Growing Risk of Steep Natural Gas and Electricity Price Spikes

IECA Spring Meeting

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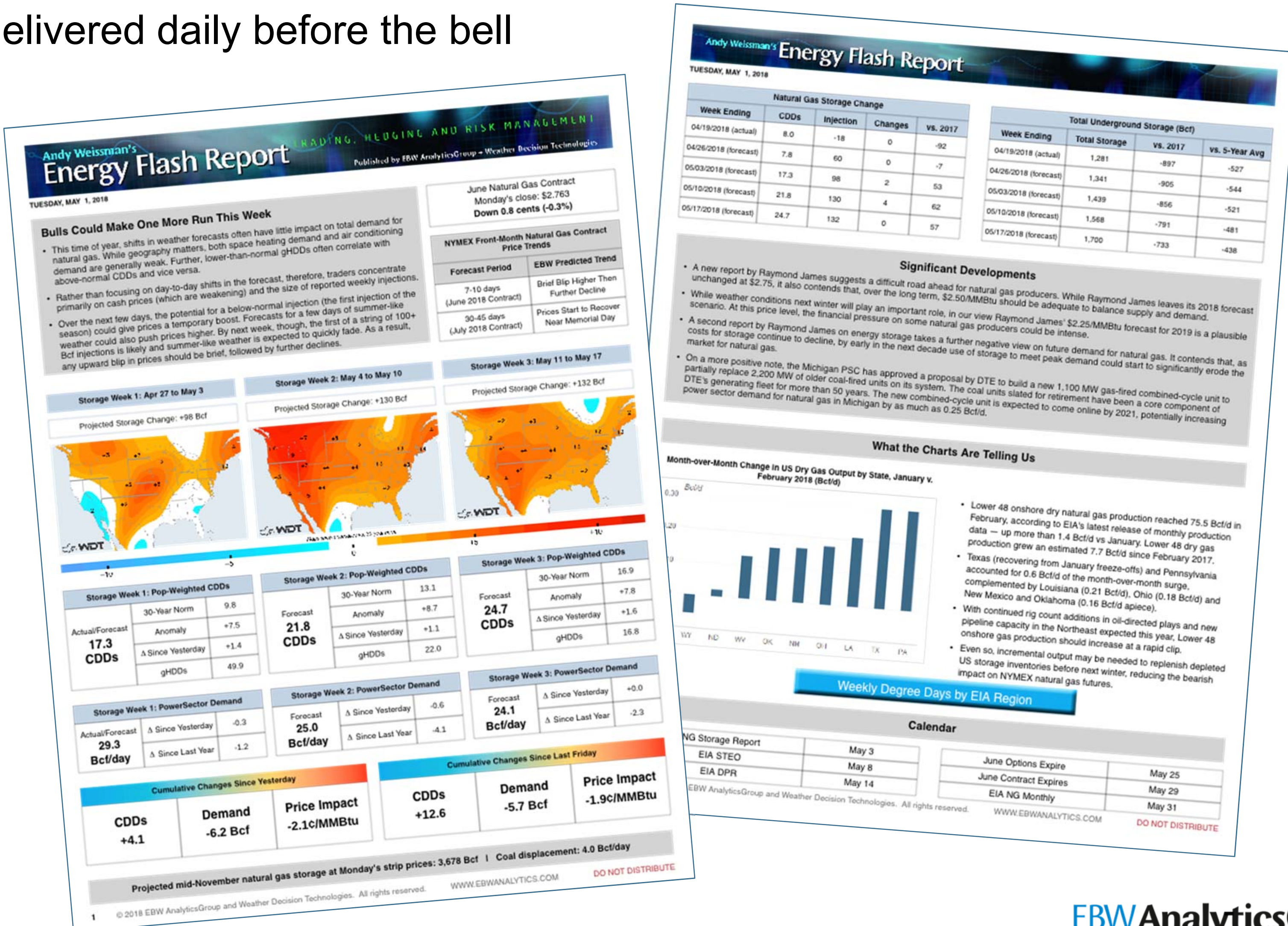
About Andy Weissman

