



Post Winter 2013/14 Review

Electric/Gas Operations Committee

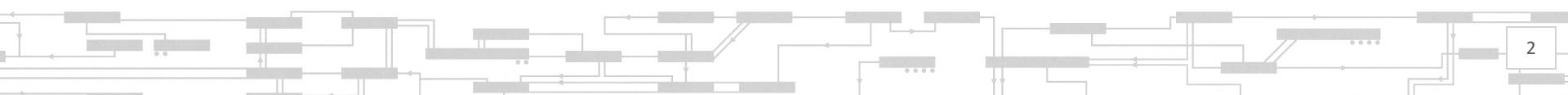
Mark Babula

PRINCIPAL ENGINEER – SYSTEM PLANNING



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- December, 2013
- January, 2014
- February, 2014



Post Winter 2013/14 Review

Winter Reliability Program

- Winter Program Inventory¹
 - Awarded (Initial Inventory): 3,057,554 Barrels
 - Awarded (Replenishment): 484,477 Barrels
 - Initial Inventory Shortfall as of Dec 1: 53,742 Barrels
 - **Program Oil burned through Feb 28: 2,700,468 Barrels**
 - **Equivalent Oil MWh burned² 1,620,279 MWh**
- Approximately 530,000 barrels of program inventory not available during January
- Approximately 112,000 barrels of program inventory not available during February

¹ Winter Program Inventory reflects only inventory obligated within the Program - it excludes oil from Program units above obligated amounts and excludes inventory from non-Program units.

² Based on an average heat content of 6,000,000 Btu/Barrel and proxy heat rate of 10,000,000 Btu/MWh.



Post Winter 2013/14 Review

Winter Reliability Program – cont'd

- Program Dollars*
 - FERC approved program value was \$75.1M
 - As of **January 31**, total program payment reductions totaled \$8.1M, including:
 - Failure to Test Fuel-Switch: \$116K
 - Failure to commit initial inventory: \$238K
 - Failure to Replenish: \$1.1M
 - Unit Unavailability: \$6.7M

*Note: Figures are preliminary estimates only (subject to change).

Post Winter 2013/14 Review

Winter Reliability Program - Fleet Oil Inventory

- New England Fleet¹ Fuel Oil Survey Inventory
 - As of Dec 1: 3,544,945 Barrels
 - As of Jan 2: 3,321,735 Barrels
 - As of Feb 3: 1,874,983 Barrels
 - As of Mar 3: 2,579,320 Barrels
- Much of the remaining oil inventory is concentrated in a small number of units
 - Creates limited diversity

¹ NE Fleet usable inventory reflects all oil units, regardless of participation in Winter 2013/14 program

December 2013 – Operations Review



Post Winter 2013/14 Review

December 14, 2013 Capacity Deficiency

- On Saturday evening, December 14, 2013, the New England Balancing Area implemented M/LCC #2 - *Abnormal Conditions Alert* and OP #4 - *Action During A Capacity Deficiency* to manage a reserve deficiency on the system
- The primary contributing factors causing the deficiency included:
 - Interchange curtailments from neighboring systems
 - Loads running over the forecast
 - Generator outages and reductions approximately 400 MW
- ISO-NE experienced shortages in Ten and Thirty Minute Reserves and a “*Shortage Event*” as defined under FCM Market Rules

Post Winter 2013/14 Review

Interchange Curtailments

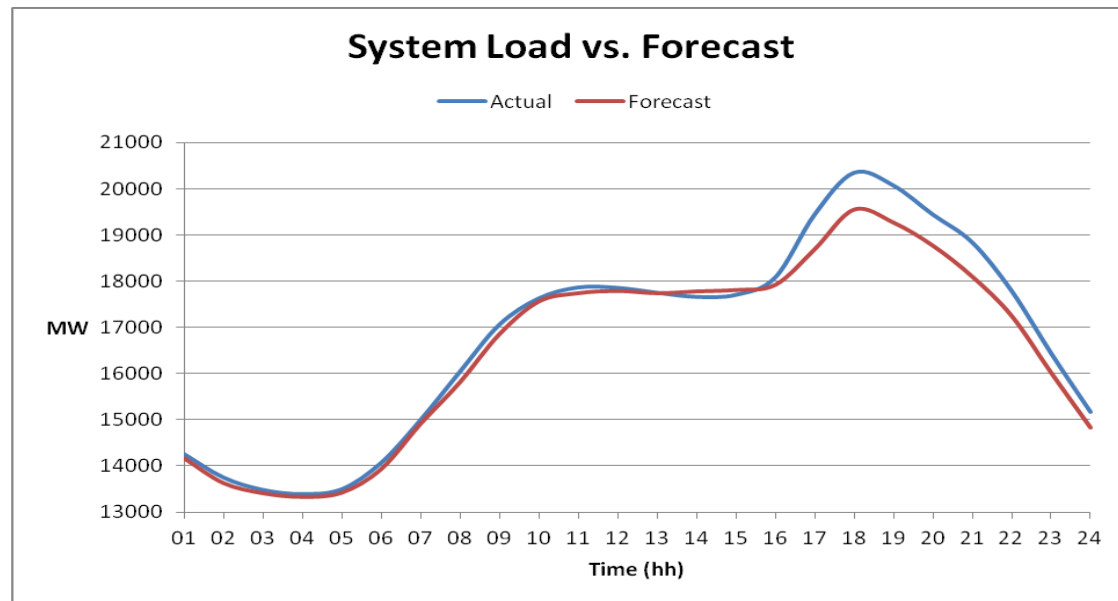
- The expected net deliveries for the peak hour were 3,277 MW and the actual net deliveries were 2,591 MW due to curtailments
- The majority of curtailments were experienced on the Hydro-Quebec interfaces due to loads in HQ running over forecast
- Control Area to Control Area Emergency Import purchased from 17:42 – 18:30 (240 MW from New York)
- No capacity transactions were curtailed across any interface during the event



Post Winter 2013/14 Review

Loads Over Forecast

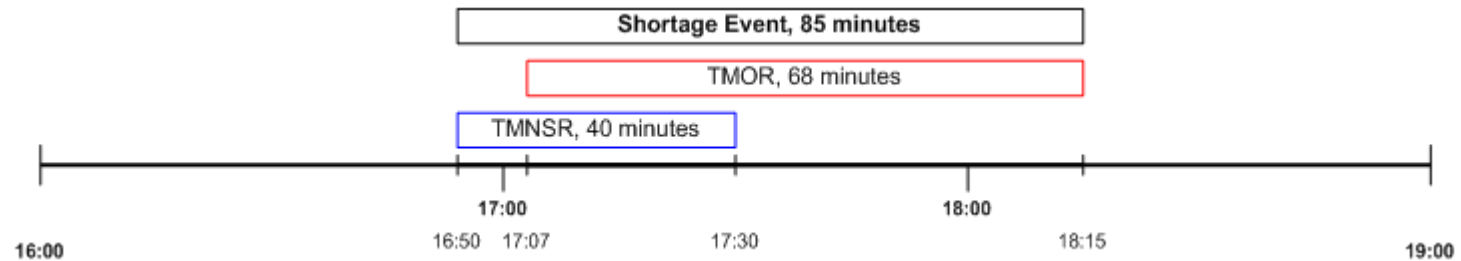
- For the first 16 hours on Saturday, the actual load vs. forecast load was very close as can be seen on the load graph below
- During HE 17:00, the actual load started to diverge above the forecast value significantly and ultimately by 632 MW



Post Winter 2013/14 Review

Shortage Event

- The timeline for the “*Shortage Event*” is as follows:



Post Winter 2013/14 Review

Shortage Event – cont'd

- December 14, 2013 FCM Shortage Event
 - Total event duration 16:50 – 18:15 p.m. (85 minutes)
 - Based on contiguous overlap of:
 - System TMNSR violation 16:50 – 17:30 (40 minutes)
 - System TMOR violation 16:35 – 18:15 combined with OP4 – Action 2 at 17:07 – 18:15
 - Shortage Event penalties (estimated) total \$6.7M *
 - 132 Generators: \$6.692M
 - 21 resources and \$629K in Maine Capacity Zone
 - 111 resources and \$6.063M in Rest-of-Pool Capacity Zone
 - 3 Imports: \$45K

* Subject to verification



Post Winter 2013/14 Review

M/LCC #2 & OP #4 Implementation Timeline on December 14, 2013

Action(s)	Implemented	Canceled
M/LCC #2	17:00	10:00 on 12/15/13
OP#4 Action 1	17:00	21:30
OP#4 Action 2	17:07	20:45
OP#4 Action 5	17:40	18:30

Post Winter 2013/14 Review

Winter Reliability Program DR Assets Dispatched Performance Across Entire Dispatch – cont'd

