ISO New England Operational and Market Update
December 2017-January 2018 Cold Weather Conditions

Compiled by ISO New England, External Affairs
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This update provides snapshots of several aspects of weather, power system, and market conditions in New England for the December/January timeframe, including: cold weather conditions; temperature data; peak demand relative to the forecast for the winter season; system operating conditions; the mix of fuels used for power generation; the relative price of fuels within New England; day-ahead, forecasted and actual loads; and preliminary wholesale market cost implications.

Background on Cold Weather and Operating Conditions in New England

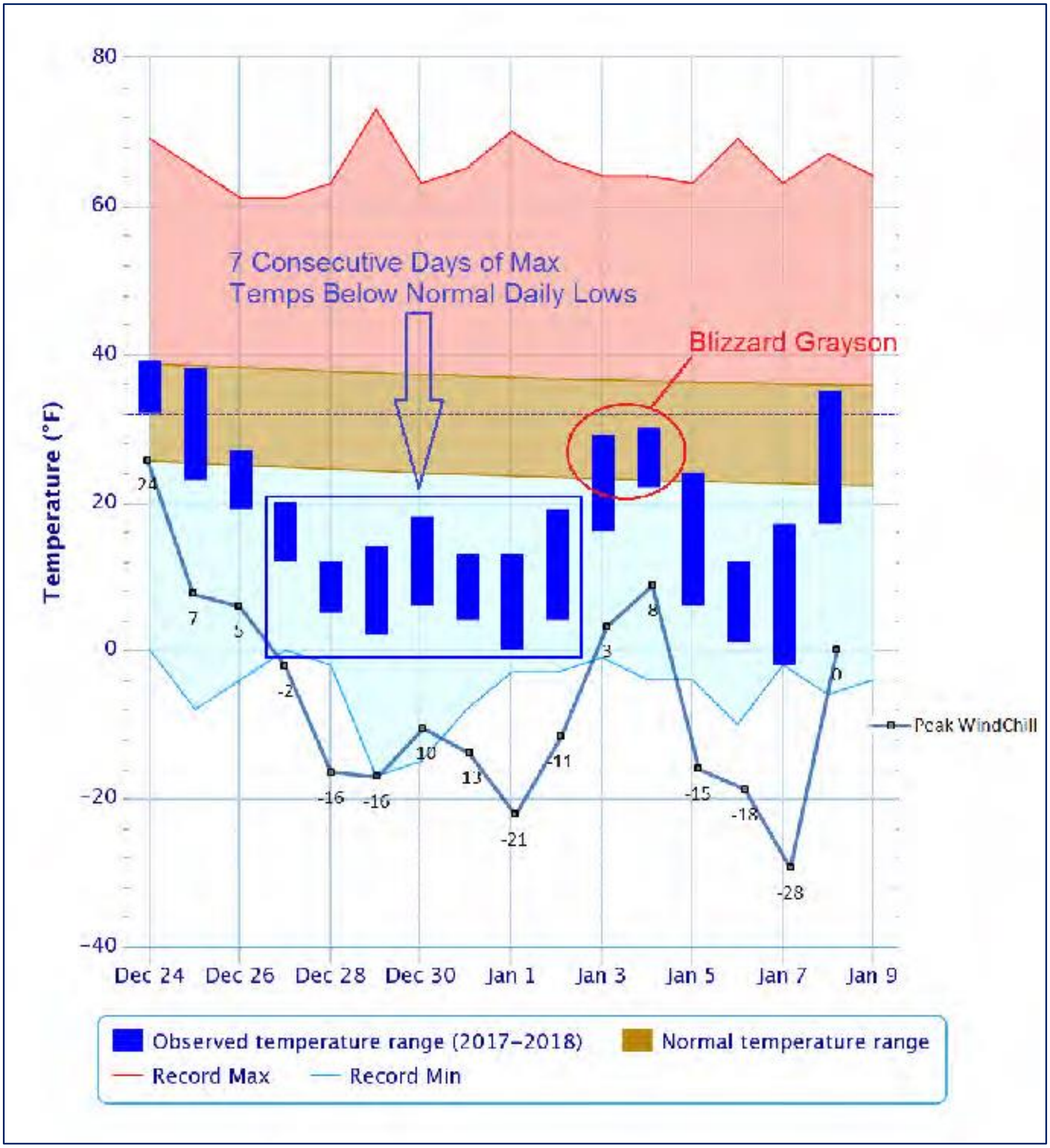
Cold Weather Conditions

For more than a week, including the weeks beginning December 25, 2017 and January 1, 2018, the six New England states experienced unrelenting cold weather conditions and, in many cases, sub-zero temperatures. On January 1, for example, the high temperature in Boston—one of the region's major load centers—was about 11°F during the peak load hour. The following day, January 2, Boston saw a high temperature of 18°F with a significant wind chill factor.