- **CEO, EBW AnalyticsGroup**
  - Premier energy market analysis service since 2003; publishes:
    - **Market Quick Takes**, weekly snapshot of the nexus between weather and the cost of natural gas and electricity
    - **Energy Risk Report**, the only analysis designed specifically to aid energy procurement professionals
    - **Energy Flash Report,** a daily analysis with the latest changes to weather and the natural gas supply/demand balance
  - To learn more, please visit **www.EBWAnalytics.com**

- **Senior Counsel at Pillsbury Winthrop Shaw Pittman**
  - 30+ years experience providing strategic advice at C-suite level
  - Highly regarded energy regulatory attorney and Clean Air Act expert
  - Couples legal expertise with deep industry expertise
- Major role in transforming U.S. energy and environmental policy
- Helped to pioneer emissions trading in United States
- Connect with me on LinkedIn “Andy Weissman”

Energy Flash Report

- Natural gas demand and weather changes and forecasts
- Forecasts for current and following two natural gas storage weeks
- Delivered daily before the bell



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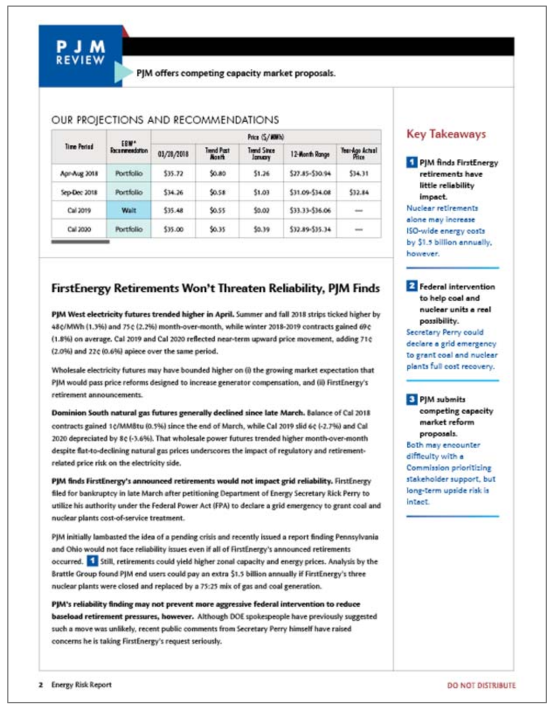
Energy Risk Report

- The only publication with *specific procurement recommendations* for large energy users
- Designed to assist buyers with optimizing timing of electricity and natural gas purchases
- Delivered in four easy-to-read issues each month: National, MISO + ISO-NE, ERCOT + CAISO, and PJM + NYISO



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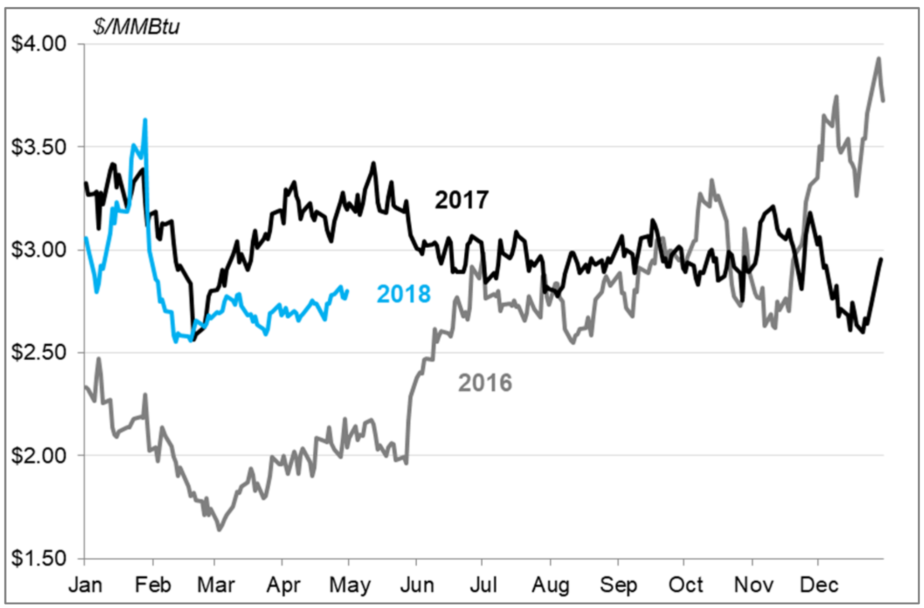
Good News First

