

# **WEATHER RESILIENCE IN THE NATURAL GAS INDUSTRY**

## **THE 2017-18 TEST AND RESULTS**

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The Natural Gas Council

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# Why These Three Storms?

**The 2017-2018 storms spanned the full range of potential weather impacts on the natural gas industry.**

## **From Gulf Storms and Flooding: Hurricane Harvey**

- » A traditional Gulf hurricane affecting offshore production, but then flooding and immobilizing the fourth largest U.S. city and the headquarters of much of the natural gas pipeline industry.

## **To Extreme Wind and Flooding in Populated Areas: Hurricane Irma**

- » A fierce South Atlantic and Gulf storm moving the length of the heavily populated state of Florida, which relies on natural gas for power generation more than any other state in the U.S., with some extended impact north into Georgia and the Southeast.

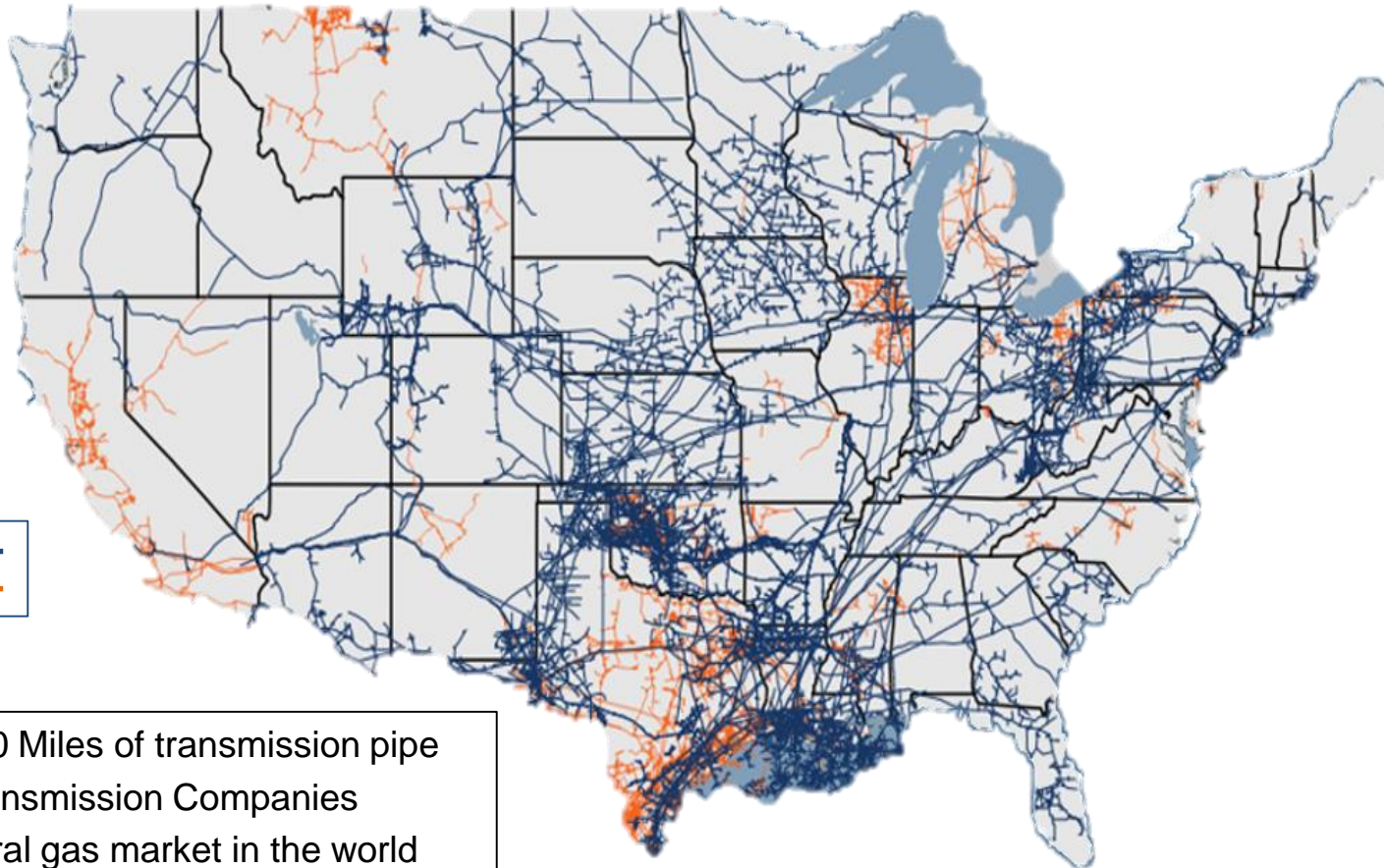
## **To a Deep Freeze and Extreme Winter Conditions: The Bomb Cyclone**

- » An historic Northeast deep freeze, exacerbated by the “Bomb Cyclone,” a snow and ice hurricane affecting Northeast production areas and the most densely populated region in the U.S., the East coast.