Duration of the December 14th, 2013 Real Time Event (Local Time)		MW Dispatched	Initial Performance (net of performance allocated to coincident OP4 Dispatch)	Percent Performance vs. Dispatch
Start Time (after 30 minute ramp)	End Time			
5:35 PM	9:50 PM	21	30.975	147.5%

Post Winter 2013/14 Review

RTDR Performance under Action #2 of OP #4 on December 14th, 2013 (includes Winter Reliability Program Assets)

Including all Intervals of Dispatch (17:40 to 20:50)

Load Zones	Dispatched MW (Net CSO)	Initial Performance (MW)	Percentage of Initial Performance to Dispatched MW
CT	52.1	19.3	37.0%
ME	126.9	133.5	105.2%
NEMA	3.5	1.6	44.0%
NH	3.2	1.4	45.1%
RI	10.2	6.1	59.6%
SEMA	7.0	0.3	3.9%
VT	25.9	23.2	89.5%
WCMA	19.0	6.0	31.8%
Total	247.8	191.3	77.2%

SYSTEM OPERATIONS – DECEMBER 2013

System Operations – December 2013

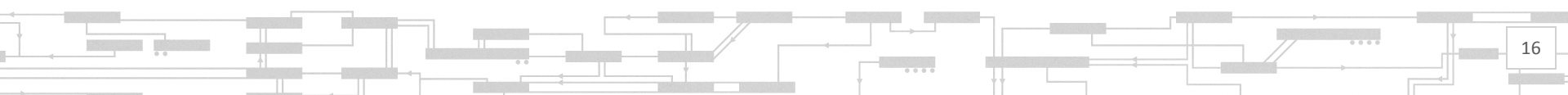
<u>Weather Patterns</u>	Boston	Temperature – Below Average (-2.2) Max 57, Min 9 Precipitation 4.55” (Liquid) Above Average Normal 3.73”	Hartford	Temperature – Below Average (-1.3) Max 65, Min 5 Precipitation 2.72” (Liquid) – Below Average Normal = 4.03”
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<u>Peak Load:</u>	21,514 MW	December 17, 2013	18:00
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<u>MLCC2:</u>			
12/12/13	08:30 – 21:00	All of New England	Capacity Deficiency
12/14/13 – 12/15/13	17:00 – 10:00	All of New England	Capacity Deficiency
12/17/13	10:30 – 21:30	All of New England	Capacity Deficiency

<u>OP-4 :</u>			
12/14/13	16:48 – 20:45	All of New England	Capacity Deficiency Steps 1,2, and 5

<u>NPCC Simultaneous Activation of Reserve Events:</u>			
12/02/2013		NYISO	501 MW
12/12/2013		ISO-NE	790 MW
12/15/2013		ISO-NE	518 MW
12/23/2013		NYISO	520 MW



System Operations – December 2013 - cont'd

Minimum Generation Warnings & Events:

Minimum Generation Warning	12/01/13 – 12/02/13	Start-23:00, Expired-06:00 Interchange Cuts Only
Minimum Generation Warning	12/03/13	Start-00:01 Expired-06:00 No Actions Taken
Minimum Generation Warning	12/06/13	Start-00:01, Expired-06:00 Interchange Cuts Only
Minimum Generation Warning	12/08/13	Start- 06:00, Expired-09:00 SS Denied Only
Minimum Generation Warning	12/21/13	Start – 13:00, Expired – 17:00 Interchange Cuts Only
Minimum Generation Warning	12/21/13 – 12/22/13	Start – 22:00, Expired – 10:00 Interchange Cuts Only
Minimum Generation <u>Event</u>	12/21/13 – 12/22/13	Start-23:00, Expired-05:00 Interchange Cuts Only
Minimum Generation Warning	12/22/13 – 12/23/13	Star-22:00 , Expired-09:00 Interchange Cuts & SS Denied
Minimum Generation Warning	12/23/13	Start-21:00, Expired–23:59 No Actions Taken
Minimum Generation Warning	12/24/13	Start-00:01, Expired-08:00 Interchange Cuts & SS Denied
Minimum Generation <u>Event</u>	12/24/13	Start-01:30, Expired-05:00 Interchange Cuts Only

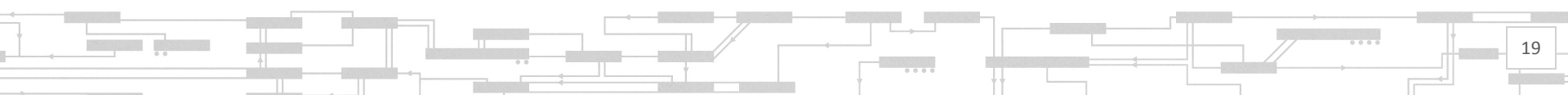
System Operations – December 2013 - cont'd

Minimum Generation Warnings & Events:

Minimum Generation Warning	12/26/13	Start-03:00, Expired-06:00 No Actions Taken
Minimum Generation Warning	12/30/13	Start- 01:00, Expired-08:00 Interchange Cuts Only
Minimum Generation <u>Event</u>	12/30/13	Start – 02:00, Expired – 06:00 Interchange Cuts Only



January 2014 – Operations Review



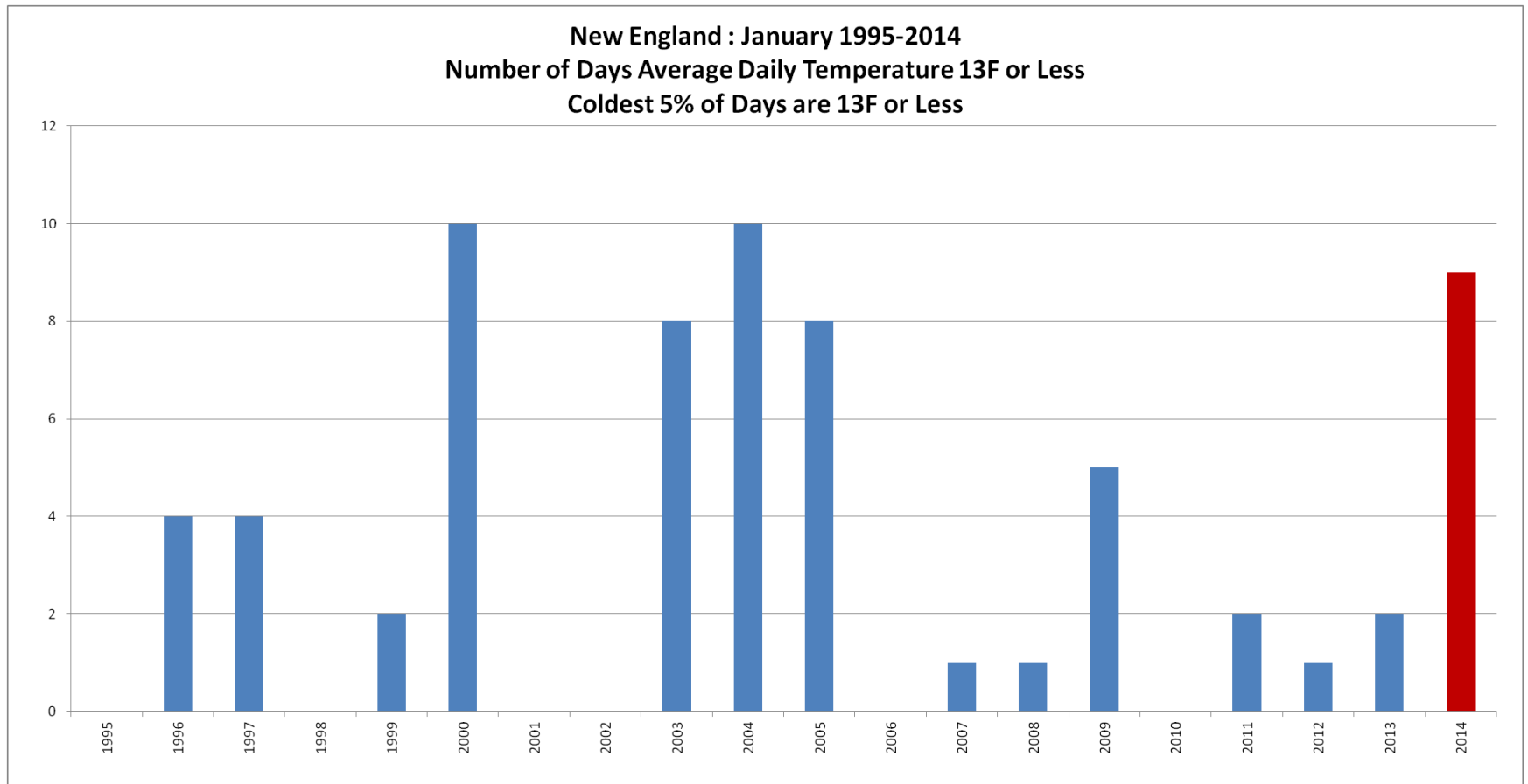
Post Winter 2013/14 Review

Cold Weather – January 2014

- Temperatures were below average for the month
- Three distinct weather periods
 - January 1 – 10 was unusually cold
 - January 11 – 20 was mild
 - January 21 – 28 was unusually cold again
- Ranks among the coldest months in recent history
 - 9 days in January 2014 were in the coldest 5% of days over the past 20 years

