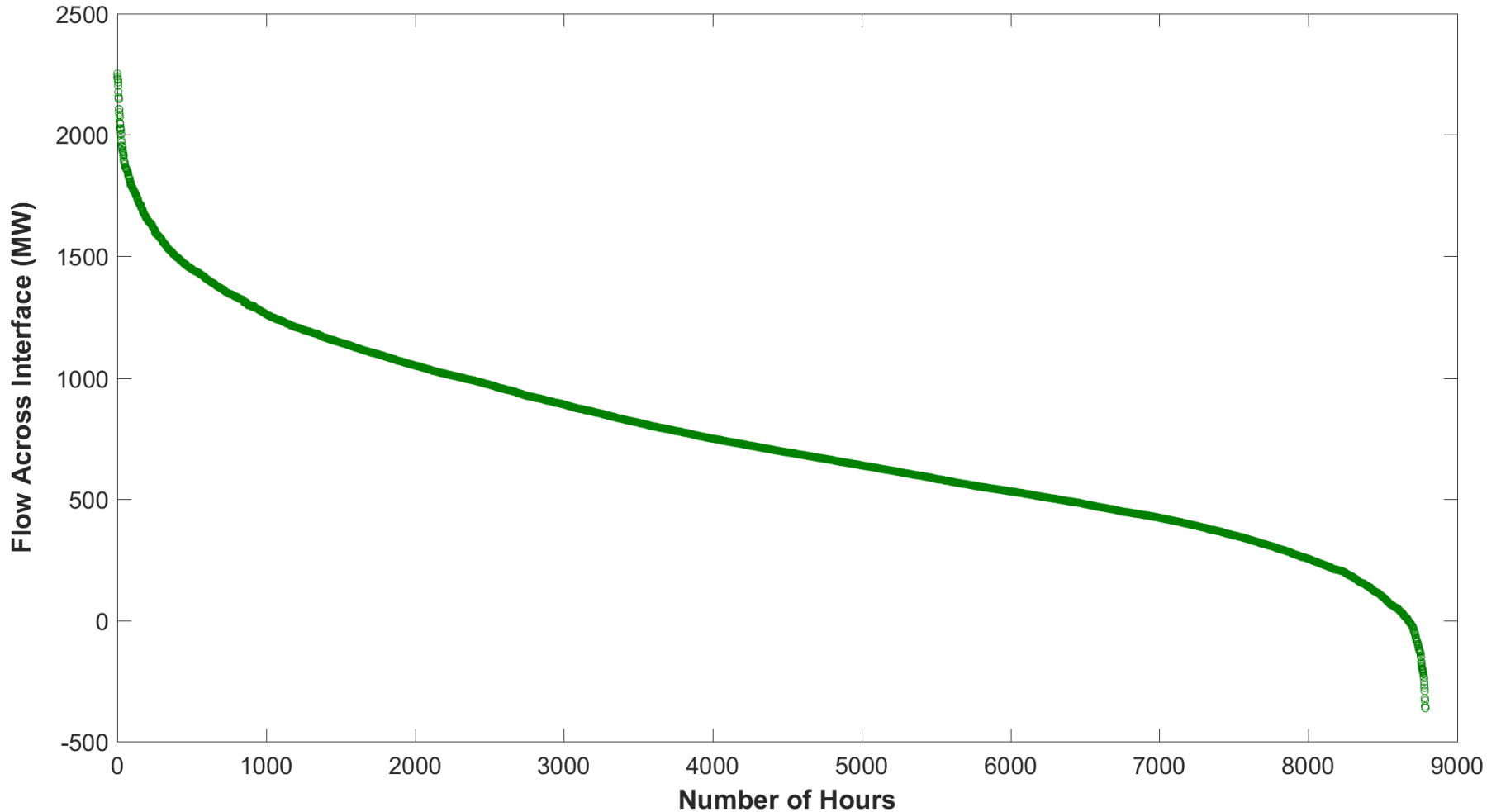


*Positive values indicate power flowing into West Connecticut



Southwest Connecticut Duration Curve

All Hours

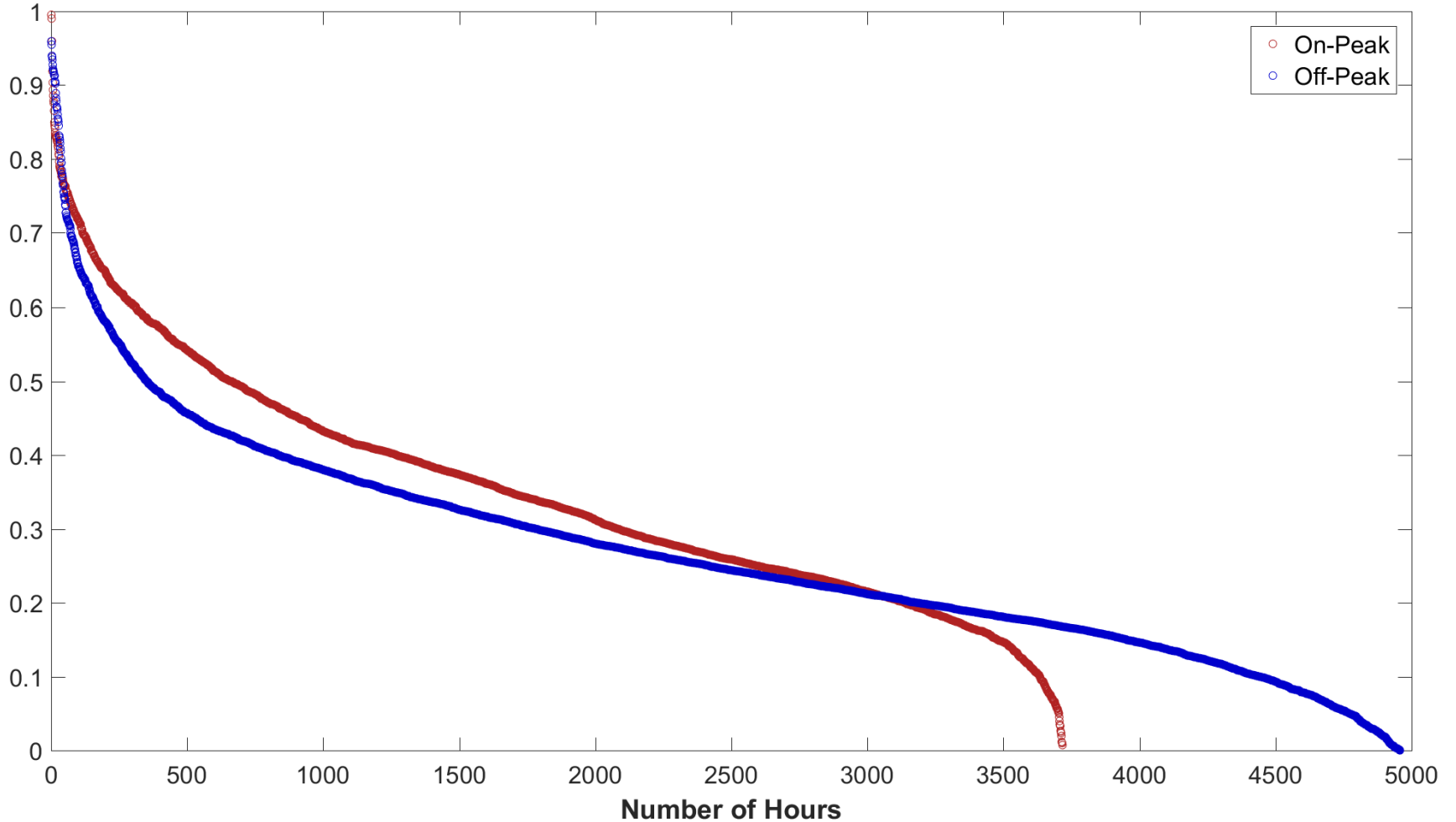


*Positive values indicate power flowing into Southwest Connecticut



Southwest Connecticut Duration Curve

Net Flow as a % of Interface Limit

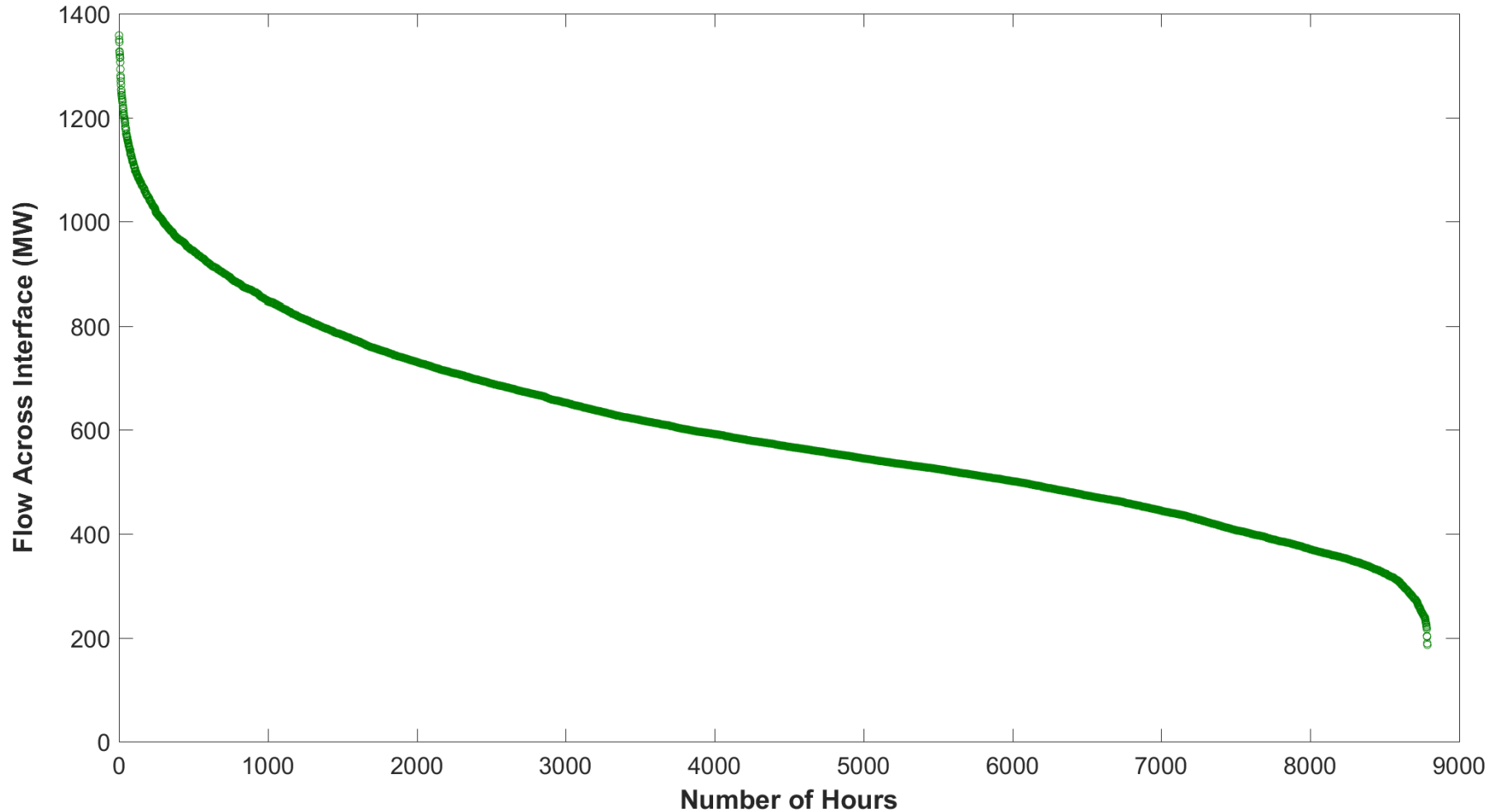