# Definition of “Resilient”

- » The Merriam-Webster Dictionary defines “resilient” as follows:
  - a:** capable of withstanding shock without permanent deformation or rupture.
  - b:** tending to recover from or adjust easily to misfortune or change.<sup>2</sup>
- » For the natural gas industry, in the context of the last year’s weather events and incorporating the Department of Energy’s definition of resilience,<sup>3</sup> the working definition may be translated to:
  - **Able to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions.**
  - **Able to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.**
- » Ultimately the test is whether commitments to customers can be met regardless of the degree of stress that is caused by a weather event. As this study demonstrates, the natural gas industry passes this test with flying colors.

# The U.S. Natural Gas Industry Is Large and Very Resilient



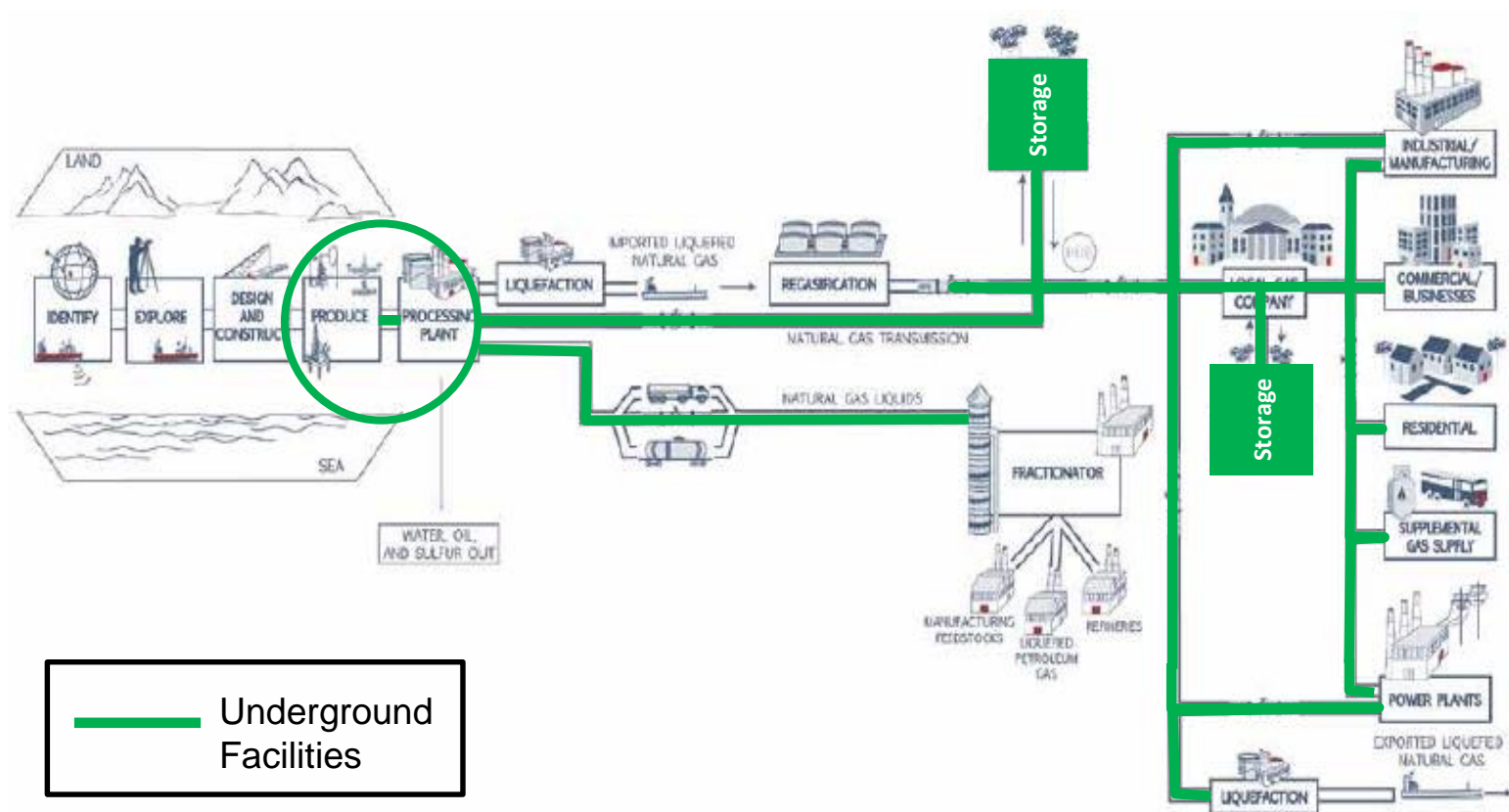
Interstate —  
Intrastate —

- » Over 300,000 Miles of transmission pipe
- » Over 200 Transmission Companies
- » Largest natural gas market in the world
- » Production dispersed across 30 states and 500,000 natural gas wells
- » Over 300 active storage fields