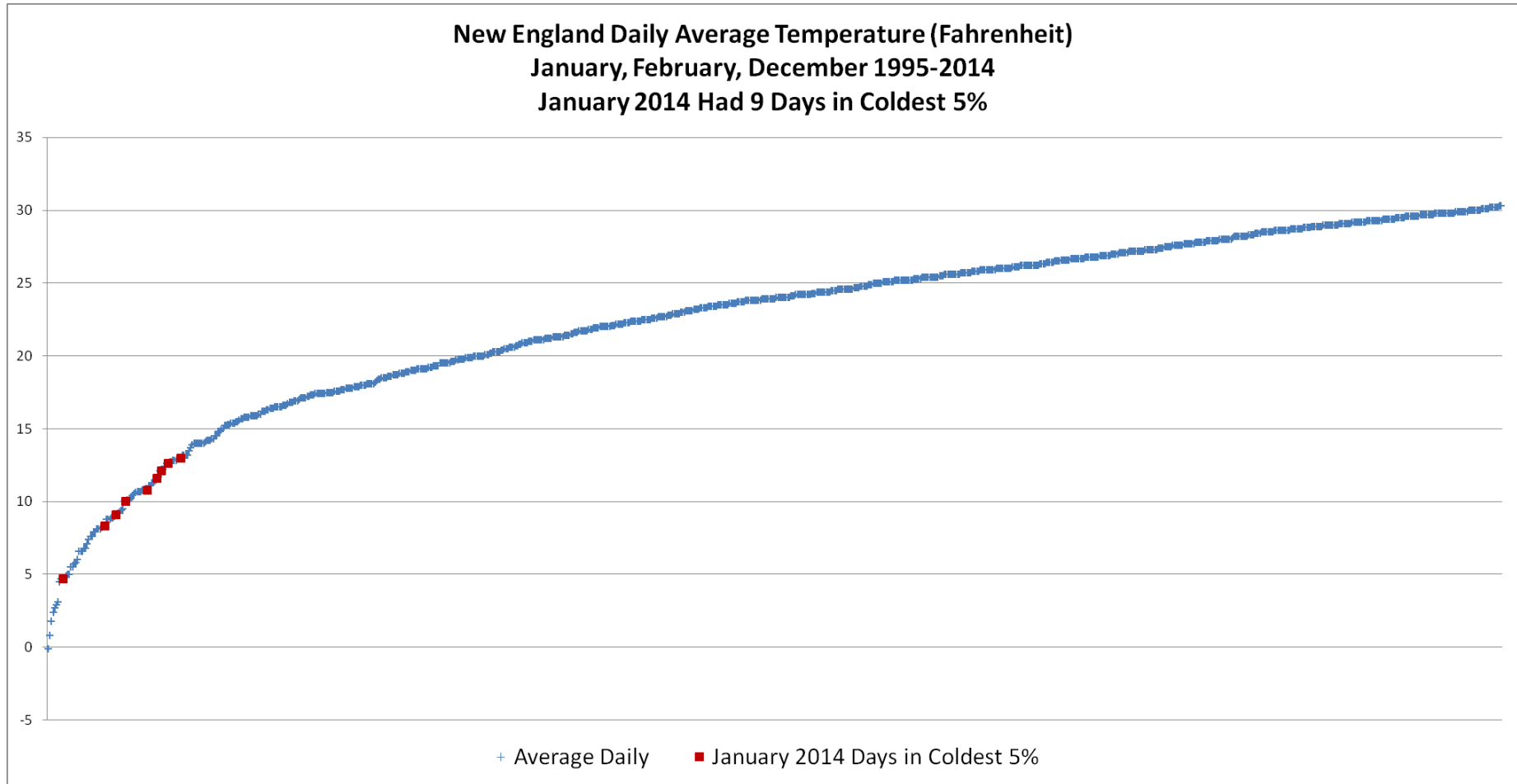
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January Temperature by Year



Post Winter 2013/14 Review

New England Daily Average Temperatures



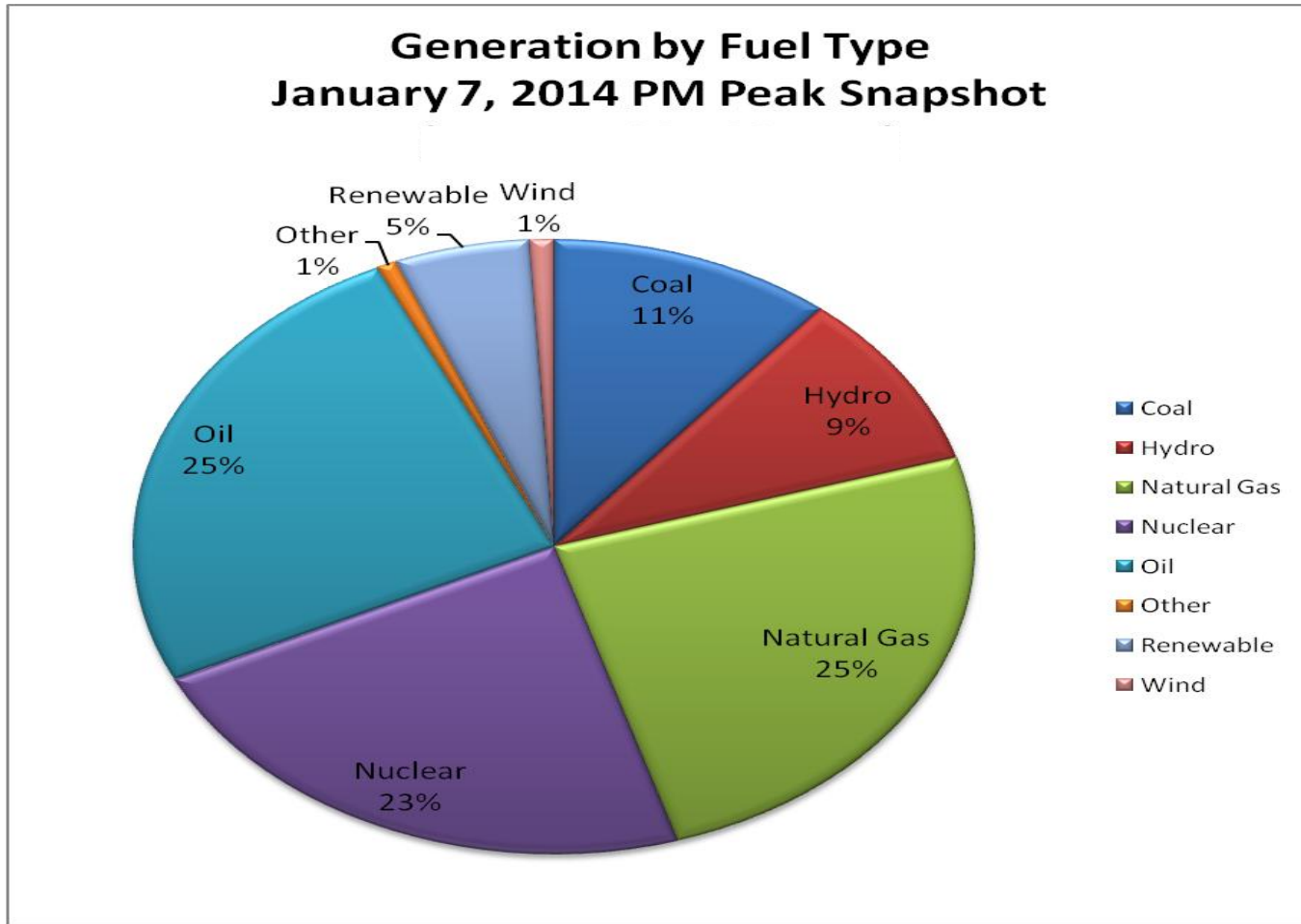
Post Winter 2013/14 Review

New England Fuel Mix

- Gas and fuel oil price inversion has led to oil being in economic merit and thus base loaded
 - When temperatures fall and gas prices increase above that of oil, oil units are committed ahead of gas units
- The following graphs shows that trend
 - Daily fuel mix (on-peak) on January 7, 2014
 - Cumulative monthly energy for January 2014 - the total percent of energy (MWh) generated by each fuel
- Significant use of coal and oil during the month

