Improving ISO-NE's reporting on the electric power sector's air emissions

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Two core issues to address

- **Problem 1:** Imports are excluded from ISO-NE's System GHG emissions.
- **Solution 1**: Incorporate emissions associated with NY and Canadian imported energy.

- **Problem 2**: ISO-NE overestimates the contribution of marginal units in small, local export-constrained areas.
- **Solution 2**: ISO-NE emission reporting adopt the ISO-NE Internal Market Monitor's methodology for reporting marginal emissions based on a unit's contribution to system load.

Why does this matter?

- **Average Emissions** – comprehensive understanding of the regions actual emission trends over time.

- **Marginal Emissions** – correctly estimating the impacts of beneficial electrification, new generation, and energy efficiency.

- **Real-Time Marginal Emissions** – Ensure that Energy Storage Systems actually reduce grid emissions.

How are carbon emissions from electricity consumption calculated?

1) Average Emission Rate

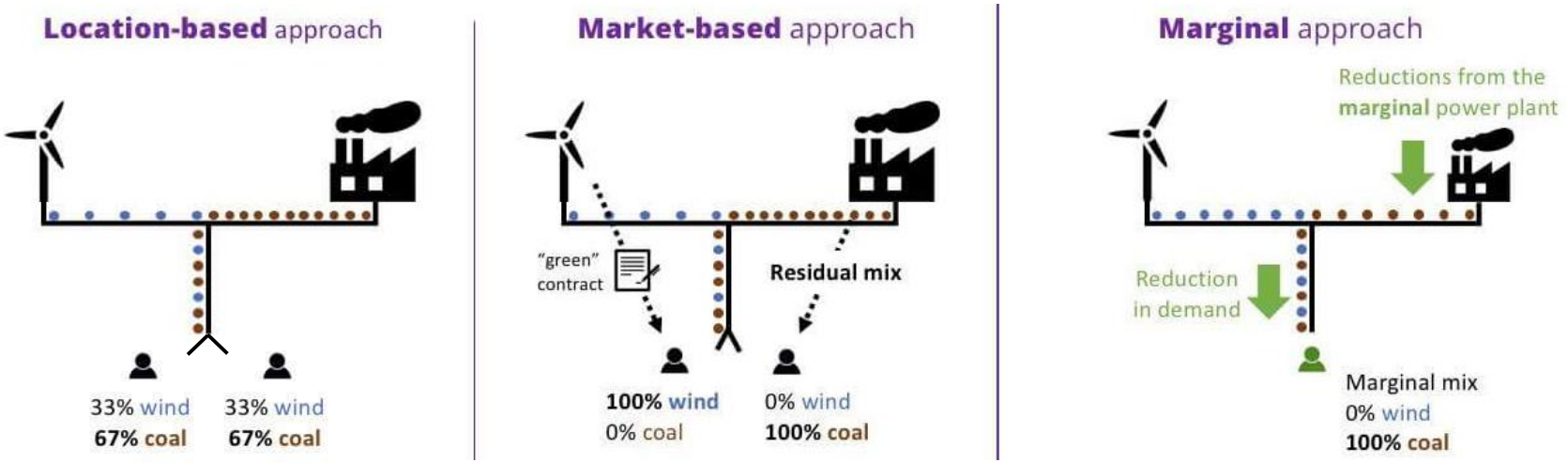
How much CO_2 was emitted to generate the electricity I consumed across a given time?

Relevant for electricity consumers calculating Scope 2 carbon footprint.

2) Marginal Emission Rate

How much CO_2 is my project's new electricity usage causing or avoiding?

Relevant for project owners calculating avoided emissions.