## Security of Service:

- » Most pipeline facilities are buried, protected from weather.
- » Cyber exposures are managed through layered protection, isolation of operating systems, etc.
- » The size and configuration of the grid enables substantial redundancy to compensate for any physical pipeline outage.
- » During most pipeline events, service is maintained with a “work-around” and collaborative help from other pipelines, similar to mutual aid in the electric industry.

# From Producer to Consumer, the Pipe is Buried





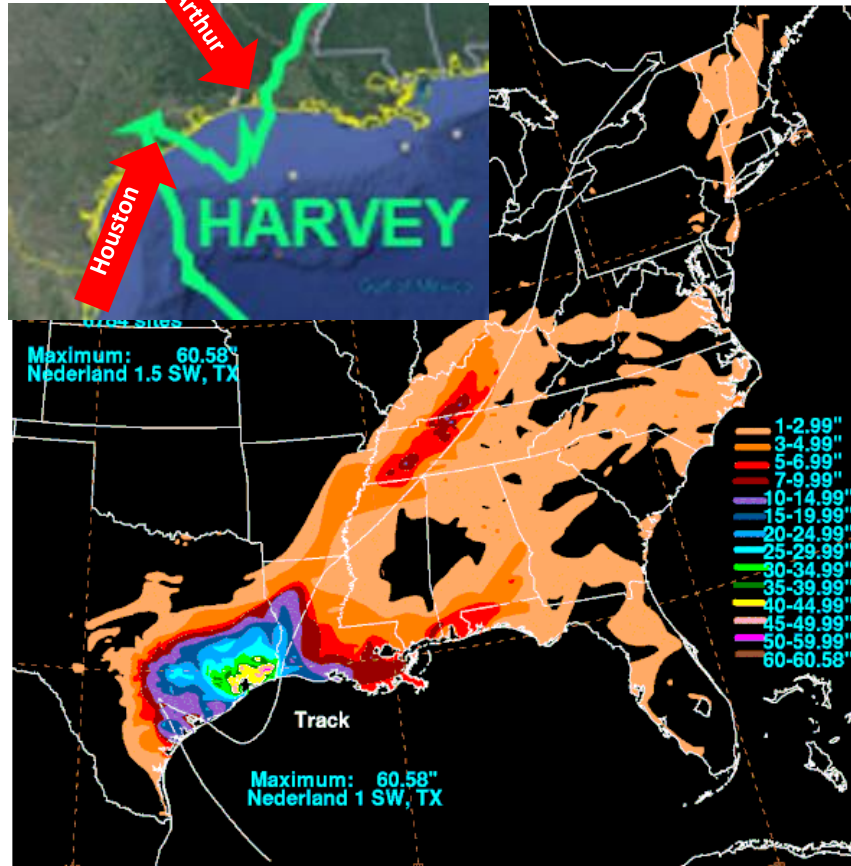
# The Gulf Storms—A Busy Year



- » Harvey (Aug-Sept) profoundly affected Houston, and had barely passed when Irma hit Florida.
- » Irma (Sept) tracked the length of the state of Florida, resulting in 64% of power being lost (per EIA).
- » Then Maria (Sept) hit in the islands in the Caribbean, creating an additional logistics crisis.

# Harvey Had a Record Impact, but the Natural Gas Industry Performed Normally

Landfall: August 24, 2017  
End: September 2, 2017



Source: National Oceanic and Atmospheric Administration

- » Hurricane Harvey made landfall south of Houston, turned back out to sea, came back, stayed in place, then made landfall again at Port Arthur.
- » The resulting rain totaled 51 inches in Houston, and Port Arthur sustained both flooding and wind damage.
- » Harvey was the costliest storm in U.S. history, inflicting damages estimated at \$125 billion.
- » Yet the natural gas industry continued to perform normally before, during, and after the storm.