- Growth in natural gas supply greatly outpacing demand
- While winter still matters, 2018-2019 electricity and natural gas prices in most regions likely to be at or near multi-year lows
  - Potential doomsday scenario for some natural gas producers
  - Could trigger new wave of coal and nuclear retirements

Front-Month Natural Gas Contract Prices, 2018 v. Last Two Years ($/MMBtu)



Source: Bloomberg, EBW Analytics

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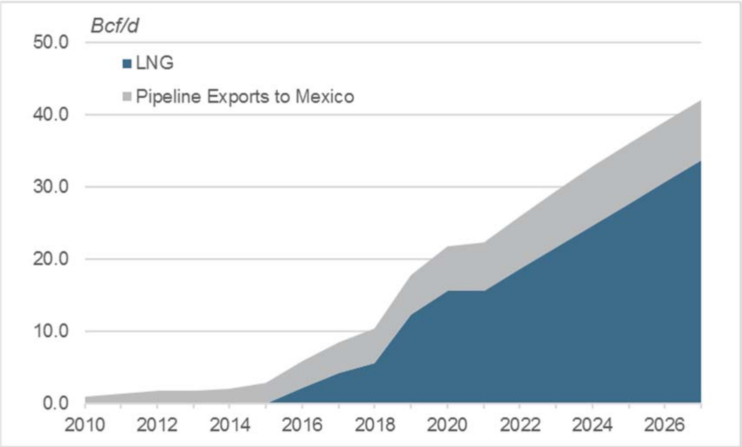
Far-reaching Transformation of US & Global Energy Market

- Past *not* necessarily prologue
- Massive changes
  - US in the process of becoming #1 oil producer and oil exporter in the world
    - Huge surge in production of associated gas
  - Massive increases in US LNG and natural gas pipeline exports
  - Sweeping changes in composition of electricity grid
    - Unprecedented coal and nuclear retirements
      - More stable cost structure than natural gas
    - Dramatic increases in on-shore wind, utility-scale solar, off-shore wind and energy storage
    - Increased reliance on transmitting power over long distances
- Dysfunctional FERC market rules
  - Stunning failure by the Commission to adapt to changing market needs
    - Operating almost entirely in the dark

Total Natural Gas Demand for LNG and Pipeline Exports to Mexico, 2010-2027 (Bcf/d)



Source: EIA, EBW Analytics

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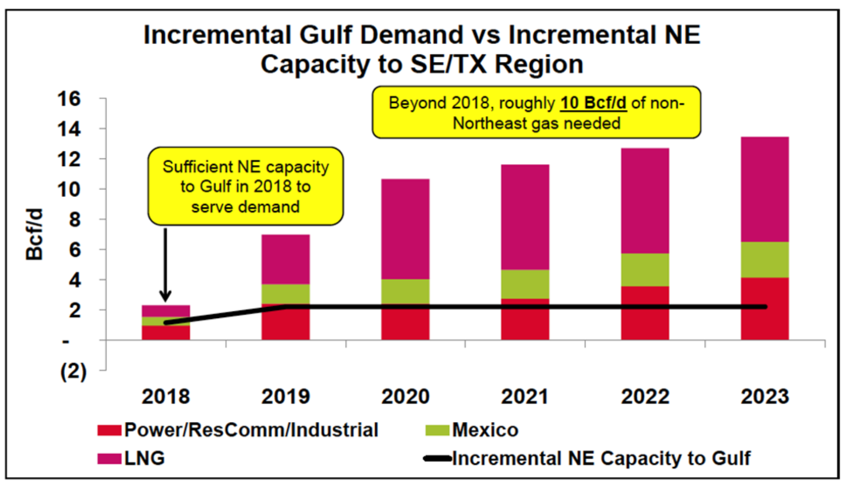
Impacts Not Yet Fully Understood

- Creates tight linkage between US natural gas, electricity and oil prices and global markets
- Requires massive infrastructure buildout not yet occurring
  - Interstate oil and gas pipelines, natural gas storage and electric transmission
  - High risk infrastructure expansion will lag market needs
- Radically changes gas flows within the US
  - Already resulting in Henry Hub selling at a significant premium to most other hubs
- Combination of these factors greatly increases risk of extreme price volatility by early in the next decade