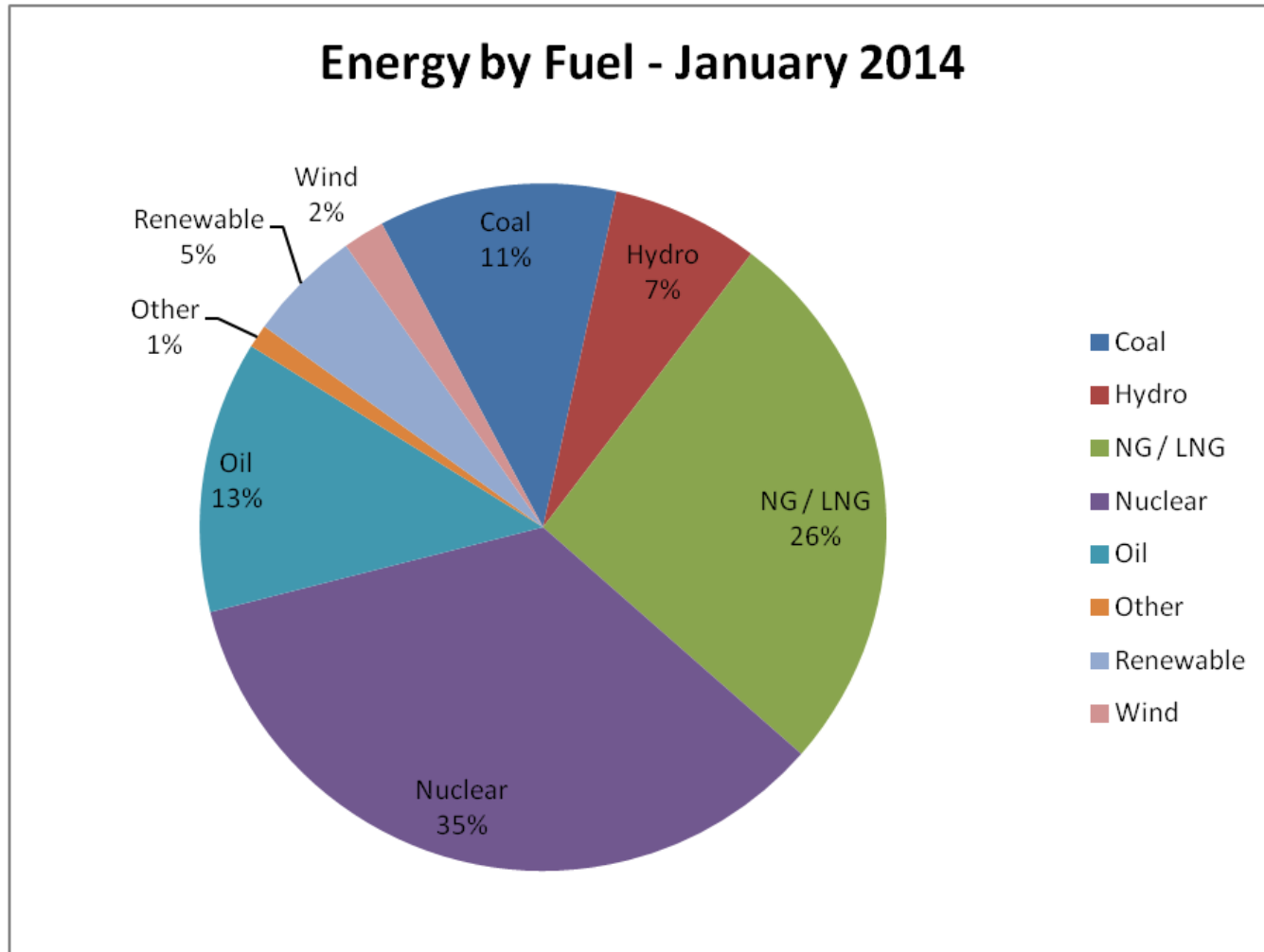
Post Winter 2013/14 Review

January 7, 2014 Peak Snapshot



Post Winter 2013/14 Review

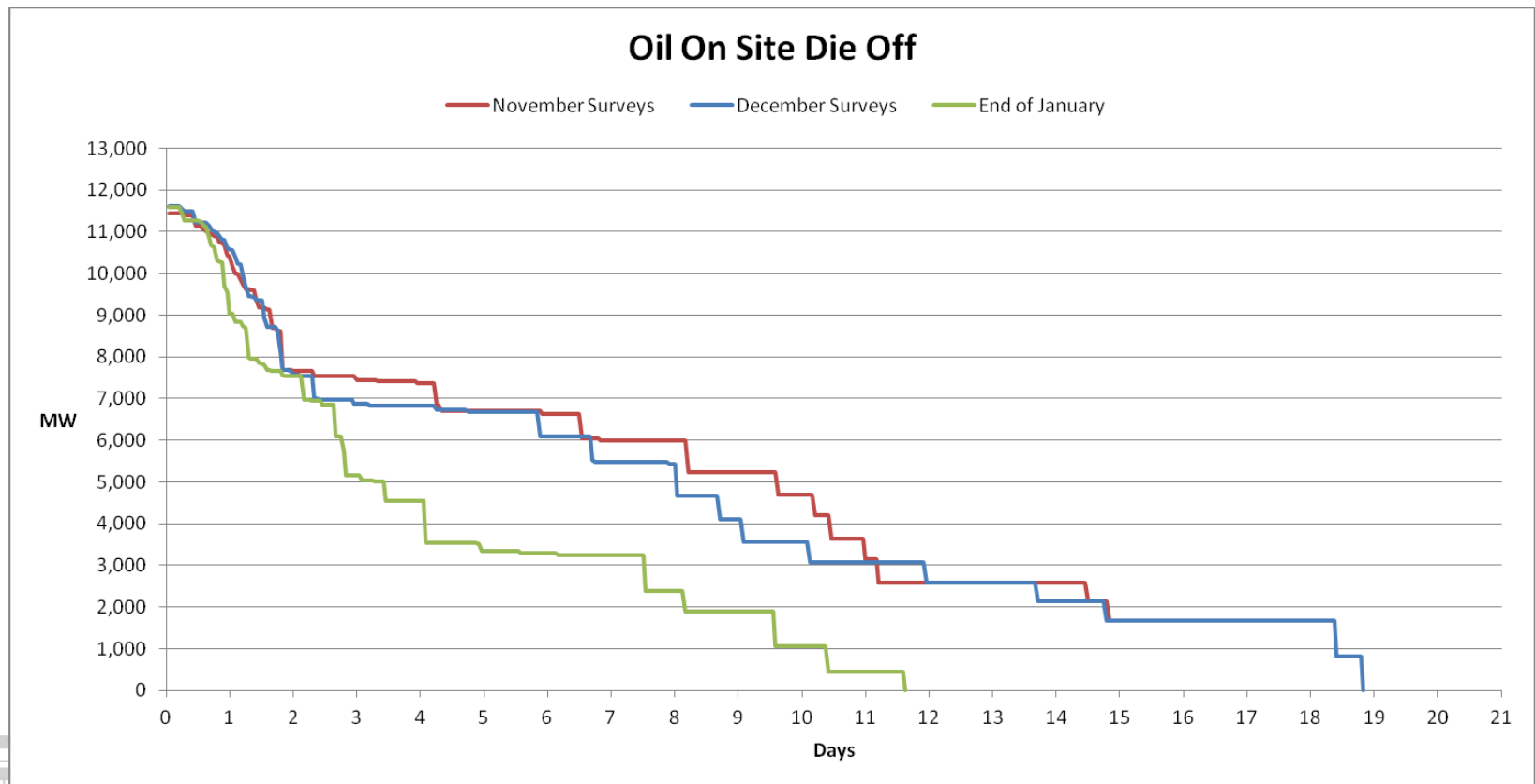
Cumulative Energy by Fuel Type – January 2014



Post Winter 2013/14 Review

Oil Inventory

- Using on-site oil, inventories will diminish substantially in 3 days without replenishment
 - Oil inventories are depleting through the winter
 - Heaviest burn in January



Post Winter 2013/14 Review

Oil Supply Replenishment Concerns

- Oil replenishment is challenging during cold weather and, in addition to New England, was experienced in other regions as well
- Oil Transportation
 - Great difficulty securing barge transportation
 - Throughout the northeast, barge transportation is slowed/limited due to maritime weather and ability to transport through shallow areas
 - Many entities competing for the same barges
 - Other transportation issues
 - Locating trucks, especially to transport No.6
 - Limited hours for truck drivers
- Oil Availability
 - Increased demand for both heating and power sectors
 - Moving heavy residual oil (No.6) is difficult in cold weather
 - No.6 is not readily available on short notice
- Environmental concerns for several units due to extensive runs on oil



Post Winter 2013/14 Review

ISO-NE Fuel Surveys

- To increase situational awareness, ISO-NE initiated daily fuel surveys in the second half of January 2014
- New daily fuel surveys
 - Usable oil inventory
 - Plans for refueling
 - Replenishment strategies
 - Procurement and transportation issues
- Twice weekly beginning on February 3, 2014 on Monday and Thursday of each week