*Positive values indicate power flowing into Southwest Connecticut



Norwalk-Stamford Duration Curve

All Hours

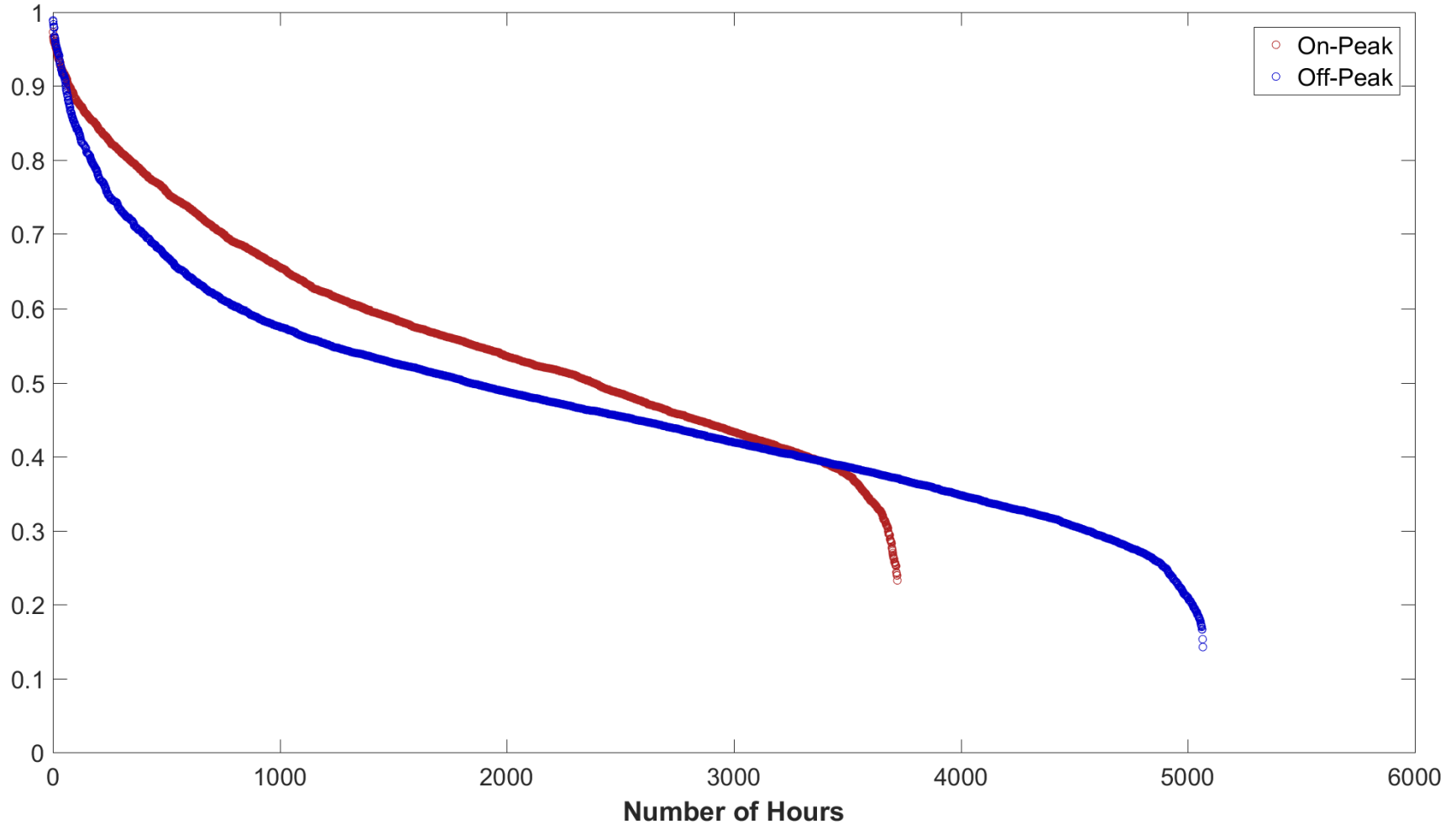


*Positive values indicate power flowing into Norwalk-Stamford



Norwalk-Stamford Duration Curve

Net Flow as a % of Interface Limit

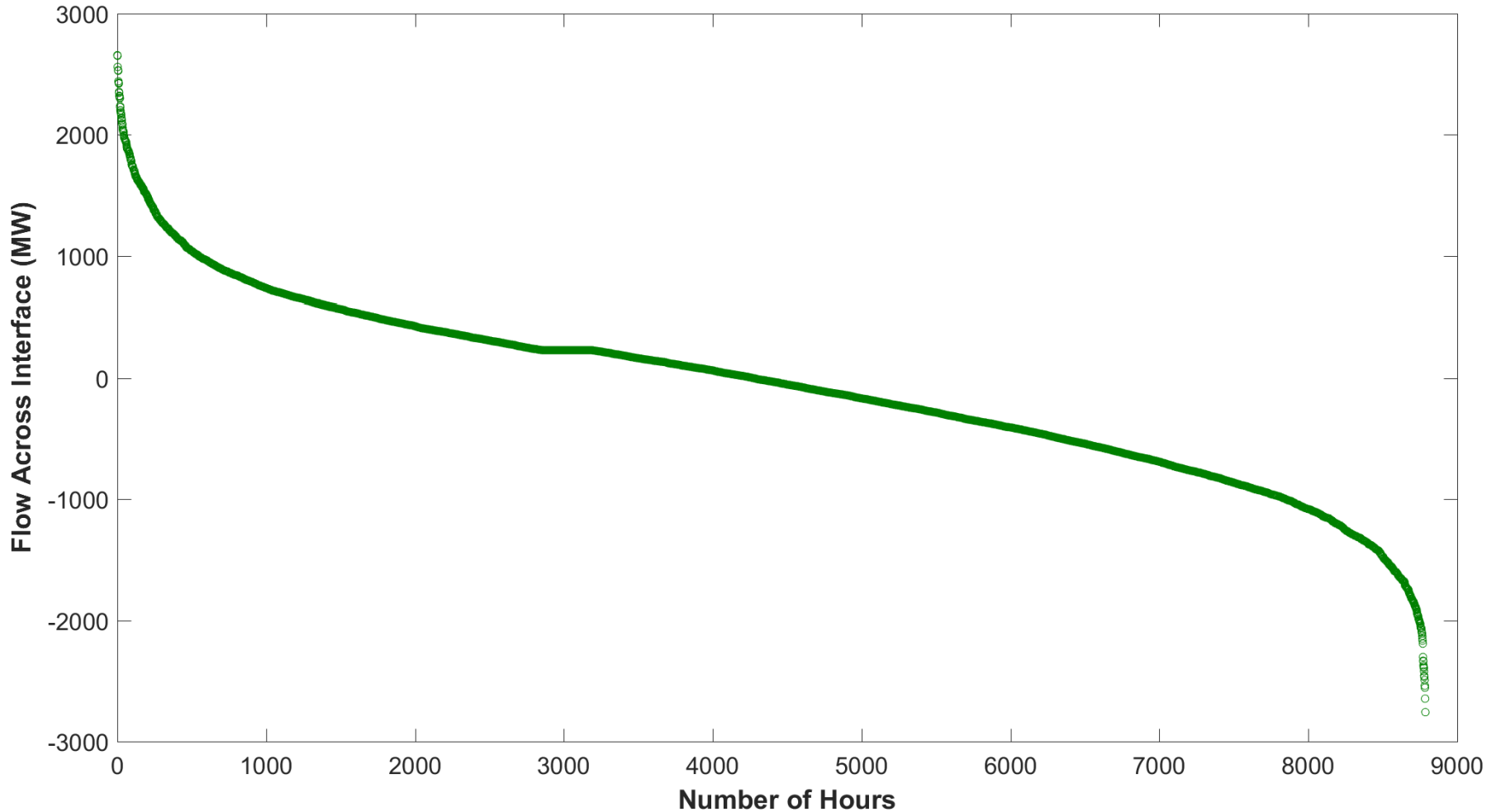


