

Resilience in the Face of Critical Events

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American Gas FOUNDATION

Enhancing and Maintaining Gas and Energy System Resiliency

Areas of Focus and Change

Report Key Questions

- What characteristics of the current regulatory framework enable or disable gas resilience?
- How does resiliency in the gas system enhance energy system resiliency?
- How can resilience be valued and measured to better qualify gas infrastructure investments?
- What recommended changes are needed to enable gas and energy system resilience?



Resilience Compared to Reliability

Resilience

The set of energy system abilities that allow it to prevent, withstand, adapt to, and quickly recover from system damage and/or operational disruption.

Reliability

The ability of the energy system to deliver services in the quantity and with the quality demanded by endusers.



Source: Guidehouse



Building a Resilient Energy Future – How the Gas System Contributes to US Energy System Resilience

Natural gas infrastructure is critical to supporting gas-powered electric generation systems – this is central to ensuring resiliency of the overall energy system.

Natural gas pipeline and storage infrastructure are critical in supporting energy grid resilience by reliably delivering natural gas, even during short and long-term duration needs (e.g., including extreme weather).

Natural gas and other low-carbon fuels will remain a core element of the US energy system for decades to come and natural gas electric generation is critical to scaling the integration of renewables.



Additional Research Insights – Impacts to the Energy System

Lack of coordination between the electric and gas industries create issues in ensuring resiliency and operation of critical natural gas infrastructure.

- Natural gas interstate and local distribution are inherently more resilient than electric transmission and distribution systems since underground pipelines are insulated from extreme weather events.
- Resilience of the overall energy system rests upon gas system resilience since natural gas accounts for one-third of primary energy consumption across all principal sectors of the economy and is the primary fuel for the generation of electric power in the US.

Source: Guidehouse



Research Insights – Extreme Weather Events



U.S. Year 2021 Billion-Dollar Weather and Climate Disasters

This map denotes the approximate location for each of the 20 separate billion-dollar weather and climate disasters that impacted the United States in 2021

Source: NOAA National Centers for Environmental Information (NCEI)

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Research Insights – Extreme Weather Events





Source: NOAA National Centers for Environmental Information (NCEI); Dollars are shown in nominal values over time.

Regulatory constraints exist in the gas system - many times gas utilities are not appropriately compensated for resiliency investments.



Research Insights – Market Response to Resilience

Increasing service disruptions hastened the use of gas-powered distributed energy resources (DERs) to counter outages and improve customer resiliency.

Annual Total DER Capacity by Region, World Markets: 2022-2031



- Customers are mitigating energy system risk by installing DERs, including standby and other types of dispatchable gaspowered electric generation.
- DERs allow customers to leverage the inherent resilience of the natural gas distribution network.
- Standby generators has soared over the past few years due to storm-induced increased net sales of **122.5%** from 2017 to 2021.

⁽Source: Guidehouse Insights)

Recommendations - Resilience Investments

Integrated solutions are required for resilient gas service to LDC customers - primary driver of enhanced energy system resilience is improving gas resilience.

Upstream of the City Gate Investments

- Ensure preparation for extreme weather -Increase investments in the weatherization of wellheads, gathering, and processing systems, gas transmission networks, and storage facilities
- Continue replacing aging pipelines and interconnections with long lived assets that support broader energy system resilience
- Design systems to accommodate low-carbon fuels for future operations to provide resilience benefits and support decarbonization goals

Downstream of the City Gate Investments

- Increase investments in pipeline and storage infrastructure weatherization
- Expand upstream pipeline interconnections
- Develop additional distributional storage facilities to enhance the resilience of the overall pipeline distribution system
- Expand integration of alternatives fuels (e.g., hydrogen) or locally produced LNG
- Modernize infrastructure to lower emissions and enhance safety, reliability, resiliency and affordability



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Recommendations - Implementing Resilience

Broader energy federal and state policies and regulatory mechanisms to increase resilience are required to support resilience investments across the energy system.



(C) Actions to Implement Resilience

- Federal and state legislative approval of resilience measures
- Resilience regulatory requirements written into state and federal frameworks
- ✓ Federal and state funding support for energy system resilience investments
- Energy system management across natural gas and electric networks



Conclusions & Key Themes

Climate events have created direct and indirect costs due to disruptions in electric and gas supply and the system vulnerabilities of these assets and operations.

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Lack of integrated operational coordination and regulation between natural gas operations (i.e., pipelines, storage infrastructure) and electric operations (i.e., ISOs and electric utilities) – this exposes the entire energy system to increased risk.

2

Need to increase momentum for regulators to address energy system failures - stakeholders and the public need to better understand the role pipeline and storage infrastructure needs to play in the future state energy system.



5

Recommended resilience investments include replacing aging infrastructure, increasing weatherization standards, building additional storage facilities, and developing systems to integrate low-carbon fuels

Public, regulatory and financial support are the foundational principles to implement resilience.



Resilience in the face of critical events

NOVEMBER 13, 2022

Sean Smillie PhD Candidate, Engineering and Public Policy Carnegie Mellon Electricity Industry Center

Low hanging fruit

- 1. Collect high-granularity data of gas disruptions
- 2. Classify electric compressor stations on gas network as critical electric load

Collect high-granularity data of gas disruptions

Carnegie Mellon University

Gas interruption data is sparse

- No gas interruption reporting for 26 states
- Where reported, thresholds often high
- Often not publicly available
- Interstate reporting isn't much better



Carnegie Mellon University

Why do we need it?