On January 3, a National Weather Service Hazardous Weather Outlook and a Winter Storm Warning were in effect for much of the Northeast, and a Coastal Flood Warning was in effect for eastern Massachusetts. The region saw a foot or more of snow and flash flooding in eastern Massachusetts on Thursday, January 4. After the storm cleared out, bitter cold temperatures returned on Friday, January 5 and persisted through the weekend across New England.

See Figure 1 for daily temperature data in Boston for December 24, 2017 through January 8, 2018. An arctic air-mass arrived on December 26 and brought one of the most extreme cold waves in 100 years. Boston saw seven consecutive days with daily *maximum* temperatures below the normal low for the date. The city saw 15 consecutive days with *minimum* temperatures below the normal low for the date. A powerful blizzard (Grayson) briefly moderated temperatures on January 3 and 4, but dropped more than a foot of snow on Boston, with bitter cold temperatures returning on January 5. Winds were frequently stronger than average during the outbreak, which caused extended periods of frigid wind chill temperatures.

Figure 1: Daily Temperature Data for Boston, Massachusetts
December 24, 2017 – January 8, 2018



Peak Demand Forecast
In its November 30, 2017 Winter Outlook press release, ISO New England stated that its peak demand forecast, under normal winter temperatures of about 7°F, was expected to be 21,197 MW. Extreme winter weather of 2°F could result in a peak demand of 21,895 MW, according to the Outlook.

On Monday, January 1, the peak demand for electricity in New England was 20,297 MW, and on Tuesday, January 2, the peak demand for electricity was 20,620 MW. The peak demand for electricity in New England on Saturday, January 6 and Sunday, January 7 was 20,340 MW and 20,186 MW, respectively. These two days rank in the top ten for highest peak demand on a weekend day. [Note: Peak demand data for January 2018 is preliminary and subject to resettlement.]