*Positive values indicate power flowing into Norwalk-Stamford



East to West New England Duration Curve

All Hours

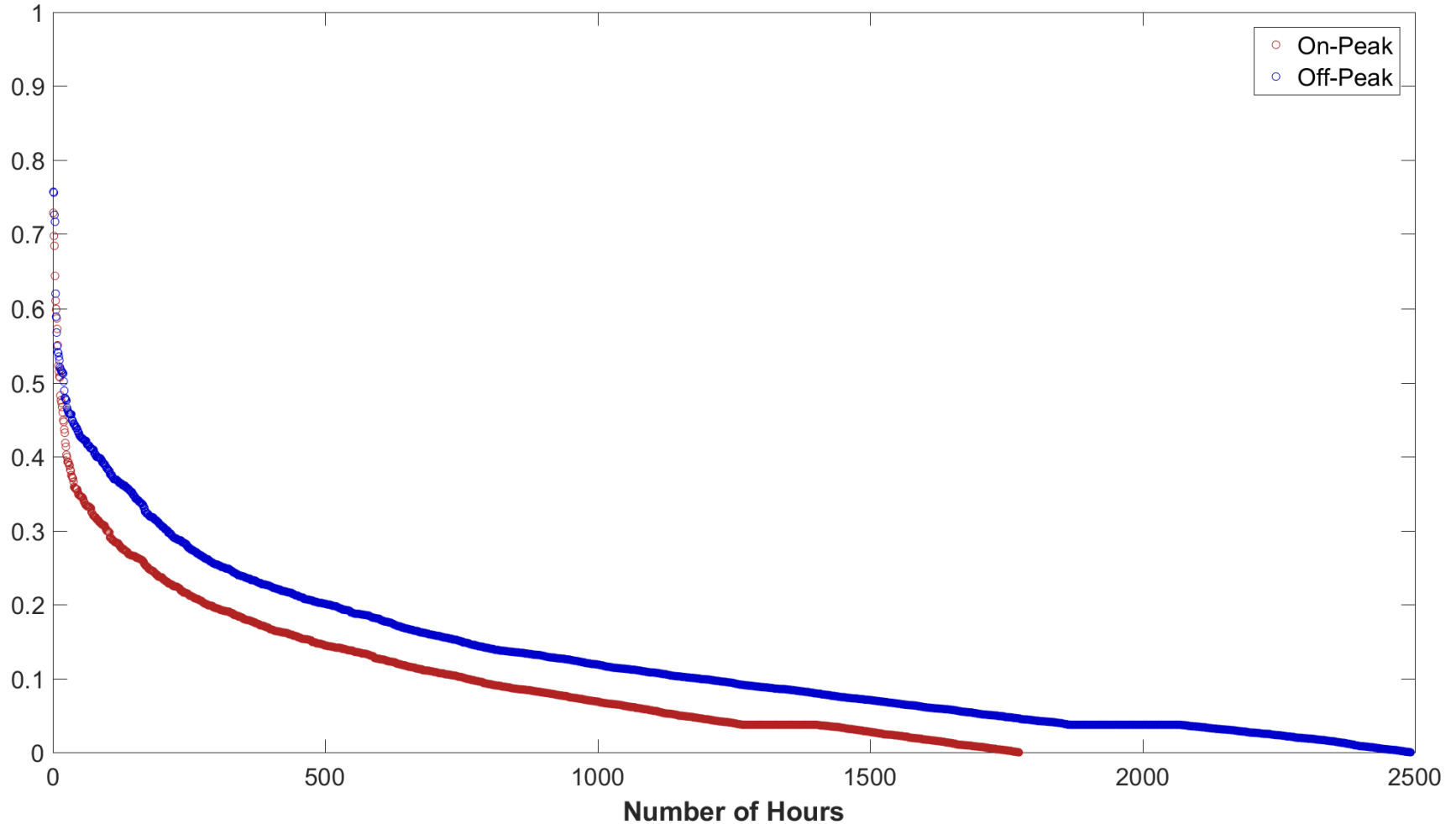


*Positive values indicate power flowing West



East to West New England Duration Curve

Net Flow as a % of Interface Limit

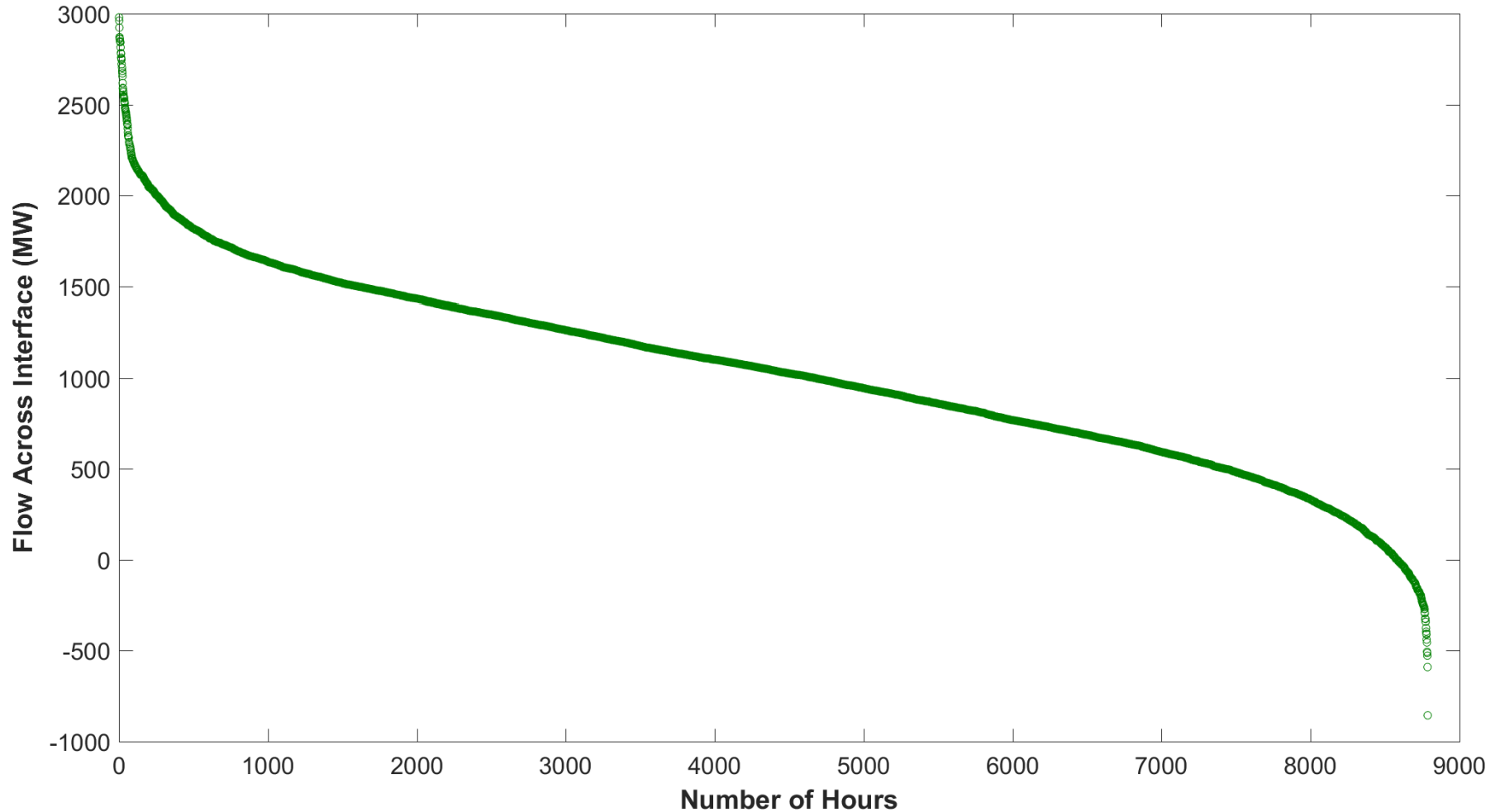


*Positive values indicate power flowing West



North to South New England Duration Curve

