NARUC

Winter Committee Meetings

Committee On Gas

Natural Gas Opportunities
Round Table Discussion Phase Two
Gas–Electric Interdependencies;
Accommodating an Increased Dependence on Natural Gas

FEBRUARY 14, 2017 | WASHINGTON, DC

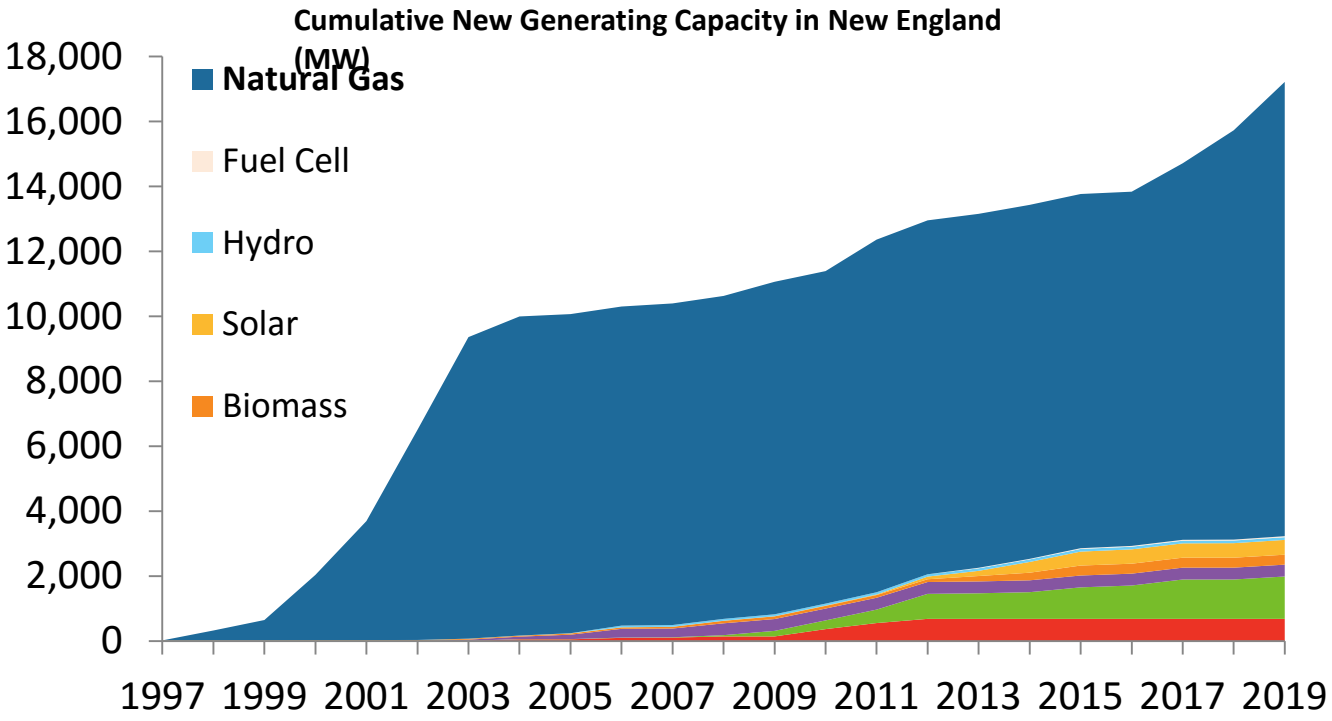
Managing Gas-Electric Interdependencies in the New England Region

NARUC 2017 Winter Committee Meetings

Peter T. Brandien

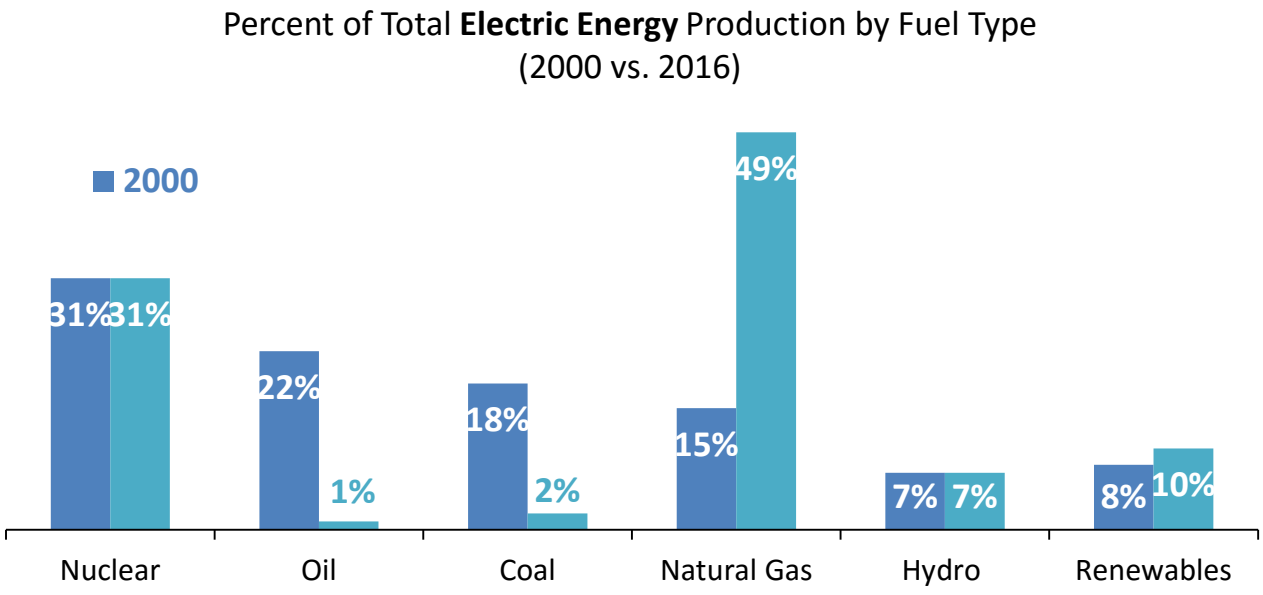
VICE PRESIDENT, SYSTEM OPERATIONS

Natural Gas Is the Dominant Fuel Source for New Generating Capacity in New England



Note: New generating capacity for years 2016 – 2019 includes resources clearing in recent Forward Capacity Auctions.

New England Has Seen Dramatic Changes in the Energy Mix: *From Coal and Oil to Natural Gas*



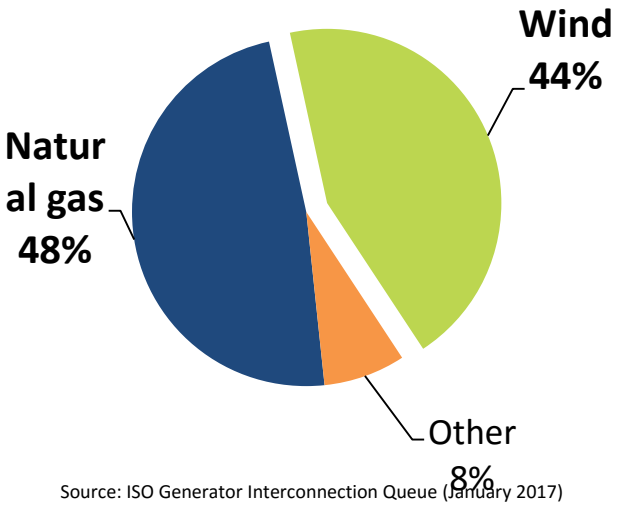
Source: ISO New England Net Energy and Peak Load by Source
Renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and miscellaneous fuels

New England Has Relatively Few Interstate Natural Gas Pipelines and Few Delivery Points for LNG