# Harvey Was Very Nasty



From the Slogan  
We Took to the  
World Series

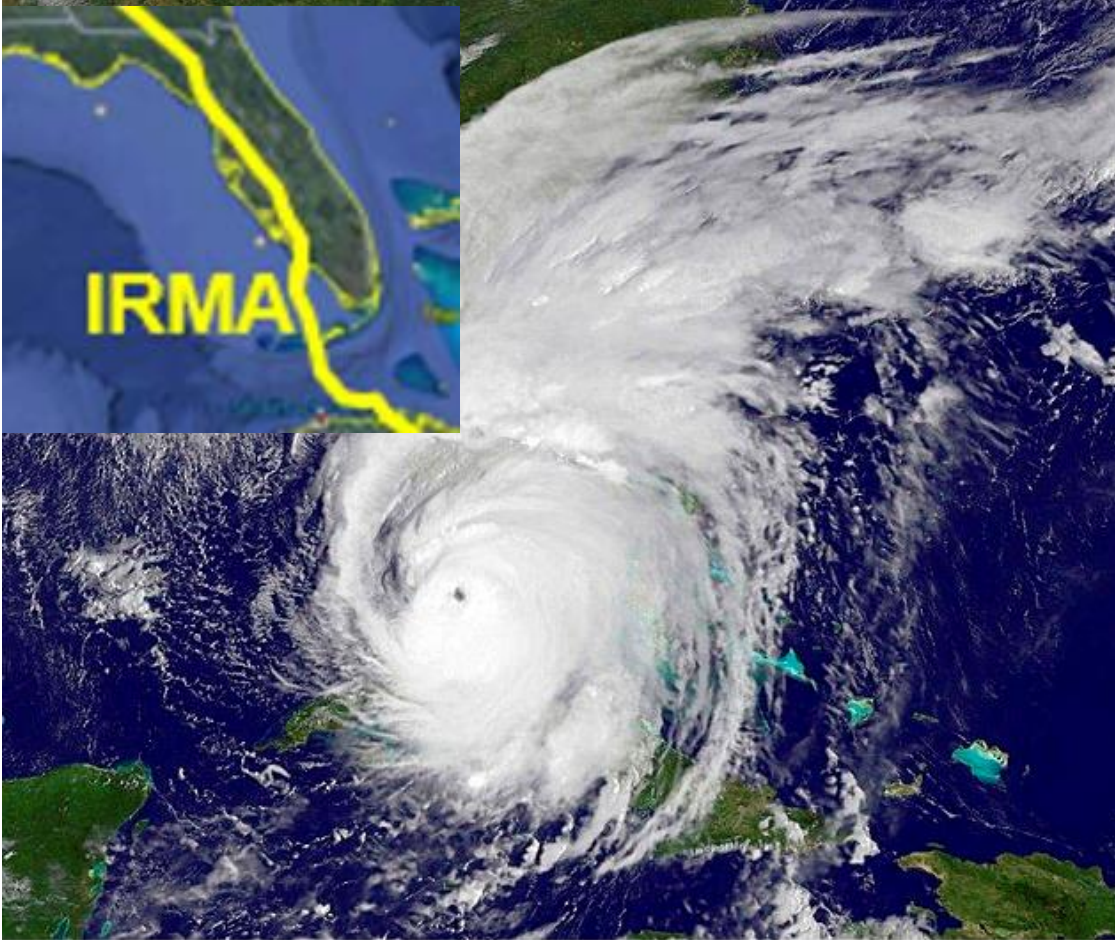


To the View from  
my House (and we  
stayed dry)



# Irma Took Out Power Region-Wide, but Gas Stayed on and Performed Normally

Landfall: September 7, 2017  
End: September 13, 2017



Source: National Oceanic and Atmospheric Administration/NASA

- » Hurricane Irma ultimately threatened, but was not centered over the Gulf.
- » It went straight up the West Coast of Florida, causing widespread damage throughout the state that relies on natural gas for electricity more any other.
  - Power was out from downed lines.
  - Natural gas supply was unimpaired to all users, including distributed generation.
  - While power outages also happened in Georgia, Alabama, and the Carolinas, none were related to unavailability of natural gas supply.
- » Throughout, gas performed normally, allowing alternative generation to operate.