Mismatch Between NE Capacity, Gulf Demand



Source: Platts

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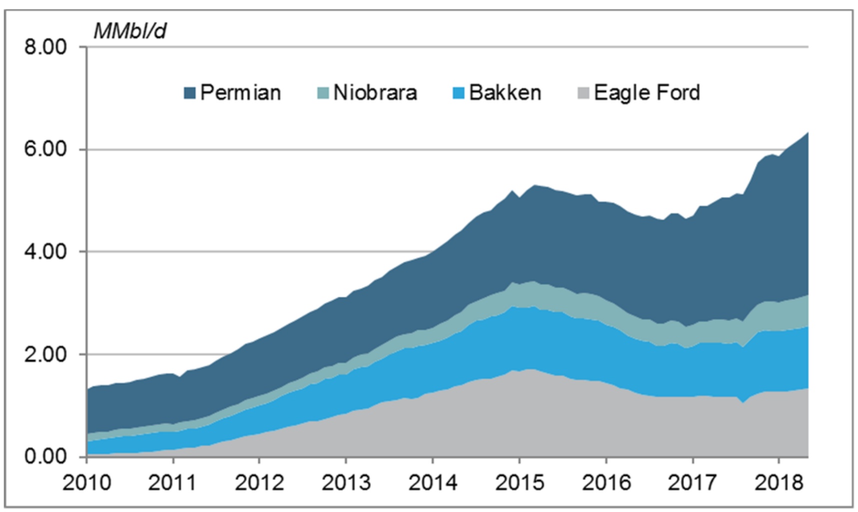
Emergence of US as #1 Oil Producer in the World

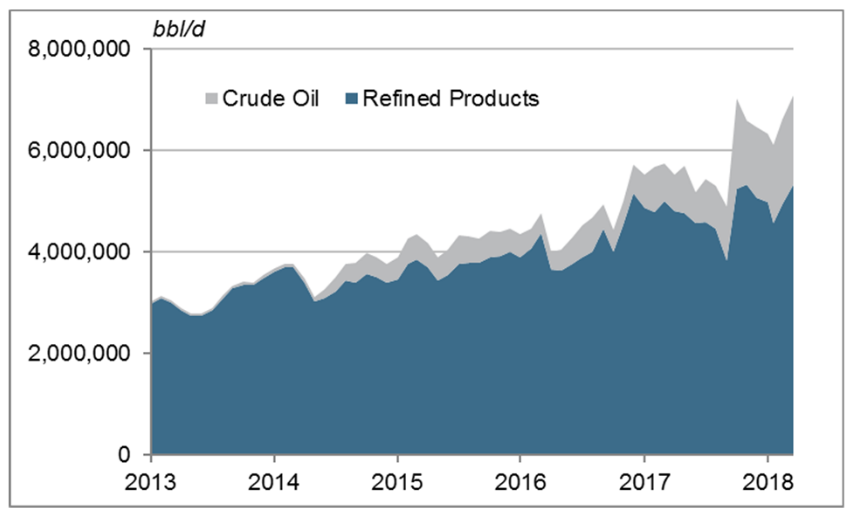
- Dramatic increases in US production and exports
- Global supply deficit emerging much earlier than previously expected
  - Stronger than expected growth in global demand
  - Rapid depletion of other supply sources
- Sharp decline in global CapEx starting four years ago and current low prices creates high risk of major supply deficits
  - Potentially as early as next year, but nearly certain by 2020-2021
- US = swing supplier
- Production likely to soar, potentially exceeding nearly every projection
- Huge implications for production of associated gas

Monthly Crude Oil Production from the Four Largest US Shale Plays, 2010-2018 (MMbl/d)



Source: EIA

US Monthly Crude and Refined Product Exports, 2013-2018 (MMbl/month)