Infrastructure Will Be Needed to Deliver Energy from Proposed Resources

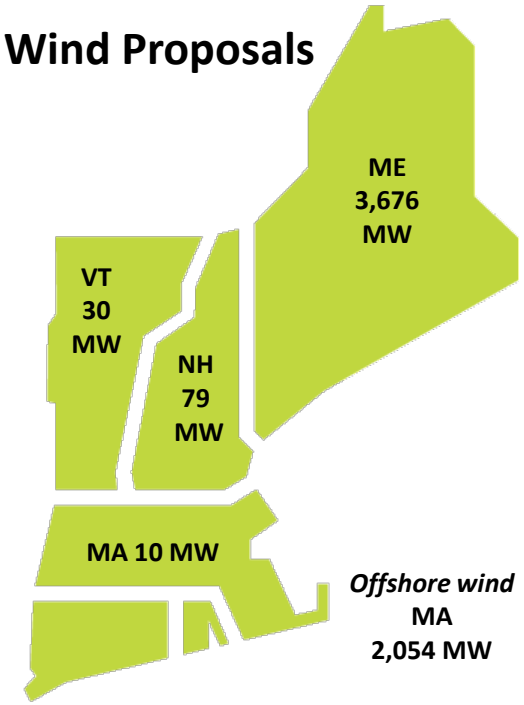
All Proposed Generation

Developers are proposing to build roughly 13,250 MW
of generation, including nearly 6,400 MW of gas-fired generation and more than 5,800 MW of wind



Source: ISO Generator Interconnection Queue (January 2017)
FERC Jurisdictional Proposals Only

Wind Proposals



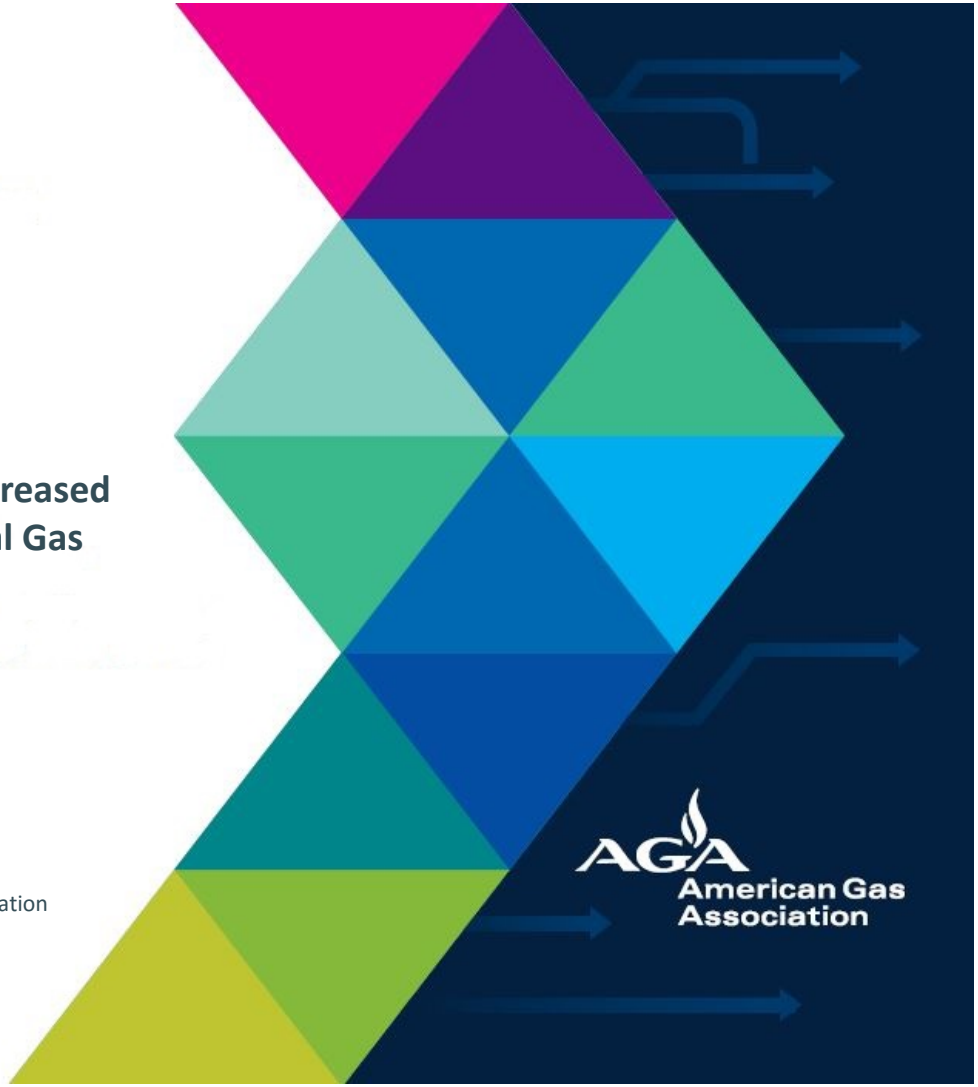
Source: ISO Generator Interconnection Queue (January 2017)
FERC Jurisdictional Proposals; Nameplate Capacity Ratings

Questions

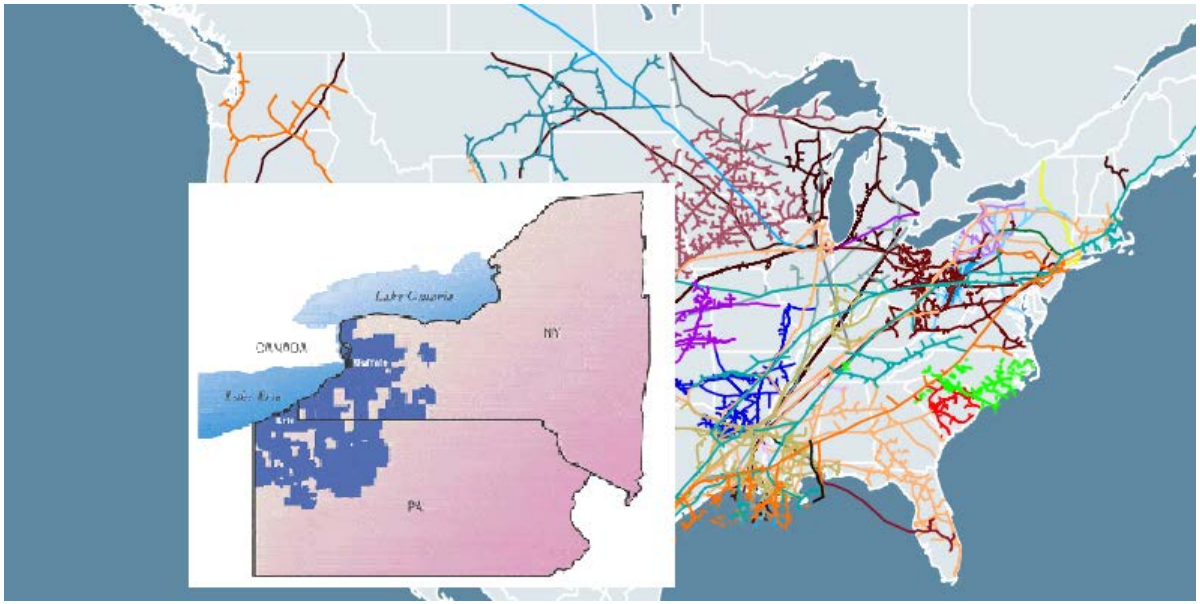
Gas-Electric Interdependencies – Accommodating an Increased Dependence on Natural Gas

The LDC Perspective

Michael Novak
Asst. General Manager
National Fuel Gas Distribution Corporation
Second Vice Chair, AGA FERC
Regulatory Committee



Gas-Electric Interdependencies
Accommodating an Increased Dependence on Natural Gas
The LDC Perspective



LDCs serve the generation market today:

- Sales vs. Transportation;
- Firm vs. Interruptible

Interruptions vs. Curtailments

Gas-Electric Interdependencies
Accommodating an Increased Dependence on Natural Gas
The LDC Perspective

- **Generators and LDCs face similar challenges: scheduling, load planning, disruption planning**
  - Unplanned load changes, typically in response to weather forecasting error.
- **LDC Procurement Portfolios**
  - Reliance on Pipeline Firm Transportation and Storage Services.
  - No-Notice Service.
  - Diversified gas supply arrangements designed to achieve both reliability and flexibility.

- **Benefits of FERC Order 787**
  - Operational Communications between RTOs/ISOs and pipelines and/or LDCs.
  - Better coordination between the gas market and electric timelines.
- **Role of RTO/ISO Gas-Electric Working Groups**

Improved communications and coordination are helpful but have their limitations.

Gas-Electric Interdependencies
Accommodating an Increased Dependence on Natural Gas
The LDC Perspective

- **Fundamentally, physical limitations on flow are resolvable through new capacity**
  - Reliability is a function of Service Priority matters most during periods of peak demand.
  - To serve their customers reliably, LDCs are concerned about the costs of NOT having capacity during a peak period.
  - If peak period fuel alternatives are not available, how does the electric industry address comparable concerns?