Post Winter 2013/14 Review

Commitment Challenges

- Virtually the entire non-nuclear and coal fleet has become “*limited energy generation*” – which distorts market efficiency and causes unpredictable commitment and dispatch patterns
 - It is very difficult to maintain a security constrained economic dispatch when a large portion of the generator fleet is managing a limited ‘fuel inventory’
 - This issue has posed the biggest challenge over the past month
- Outages and Uncertainty
 - Additional commitments required due to uncertainty of generators returning from outages (example: ~ 700 MWs of generation experienced forced outages on January 21st evening and had to be replaced, but were back in service the next day)
 - Under such scenarios, the system is likely to have a larger surplus than otherwise planned
- Over the past year, due to the tight gas supply conditions, ISO-NE implemented operating procedures that eliminate cancellation of gas starts (except for reliability reasons)
 - While providing benefits to the system, this limits operators ability to reduce surplus intra-day

Post Winter 2013/14 Review

Commitment Challenges – cont'd

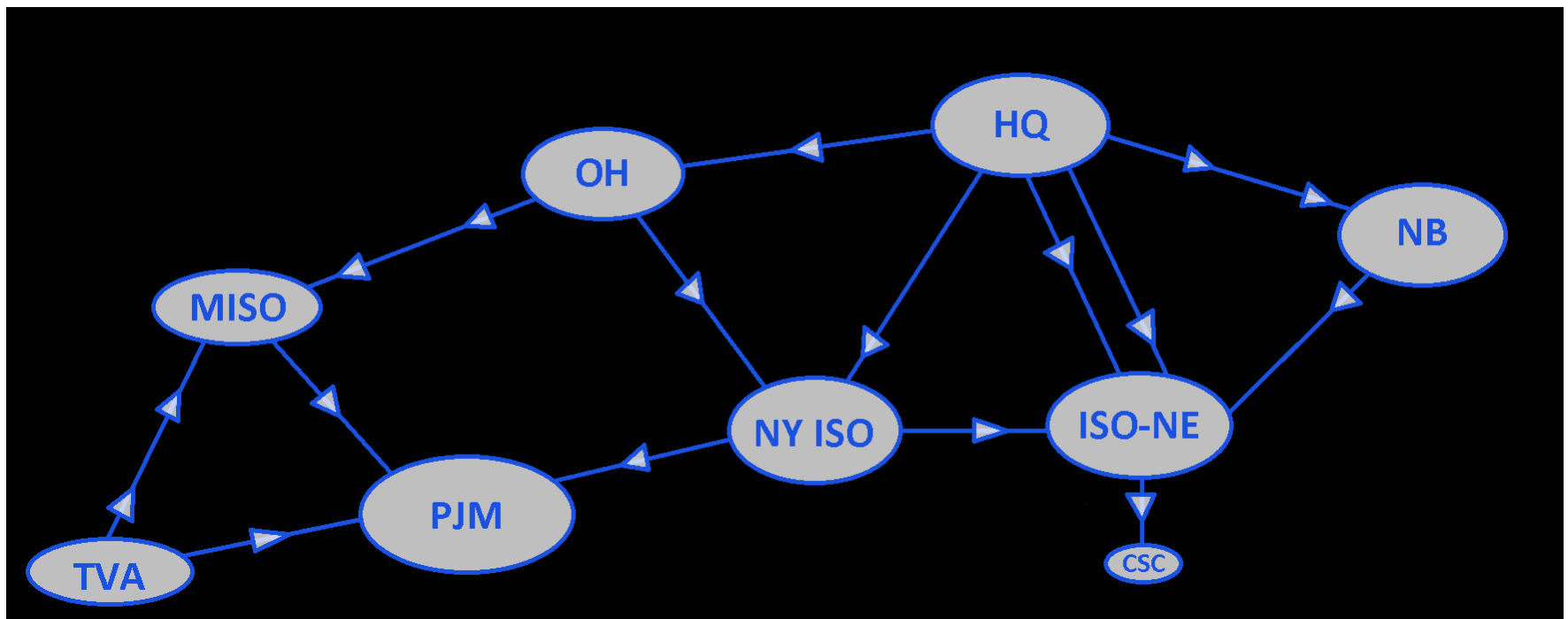
- Generators are committed based on forecast interchange and changes from Day Ahead to Real Time can cause excess generation or generation deficiencies depending on the condition within the external area
 - Additional imports can cause New England generation to be dispatched down, in many cases to Economic Minimum
 - Generators at Economic Minimum receive payments via uplift
 - Even if generators are marginal, they can receive significant uplift via start-up and no-load costs
- Example: On January 23, 2014, across two of the interfaces, the Day Ahead market cleared ~1,200 MW of imports, but in Real Time, the imports were ~2,000 MW



Post Winter 2013/14 Review

Commitment Challenges – cont'd

- Conditions outside New England can also significantly affect New England
 - Energy is being imported to New England from external areas beyond the neighboring control areas
 - These imports can be curtailed at any time for contingencies outside of New England



Post Winter 2013/14 Review

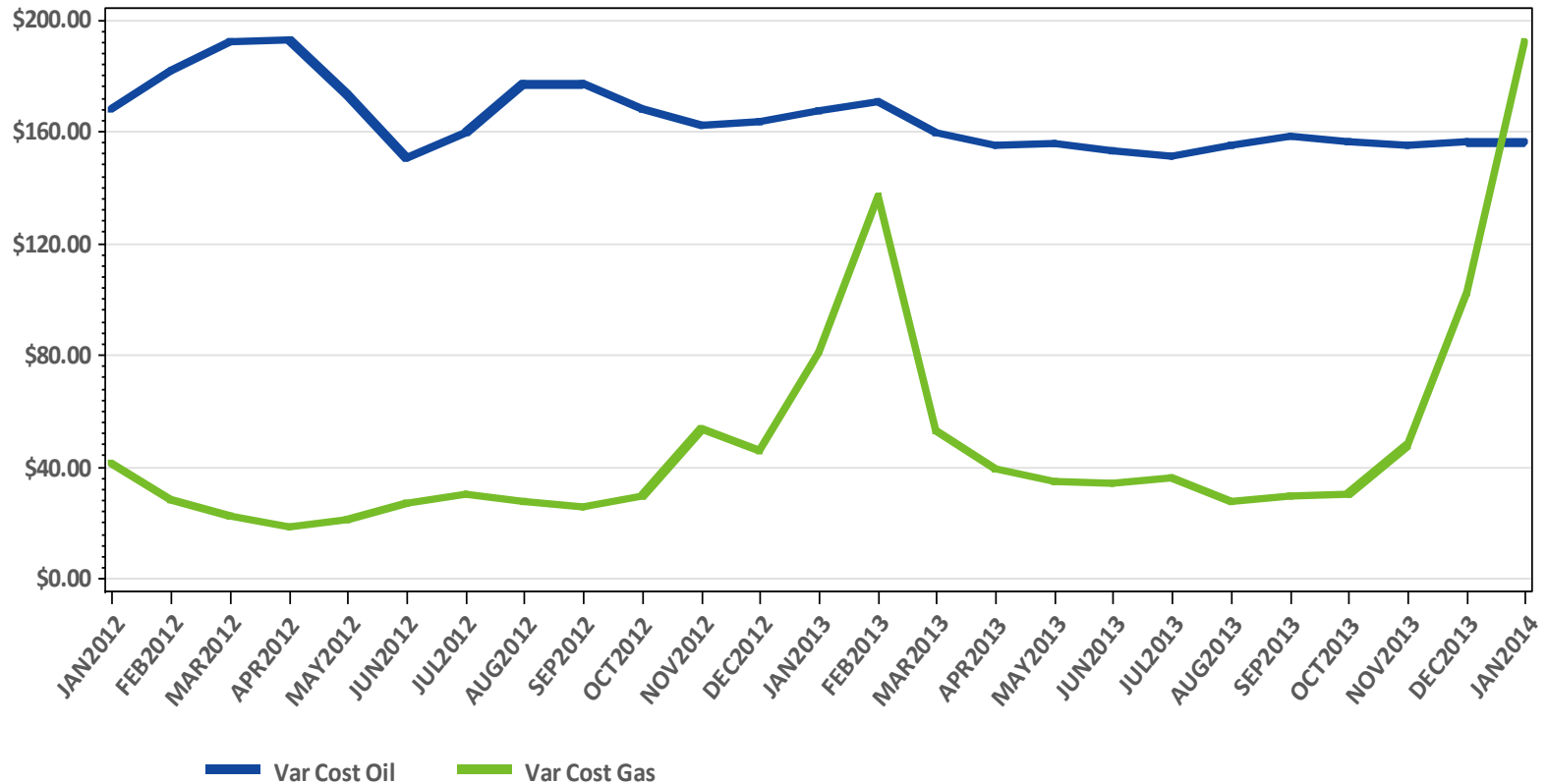
Fuel Price Inversion

- Gas prices have been higher than oil prices on several days in January 2014
 - Oil generators running at full load, even through the night
 - Heavy ICU utilization due to fuel pricing
 - Small on-site storage at ICU stations makes replenishment very difficult when run times are extended
 - During coldest weather days, ISO-NE carries reserves on gas-fired units which stresses the interstate pipelines for non-gas contingencies
- The “limited energy generation” profile identified earlier and significant separated fuel prices lead to more uplift \$\$
 - Significant amounts of uplift generated because gas units have high start-up and no-load costs (further exacerbated by very high gas prices)