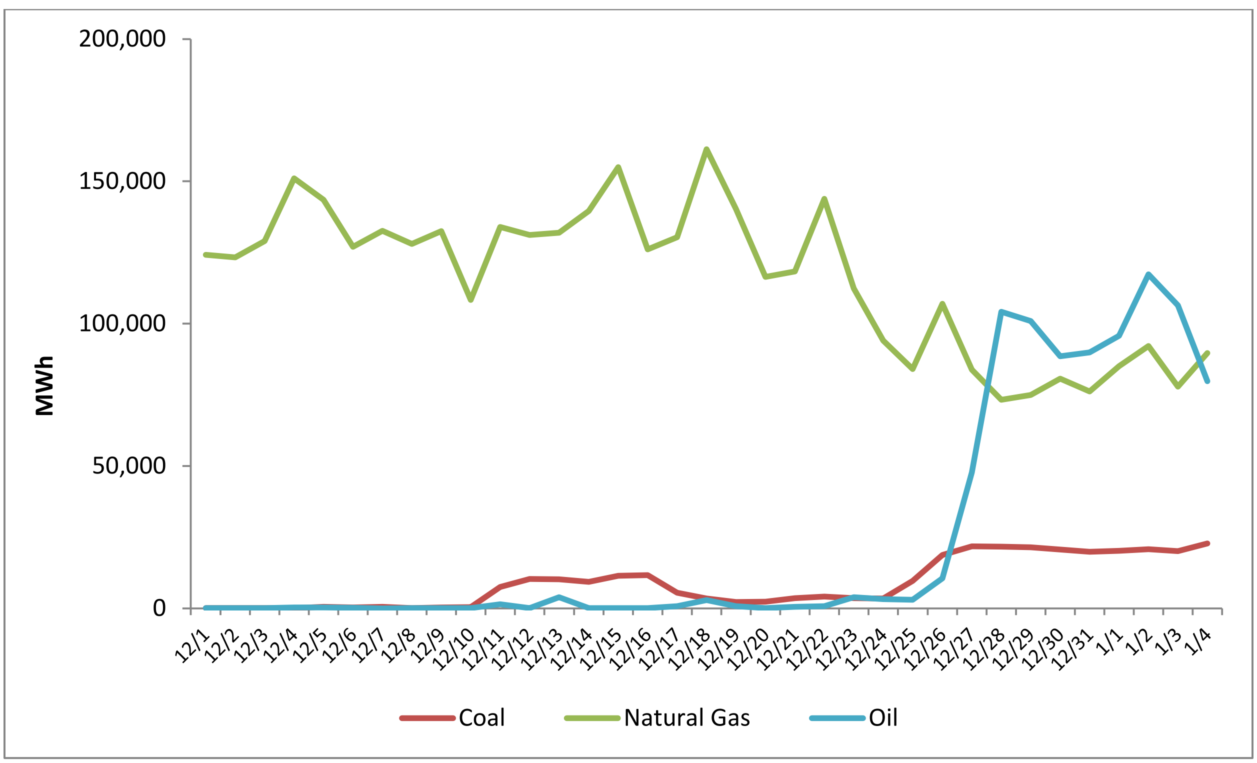
Operating Conditions

The New England power system operated under normal conditions for most of the extended arctic outbreak. However, the cold weather had a significant effect on wholesale energy prices as well as operations, particularly the types of power plants that were being used to meet the demand for electricity.

As a precautionary measure, the ISO issued an abnormal conditions alert under Master/Local Control Center No. 2 (M/LCC 2) on January 3 at 4 p.m. in light of the impending winter storm as well as the forecasted extreme cold after the storm and continued concerns about fuel supplies and unexpected outages. M/LCC2 is an operating procedure issued when an abnormal