Potential next steps as a part of a comprehensive approach to ensuring reliability

- for the Gas Industry…
- for the Electric Industry…

NERC

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Special Assessment:

Single Point of Disruption on Natural Gas Infrastructure

John Moura, Director, Reliability Assessments and System Analysis

NARUC Winter Meeting

February 14, 2017

RELIABILITY | ACCOUNTABILITY



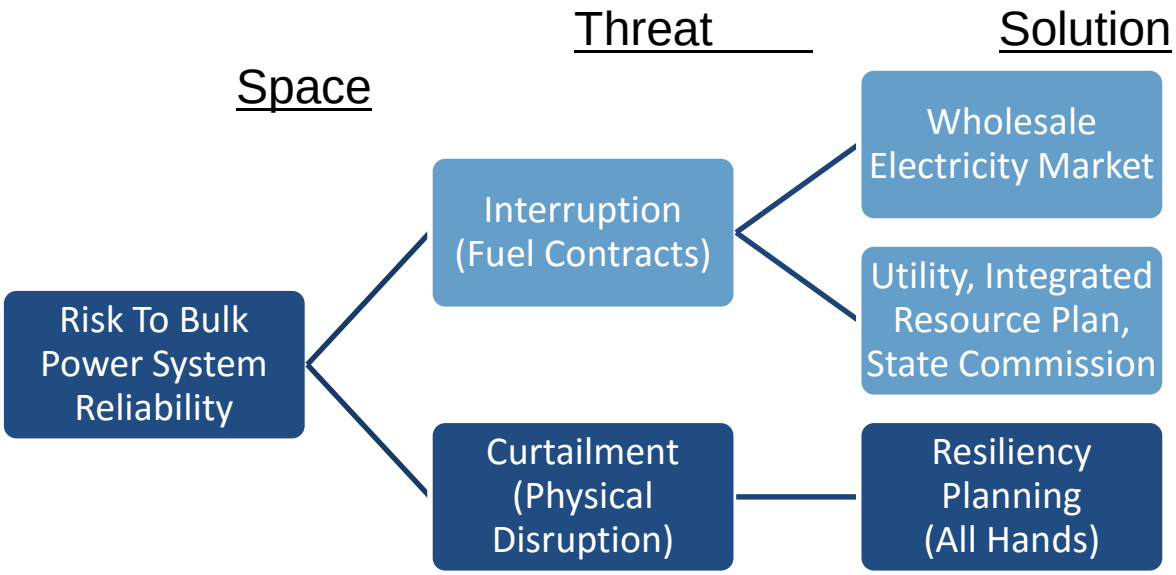

NERC: Mission and Purpose

Assure the reliability of the bulk power system

- **Develop and enforce NERC Reliability Standards**
  - Over 100 mandatory standards (1,500 requirements)
  - Developed and voted on by technical experts
  - Approved and enforced by NERC and FERC
- **Assess current and future reliability**
  - Develop reports to assess resource adequacy and identify reliability issues
  - Analyze system events and recommend improved practices
  - Manage technical committees and stakeholder groups

Gas – Electric Interdependency

- Increased dependence on natural gas for generating capacity can amplify the bulk power system's (BPS) vulnerability to disruptions in fuel supply, transportation, and delivery.



Special Assessment Scope and Drivers

- Aliso Canyon storage facility outage underscored risks to electric generation and potential reliability issues
- Evaluate impacts to BPS reliability as a result of potential disruptions and the loss of major natural gas infrastructure facilities:
  - Key pipeline segment outages
  - Disruption of LNG transport operations
  - Natural gas storage disruptions
- Collaborative effort with Argonne National Laboratory analysis on critical facilities
- Report expected in Q3 of 2017

Changing Resource Mix Drives Changes to Fuel Risk Profile

Natural Gas Plants

- Just-in-time fuel
- Minimal back-up fuel inventory if maintained
- Can be vulnerable to common-mode failure

Coal Plants

- 30-90 days on-site fuel inventory
- Long-term fuel supply contracts
- More resilient to fuel supply disruptions

- Maintain Fuel Security
  - Maintain fuel and resource diversity
  - Maintain firm fuel supply and transportation
  - Maintain dual-fuel capability
  - Maintain on-site fuel back-up inventory
- Resiliency Planning for Large Disruptions
  - Evaluate largest/multiple facility outages regardless of likelihood
  - State and Electric (e.g, ISO/RTO, local utility) partnerships
  - Incentives and rules in market areas
  - Security and risk assessment
- Enhance Situational Awareness
  - System operator intelligence on fuel inventories, contracts, shipments
  - Coordination with pipeline operators

Questions and Answers

ACCOMMODATING AN INCREASED DEPENDENCE ON NATURAL GAS

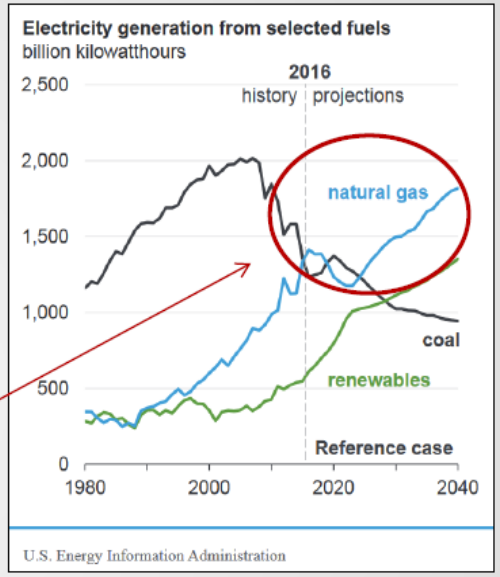
STEVE FOLGA
GUENTER CONZELMANN

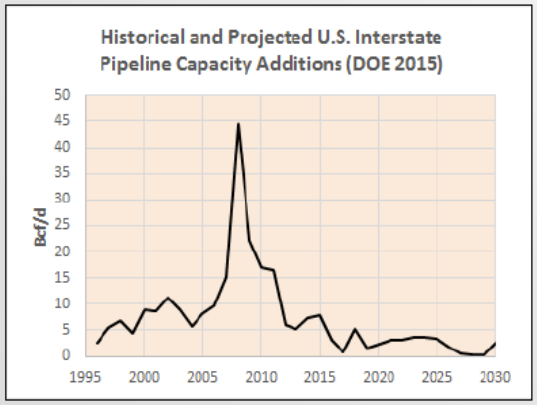
Argonne National Laboratory

February 14, 2017

GAS DEMAND FOR ELECTRIC GENERATION IS INCREASING

- **EIA's 2017 "Annual Energy Outlook" concludes that natural gas will displace electric generation by coal in the future:**
  - Due to projected low natural gas price relative to coal.
  - Natural gas may potentially displace electric generation by renewables.
  - Potential 30% increase in gas demand for electric generation by 2040.





- **DOE 2015 study concluded that less new pipeline infrastructure will be needed than in previous years, but more pipeline facilities need to be built:**
  - Due to more diverse sources of natural gas supply and demand.