# And then Winter—The Bomb Cyclone

Cold and Blizzard: December 27, 2017  
End of Bomb Cyclone: January 7, 2018



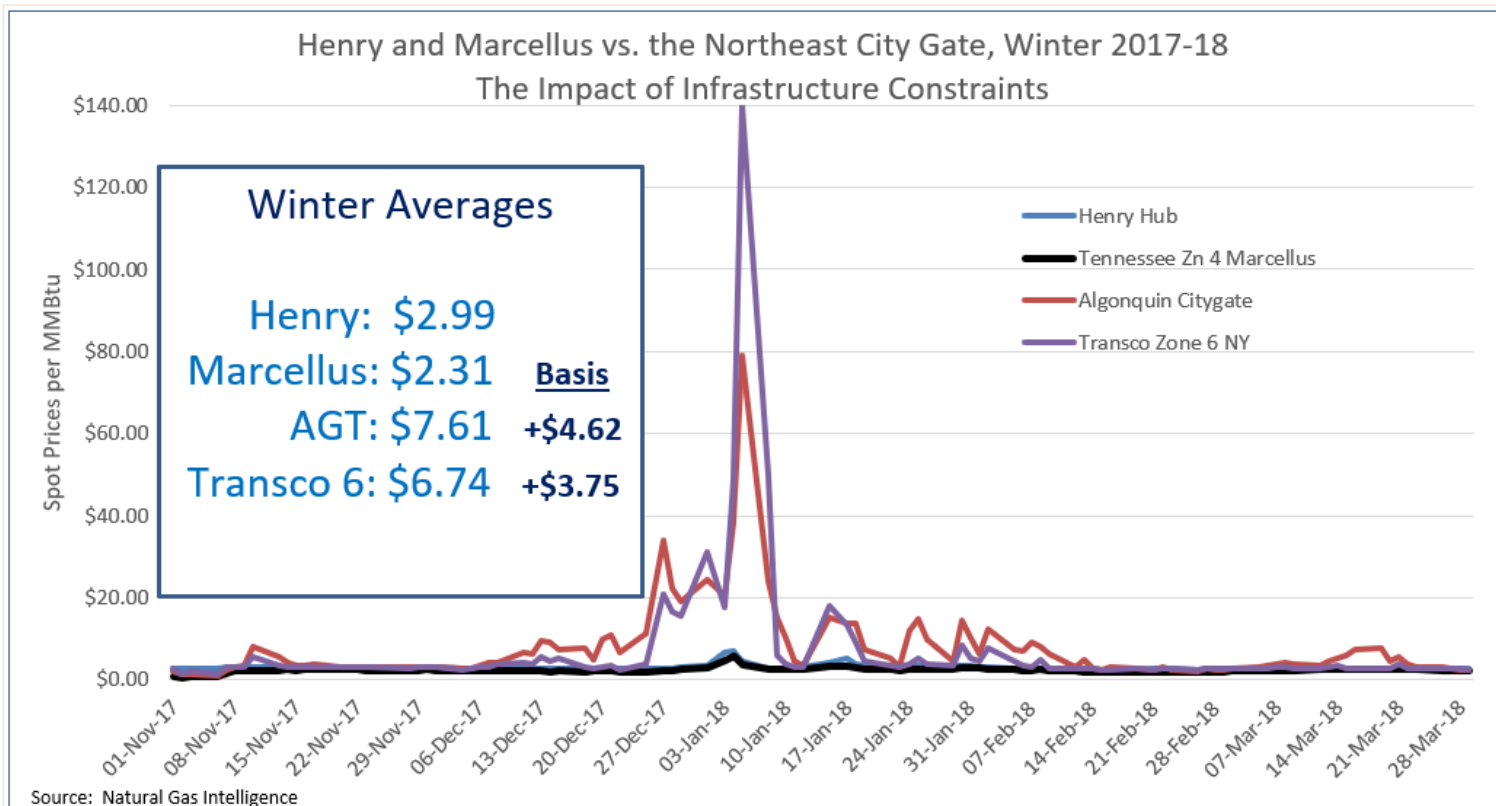
- » In the midst of a severe cold wave and blizzard beginning in December, the Bomb Cyclone descended on the East Coast in early January.
- » A “snow hurricane” combined with widespread frigid temperatures to create extreme weather conditions.
- » Also known as “Winter Storm Grayson.”
- » Regional spot gas prices were high, and national spot prices were temporarily elevated somewhat, but service was maintained.

Source: National Oceanic and Atmospheric Administration/NASA



# Northeast Infrastructure Constraints Led to Large Cold-Driven Spot Price Spikes

- » The premium of as much as \$4.31 (Algonquin minus the Marcellus price plus transport) is the price paid by customers without firm transportation.
- » Only small volumes, 1 to 2 percent of the market, reported paying the extremely high prices reported at some Northeast city gates during the Bomb Cyclone.<sup>6</sup>