condition exists or is anticipated. When market participants receive an M/LCC 2 alert, they are expected to cease any routine maintenance, construction, or test activities on their equipment that could jeopardize the reliability of the power system. The ISO canceled the M/LCC2 alert on January 9 at 12 p.m.

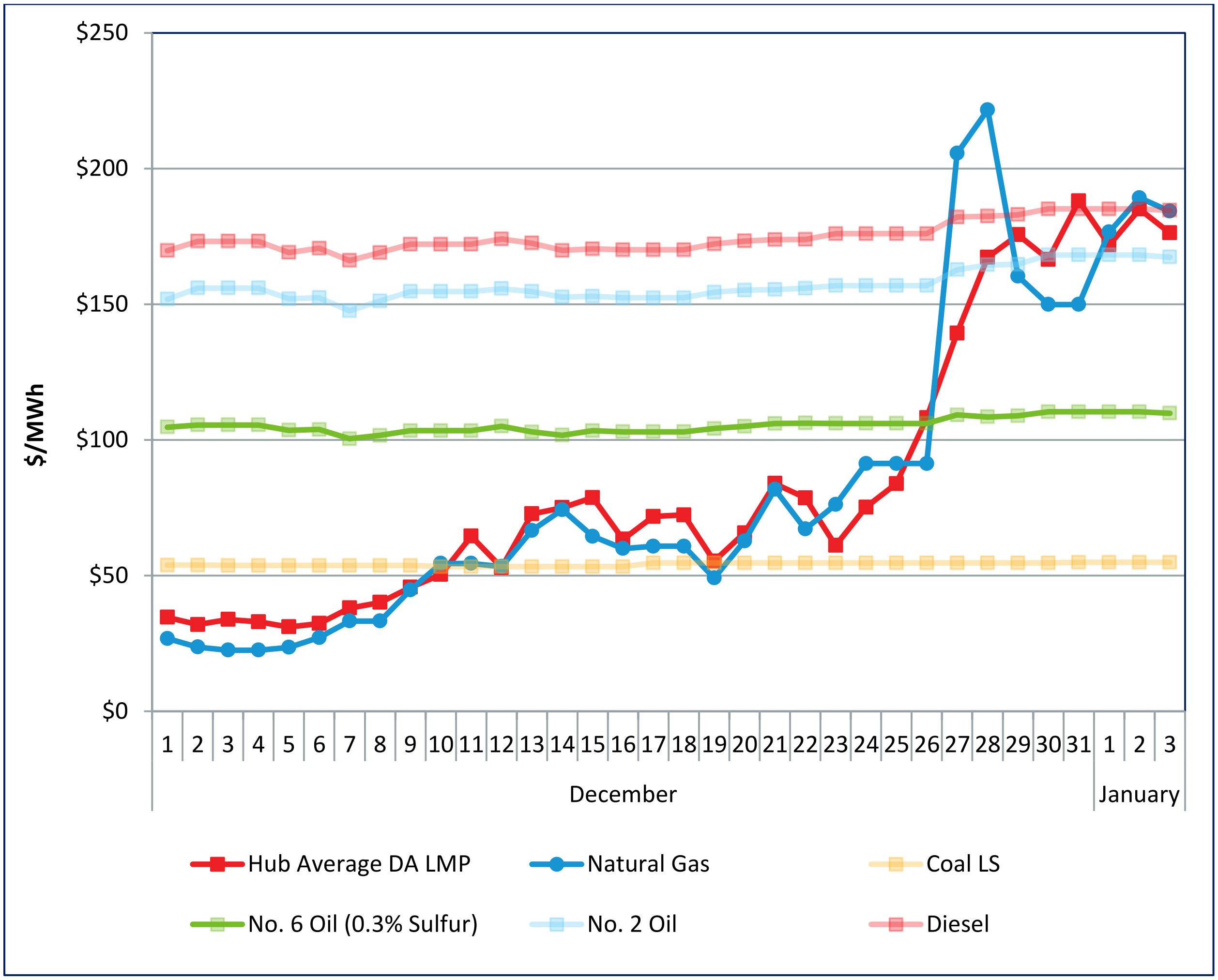
The amount of electricity generated from natural gas declined significantly at the end of December as temperatures plunged, and most available pipeline capacity was used to serve firm local gas distribution company (LDC) demand for heating customers. Oil-fired generation increased sharply during the same period, surpassing gas-fired generation on December 28. See Figure 2.