Post Winter 2013/14 Review

Variable Production Cost of Fuels - Monthly

Variable Cost Comparison: Oil vs. Gas

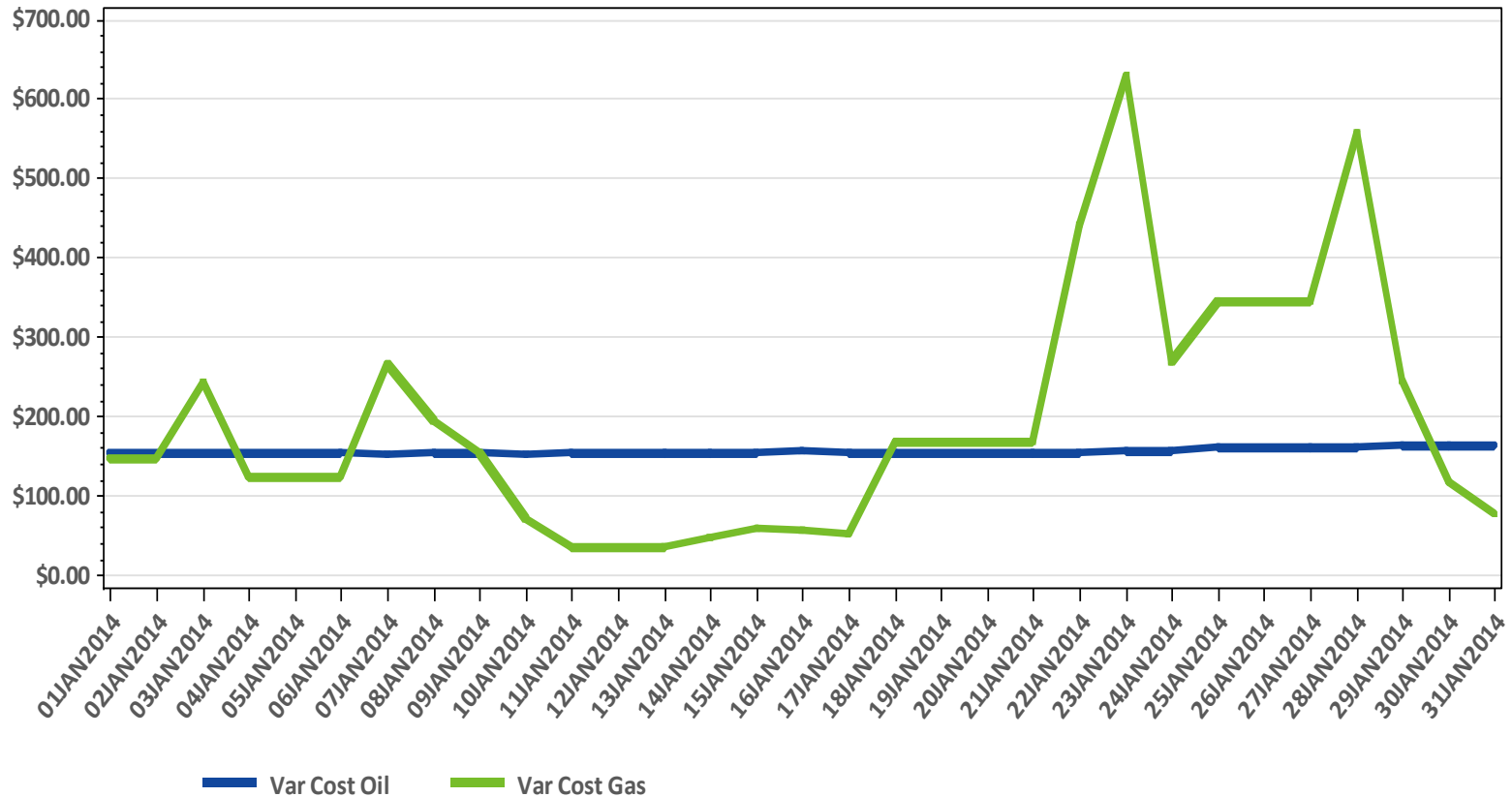


Note: Assumes proxy heat rates of 10,100,000 Btu/MWh for oil and 7,800,000 Btu/MWh for gas units.

Post Winter 2013/14 Review

Variable Production Cost of Fuels - Daily

Variable Cost Comparison: Oil vs. Gas



Note: Assumes proxy heat rates of 10,100,000 Btu/MWh for oil and 7,800,000 Btu/MWh for gas units.

Post Winter 2013/14 Review

ISO-NE Load Forecast Error

- Load forecast error also impacts the commitment and dispatch of generation
- January 2014 has been a cold month - about 2 degrees below normal in both Boston and Hartford
- Average January 2014 forecast error is comparable to other years
 - Average January error from 2002 – 2013 is 1.62%
 - Forecast error for January 2014 is 1.65% (through January 29)
- 50/50 planning forecast for January 2014 peak demand was 21,299 MW and 90/10 forecast was 21,934 MW
- January 22nd and 23rd had higher than normal forecast errors of over 3%, on average for both days (and over 5% for the peak hour)
 - Load forecasting on cold winter days has been challenging
 - Peak load was 21,320 MW which occurred on January 7, 2014

Post Winter 2013/14 Review

Transmission Constraints

- Transmission constraints can prevent the full utilization of portions of the generation fleet
- North-South transmission interface issues constrained several hundred MW of generation north of the Maine – New Hampshire transmission interface
- When NEMA generation is offline, these constraints becomes more severe



Post Winter 2013/14 Review

Other Observations

- The winter reliability program was instrumental in helping maintain system reliability this winter
 - Especially in light of the replenishment challenges that have been identified this winter
- On certain cold days, the pipelines from the north were full, but the system had very few gas-fired generators on-line - so it appears that gas was being consumed by other parties
- ISO-NE will work with the pipelines, LDC's and other parties to better understand the utilization of the gas pipeline from the north



Post Winter 2013/14 Review

Coordinated Communications

- AM and PM conference calls with NPCC Reliability Coordinators to review the following:
 - Expected weather and peak loads for the current day and for the next day
 - Expected capacity surplus above the operating reserve requirements
 - Confirmed expected interchange schedules
 - Conditions of natural gas supply and fuel oil inventory
- Periodic updates with the six Local Control Centers (LCCs) in New England to discuss the following:
 - Expected peak load conditions within New England and known issues with generation units
 - Known concerns with the natural gas interstate pipes
 - Known concerns with fuel oil inventory and transportation limitations
- Regular communication with generators and fuel energy providers in the Northeast to discuss the following:
 - Inventories
 - Fuel delivery system (trucking & barging) limitations



Post Winter 2013/14 Review

Coordinated Communications – cont'd

- Constant communications with the interstate gas pipelines to assess system conditions and ensure reliability of electric and gas systems
- Contacted State of Massachusetts and advised of growing concerns for limited trucking hours
 - Massachusetts Governor subsequently extended trucking hours



SYSTEM OPERATIONS – JANUARY 2014

System Operations – January 2014

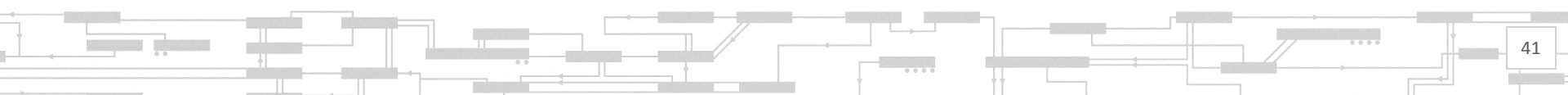
<u>Weather Patterns</u>	Boston	Temperature – Below Average (-2.0) Max 59, Min 2 Precipitation 3.24” (Liquid) Below Average Normal 3.92”	Hartford	Temperature – Below Average (-1.9) Max 59, Min -3.0 Precipitation 2.05” (Liquid) – Below Average Normal = 3.10”
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<u>Peak Load:</u>	21,320 MW	January 7, 2014	19:00
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<u>MLCC2:</u>			
01/02/14 – 01/04/14	15:00 – 19:00	All of New England	Capacity
01/07/14 – 01/08/14	12:00 – 11:00	All of New England	Abnormal Weather Conditions
01/21/14 – 01/24/14	17:00 – 22:00	All of New England	Severe Weather
01/28/14	06:30 – 11:00	All of New England	Capacity