All Hours

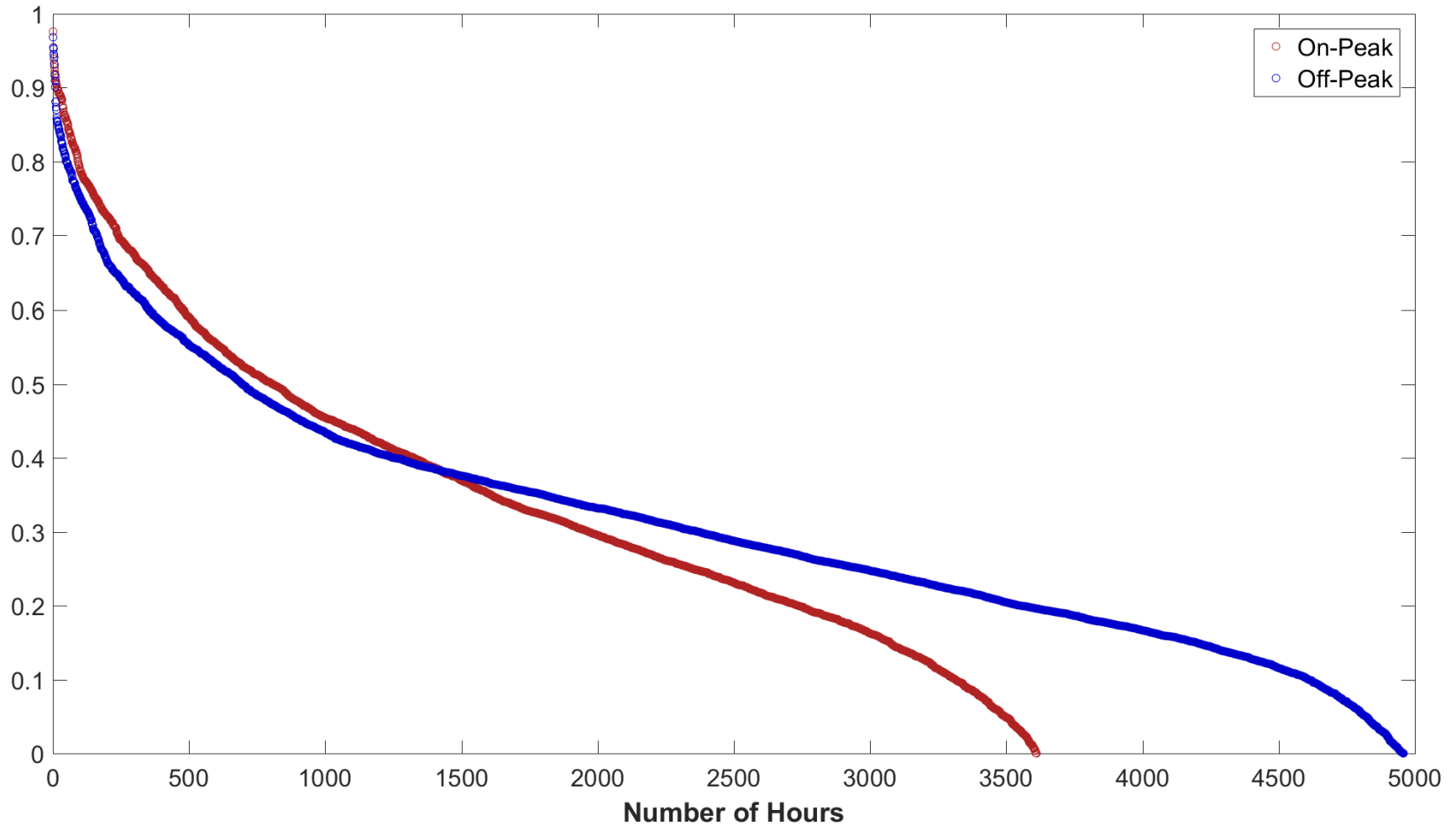


*Positive values indicate power flowing South



North to South New England Duration Curve

Net Flow as a % of Interface Limit

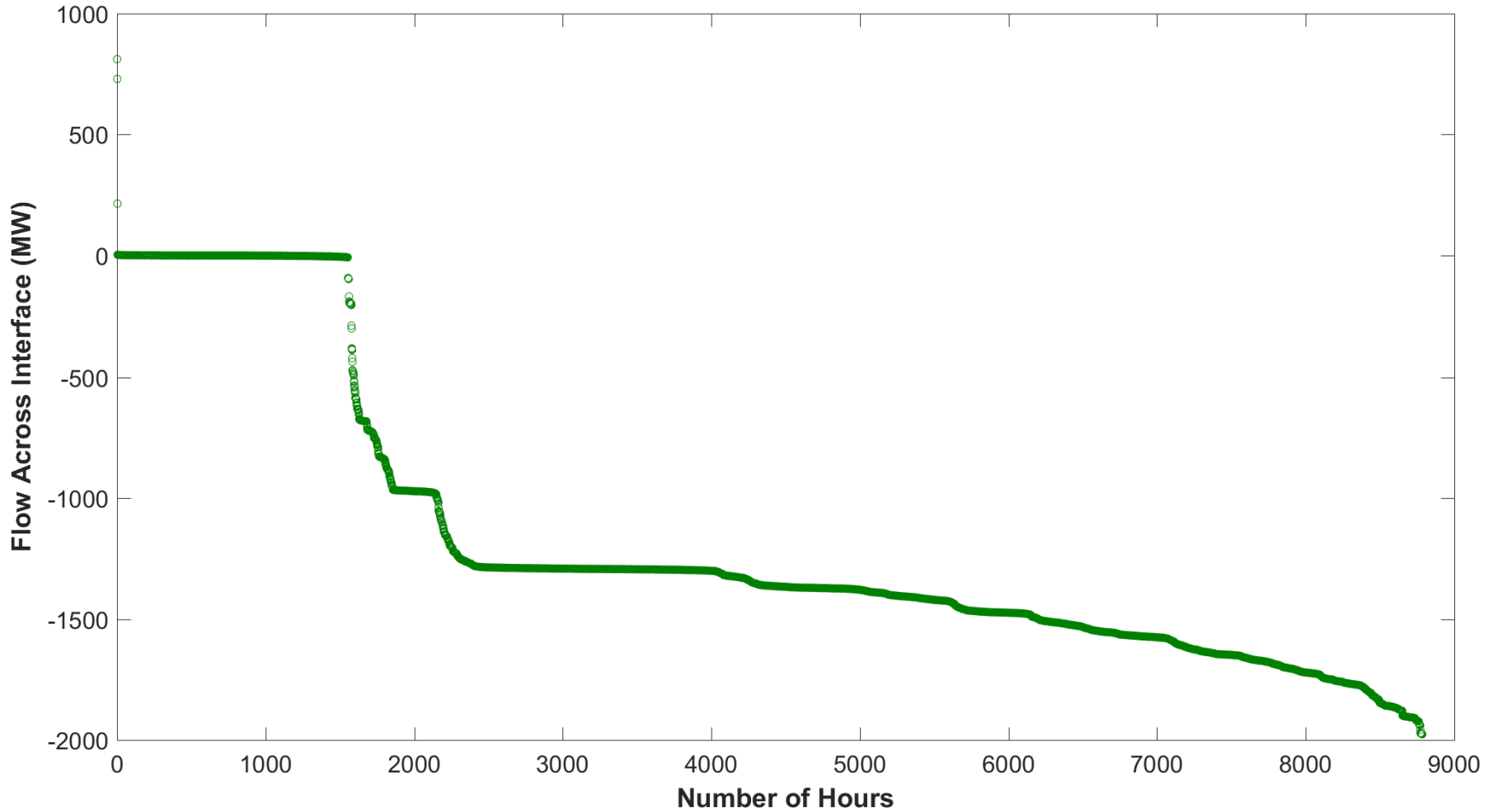


*Positive values indicate power flowing South



HQ Phase II Duration Curve

All Hours

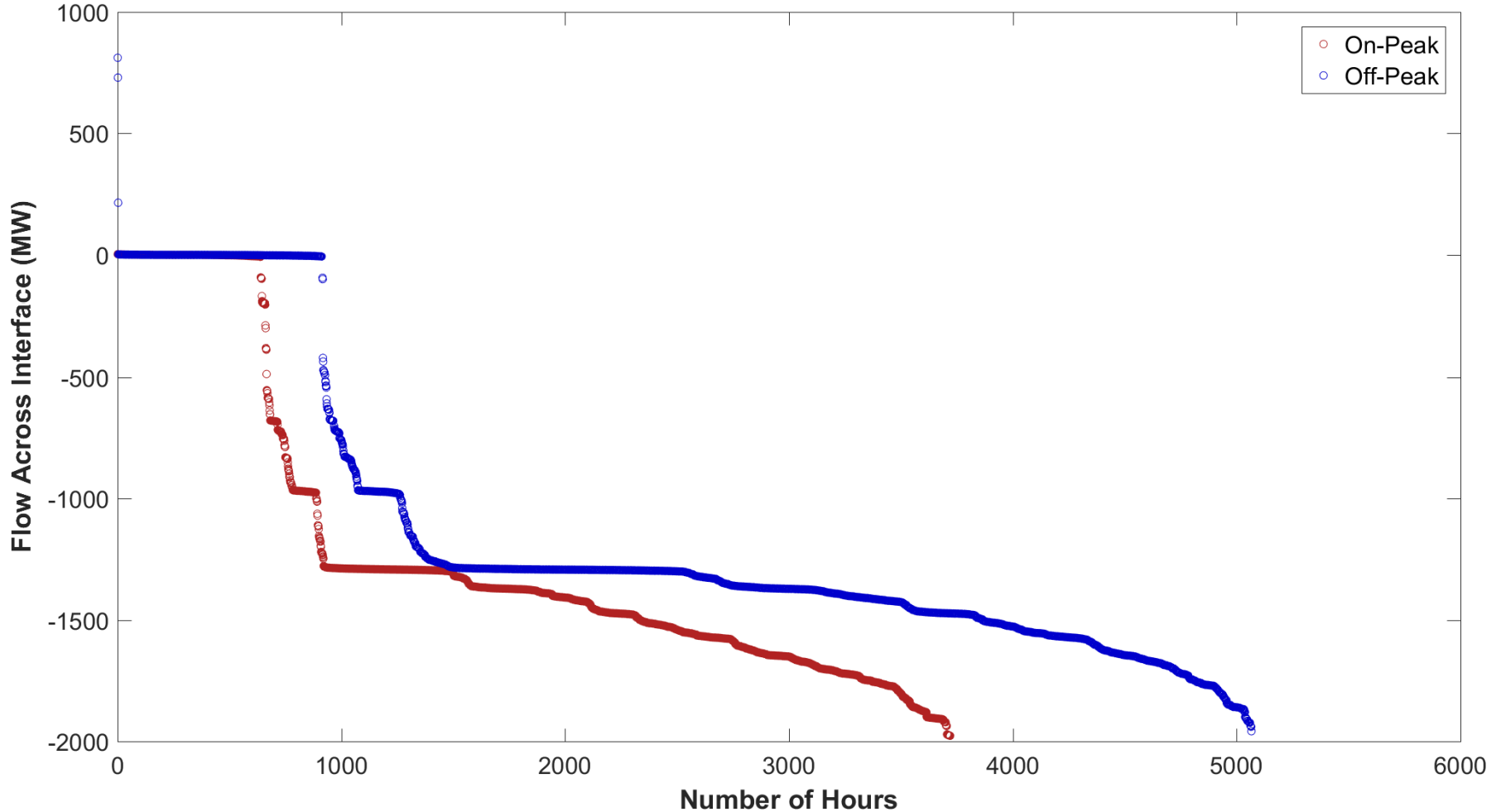