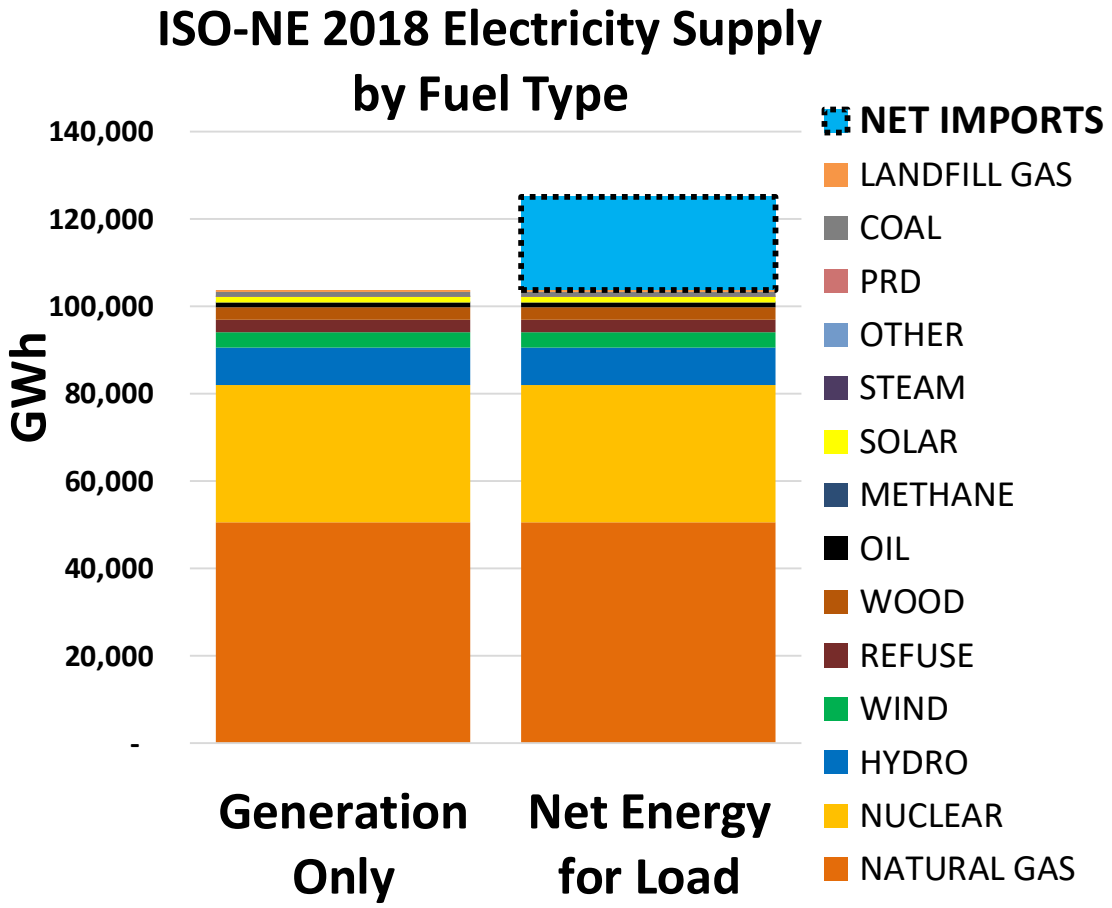


Problem 1: Energy imports excluded from system emission reports

"All electric generators dispatched by ISO New England are included in the emissions calculations.

Emissions from … generators not within the ISO New England balancing authority area are not part of this analysis."

- ISO-NE Air Emissions Report



Solution 1: Incorporate emissions associated with NY and Canadian Imported Energy

- Accurate and reliable air emission data for imported energy are available.
  - Environment Canada (Quebec & New Brunswick)
  - USA EPA eGRID (New York tie lines)
- Already being used by the Mass DEP for GWSA program.

How would this change ISO's reports?