Figure 2: Daily Generation by Fuel Type



High demand for natural gas for heating caused natural gas pipeline constraints that resulted in high natural gas prices. As a consequence, the price of generators burning natural gas rose higher than the price of generators burning oil or coal, and so a significant portion of the region's electricity was generated by power plants that use oil. See Figure 3 for average daily fuel prices of natural gas, coal, No. 6 oil, No. 2 oil, and diesel, relative to average Day-Ahead energy market prices at the New England hub.

Figure 3: Average Daily Fuel Prices in New England Relative to Average Day-Ahead Energy Prices



Note: Weighted natural gas price is a volume-weighted average of the following ICE indices: Algonquin, Algonquin non-G, Portland, Tennessee.

With this price inversion, both oil- and coal-fired power plants were generating at much higher levels than is typical. The high fuel prices pushed up wholesale power prices over the month of December (see Figure 4) and the recent cold snap (see Figure 5). Figure 4 shows average daily prices at the New England hub; Figure 5 shows average hourly prices at the New England hub.

Figure 4: Average Daily Day-Ahead and Real-Time Energy Prices

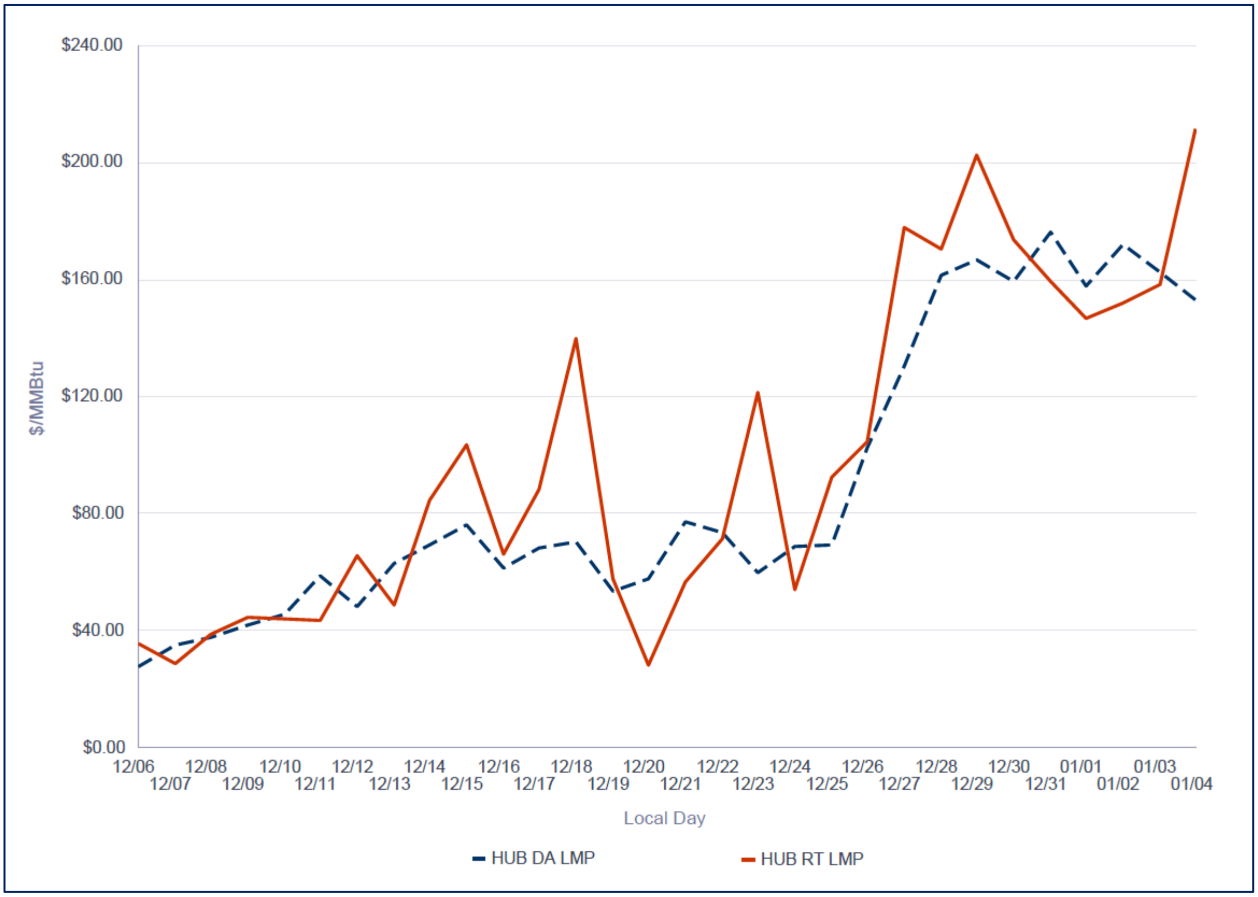
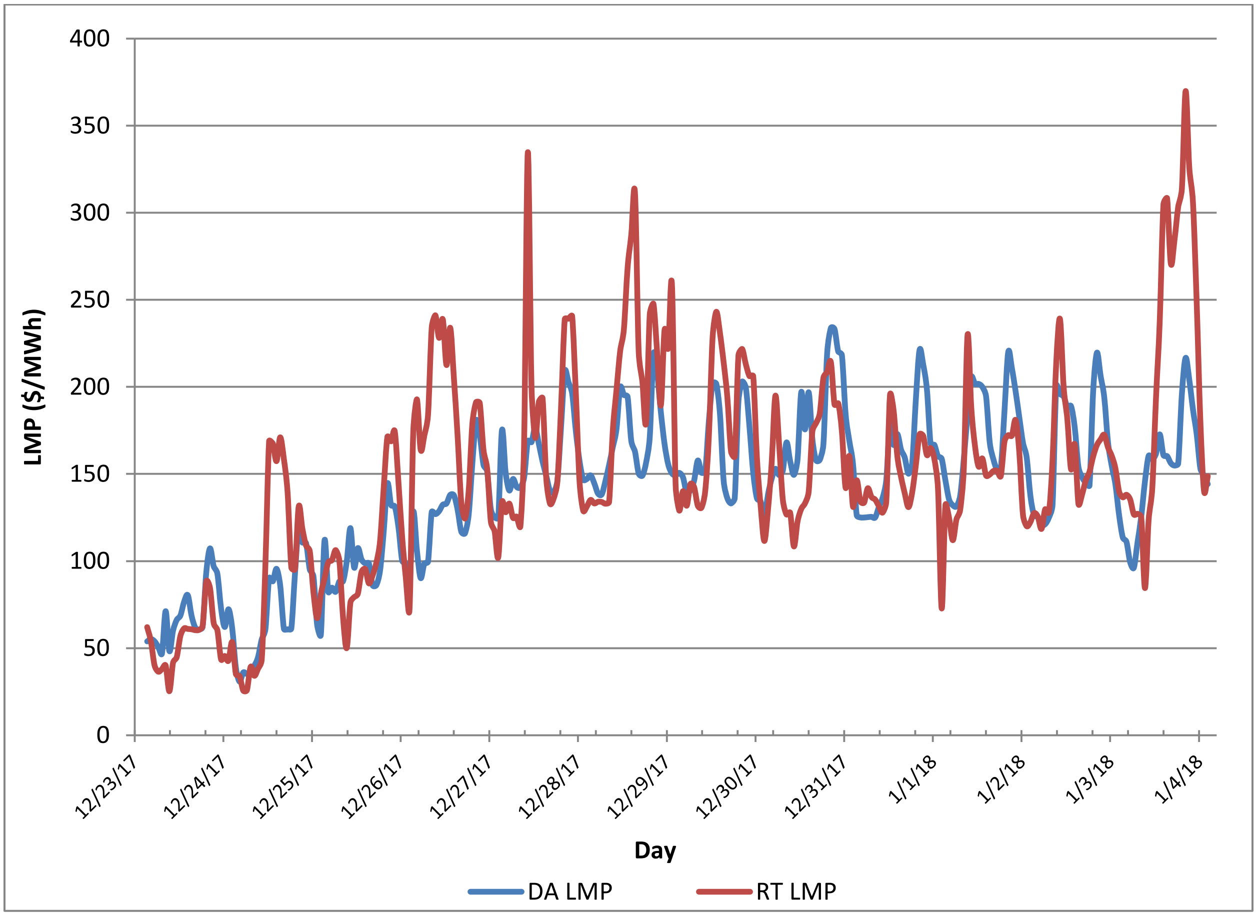