Source: EIA

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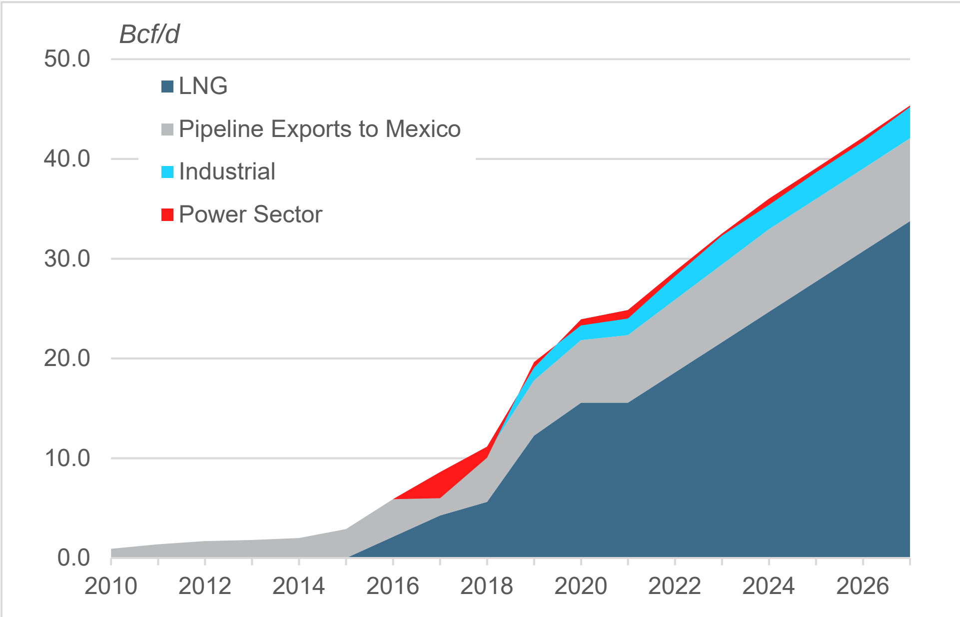
Unprecedented Growth in Demand

- Driven primarily by four factors:
  - Pipeline exports to Mexico
  - LNG exports
  - Strong growth in industrial demand
  - Continued growth in power sector demand

Natural Gas Demand for LNG and Exports to Mexico Plus Net Growth in Industrial and Power Sector Demand from 2016 Onward, 2010-2027 (Bcf/d)

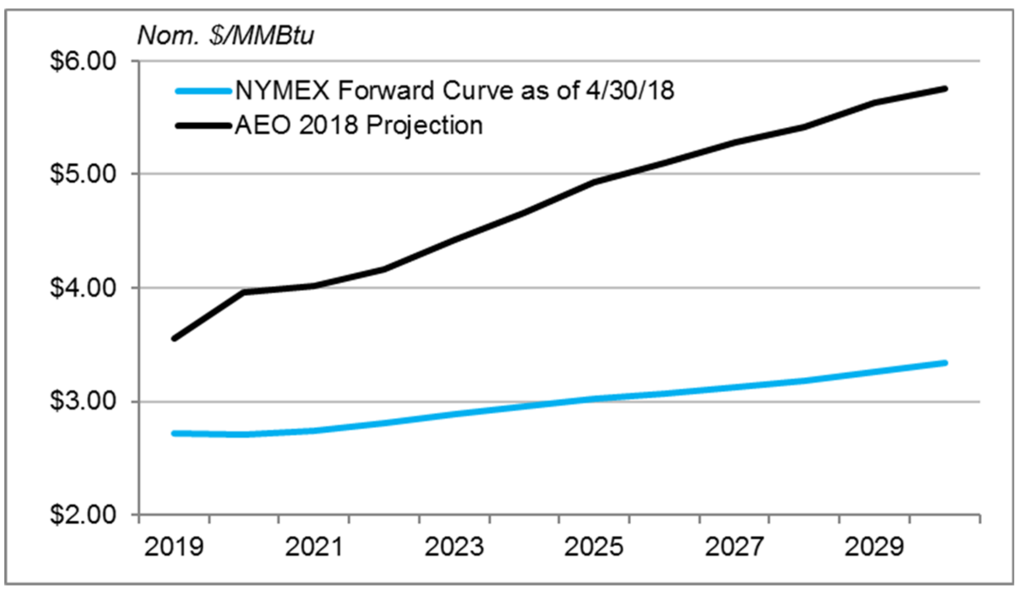


Source: EIA, EBW Analytics

Is There Enough Gas to Keep Prices Moderate?