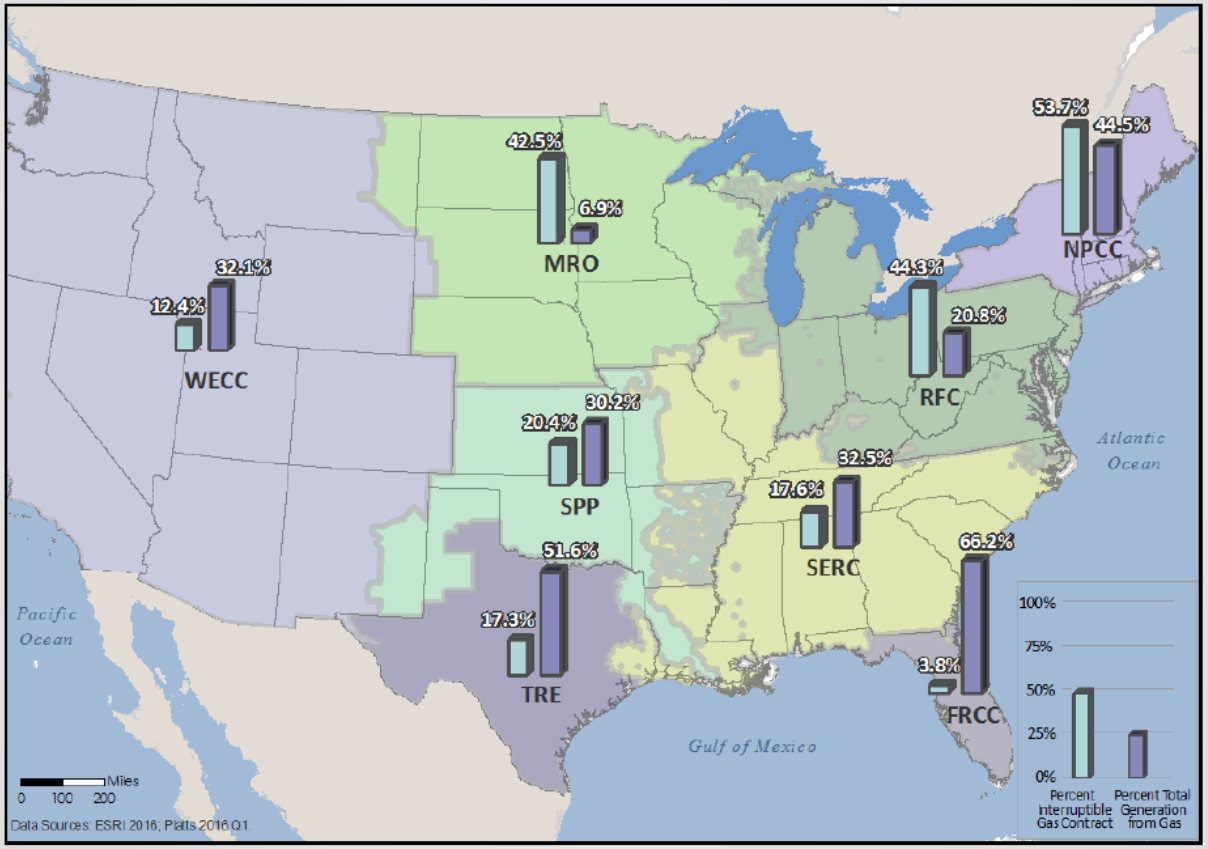
POWER PLANTS DEPEND ON INTERRUPTIBLE GAS TRANSPORTATION

- **In many cases, electric generators have opted not to hold firm gas transportation capacity:**
  - Adequate interruptible transportation capacity or "released capacity" generally available on most days.
- **During summer, natural gas utilities use only a fraction of their firm pipeline capacity:**
  - This is released on the secondary market or moves as pipeline interruptible transportation.
- **NERC regions such as NPCC and RFC are dependent on interruptible gas transportation for electric generation:**
  - Reduces the number of gas-fired electric generators that can be relied upon in extreme weather.

EIA-923 Data on Dependence on Interruptible Gas Contracts and Gas for Total Generation (2015)

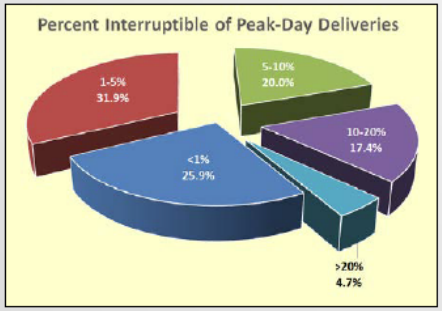
NERC Region	Percent Interruptible Gas Contract	Percent Total Generation from Gas
ASCC	0.0%	45.7%
FRCC	3.8%	66.2%
MRO	42.5%	6.9%
NPCC	53.7%	44.5%
RFC	44.3%	20.8%
SERC	17.6%	32.5%
SPP	20.4%	30.2%
TRE	17.3%	51.6%
WECC	12.4%	32.1%

NERC REGION DEPENDENCE ON NATURAL GAS FOR ELECTRIC GENERATION



BUT INTERRUPTIBLE GAS IS NOT ALWAYS AVAILABLE

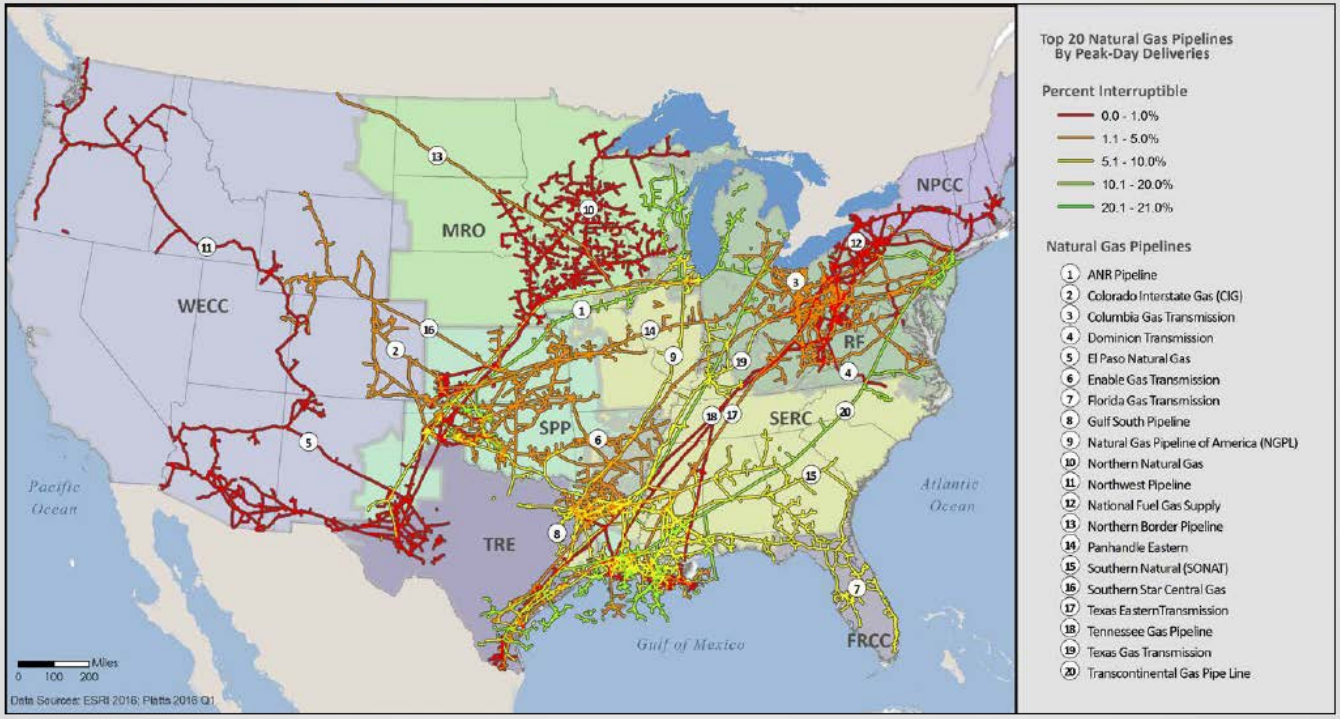
- **On many days of the year, interruptible transportation and released capacity will be unavailable:**
  - Firm customers will be using their full contractual entitlements.
  - Limited volumes of interruptible transport at peak-day conditions (total of 97 interstate pipelines).