Figure 5: Average Hourly Day-Ahead and Real-Time Energy Prices



The FERC-approved winter reliability program served as a critical support for reliability. The program provides incentives for oil-fired generators to stock up on oil before winter began and to replenish their fuel supplies as necessary prior to March 1. The sustained cold in late December and early January required round-the-clock usage of some of these oil-fired generators and some started running short on fuel. Further, some experienced air emissions limitations.

As oil inventories are depleted, replenishment of these fuels will be important given the uncertainty around weather and future fuel demands for the remaining two months of the winter period. Environmental limitations on how much, or whether, some oil-fired power plants will be able to generate electricity could become a concern for the remainder of the winter as well.

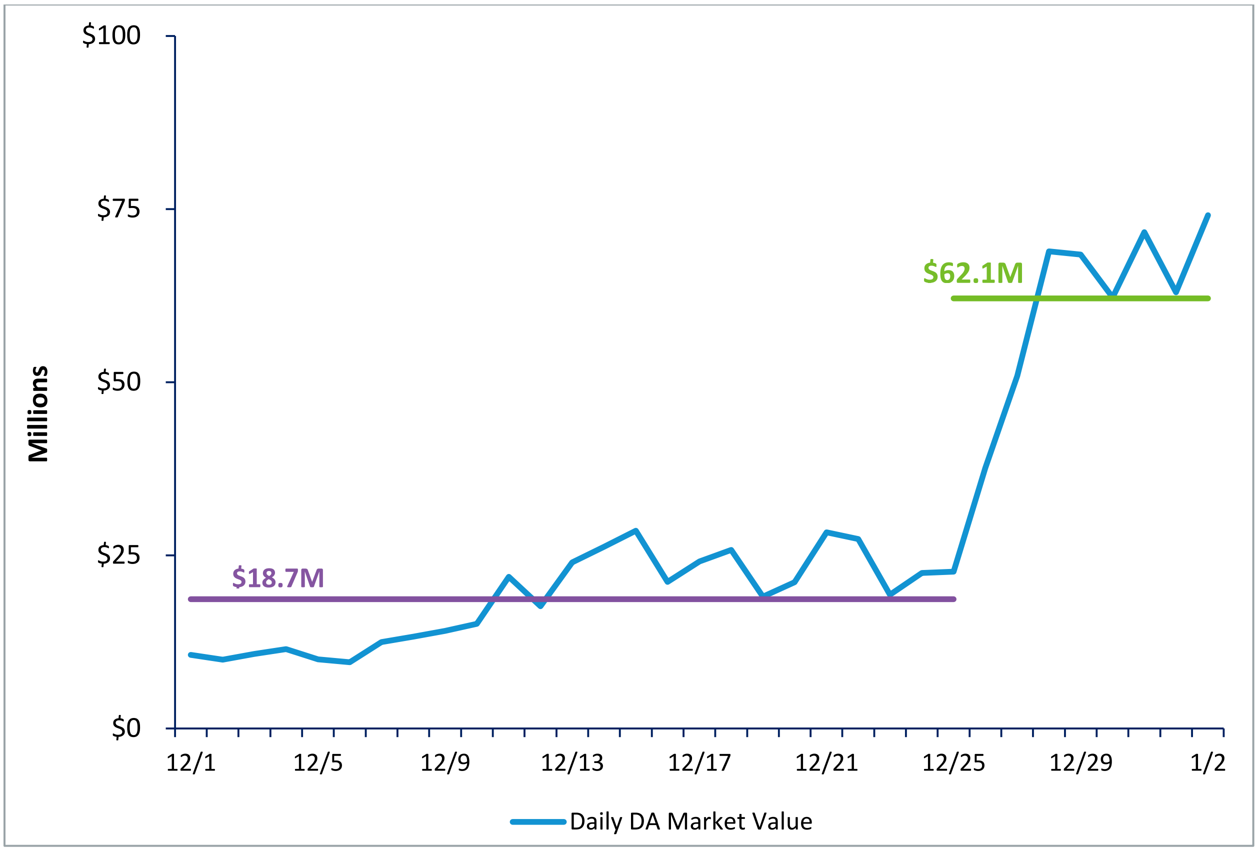
Nuclear power, coal, dual-fuel units running on oil, and liquefied natural gas (LNG) provided significant power system support. On Thursday, January 4, Pilgrim Station tripped offline due to storm conditions. While it was an unexpected outage, there were no immediate reliability issues to the local area. This outage, however, did further challenge the region on fuel availability as the ISO relied on other generating resources to meet consumer demand and overall grid reliability.

During the cold weather conditions, the ISO increased the frequency of generator fuel surveys and continued its close communication with oil-fired power plants, natural gas pipeline operators, and neighboring power systems.