*Positive values indicate power flowing out of New England



HQ Phase II Duration Curve

On/Off Peak Hours

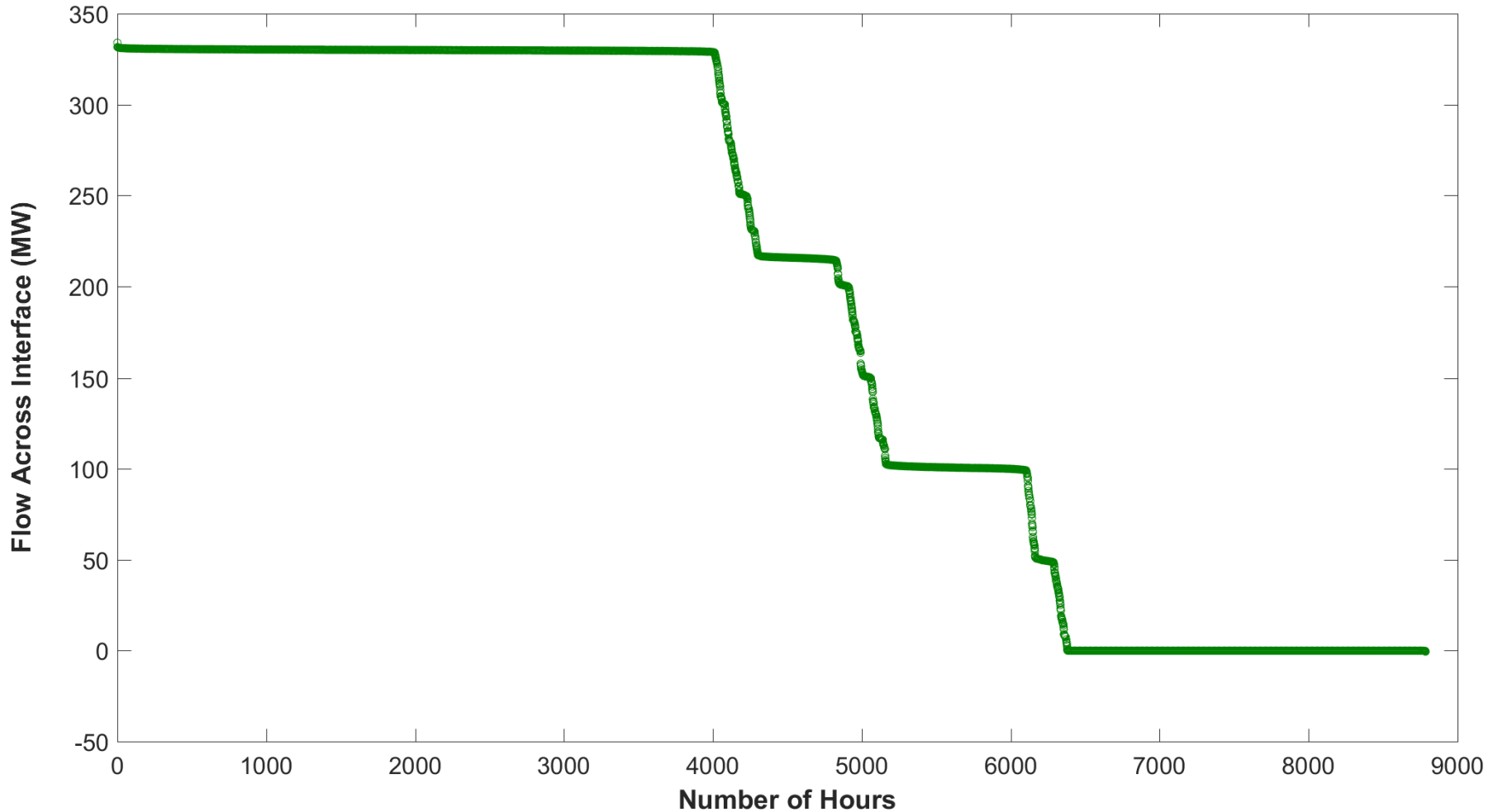


*Positive values indicate power flowing out of New England



New York: Cross Sound Cable Duration Curve

All Hours

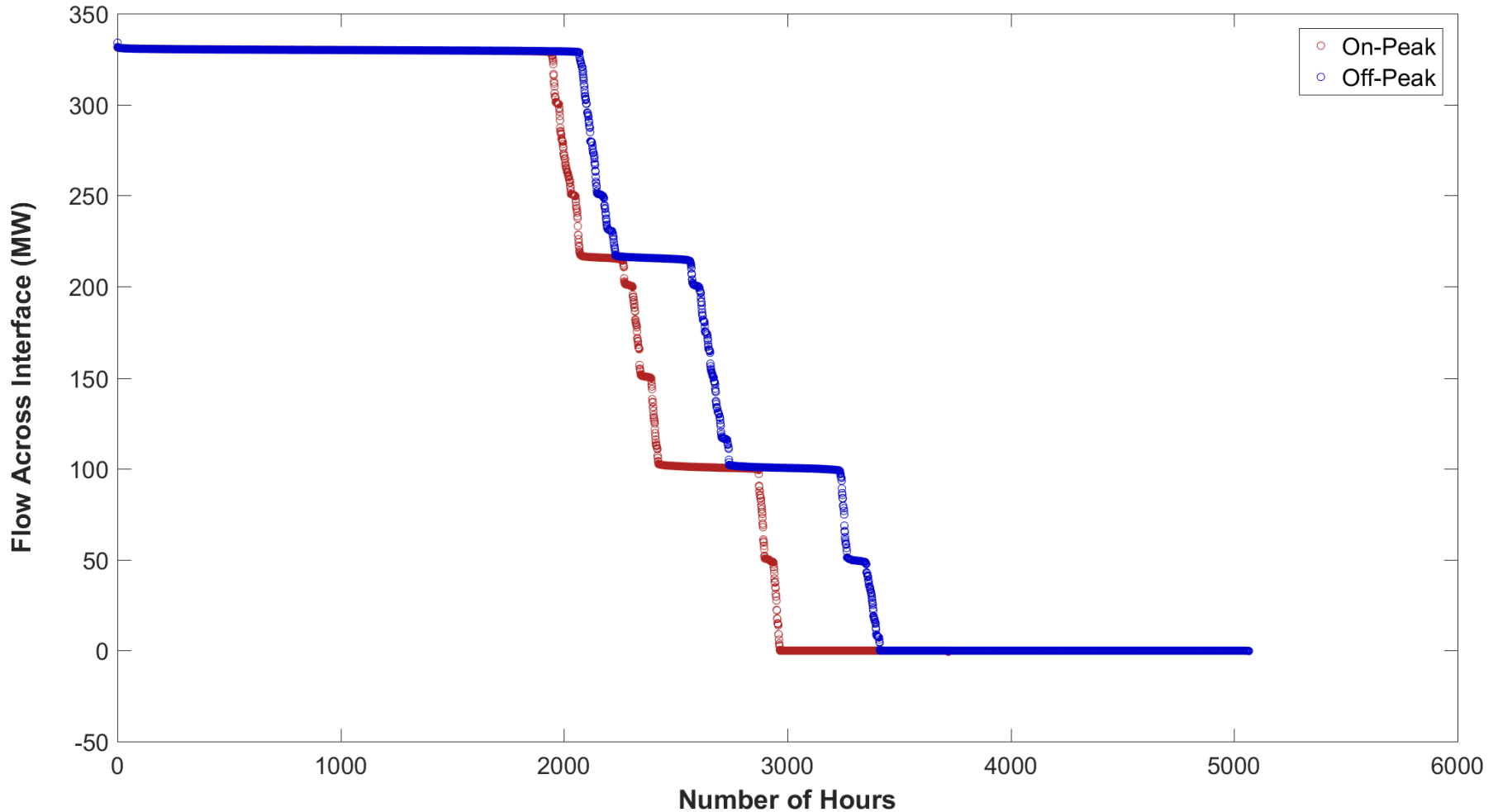


*Positive values indicate power flowing out of New England