Methodology	lbs. CO_2 /MWh	Comments
Current Native Generation Only	682	ISO-NE's reported value
Proposed w/ Imports Net Energy for Load	622	Generation-only methodology is ~10% over reporting
Proposed Net Energy for Load *(With Mass. 83D Hydro imports)*	554 *	~23% over reporting vs BAU

** Illustrative example assumes 9.4 TWh imported non-emitting hydro displaces predominately gas as the marginal generating resource in the ISO-NE grid. Displacement of coal, oil, nuclear, wind, etc. also possible.*

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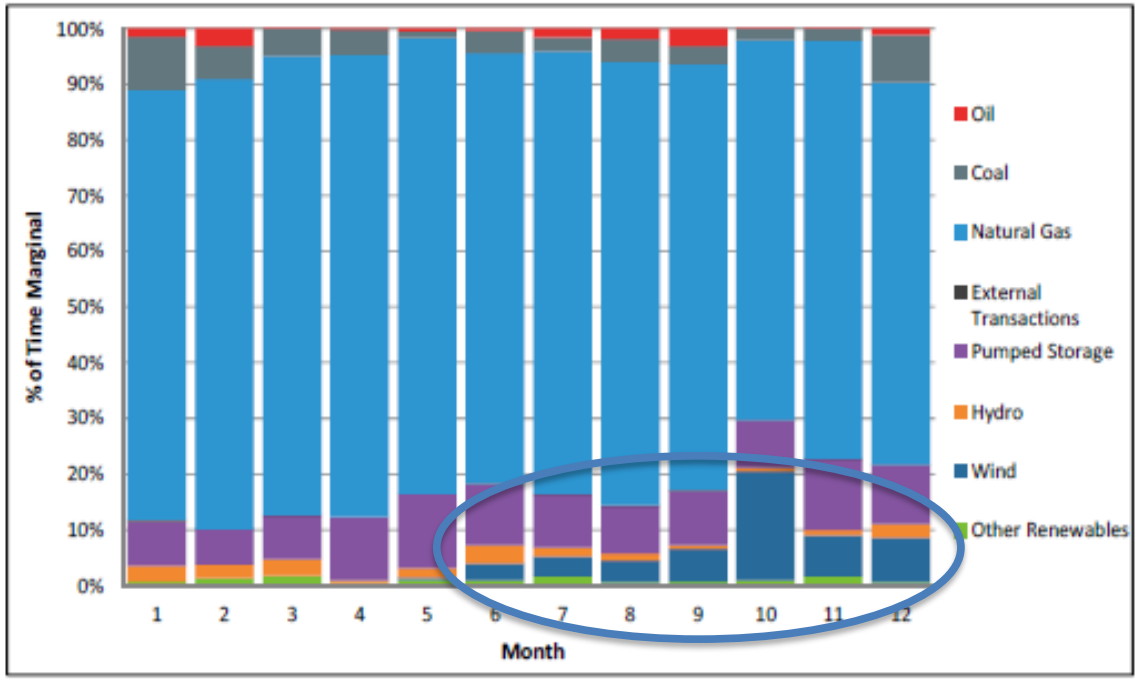
Problem 2: ISO-NE overestimates contribution of marginal units in export-constrained areas

Starting May 2016, wind jumps from being marginal for the system 0% of the time, to a maximum of nearly 20% in October.