Wholesale Market Cost Implications

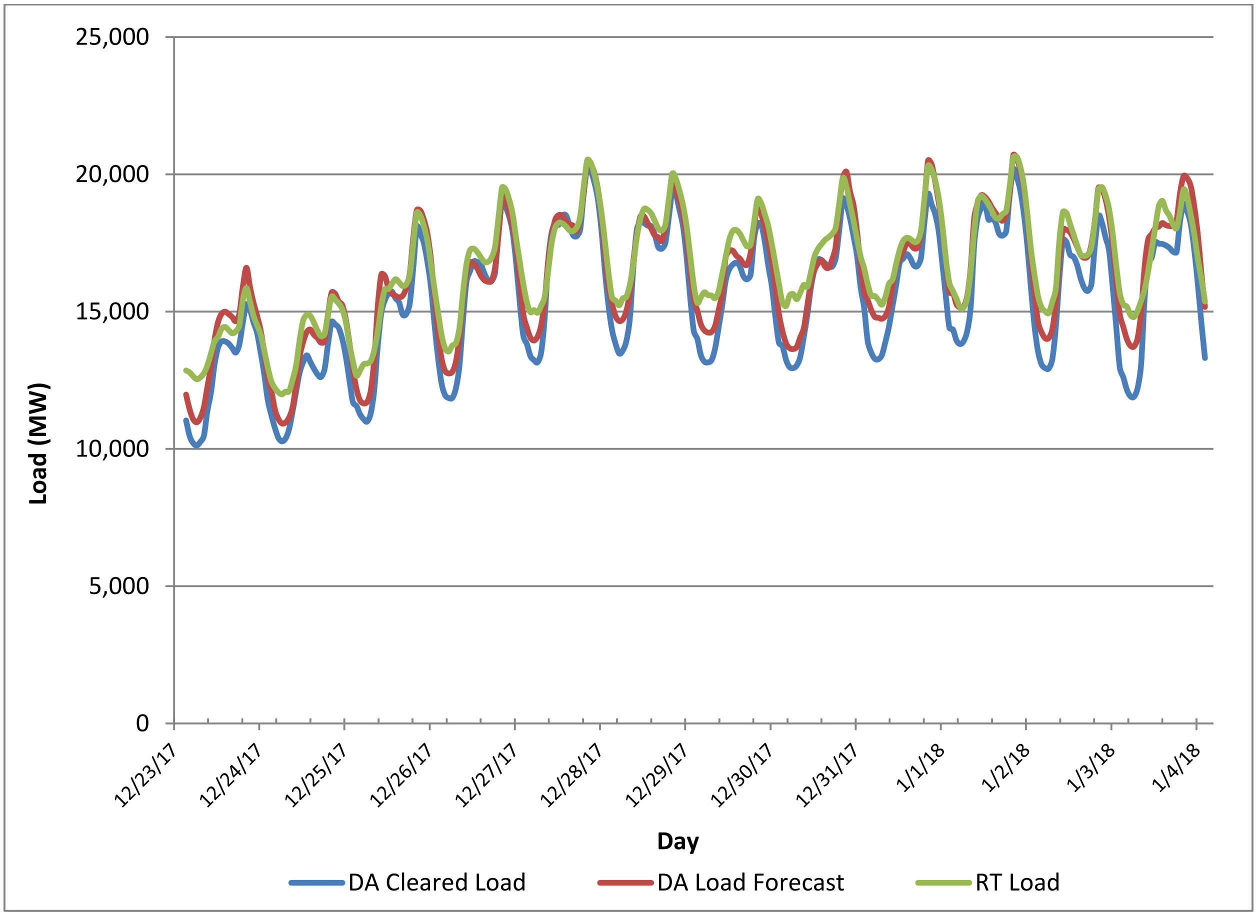
Higher fuel prices had a significant impact on wholesale energy market costs. The preliminary energy market values for the entire month of December totaled more than $800 million, and from December 20 through December 31, totaled more than $500 million. Daily Day-Ahead energy market costs tripled after December 25. Note: the Day-Ahead market accounts for roughly 96% of the total energy market value. See Figure 6.

Figure 6: Daily Day-Ahead Energy Market Costs



The real-time system load followed the ISO's daily load forecast, particularly at the peak hour. (The ISO makes a supplemental commitment of resources if the resources that clear in the Day-Ahead market are insufficient to meet the forecasted load.) See Figure 7.

Figure 7: Day-Ahead Cleared Load versus Forecasted Load versus Actual Load



System Operating Procedures for Cold Weather Conditions

On several occasions, ISO New England implemented system operating procedures to manage forecasted extreme cold weather conditions in New England. As part of these procedures, the ISO sends notices of forecasted cold weather conditions and generating capacity margins to market participants, as well as state and federal officials, including the Federal Energy Regulatory Commission. These notices are a signal to the market that New England is facing extreme cold weather conditions and potential shortages of operating reserves. To date, the ISO has been able to maintain adequate capacity and reserves during the cold weather conditions in New England, and has not needed to take further action to ensure reliability.

Through its system operating procedures, ISO New England forecasts cold weather conditions and generating capacity margins to help maintain adequate capacity and operating reserves during extreme cold weather conditions in New England. Each day, ISO New England develops a Seven-Day Capacity Margin Forecast and classifies each day in the coming week as a Cold Weather Watch, Cold Weather Warning, Cold Weather Event, or No Cold Weather Conditions. For a Cold Weather Watch, ISO New England forecasts extreme cold weather conditions and a capacity margin of greater than or equal to 1,000 MW. For a Cold Weather Warning, ISO New England forecasts extreme cold weather conditions and a capacity margin of less than 1,000 MW. For a Cold Weather Event, ISO New England forecasts extreme cold weather conditions and a capacity margin of less than or equal to 0 MW (effectively, no surplus generating capacity in New England). If ISO New England forecasts a Cold Weather Event, emergency actions are expected to address an anticipated capacity deficiency.

During the weeks of December 25, 2017 and January 1, 2018, ISO New England forecasted seven Cold Weather Watches (for December 28, December 31, January 1, January 2, January 5, January 6, and January 7). They did not trigger appeals for voluntary conservation. The ISO forecasted a positive capacity margin of at least 3,900 MW of generation on all seven days.