New York: Cross Sound Cable Duration Curve

On/Off Peak Hours

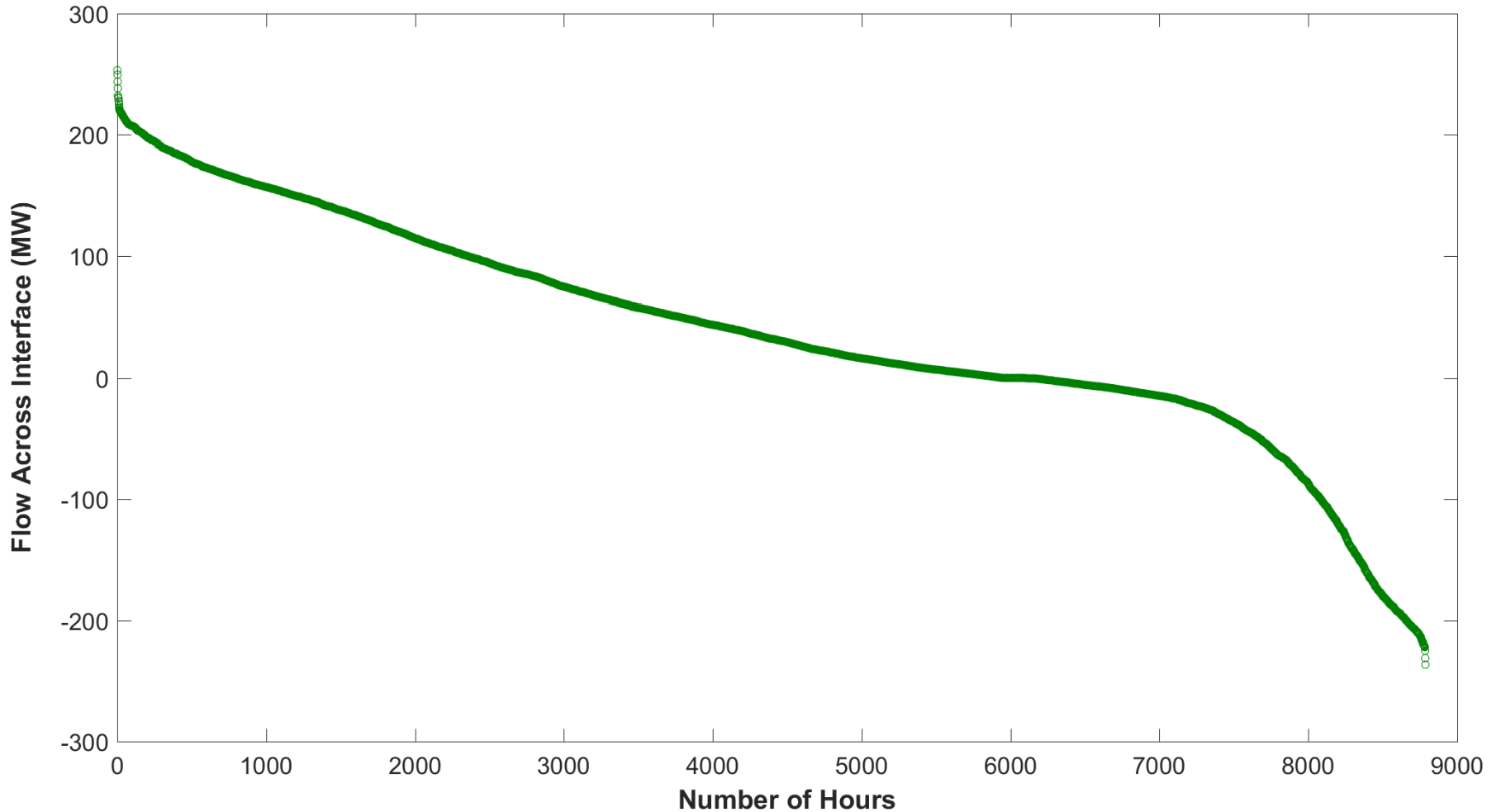


*Positive values indicate power flowing out of New England



New York: Northport Duration Curve

All Hours

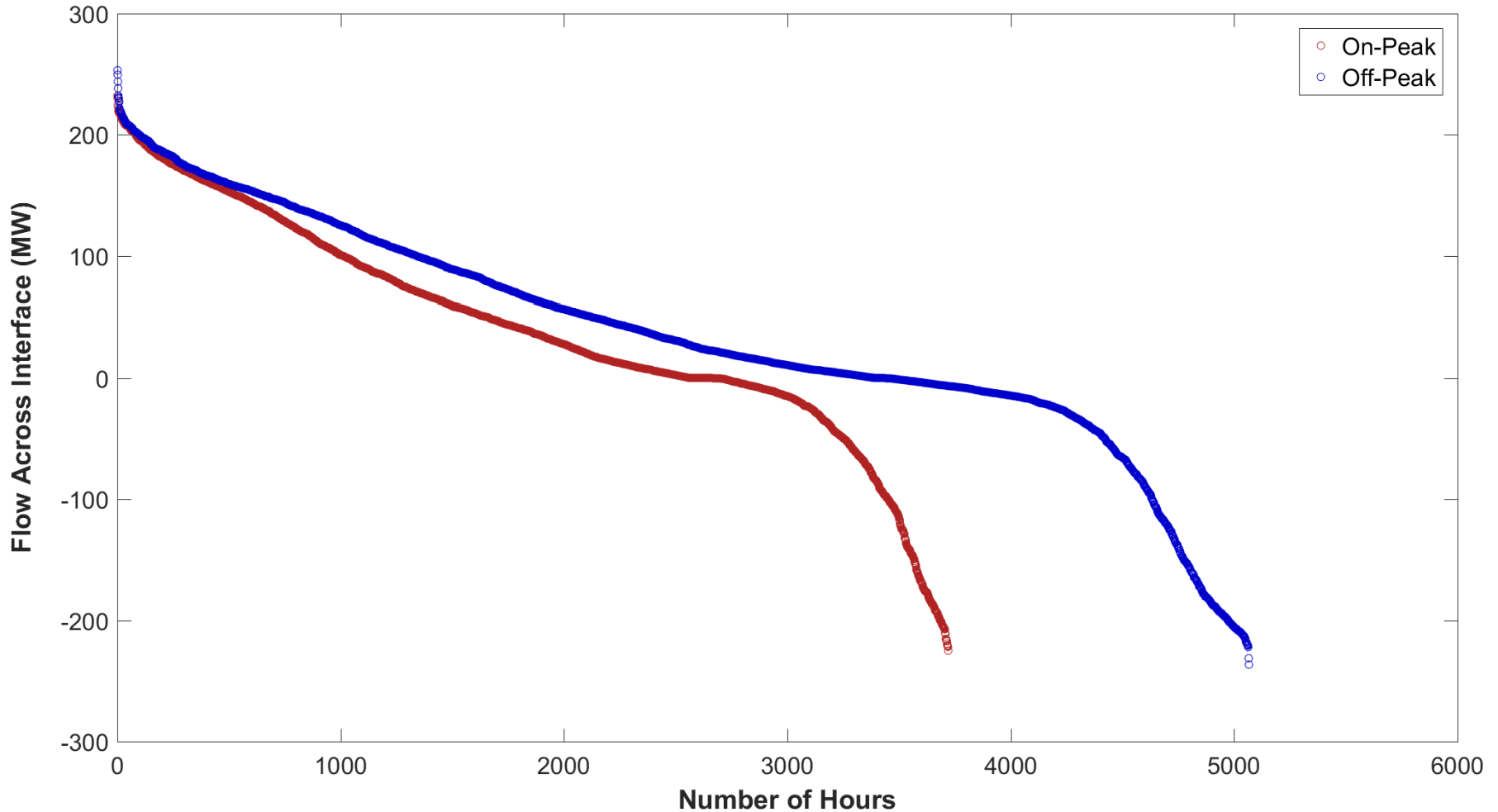


*Positive values indicate power flowing out of New England



New York: Northport Duration Curve

On/Off Peak Hours