<u>OP-4:</u> None

<u>NPCC Simultaneous Activation of Reserve Events:</u>		
01/06/14	PJM	1,550 MW
01/06/14	NYISO	1,080 MW
01/06/14	PJM	1,600 MW



System Operations – January 2014 – cont'd

NPCC Simultaneous Activation of Reserve Events: (Continued)

01/21/14	PJM	1,600 MW
01/22/14	IESO	800 MW
01/22/14	NYISO	540 MW
01/30/14	IESO	500 MW

Minimum Generation Warnings & Events:

Minimum Generation Warning	01/11/14 – 01/12/14	Start-20:00, Expired-10:00 Interchange Cuts & SS Denied
Minimum Generation <u>Event</u>	01/11/14	Start-22:00 Expired-23:59 Interchange Cuts & SS Denied
Minimum Generation Warning	01/12/14 – 01/13/14	Start-23:00, Expired-07:00 Interchange Cuts Only
Minimum Generation Warning	01/13/14 – 01/14/14	Start- 23:00, Expired-06:00 Interchange Cuts Only



System Operations – January 2014 – cont'd

Minimum Generation Warnings & Events : (Continued)

Minimum Generation <u>Event</u>	01/14/14	Start – 04:30, Expired – 07:00 Interchange Cuts & SS Denied
Minimum Generation Warning	01/14/14 – 01/15/14	Start – 22:00, Expired – 07:00 Interchange Cuts & SS Denied
Minimum Generation <u>Event</u>	01/14/14 – 01/15/14	Start-22:00, Expired-03:00 Interchange Cuts & SS Denied
Minimum Generation Warning	01/15/14	Star-14:00 , Expired-17:00 Interchange Cuts & SS Denied
Minimum Generation Warning	01/15/14 – 01/16/14	Start-23:00, Expired–06:00 No Actions Taken
Minimum Generation Warning	01/17/14 – 01/18/14	Start-22:00, Expired-09:00 Interchange Cuts Only
Minimum Generation <u>Event</u>	01/18/14	Start-00:00, Expired-06:00 Interchange Cuts Only
Minimum Generation Warning	01/19/14 – 01/20/14	Start-23:00, Expired-08:00 Interchange Cuts & SS Denied
Minimum Generation <u>Event</u>	01/20/14	Start- 04:00, Expired-06:00 Interchange Cuts & SS Denied
Minimum Generation Warning	01/21/14	Start – 02:00, Expired – 07:00 Interchange Cuts Only
Minimum Generation <u>Event</u>	01/21/14	Start – 03:30, Expired – 06:00 Interchange Cuts Only

February 2014 - Operations Review

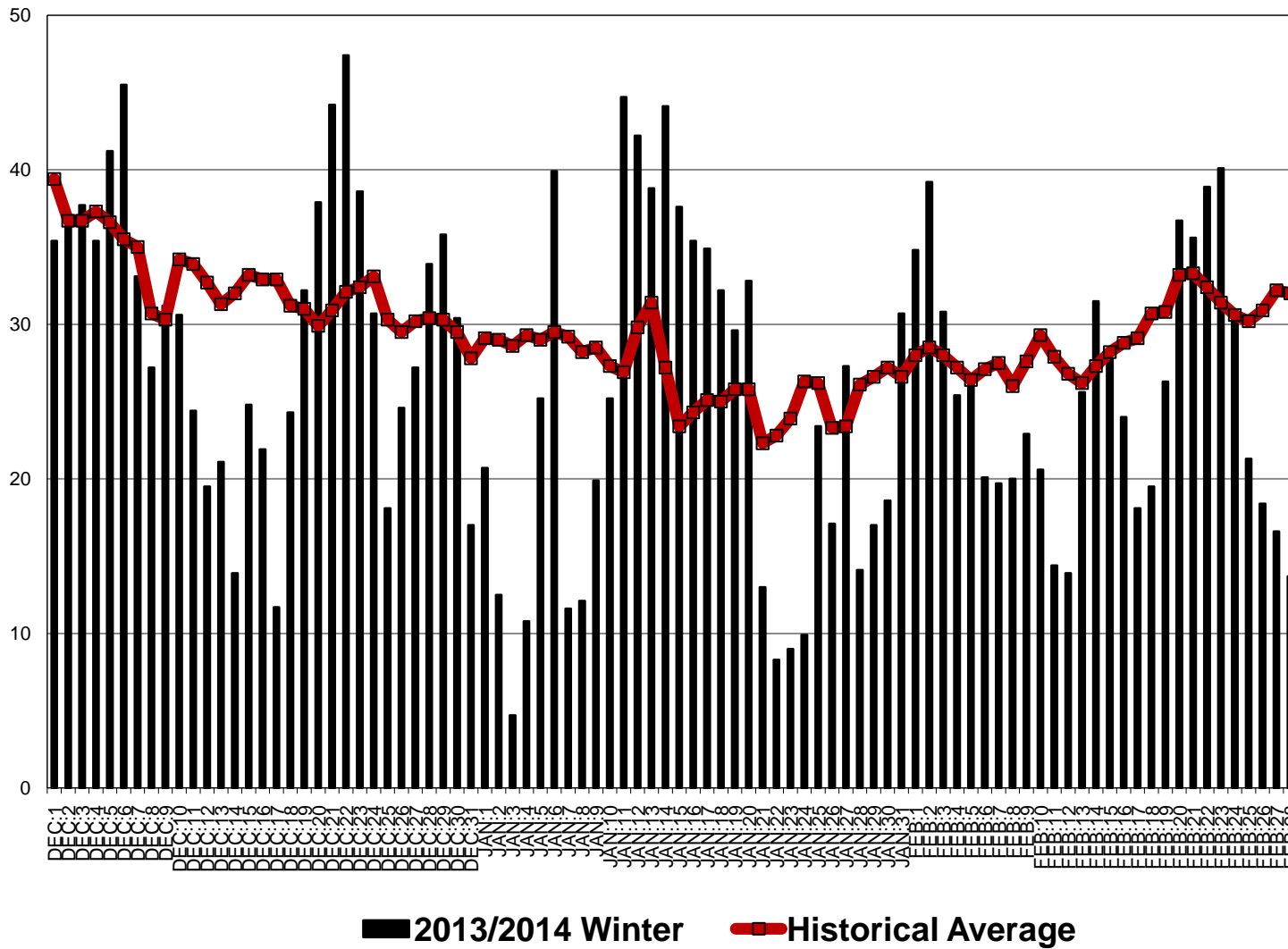


Post Winter 2013/14 Review

- During a number of time periods this winter, daily average temperatures were well below 20 year historical average
 - December 10 - 17
 - January 01 - 10
 - January 21 - 30
 - February 06 - 12
 - February 16 - 19
 - February 25 - 28