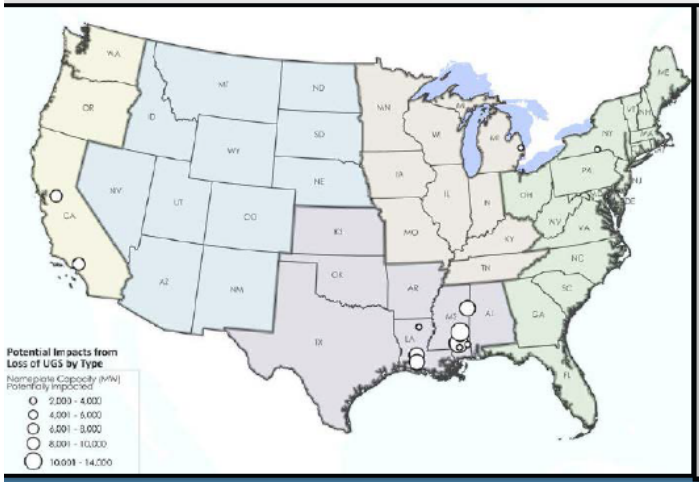
2015 FERC Form 2 Data on Peak-Day Deliveries by Natural Gas Interstate Pipeline Companies (top-twenty by peak-day deliveries)

Pipeline Company	Peak-Day Deliveries (Bcf/day)	Percent Interruptible
Columbia Gas Transmission,LLC	14.1	1.2%
Transcontinental Gas Pipe Line Company, LLC	13.2	17.1%
Texas Eastern Transmission, LP	11.0	4.8%
Tennessee Gas Pipeline Company, L.L.C.	10.8	0.9%
Dominion Transmission, Inc.	8.8	0.4%
Natural Gas Pipeline Company of America LLC	8.3	6.6%
ANR Pipeline Company	8.3	11.4%
Northern Natural Gas Company	6.1	4.6%
Gulf South Pipeline Company, LP	5.2	9.6%
Texas Gas Transmission, LLC	4.8	8.3%
Southern Natural Gas Company, L.L.C.	4.6	5.6%
Colorado Interstate Gas Company, L.L.C.	4.5	1.1%
El Paso Natural Gas Company, L.L.C.	4.1	0.2%
Enable Gas Transmission, LLC	3.7	1.5%
Florida Gas Transmission Company, LLC	3.4	7.5%
Southern Star Central Gas Pipeline, Inc.	3.3	2.2%
Northwest Pipeline LLC	3.1	0.0%
National Fuel Gas Supply Corporation	3.1	0.6%
Northern Border Pipeline Company	3.0	0.8%
Panhandle Eastern Pipe Line Company, LP	3.0	4.0%

LOCATIONS OF TOP-20 GAS PIPELINES BY PEAK-DAY DELIVERIES



ALISO CANYON WAS A WAKE-UP CALL TO THE ELECTRIC SECTOR



Please Choose: CA-SOUTHERN CALIFORNIA GAS COMPANY-ALISO CANYON <--- Please Choose Wisely

Please click on cell "B3", right-click on the arrow, and choose the UGS from the list to analyze

EIA 191 State	EIA 191 Company Name	UGS
CA	SOUTHERN CALIFORNIA GAS COMPANY	ALISO CANYON

Area	EIA 176 Company Name
California	SOUTHERN CALIFORNIA GAS COMPANY

The values in cells "G13" to "G15" revise the conditions of the analysis, to account for increased pipeline deliverability (cell "G13"), effects of voluntary reductions by the public (cell "G14"), and the degree of damage and disruption of UGS operations (cell "G15").

Argonne Analysis

Number of Customers Shed

Residential	Commercial	Industrial	Vehicle + Other	Electric Customers
0	0	0	0	17

Please Add		
Factor	100%	<--- Please Add This Value
Voluntary Reduction	0%	<--- Please Add This Value
Damage Fraction	100%	<--- Please Add This Value

Estimated Affected Total

Number	Capacity (MW)	Electric Customers
57	7,820	17

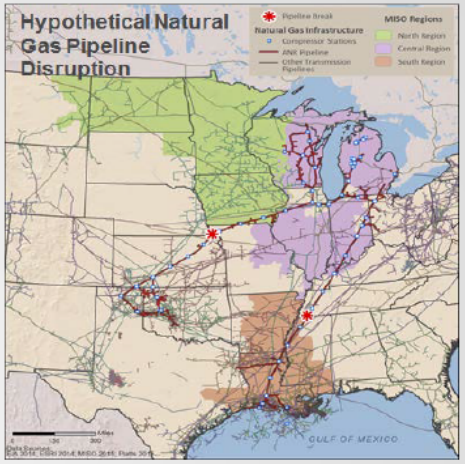
Number of Equivalent (Residential) Customers

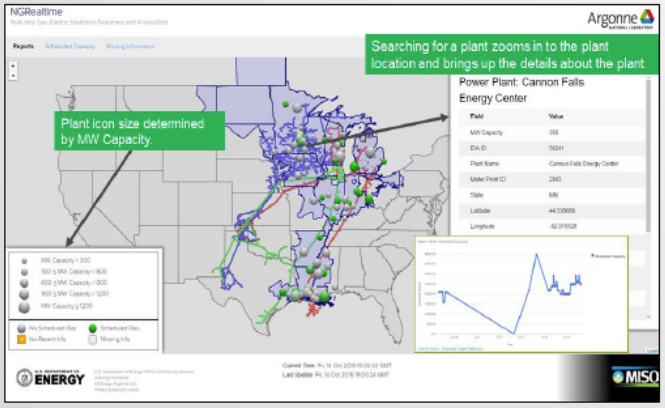
Residential	Commercial	Industrial	Vehicle + Other	Electric Customers	TOTAL
0	0	0	0	3,230	3,230

- Power system planners and operators need to know the electric reliability impacts of prolonged natural gas disruptions.
- Recent Argonne study concluded over 60 UGSs with potential impacts on power plant capacity (part of Interagency Task Force Report on "Ensuring Safe and Reliable Underground Natural Gas Storage").
- 12 UGS facilities appear to have the potential to affect 2 GW or more of available generation capacity → *working with gas storage operators to verify analysis.*
- Assessment will be updated as part of ongoing NERC *Single Point of Disruption* Study.

JOINT GAS/ELECTRIC PLANNING AND COORDINATION SHOULD BE STRENGTHENED

- **Electric sector entities should develop and train on new operating/market procedures, to increase situational awareness:**
  - Argonne developed a NERC-certified training course for MISO system operators on natural gas and electric coordination.
  - Course simulated and evaluated risk-based scenarios and possible impact on BES → *hypothetical pipeline disruption*.





- **There is a need for tools for analysis of short-term gas deliverability:**
  - Real-time version of gas-electric interdependency tool under development for MISO.
  - Provides additional insights into generator and pipeline activities not currently available to MISO.

BACKUP STRATEGIES CAN REDUCE RISKS

- **Availability of back-up fuel source can enable continued generation:**
  - Helps maintain a reliable source of operable capacity during peak electric demands.
  - Limited percentage of gas-fired capacity has dual-fuel capabilities.
  - NERC, generators, and Federal and State agencies should consider broader usage of backup strategies.

EIA-860 Data on Dual-Fuel Capability for Gas-Fired Electric Generators

NERC Region	Gas-Fired Capacity (MW)	Percent Dual-Fuel
ASCC	2,764	14%
FRCC	63,300	51%
HICC	2,921	0.4%
MRO	66,458	12%
NPCC	79,873	33%
RFC	241,119	10%
SERC	296,592	16%
SPP	76,936	7%
TRE	105,586	6%
WECC	227,408	4%

Number of Pipeline Interconnects for Each Electric Generator in MISO

Number of Pipeline Interconnects	Number of Power Plants	Total MWs
1	270	46,991
2	38	12,206
3	14	6,691
4	6	1,808

- **Multiple pipelines and storage operators provide diversity in natural gas infrastructure serving gas-fired electric generators:**
  - Multiple pipeline interconnects per power plant in ERCOT.
  - Single connection is typical.

FOR MORE INFORMATION PLEASE CONTACT:

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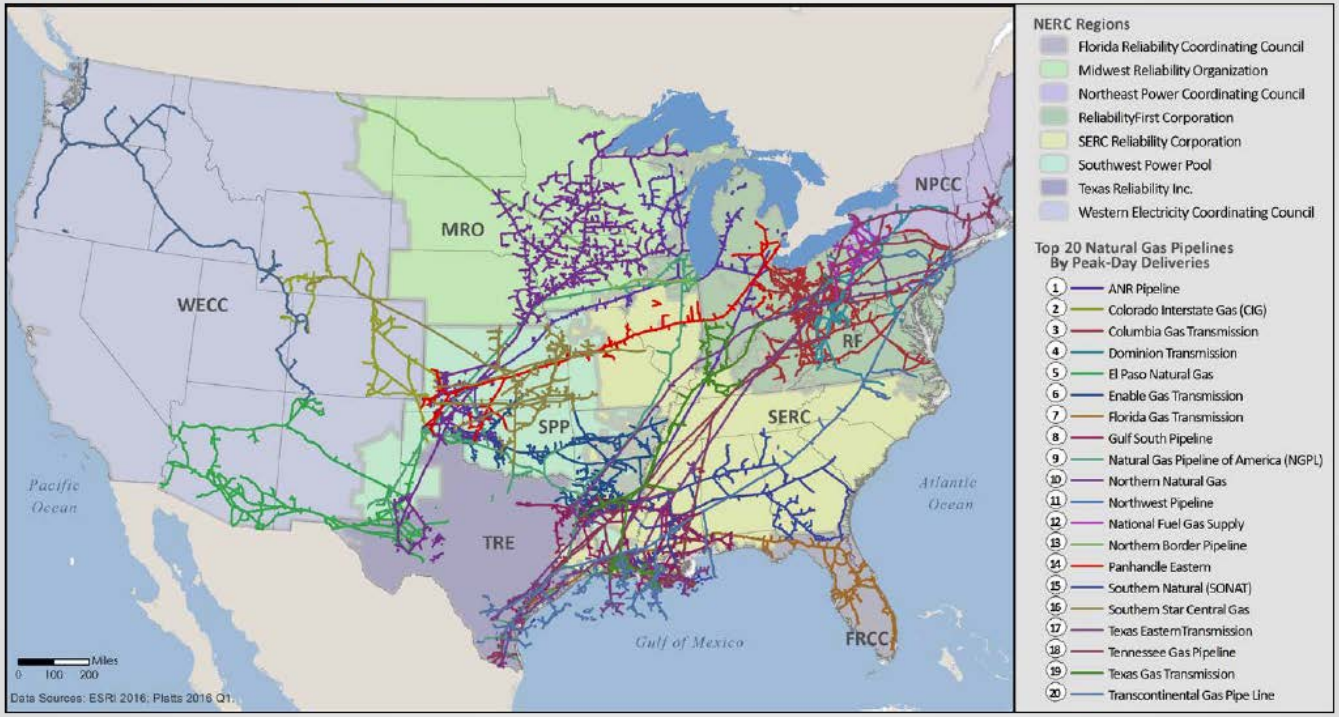
LOCATIONS OF TOP-20 GAS PIPELINES BY PEAK-DAY DELIVERIES



Southern Company

Gas Dependency and Analyzing Potential Disruptions

NARUC Winter Meetings

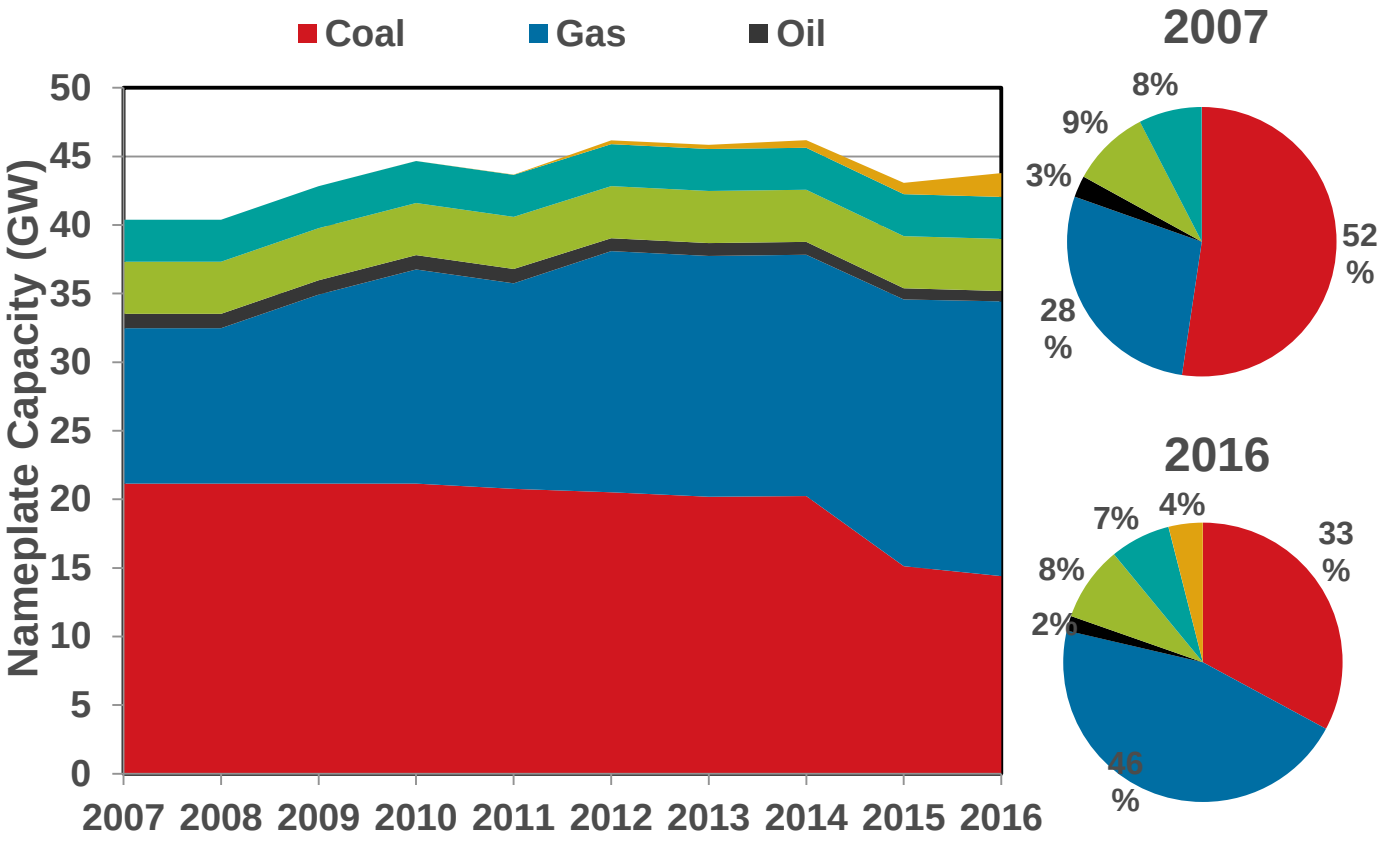
2/14/2017

Ryan Colley

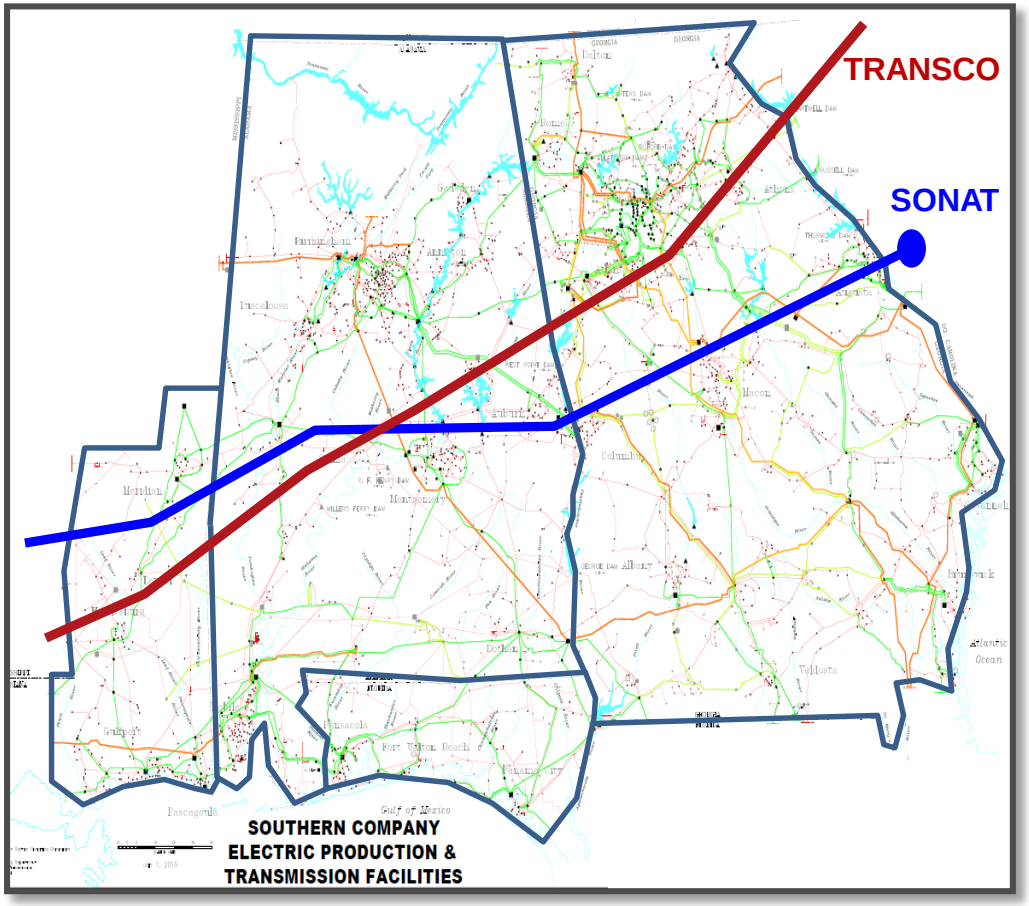
Planning Manager, Transmission Planning

Southern Company

Southern Company Generating Capacity



Supply Pipelines



Two Independent Supply Pipelines:

- SONAT
- TRANSCO

~ 5-8 GW in SOCO served from each pipeline

Firm generation resources are backed with “annual firm gas supply contracts” or “on-site oil”

Background

- Coordination with gas supply company's operating groups to discuss potential disruptions
  - Developed process and procedures in event of emergency
- Southern's Gas / Electric Infrastructure Study
  - NOT related to daily gas availability concerns as we contract for annual firm gas
  - Related to catastrophic loss of gas pipeline event at a point between gas supply (including storage) and delivery to generators
  - Annual coordination with Gas Operations to be sure we have latest fuel assumptions (e.g., back-haul capability)

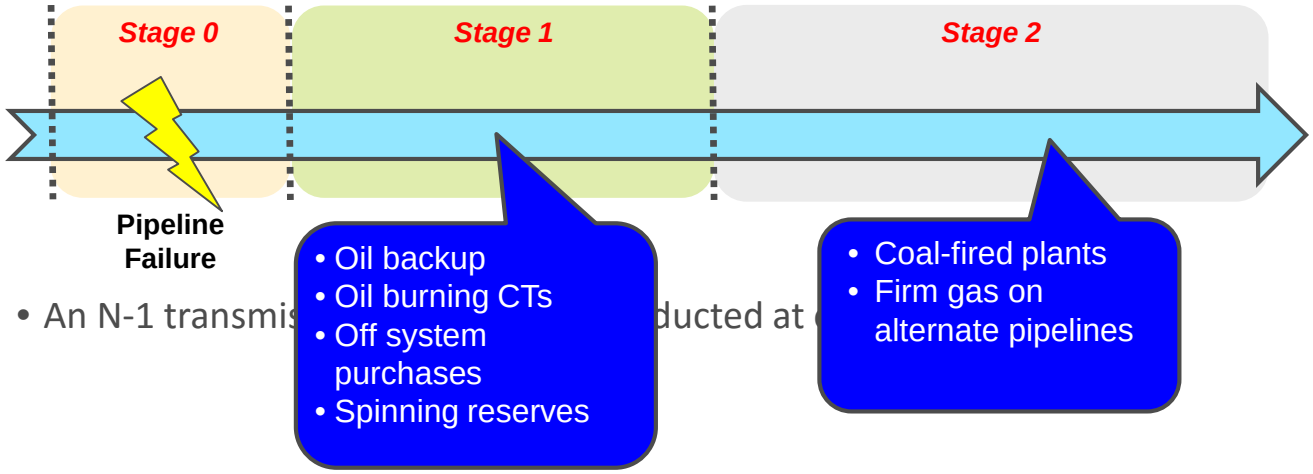
Preparing for Failure of Pipeline

- Southern Company analyzes on an annual basis the potential impacts to the Southern Balancing Authority's Area (SBAA) Generation and Transmission System of a hypothetical pipeline failure event at critical locations.

- This hypothetical pipeline failure event is studied at peak seasons (Summer and Winter) to identify the potential impacts at the most constrained timeframes.

Study Methodology

- A three-stage approach is used for the analysis:
  - Stage 0: system conditions prior to the failure and the system response immediately (~15-60 min) following the failure
  - Stage 1: system conditions 1-24 hours after the failure
  - Stage 2: system conditions days following failure

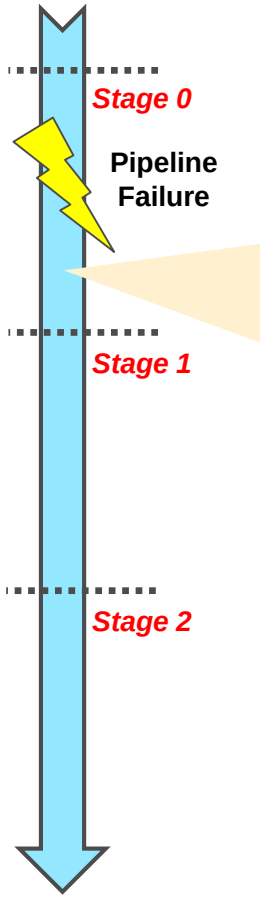


- An N-1 transmis ducted at

Key Assumptions

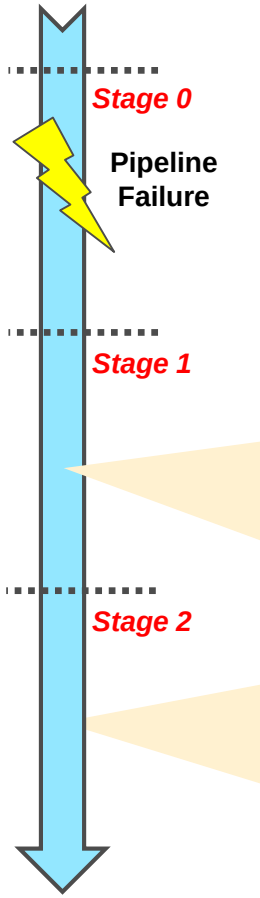
Conservative	*Optimistic*
• Full summer & winter peak loads • All system load remains post event • Interruptible load is not called • Firm contract transfers off-system remain • LNG storage is not used • Solar resources modeled offline in winter peak cases	• All units with oil transition seamlessly • No EFOR • No oil delivery issues • No environmental constraints • No issues on surviving pipeline • Power imports are readily available. • Hydro levels normal

Post Failure (Initial Moments)



- Prompt communication/notification of failure from pipeline Operator to Transmission and Fleet Operations
- Decisions made on how to burn the remaining gas (first hour)
- All plants on pipeline are turned off unless they have backup oil ; if oil is available, convert gas units to oil
- Start all available oil-fired CTs (15 min)
- Utilize Spinning reserves (online coal and CCs)
- Run Hydro
- Arrangements for additional gas on non-affected pipelines and, if necessary, additional off-system purchases
- Initiate processes for oil resupply and for available off-line steam units

Beyond Initial Response



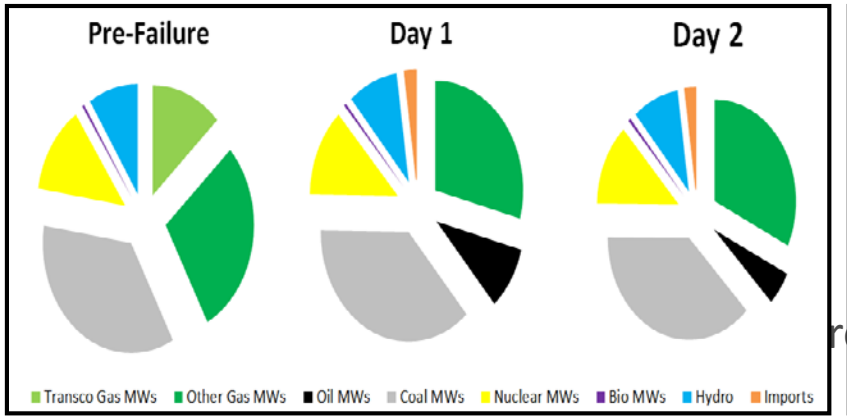
Critical Elements for Success:

- Steam units called on during initial response are available
- Gas units from non-affected pipeline are available
- Off-system purchases are available
- Begin reducing oil burn to replenish sustainable rates
- Considerations for oil replenishment:
  - supply depot min levels
  - loading terminal capability
  - # of trucks needed
  - unloading terminal capacity
- Identify & prepare Operations for any needed transmission mitigation

Results of Study

- Southern has adequate resource flexibility and backup fuel capability to maintain reliability in the event of a pipeline failure

TRANSCO:



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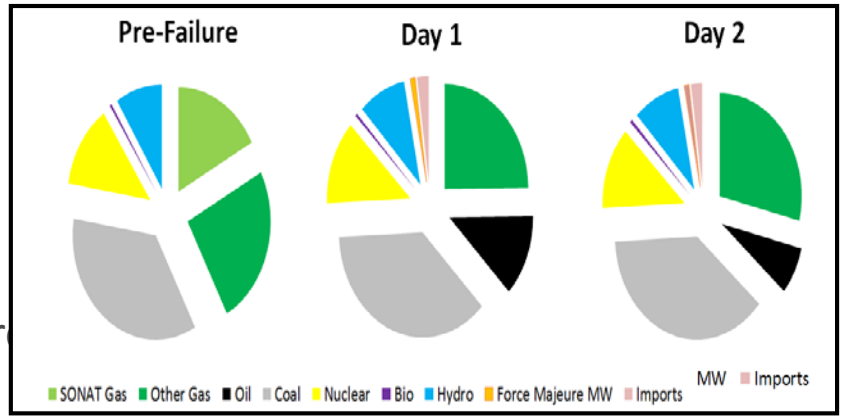


Key Takeaways

- Understanding resource impacts & response to disruption is critical element of study
  - More time spent coordinating and understanding impacts to resource adequacy than performing transmission analysis

- Coordination with Operations (Gas & Transmission) is key to developing processes and procedures

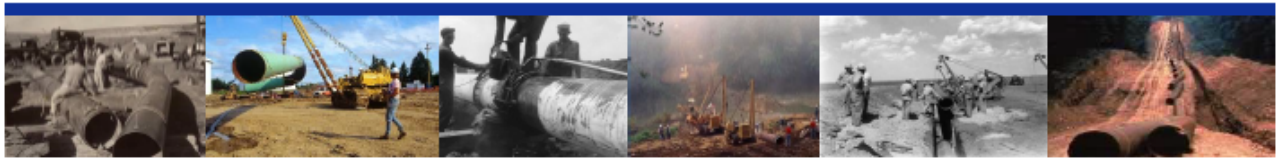
Southern Company

Questions?

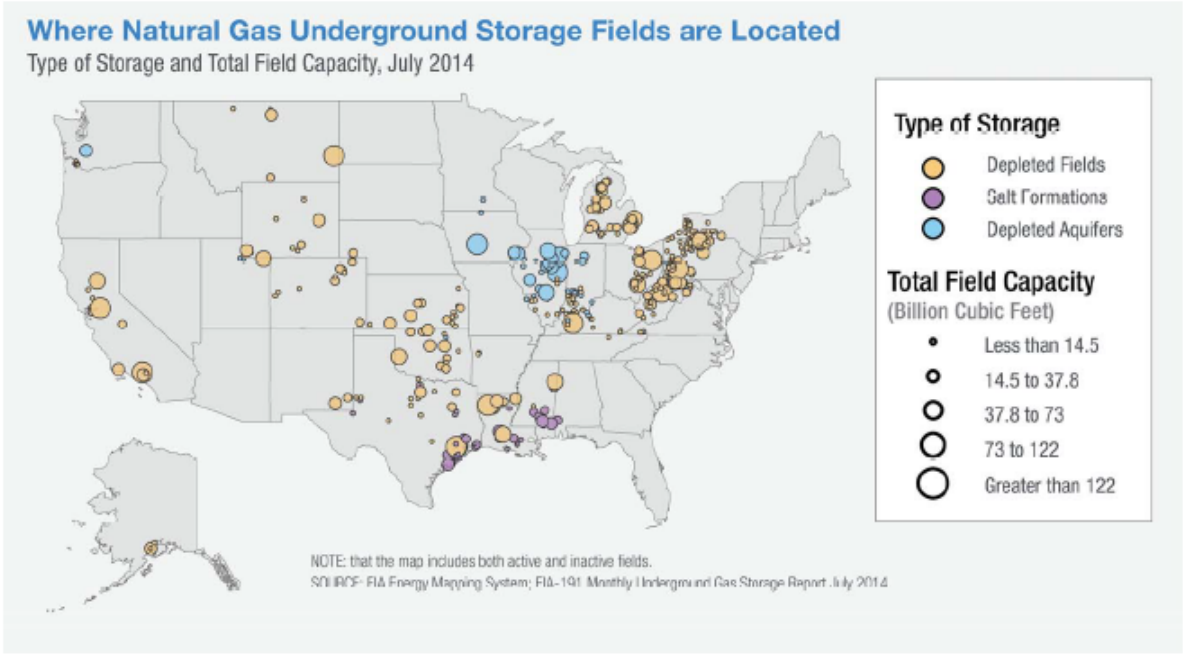
US Gas Transmission & Storage Network: Resilient & Reliable

Joan Dreskin
General Counsel, Vice President of Regulatory Affairs
Interstate Natural Gas Association of America

NARUC | February 14, 2017



Where Are Underground Gas Storage Facilities?



PHMSA's Underground Storage Interim Final Rule Will Improve Safety and Reliability

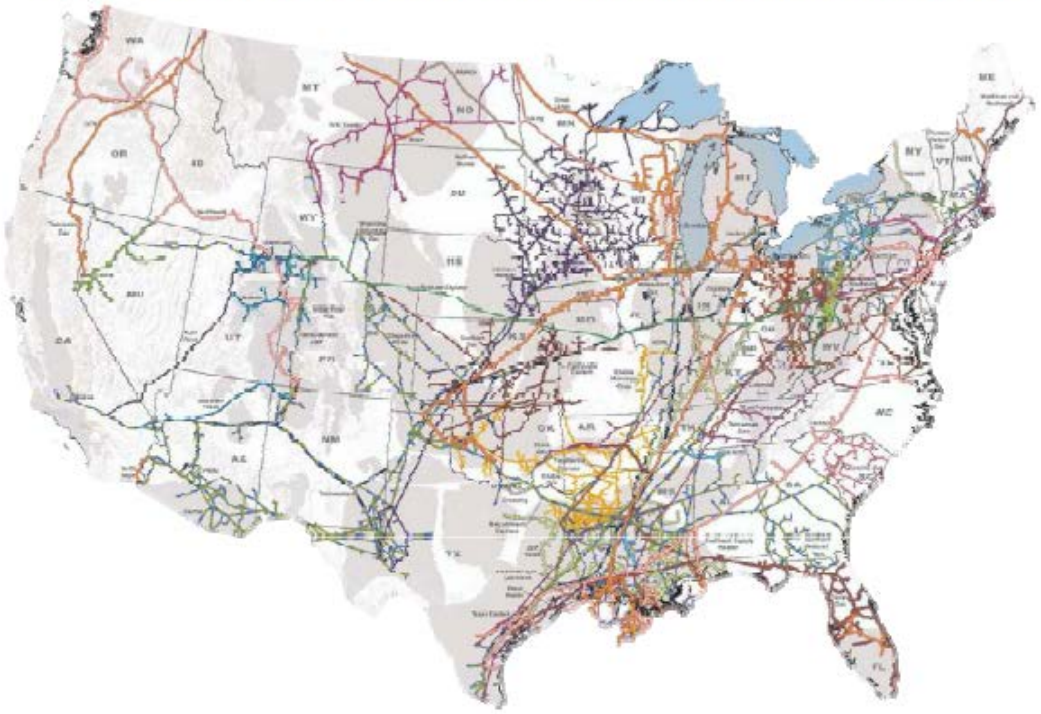
- Operators are required to implement Functional Integrity Management Systems
  - Safety Management Systems → Increase Physical *Integrity* → Increase Performance *Reliability*
- Risk-based approach to selecting preventative and mitigative measures:
  - Collect and analyze additional data
  - Conduct assessments
  - Modifying well completions
  - Installing new equipment
- IFR is in effect
  - One Year: Develop functional integrity management plan
  - Three – Eight Years: Risk assessments and P&M measures (including integrity assessments)

INGAA

Contracts Matter

- The reliability of natural gas supply delivered by interstate pipelines or storage facilities is established by contract.
- If a shipper wishes to ensure reliable service, it cannot rely on interruptible transportation or storage during peak periods.

US Interstate Natural Gas Transmission Network



Infrastructure Matters

"[U]ltimately, improving the natural-gas delivery infrastructure in New England… will have the most impact on addressing the reliability, price volatility, and negative emission impacts during winter."

- ISO-New England

Questions?

Contact:

Joan Dreskin

General Counsel
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NARUC

Winter Committee Meetings

Committee On Gas

Natural Gas Opportunities
Round Table Discussion Phase Two
Gas–Electric Interdependencies;
Accommodating an Increased Dependence on Natural Gas