Percent of month each fuel type was marginal



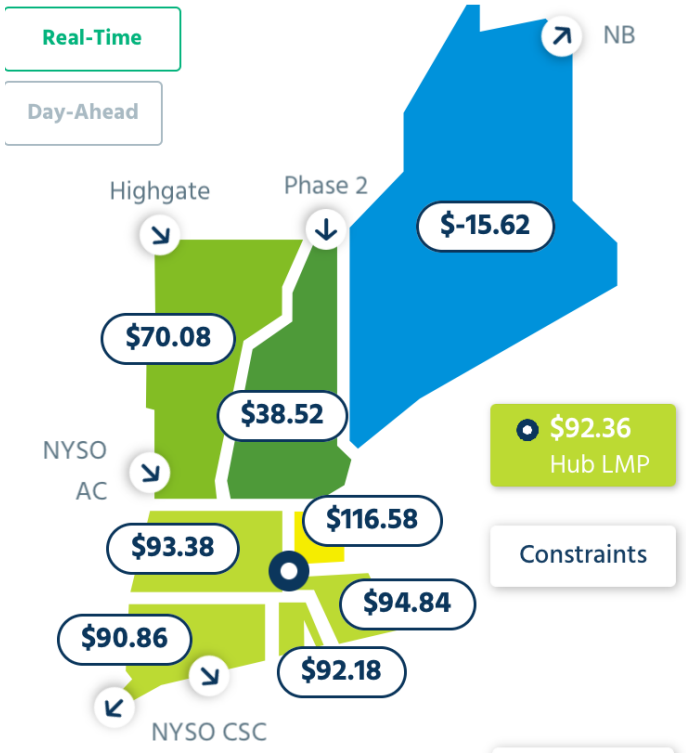
- 2016 ISO-NE Air Emissions Report

Do Not Exceed (DNE) dispatch rules went into effect on May 2016.

Problem 2: ISO-NE overestimates contribution of marginal units in export-constrained areas

"Wind *was* the second most frequent marginal fuel type… Despite the high percentage of time wind generators were marginal, they only set price for the entire system 0.5% of the time. …due to the limitations of the transmission system... Wind generators are often in export-constrained areas…

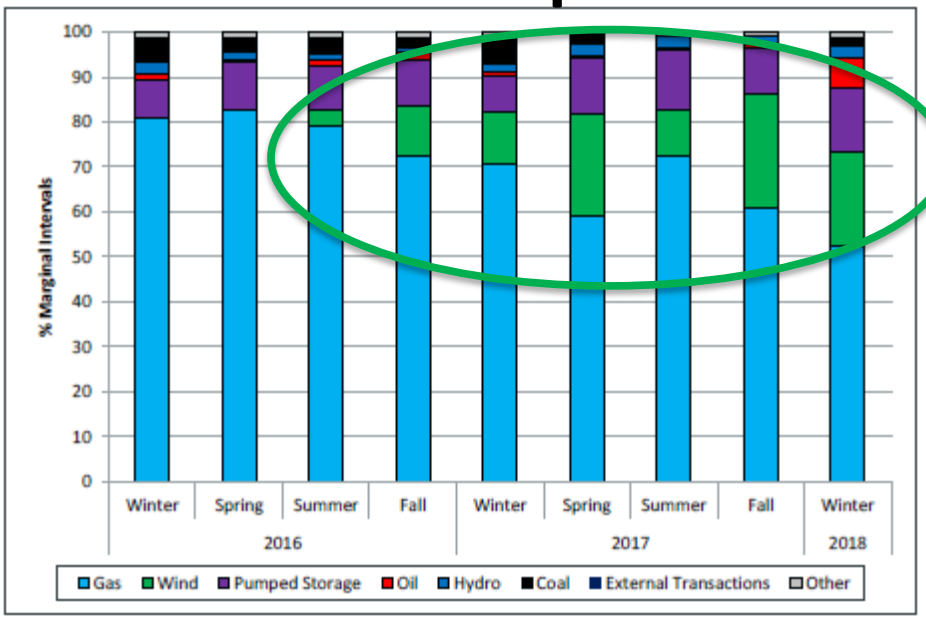
- ISO-NE 2018 Winter Quarterly Markets Report