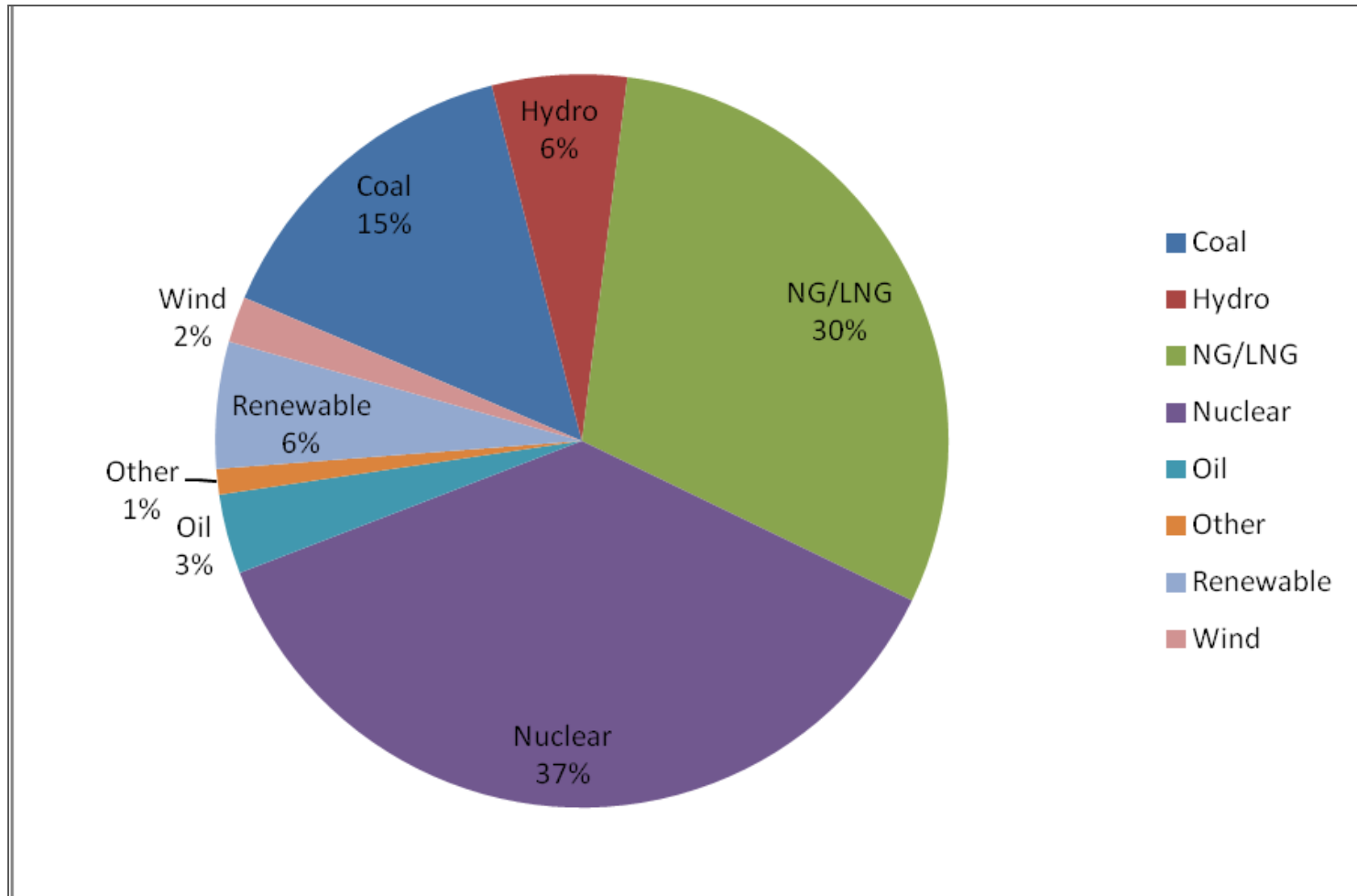


NEW ENGLAND WINTER DAILY AVERAGE TEMPERATURES 2013/2014 WINTER AND 20 YEAR HISTORICAL AVERAGE



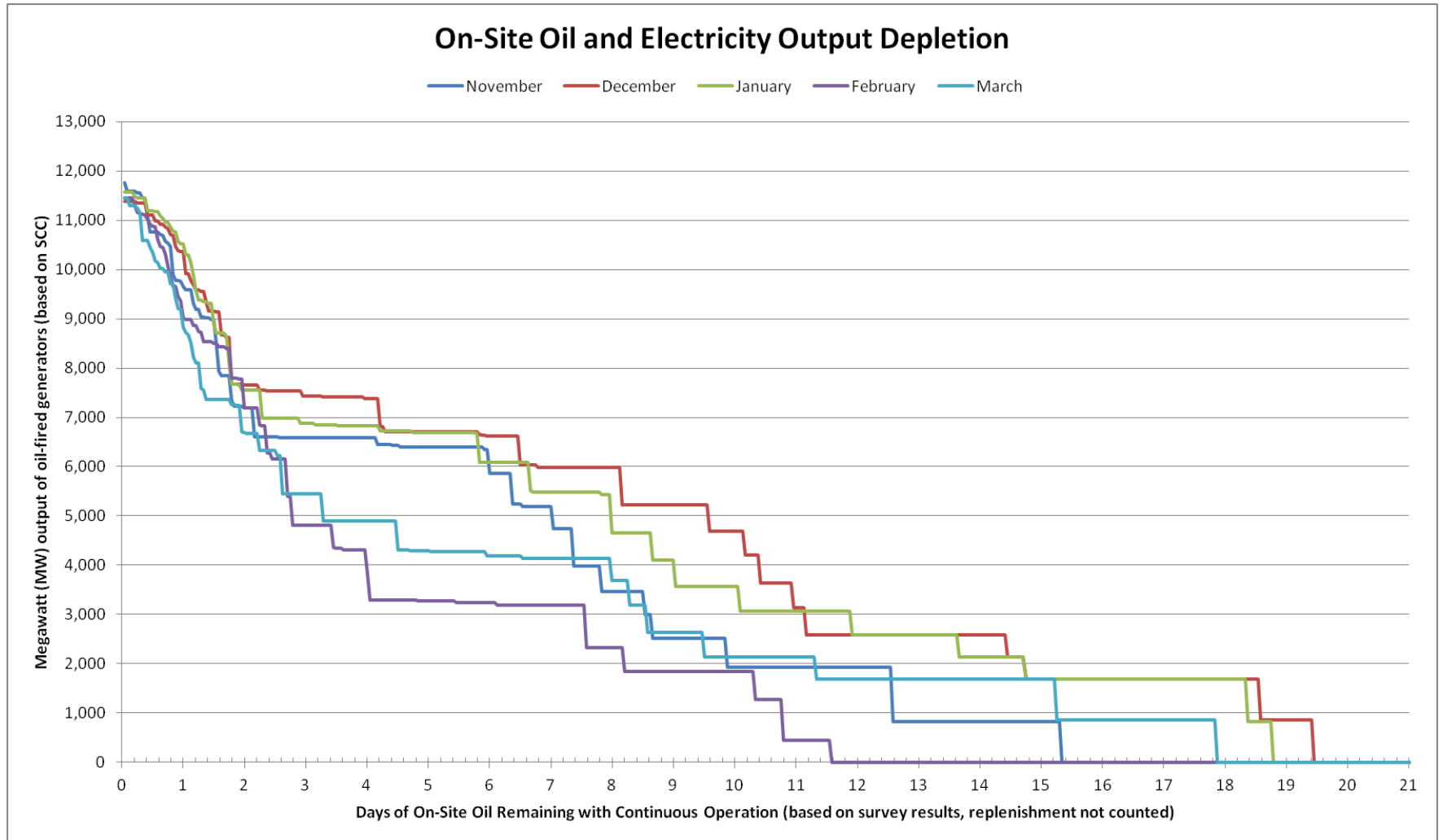
Post Winter 2013/14 Review

Cumulative Energy by Fuel Type – February 2014



Post Winter 2013/14 Review

On-Site Oil and Electricity Output Depletion



Post Winter 2013/14 Review

Fuel Surveys

- To increase situational awareness, the ISO is continuing with its fuel surveys
 - Fuel surveys are being done twice a week
- Oil inventories have improved on most units due to less usage in February and additional fuel deliveries



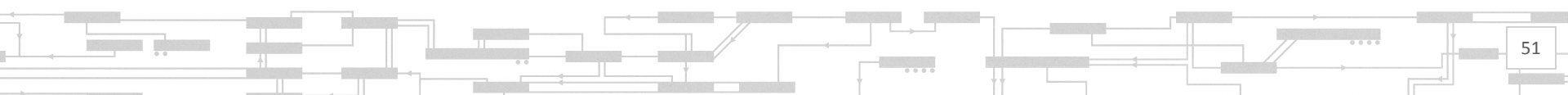
SYSTEM OPERATIONS – FEBRUARY 2014

System Operations – February 2014

<u>Weather Patterns</u>	Boston	Temperature – Below Average (-2.8) Max 55, Min 8 Precipitation 3.41” (Liquid) Above Average Normal 3.30” Snowfall = 25.20”	Hartford	Temperature – Below Average (-5.2) Max 51, Min -4.0 Precipitation 2.67” (Liquid) – Below Average Normal = 2.96” Snowfall = 26.32”
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<u>Peak Load:</u>	19,635 MW	February 11, 2014	19:00
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<u>MLCC2:</u> None		
<u>OP-4:</u> None		
<u>NPCC Simultaneous Activation of Reserve Events:</u>		
02/08/14	NYISO	501 MW
02/12/14	ISO-NE	651 MW
02/26/14	ISO-NE	525 MW
02/27/14	ISO-NE	575 MW



System Operations – February 2014

Minimum Generation Warnings & Events:

Minimum Generation Warning	02/01/14	Start- 01:00, Expired-08:00 Interchange Cuts Only
Minimum Generation Warning	02/01/14	Start- 15:00, Expired-16:00 Interchange Cuts Only
Minimum Generation Warning	02/02/14 – 02/03/14	Start-20:00, Expired-09:00 Interchange Cuts & SS Denied
Minimum Generation <u>Event</u>	02/02/14 – 02/03/14	Start-22:00 Expired-06:00 Interchange Cuts & SS Denied
Minimum Generation Warning	02/03/14	Start- 22:00, Expired-23:59 Interchange Cuts Only
Minimum Generation Warning	02/04/14	Start- 00:01, Expired-06:00 Interchange Cuts Only
Minimum Generation Warning	02/04/14	Start-22:00, Expired–23:59 No Actions Taken
Minimum Generation Warning	02/22/14	Start-16:00, Expired-18:00 Interchange Cuts & SS Denied
Minimum Generation Warning	02/22/14 - 02/23/14	Start- 22:00, Expired-10:00 Interchange Cuts Only
Minimum Generation Warning	02/24/14	Start- 00:01, Expired-07:00 Interchange Cuts Only
Minimum Generation <u>Event</u>	02/24/14	Start- 01:00, Expired-05:00 Interchange Cuts Only

Questions