- Huge disconnect between EIA forecast and NYMEX forward curve
  - Potential prices could significantly exceed EIA forecast
    - Particularly at Henry Hub
- Upside price risks include:
  - Potential that "sweet spots" in major shale plays will soon be exhausted
  - Infrastructure constraints
    - Both pipelines and storage
  - Increases in oilfield service costs

NYMEX Henry Hub Forward Curve v. EIA Henry Hub Price Outlook, 2019-2030 (Nom. $/MMBtu)



Source: Bloomberg, EIA AEO

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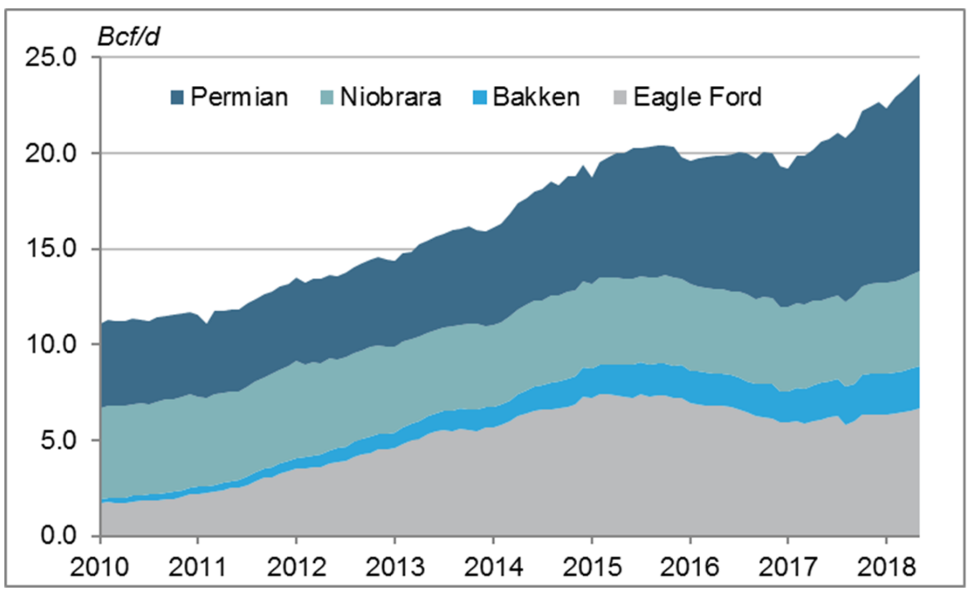
Countervailing Factors

- Factors that could keep prices moderate next 5-10 years:
  - Vast increases in production of associated gas
    - Much lower decline rate than previously expected
    - Could reach 30 Bcf/day from Permian Basin alone
  - Ability to tap additional sources of supply still at an early stage in development
    - High Alpine
    - Canada
  - Continued improvements in technology
    - Future costs for Tier II and III reserves could prove to be inline with current Tier I
  - Enhancing future production from existing wells
  - Development of multiple seams

Associated Gas Production in the Four Largest US Shale Oil Plays, 2010-2018 (Bcf/d)



Source: EIA DPR

Major Upside Price Risks Not Primarily Due to Limitations on Available Supply

- Most significant risk factors:
  - Failure to build-out adequate infrastructure in timely manner
  - Inability to deliver sufficient natural gas to key regional markets in winter
  - Potential for runaway basis differentials at Henry Hub
  - Volatility of demand for US LNG exports
    - Bidding wars possible with some of the deepest pockets in the world

Regulatory Failure Has Cost End Users More than $500 Billion

- Infrastructure risks due primarily:
  - Monumental CapEx requirements
  - Lack of coherent FERC policy or sound planning by RTOs
    - Failure to examine electricity and natural gas market in an integrated manner
    - Failure to plan or provide mechanisms to pay for system needs
    - Primary cause of $500 billion in unnecessary costs since industry restructuring began
  - Concerted campaign to stop development through litigation
- ***FERC natural gas pipeline review most important FERC rulemaking for industrial energy users in years***
  - One of the biggest regulatory failures ever