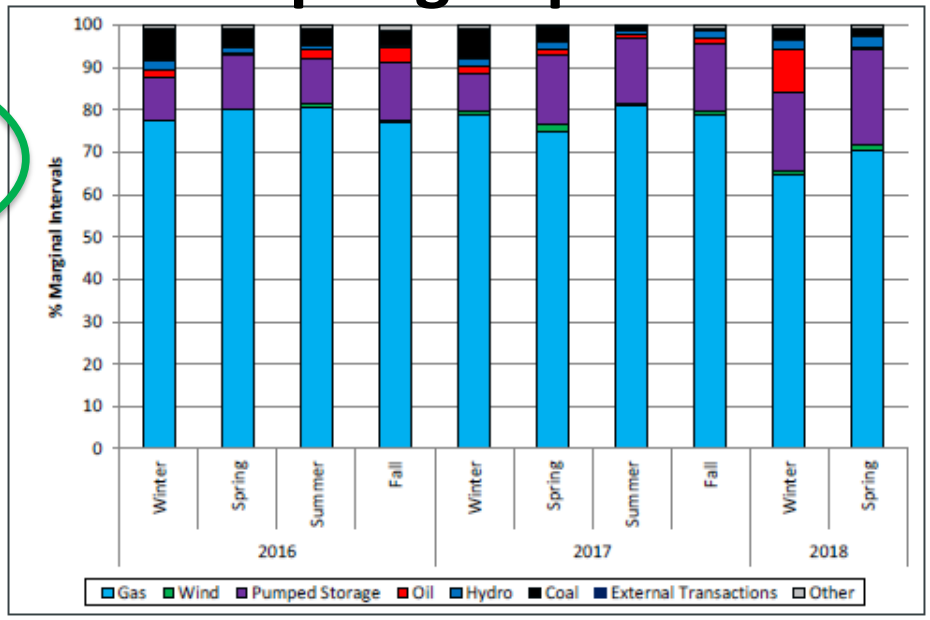
Solution 2: Report marginal emissions based on a unit's contribution to system load

2018 ISO-NE Internal Market Monitor Quarterly Markets Report

Winter Report



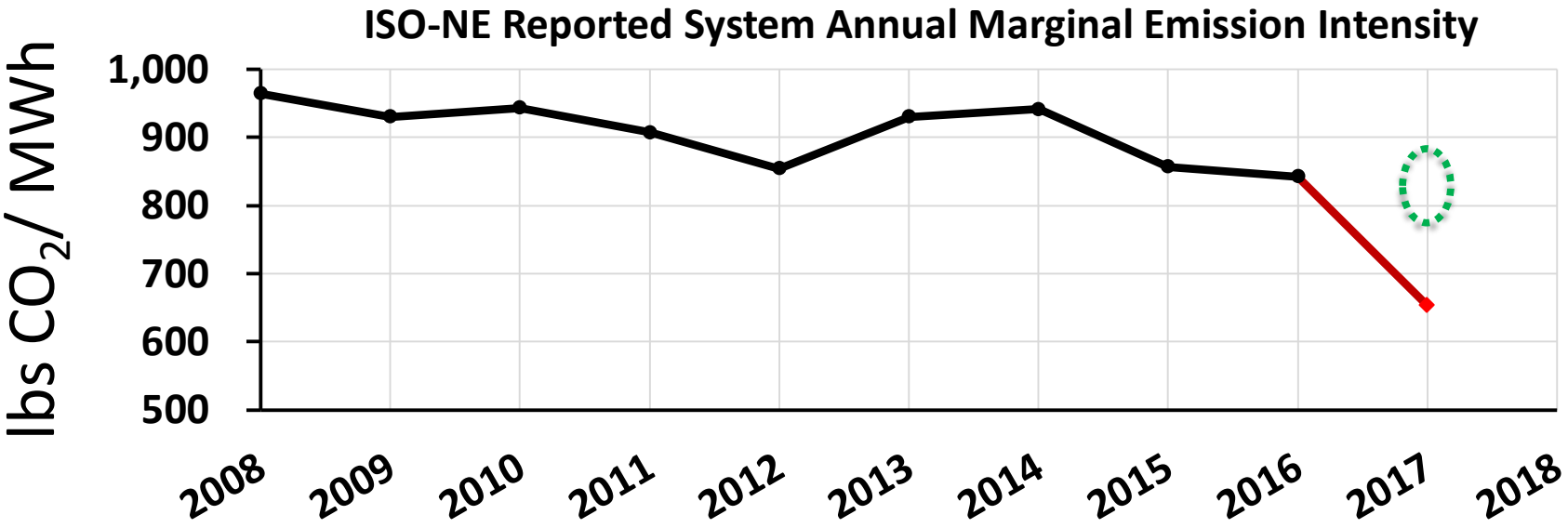
Spring Report



Wind **frequently reported** before change as marginal for entire system.