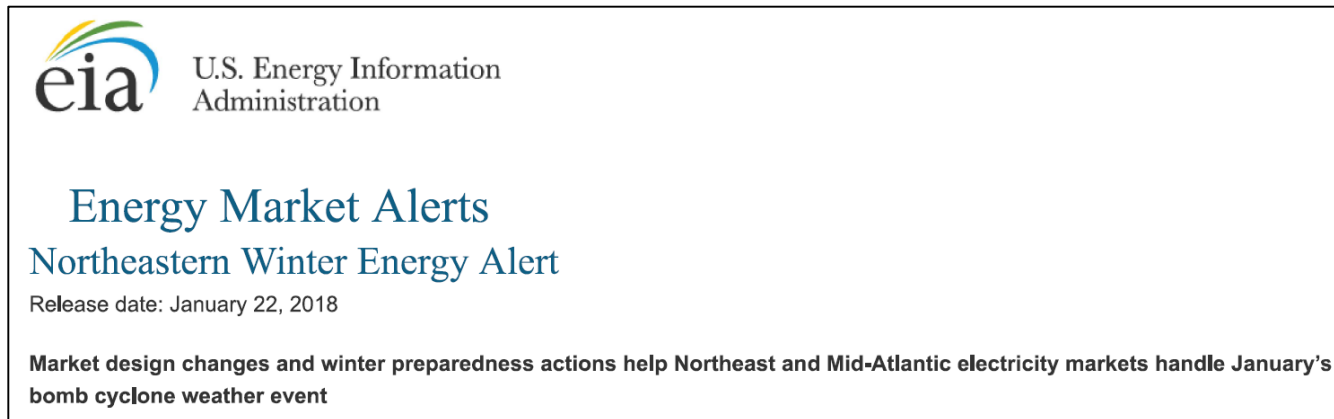




# EIA and RTO/ISO Reports on the Winter

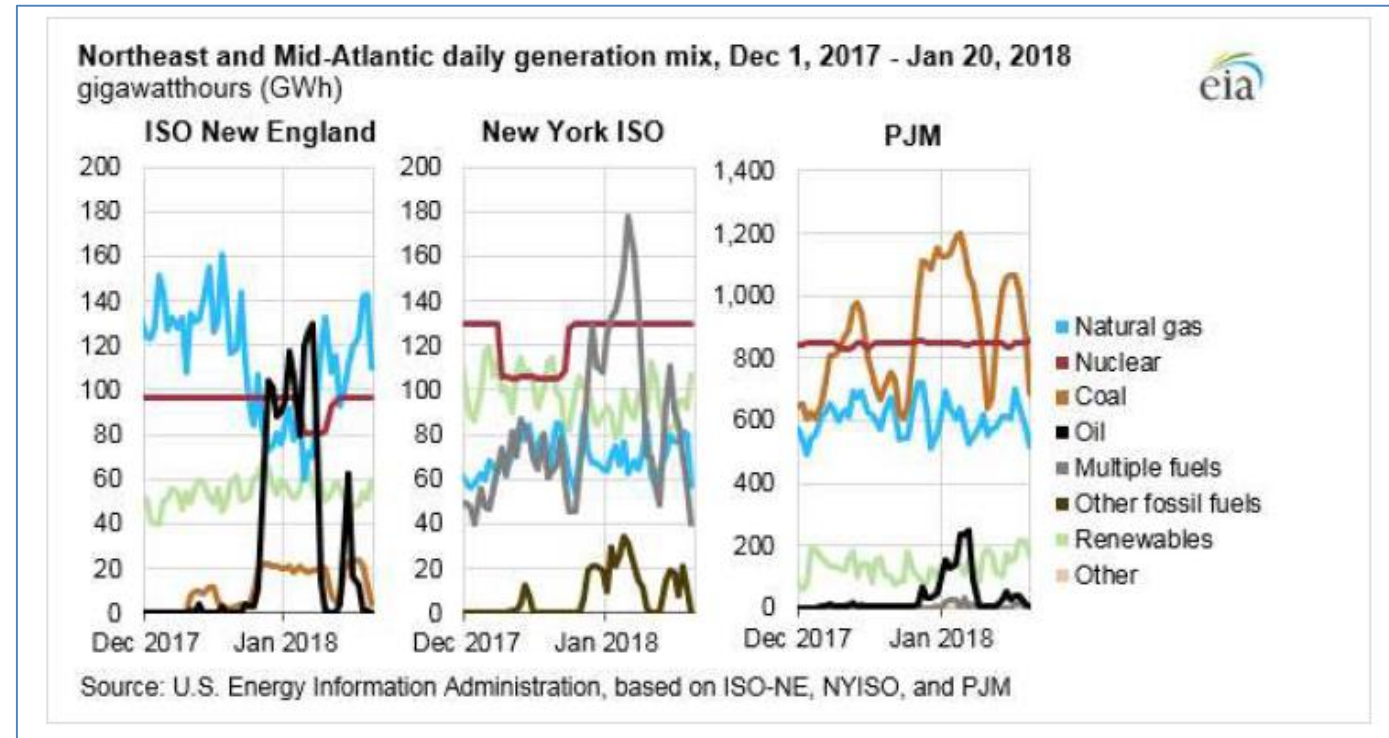
- » While PJM, ISO-NE, and NYISO all published post-mortem reports examining performance during the Bomb Cyclone,<sup>10</sup> the Energy Information Administration (EIA) published a single overall report on all three.
- » Its comprehensive view is best summarized by the main headline of the report:

**“Market design changes and winter preparedness actions help Northeast and Mid-Atlantic electricity markets handle January’s bomb cyclone weather event.”**



# EIA's Overall Summary of Northeast Generation

- » Of the three markets, only New England saw a sharp drop in gas-fired generation (the blue line) and a corresponding increase in alternate fuel during the Bomb Cyclone, representing the use of oil (black) to avoid high spot prices for generators that did not have firm transportation available.
- » PJM (whose electric load was six times as large as either New England or New York) saw a significant increase in coal use (brown), rather than a turn-up of gas facilities.
- » As PJM has explained, this was strictly an **economic decision, not a lack of availability of gas**.