- Key issues
 - Dependence of electric system on gas
 - End use electrification
- Importance of cross-utility datasets
 - What causes interruptions?
 - Frequency of small and large events?
 - On what part of the system?

Classify electric compressor stations on gas network as critical electric load

Carnegie Mellon University

If grid power fails, backup power unavailable for compressor electric motors



10% of compressor stations are electrically-dependent



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Electric dependence by state



Recommendations

- Require high granularity gas interruptions data reporting
 - Ensure public availability
- Ensure electrically-dependent compressor stations are classified as critical infrastructure
 - Examine intrastate gas compressor stations
 - Consider in electric load shed plans

Resilience in the Face of Critical Events



Introduction to Atmos Energy

Atmos Energy is the country's largest natural gasonly distributor. We safely deliver reliable, affordable, efficient, and abundant natural gas to more than 3 million distribution customers in over 1,400 communities across eight states located primarily in the South.

Our Vision

Our vision is for Atmos Energy to be the safest provider of natural gas services. We will be recognized for Exceptional Customer Service, for being a Great Employer and for achieving Superior Financial Results.

- Atmos Energy Corporation headquarters
- Division offices
- Natural gas distribution service area



Resilience

Resilience is an inherent and crucial component of a dependable energy system, which is obtained through diverse and redundant energy sources.

Gas system resilience enables overall energy system resilience.

The **resilience** of the overall energy system rests upon gas system **resilience** since natural gas accounts for one-third of primary energy consumption across all principal sectors of the economy and is the primary fuel for the generation of electric power in the US.





Preparation with Respect to Resilience



EIA Info on Natural Gas Demand through 2050

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Note: Biofuels are shown separately and included in petroleum and other liquids.



Regulatory Framework in Atmos Energy Jurisdictions

Annual Formula Rate Mechanisms		
State	Infrastructure Programs	Comprehensive Annual Rate Mechanisms
Colorado	System Safety and Integrity Rider (SSIR)	
Kansas	Gas System Reliability Surcharge (GSRS)	—
Kentucky	Pipeline Replacement Program (PRP)	—
Louisiana	(1)	Rate Stabilization Clause (RSC)
Mississippi	System Integrity Rider (SIR)	Stable Rate Filing (SRF)
Tennessee	(1)	Annual Rate Mechanism (ARM)
Texas	Gas Reliability Infrastructure Program (GRIP), (1)	Dallas Annual Rate Review (DARR), Rate Review Mechanism (RRM)
Virginia	Steps to Advance Virginia Energy (SAVE)	

(1) Infrastructure mechanisms in Texas, Louisiana and Tennessee allow for the deferral of all expenses associated with capital expenditures incurred pursuant to these rules, which primarily consists of interest, depreciation and other taxes (Texas only), until the next rate proceeding (rate case or annual rate filing), at which time investment and costs would be recoverable through base rates.



Modernizing Our Distribution System

~\$11 Billion Capital Plan Through 2027; > 85% Focused On Safety and Reliability

- Replace 4,000 5,000 miles of distribution system pipe
 - 6% 8% of total system
- Replace 120,000-170,000 steel service lines
 - 15% 20% reduction
- Install wireless meter reading
 - ~75% anticipated WMR coverage
- Support Customer Growth



Bare Steel, Cast Iron, Vintage Plastics Other Risk-Based Materials

Inventory of Steel Service Lines^{1,2}





Modernizing Our Transmission System ~\$4 Billion Capital Plan for APT Through 2027

- Pipeline Integrity Management
 - Upgrading lines with pigging facilities
 - Replacing valves, fittings, and pipe to allow In-Line Inspection tools to travel through pipeline
 - Prioritized replacement based on integrity management results
- Supply Reliability and Growth
 - Replacing 400-600 miles APT transmission pipe through 2027
 - Line S-2 east of Dallas
 - WA Loop West of Fort Worth
 - Permian Highway Connector
 - Bethel to Groesbeck line
 - Bethel Cavern upgrade







Total Pipelines High Consequence Areas

1. 2021 DOT Report

2022 figures are based on fiscal year data

Atmos Energy System Integrity Investment

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Distribution Pipeline



Atmos Energy Residential Customer Growth

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Tests of Resilience in the Face of Critical Events



Recent Critical Events in Atmos Energy Service Territory











Atmos Energy in Texas





Regulatory Actions Post-Winter Storm Uri

Recovery of extraordinary costs

- Gas costs (Uri KS, TX both states had orders to support cost recovery during the event)
- O&M costs (KY tornadoes, LA hurricane)

Need for modernization of curtailment plans to clarify priority of service (Uri - TX RRC rule)

Coordination of gas and electric (Uri - TERC, Supply Chain Map, Curtailment Rule)

Weatherization of Critical Infrastructure (Uri – TX: developing lessons learned and taking precautions at all stages of the natural gas supply chain for weather preparedness)



Keys to Resilience in the Face of Critical Events

- Supportive regulatory treatment on system integrity investment
 - Modernization of natural gas distribution, transmission and storage systems
- Strong balance sheet creditworthiness in a market of extraordinary gas prices
- Value of natural gas the characteristics of our business lends itself to performance under extreme conditions
- Dedication of our employees and the thorough training and planning for peak demand events



Resilience in the Face of Critical Events