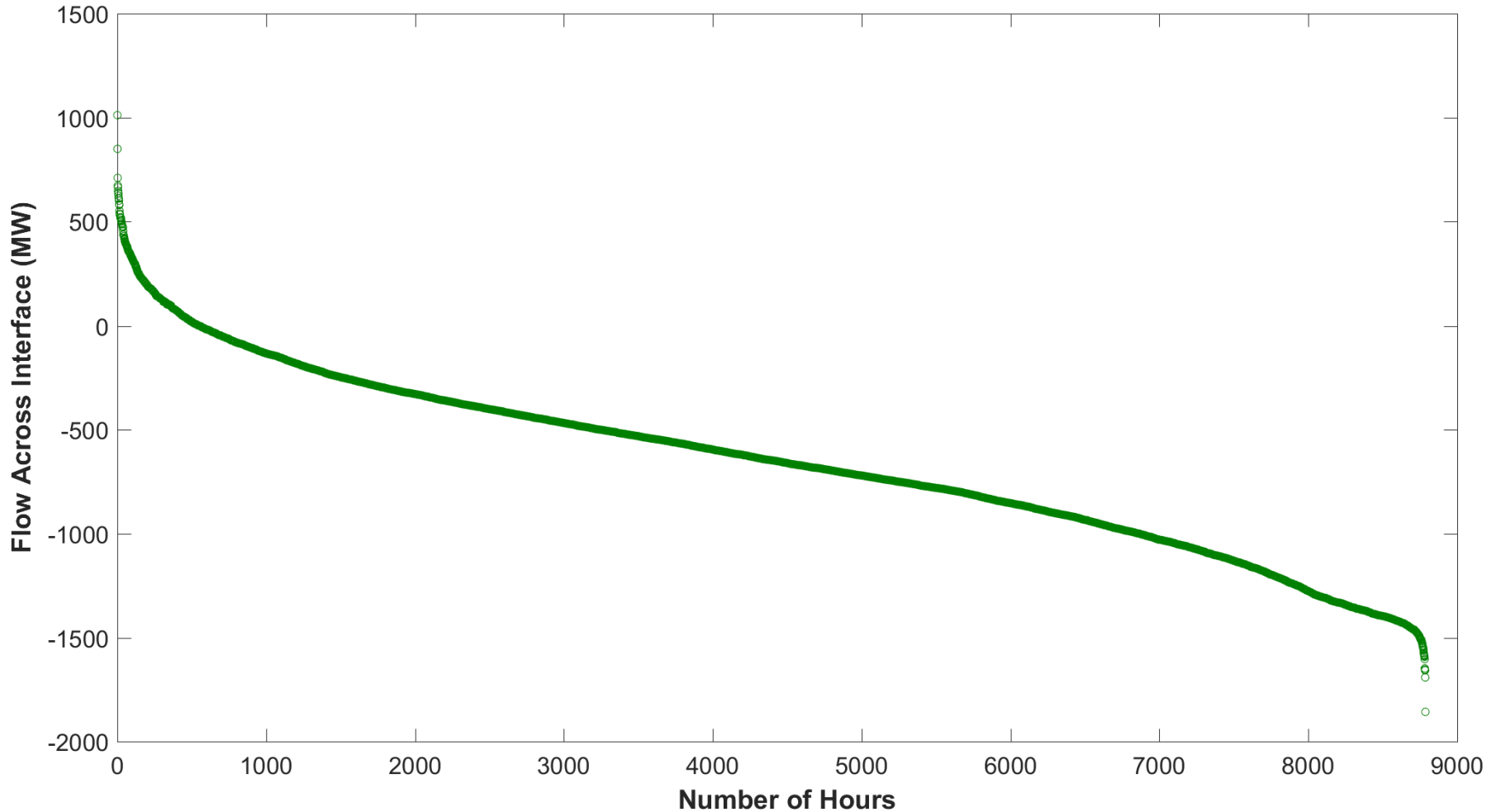


*Positive values indicate power flowing out of New England



New York: Northern Ties Duration Curve

All Hours

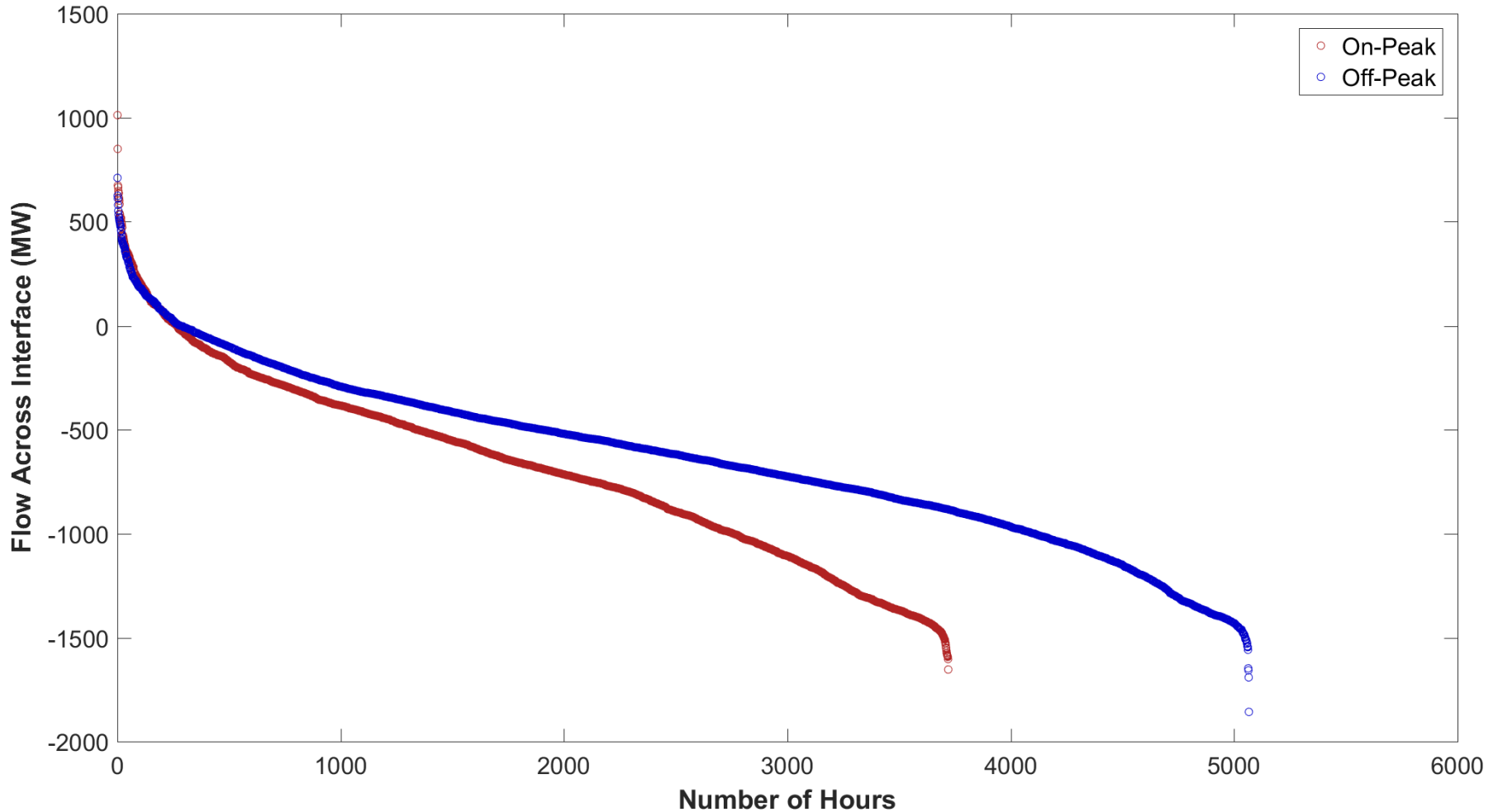


*Positive values indicate power flowing out of New England



New York: Northern AC Ties Duration Curve

On/Off Peak Hours



*Positive values indicate power flowing out of New England



Observations

- The small Congestion Component of the Locational Marginal Prices suggests there is little congestion on these interfaces
- In general, interface flows operate closer to the limit during on-peak hours as opposed to off-peak hours
- Portions of the system that are remote from load centers, especially northern Maine, have high negative loss components