Wind **essentially not reported** after change as marginal for entire system.

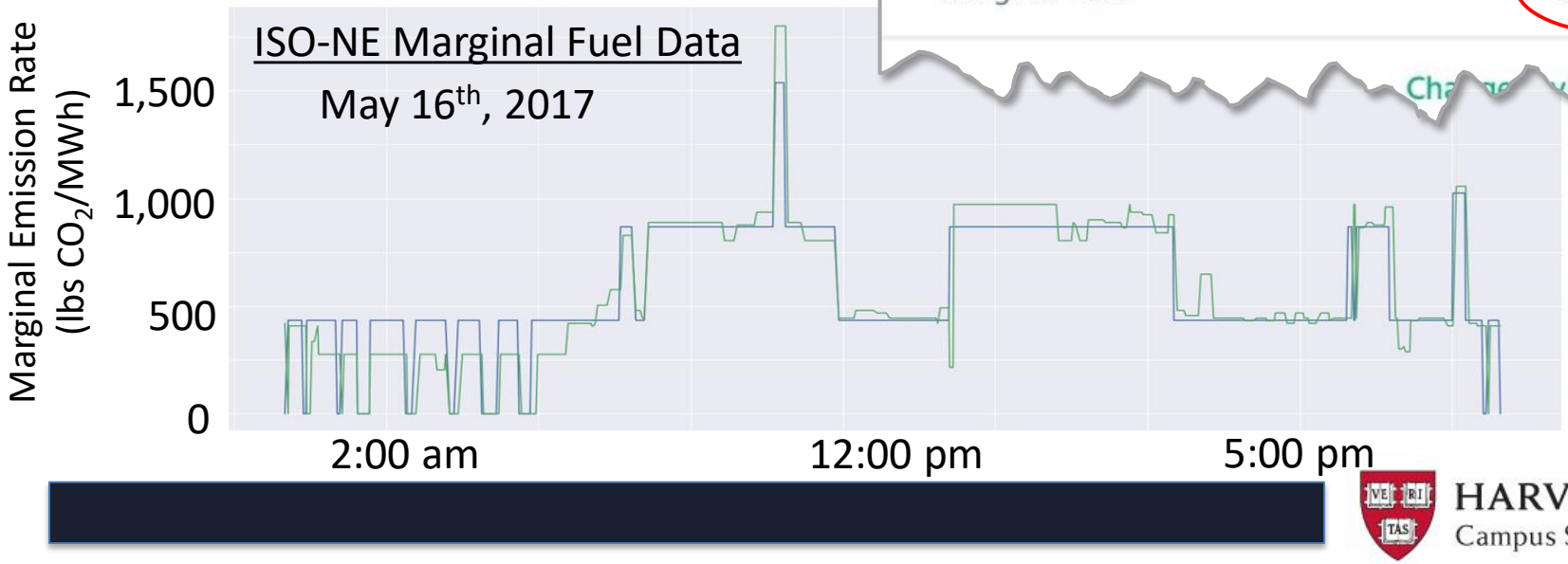
How would this change ISO Reports?



- 2017's stated emission rate, 682 lbs. CO_2/ MWh, is artificially low due to over-counting contribution of export-constrained wind units.
- System-wide rate presumably 800-900 lbs CO_2/MWh.
- Region-specific marginal emission rates would be ideal, as well as accounting for embodied emissions for Pumped Storage Hydro.

Real-Time Marginal Emission Rates are possible!

The environmental performance of Energy Storage Systems and Dynamic Load Management could significantly benefit from ISO-NE reporting real-time marginal emission information.