# NETL's Claim and PJM's Response

- » The Department of Energy, through NETL, issued a report on the role played by coal and nuclear units<sup>8</sup> claiming that PJM's dispatch of coal units during the Bomb Cyclone meant that there would have been a major reliability crisis without coal.
- » PJM strongly contradicted that conclusion.<sup>9</sup> PJM stated in no uncertain terms that its dispatch decision was purely economic, and that no resource shortage drove its choice to run coal plants. Below are the NETL statement and PJM response:

## **NETL Report, Executive Summary at p. 1**

*"In PJM, the largest of the ISOs, coal provided the most resilient form of generation, due to available reserve capacity and on-site fuel availability, far exceeding all other sources (providing three times the incremental generation from natural gas and twelve times that from nuclear units); without available capacity from partially utilized coal units, PJM would have experienced shortfalls leading to interconnect-wide blackouts."*

## **PJM Response to NETL, March 13, 2018 (emphasis added)**

"PJM agrees that the report underscores the importance of a fuel-secure generation fleet to serve future demands. But in PJM's view, the report erroneously concludes that the relative economics of coal and nuclear vs. natural gas during the cold snap, which drove the dispatch of coal units (i.e., that the cost of coal was lower), indicates that the system would have faced "shortfalls leading to interconnect-wide blackouts" during this period. As PJM demonstrated in its own report on system performance during the cold snap, **PJM had adequate amounts of resources to supply power—the price of natural gas relative to coal and nuclear during the cold snap drove dispatch decisions.**

During the cold snap, the region experienced an increase in the price of natural gas, which made coal resources (which often did not run under periods of lower natural gas prices) the more economic choice during times of high gas prices. **But one cannot extrapolate from these economic facts a conclusion as to future reliability within PJM.**



# The Gas Industry Showed its Resilience through Major Challenges

- » Based on the public records, interviews, and observations of the three major weather events affecting the last year, the gas industry faced the full range of the challenges weather can pose, and prevailed convincingly.
- » Succeeding through these events without reportable issues fully demonstrates the first aspect of resilience -- resistance to shocks that can cause damage..
- » Rapid recovery from or mitigation of any issues that did occur demonstrates the second aspect of resilience.
- » The most significant effects that were observed were the economic consequences of the freeze and Bomb Cyclone, primarily involving gas prices for power generation where sufficient firm commitments were not in place.

# The Northeast Experience Shows More about Choices than Resilience

- » In the areas hardest-hit by the freeze and Bomb Cyclone, price behavior reflected the contractual choices of pipeline users in the market, and otherwise generally tracked normal supply and demand.
- » In power markets, successful management of gas along with other resources maintained reliability, sometimes holding gas in reserve for economic reasons.
- » The extent to which some coal and nuclear facilities were temporarily relied upon could suggest that as those facilities phase out and gas becomes more of a dominant baseload fuel, **the longstanding need for more firm transportation in some markets may be exacerbated and confirmed.**
- » The need for market participants to firm up their contractual requirements as the generation mix evolves does not indicate a lack of resilience in natural gas supply and infrastructure—just a need for the market to evolve.

# **ADDENDUM FOR FLORENCE AND MICHAEL**

Florence and Michael were subsequent to the completion of the NGC study. Thus, this review is based on quick survey of press, regulatory reports, and informal interviews.



# Florence—Cat 1, Sept. 14, 2018

## Heavy Flooding



- » More flood than wind, but extensive damage throughout North Carolina.
- » Widespread power outages, including 90 percent of Hanover County.
- » No record of loss of gas service or impact on reliability.
- » Communities were isolated by flooding, distributed generation continued to work.