Gas Deliverability Most Critical Issue Facing Markets in Northeast and California

- Resilience NOPR profoundly misguided
  - Key issue = gas deliverability
  - Not yet being examined by FERC
    - PJM just starting
- RTOs in the Northeast pay massive amounts to ensure adequate total generation to meet peak demand – but nothing to ensure availability of gas to gas-fired generating units
- At height of this year’s cold snap event, nearly 45,000 MW of gas-fired generation in three Northeast ISOs remained idle
  - Zero benefit to end users, despite tens of billions of capacity payments over past decade
  - “Paper” reserve margins were just that
  - PJM and other RTOs attribute ideal status to dispatch cost
  - In fact, even at record high natural gas prices, no supplies remained available to dispatch these units
- Under entirely plausible scenarios, Northeast could have been short as much as 20,000-30,000 MW of generation, with potentially catastrophic consequences

Total and Idle Gas-Fired Capacity by ISO, January 1-January 7, 2018

	PJM	NYISO	ISO-NE	Total (MW)
Idle Capacity (MW)	12,480	19,118	13,125	44,723
Total Gas-Fired Capacity (MW)	37,066	22,170	17,091	76,327
% Idle Capacity	33.7%	86.2%	76.8%	58.6%

Source: ISO-NE, NYISO, PJM, EBW Analytics

At highest PJM capacity price in the last three years ($164.77/MW-day), the total capacity payment for the 44,723 MW of idle Northeastern gas capacity would be $7,369,009/MW-day, or $2.69 billion/MW-year.

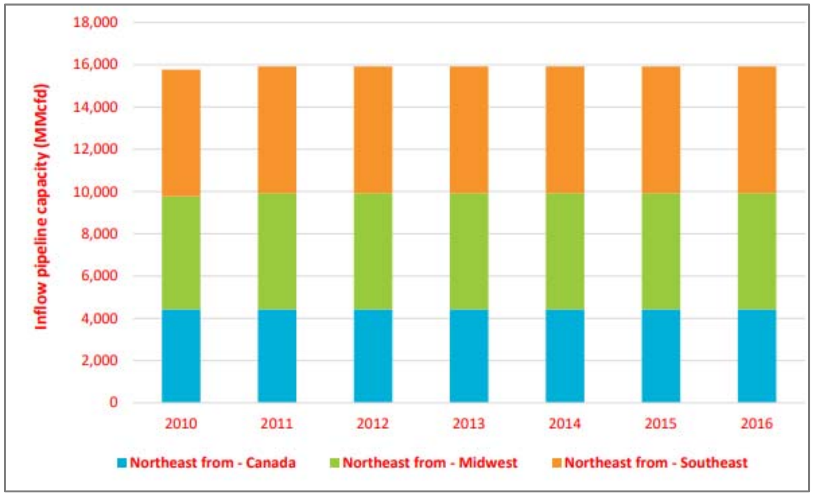
Ensuring Adequate Deliverability of Natural Gas on Peak Winter Days a Huge Challenge

- Needle peak in demand for natural gas three to four times steeper than mid-summer peak in electricity demand
  - On January 1st (the coldest day), total US demand for natural gas was twice total US production
  - Ratio even steeper in Northeast
    - Only 35-40% of gas utilized in the region obtained from wells in the Northeast
- Only remaining sources of supply were pipeline imports into the region + withdrawals from regional storage
  - Both were fully tapped out, limiting total supplies available for use in the three RTOs in the Northeast to 58-60 Bcf/day
- *All* of this gas was utilized for space heating and dispatch of small amounts of gas-fired capacity
  - No more gas available to operate 45,000 MW of idle gas-fired capacity
- Only way to balance supply and demand of gas was to bid regional prices for natural gas high enough so that these generating units were no longer in the money
  - Left *zero* generation available to be dispatched

Daily Natural Gas Demand (including exports), April 1 2017 to March 31 2018

Source: Platts

Pipeline Inflow Capacity into the Northeast, 2010-2016 (MMcf/d)