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How can these improvements help policy makers and end-users?

Hourly Average Marginal Emission Rate (lbs CO_2/MWh)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12 AM	1,077	1,015	968	933	868	952	929	983	938	958	876	972
1 AM	1,059	1,039	1,004	925	881	940	877	964	937	952	892	981
2 AM	1,086	1,025	1,033	972	935	997	933	942	990	925	874	935
3 AM	1,079	1,035	973	931	852	944	1,020	967	960	949	876	1,022
4 AM	1,145	1,033	932	937	850	966	1,032	921	910	918	946	974
5 AM	1,013	1,026	945	929	899	963	1,009	913	914	916	908	988
6 AM	1,004	1,044	1,004	936	910	1,042	949	921	977	939	914	988
7 AM	1,047	1,050	984	971	935	971	931	926	1,058	972	986	1,012
8 AM	1,016	1,094	1,067	992	1,009	944	950	957	1,000	982	973	1,009
9 AM	949	996	1,007	1,007	966	966	969	942	992	1,000	996	1,065
10 AM	964	996	1,022	989	932	997	995	1,004	1,011	1,021	972	1,042
11 AM	995	1,038	943	991	947	929	992	981	1,000	973	969	985
12 PM	1,062	1,012	949	1,012	955	934	1,052	1,025	1,031	1,011	940	1,133
1 PM	1,090	1,011	967	1,005	959	962	1,033	1,103	1,085	982	942	1,056
2 PM	989	988	982	957	956	933	1,026	1,055	1,033	1,010	942	1,122
3 PM	991	960	987	968	967	952	1,103	1,086	1,099	992	924	1,049
4 PM	991	971	1,018	997	1,014	1,021	1,070	1,108	1,073	953	955	996
5 PM	1,007	1,021	948	950	966	968	1,147	1,089	1,060	993	1,017	1,084
6 PM	1,038	1,024	983	920	989	992	1,059	1,058	1,038	1,041	1,041	1,043
7 PM	1,014	1,013	992	1,014	965	965	1,091	1,112	1,067	1,070	984	1,092
8 PM	1,010	1,066	1,006	996	969	964	1,000	1,107	1,032	1,029	1,028	1,038
9 PM	1,049	940	1,008	974	951	936	973	1,000	996	959	960	1,014
10 PM	1,064	1,007	989	939	923	990	975	985	1,000	921	938	1,074
11 PM	1,081	1,007	923	1,007	869	1,004	931	916	953	931	875	1,046