# Michael—Cat 4, Oct. 10, 2018

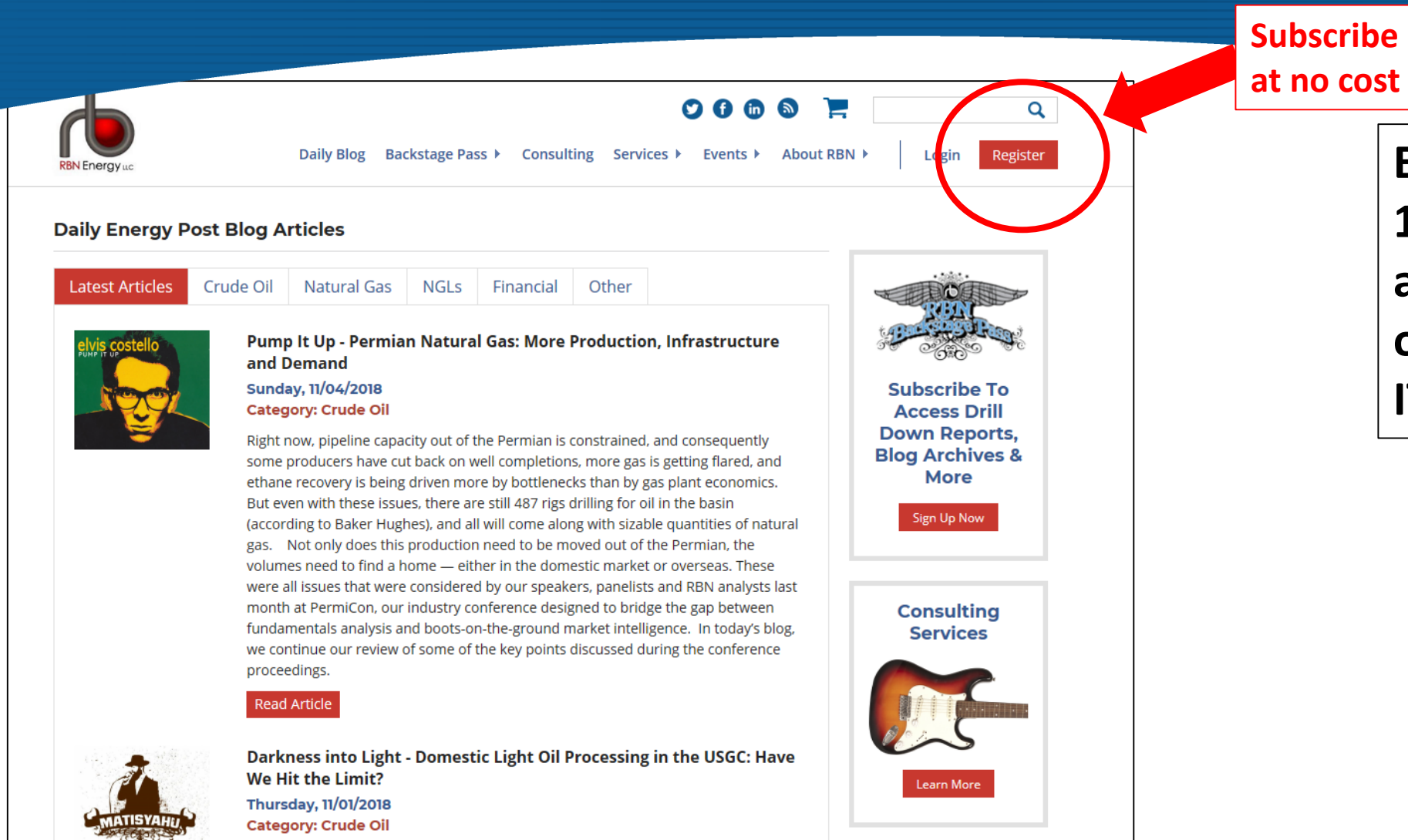


- » Florida Panhandle, Georgia, the Carolinas, Virginia.
- » Millions lost power across all four states.
- » Storm passed over all major pipelines serving the Florida peninsula, but there was no impairment of gas service.
- » No reports were found of loss of gas service, unless structures were destroyed or badly damaged.
- » Distributed gas generation allowed continuity of service for affected loads.





# This Will Be RBN's Only Ad



The screenshot shows the RBN Energy LLC website. At the top, there is a navigation bar with links for Daily Blog, Backstage Pass, Consulting, Services, Events, and About RBN. A red circle highlights the 'Register' button in the top right corner, with a red arrow pointing to it from a text box that says 'Subscribe at no cost'. Below the navigation bar, the 'Daily Energy Post Blog Articles' section is visible. It features a 'Latest Articles' tab and a list of articles. The first article is titled 'Pump It Up - Permian Natural Gas: More Production, Infrastructure and Demand' by Elvis Costello, dated Sunday, 11/04/2018, and categorized as Crude Oil. The second article is titled 'Darkness into Light - Domestic Light Oil Processing in the USGC: Have We Hit the Limit?' by Matisyahu, dated Thursday, 11/01/2018, and categorized as Crude Oil. To the right of the articles, there are two promotional boxes. The first box is for 'RBN Backstage Pass' and says 'Subscribe To Access Drill Down Reports, Blog Archives & More' with a 'Sign Up Now' button. The second box is for 'Consulting Services' and features an image of a guitar with a 'Learn More' button.

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