Locational Marginal Prices & Interface Flows

2016 Historical Market and Operational Data
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

• 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.
REAL-TIME LOCATIONAL MARGINAL PRICES

Hub and RSP Subareas
Real-Time Locational Marginal Prices
2016 Summary ($/MWh)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean: Difference from Hub</th>
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## Real-Time Locational Marginal Prices

### 2016 Summary of Congestion Component ($/MWh)

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# Real-Time Locational Marginal Prices

## 2016 Summary of Loss Component ($/MWh)

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Average Real-Time Locational Marginal Prices

$/MWh


Hub BOSTON CMA/NEMA WMA SEMA CT SWCT NOR VT NH RI BHE ME SME

ISO-NE PUBLIC
Average Real-Time Locational Marginal Prices

Difference from Hub

|$/MWh|

-8 -6 -4 -2 0 2 4


BOSTON CMA/NEMA WMA SEMA CT SWCT NOR VT NH RI BHE ME SME


ISO-NE PUBLIC
Average Real-Time Locational Marginal Prices

Difference from Hub: Congestion Component
Average Real-Time Locational Marginal Prices

Difference from Hub: Loss Component

$/MWh


BOSTON  CMA/NEMA  WMA  SEMA  CT  SWCT  NOR  VT  NH  RI  BHE  ME  SME
Monthly Average Real-Time Locational Marginal Prices at Hub

$/MWh

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

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

- **Mean**: 50th Percentile (Median)
- **Interquartile Range (IQR)**: Middle 50% of Distribution
- **1st Quartile - 1.5 * IQR**
- **25th Percentile (1st Quartile)**
- **75th Percentile (3rd Quartile)**
- **3rd Quartile + 1.5 * IQR**
- **Outliers**
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**

![Box plot diagram showing monthly power flow statistics from Maine to New Hampshire. Positive values indicate power flowing into New Hampshire.](image)

*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

*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*

Flow Across Interface (MW)

*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

*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

*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

*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

*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