Hourly Average System Load (MW)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12 AM	12,860	12,764	11,685	11,065	10,721	11,750	14,197	14,343	12,042	10,678	11,130	12,806
1 AM	12,675	12,592	11,547	10,922	10,475	11,394	13,749	14,016	11,733	10,491	10,921	12,604
2 AM	12,531	12,475	11,459	10,868	10,395	11,262	13,486	13,860	11,628	10,387	10,946	12,522
3 AM	12,563	12,475	11,438	10,864	10,365	11,245	13,281	13,731	11,564	10,327	11,000	12,555
4 AM	12,828	12,738	11,620	11,048	10,497	11,345	13,282	13,755	11,670	10,505	11,200	12,740
5 AM	13,359	13,256	12,163	11,503	10,911	11,603	13,487	14,009	12,105	10,974	11,788	13,269
6 AM	14,492	14,330	13,188	12,336	11,798	12,367	14,133	14,497	12,985	12,053	12,792	14,140
7 AM	15,364	15,109	13,967	13,140	12,683	13,426	15,097	15,382	13,722	12,943	13,587	15,002
8 AM	15,596	15,363	14,143	13,373	13,125	14,113	15,964	16,312	14,247	13,239	13,785	15,347
9 AM	15,658	15,417	14,163	13,456	13,429	14,631	16,825	17,113	14,693	13,375	13,815	15,382
10 AM	15,637	15,396	14,124	13,468	13,646	15,104	17,633	17,909	15,056	13,450	13,814	15,309
11 AM	15,519	15,300	13,975	13,391	13,754	15,471	18,289	18,574	15,307	13,443	13,735	15,208
12 PM	15,374	15,144	13,761	13,228	13,785	15,715	18,755	19,093	15,468	13,388	13,637	15,100
1 PM	15,327	15,063	13,639	13,109	13,840	15,977	19,185	19,593	15,672	13,417	13,638	15,106
2 PM	15,306	14,979	13,522	12,967	13,844	16,143	19,489	19,932	15,818	13,413	13,674	15,148
3 PM	15,502	15,093	13,528	12,935	13,896	16,313	19,693	20,206	16,013	13,510	13,935	15,420
4 PM	16,263	15,564	13,798	13,129	14,074	16,513	19,892	20,456	16,284	13,802	14,739	16,533
5 PM	17,384	16,623	14,313	13,437	14,290	16,633	19,976	20,519	16,472	14,288	15,532	17,422
6 PM	17,365	17,033	14,890	13,676	14,325	16,449	19,676	20,137	16,439	14,866	15,492	17,282
7 PM	16,941	16,636	15,156	14,065	14,327	16,082	19,125	19,625	16,589	14,760	15,069	16,882
8 PM	16,358	16,059	14,811	14,211	14,503	15,866	18,747	19,371	16,088	14,170	14,484	16,346
9 PM	15,417	15,148	13,941	13,418	13,825	15,344	18,064	18,313	15,003	13,244	13,592	15,510
10 PM	14,235	14,025	12,801	12,294	12,553	13,979	16,587	16,755	13,671	12,112	12,500	14,347
11 PM	13,260	13,133	11,942	11,422	11,379	12,630	15,157	15,316	12,554	11,199	11,630	13,350

Hourly Average LMP at NEMA ($/MWh)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12 AM	25	22	16	23	17	17	21	22	22	19	20	43
1 AM	20	23	16	22	17	18	17	22	22	19	18	45
2 AM	21	23	20	22	11	14	16	13	18	16	16	43
3 AM	30	20	13	21	13	15	14	17	15	15	16	43
4 AM	27	24	15	23	11	13	18	21	18	14	19	47
5 AM	25	32	19	25	16	7	18	22	20	17	19	47
6 AM	43	24	23	28	14	9	13	19	29	24	25	56
7 AM	52	28	23	33	20	22	18	25	28	29	29	60
8 AM	40	33	19	31	23	23	22	27	30	28	27	61
9 AM	38	29	17	32	23	22	25	27	28	30	27	57
10 AM	35	28	16	32	24	22	28	30	28	34	25	55
11 AM	36	31	17	29	24	23	33	38	32	32	26	56
12 PM	35	27	17	30	23	25	36	43	35	30	25	49
1 PM	33	28	16	31	24	28	38	57	38	32	23	47
2 PM	32	26	14	28	26	29	46	97	39	31	23	50
3 PM	32	27	13	27	24	29	45	73	42	29	24	54
4 PM	36	28	17	28	29	30	48	93	43	33	33	70
5 PM	53	34	20	31	25	32	53	110	45	37	44	77
6 PM	47	35	22	30	26	29	47	75	40	50	35	68
7 PM	41	32	24	35	30	27	38	40	44	45	29	60
8 PM	40	31	21	37	29	26	37	43	30	32	26	58
9 PM	35	28	17	29	24	26	30	32	25	23	22	56
10 PM	23	25	11	24	19	20	26	26	22	19	22	50
11 PM	20	22	11	22	18	15	18	15	20	17	20	42

Understanding interrelationship of emissions, load, and price should be the foundation of electricity-sector environmental policy.

How can you help?

- Voice your support for these improvements by signing onto stakeholder letter to ISO-NE.
- ISO-NE staff understand and appreciate the issues raised. More stakeholder engagement elevates the issues.

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