Source: Department of Energy National Energy Technology Laboratory

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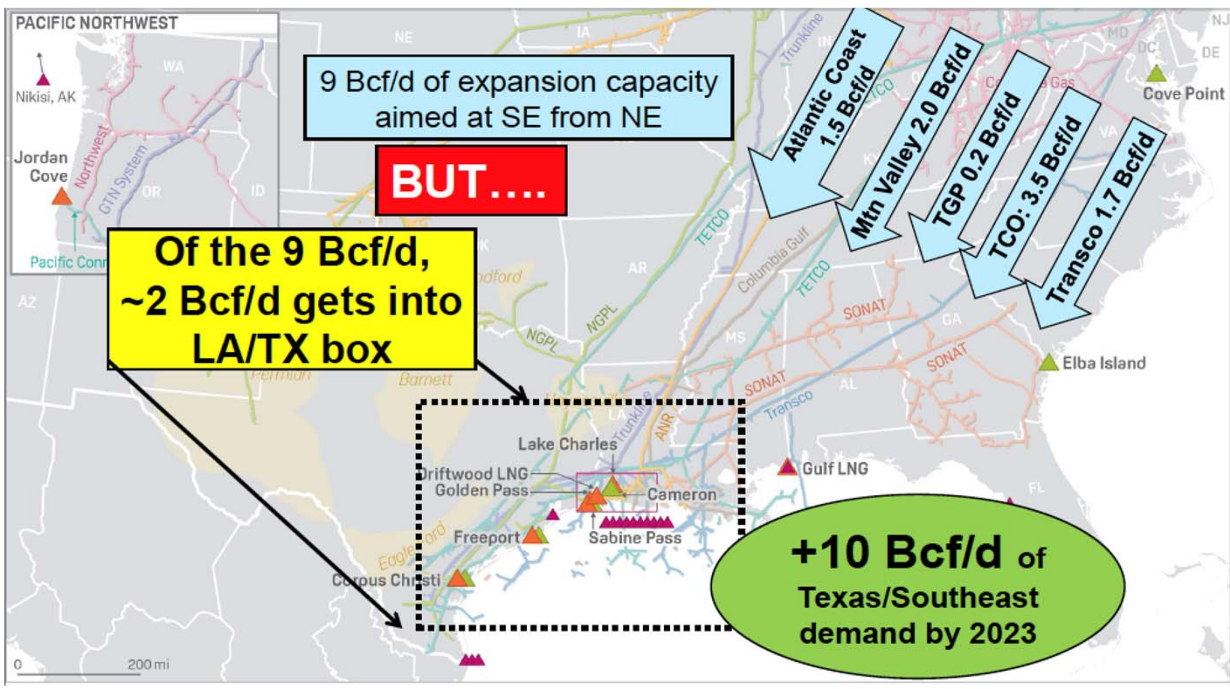
Conditions Could Easily Have Been *Much* Worse

- Any of a long list of factors could have reduced supplies available for power generation and/or required more generation to be dispatched
  - By comparison, $175/MMBtu price for natural gas and $300/MW+ prices for electricity would have seemed modest
- Factors that could have led to more severe crisis – none of which require extreme assumptions – include:
  - Coldest day occurring one day later, on January 2nd (a normal workday) vs January 1st holiday when nearly all commercial electricity users and some industrials were shut down
  - Colder temperatures (increasing space heating demand)
  - Future coal and nuclear plant retirements (including those already scheduled for next winter)
  - Multiple cold weather episodes that depleted on-site oil supplies at dual-fired plants that burned oil during the first week in January (when some plants were nearly running out of oil and system-wide on-site storage was reduced to 19% of maximum capacity)
  - Higher incidence of well-head or pipeline shutdowns
  - Higher forced-outage rate for coal and nuclear retirements
  - Firm commitments by producers in Marcellus Shale to ship gas to other regions
- Electricity and natural gas prices could have spiked to two to four times early January levels
  - Excess costs to end users could easily have been $50 billion or more
- Even *with* all-time record prices, the lights would have gone out over large portions of the Northeast

Henry Hub Basis Differential Just as Significant an Issue

- Basis differential vs. Chicago and many other regional highs already at record levels
- As regional demand continues to increase, likely to get much worse
  - May lead to serious challenges in hedging prices for electricity and gas
- No quick fix

The Last Mile Problem: New Northeast Capacity Falls Short of Southeast Markets



Source Platts

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