AGA
American Gas Association

Assessing the Value of Natural Gas Storage

Promoting Energy Resiliency in a Changing Energy Landscape

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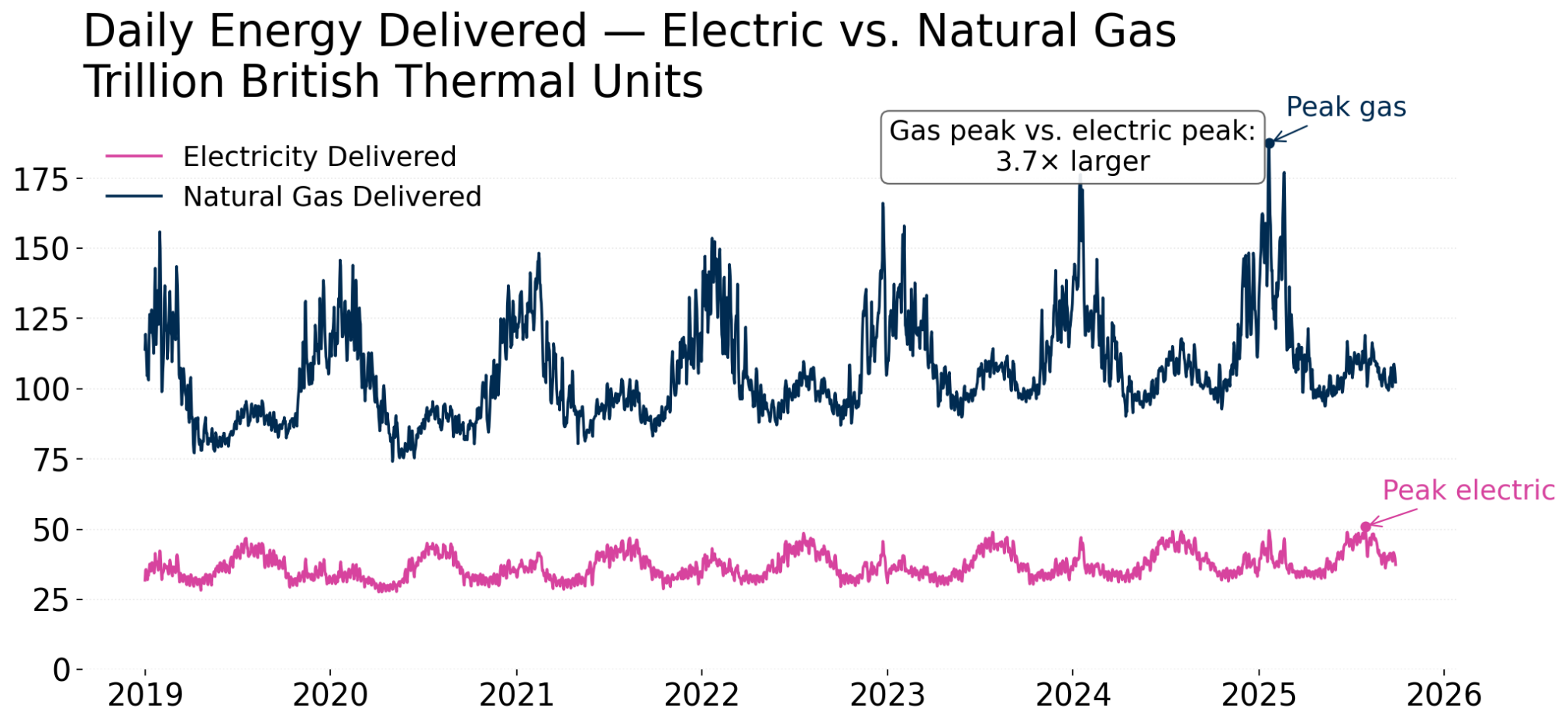
2021 Study: Enhancing and Maintaining Gas and Energy System Resiliency

High Level Detail

- **Resilience** is an inherent and crucial component of a dependable energy system, which is obtained through diverse and redundant energy sources.
- This **report examines gas system resilience attributes focusing on how it enables overall "energy system" resilience (gas + electric systems)**, changes to the regulatory framework to support resilience investments and infrastructure improvements to support broader energy system resilience.
- The **ability of the gas system to meet seasonal and peak day demands** is a key resource that must be considered when designing future energy systems and building pathways to a low-carbon future.
- **The report also examines opportunities to enhance the resilience of the entire energy system** and how future gas system investments support resilience of other parts of the energy system – this approach can also support a low-carbon future.

Natural gas delivers nearly 4x more energy than the electric system on peak days



Source: Rystad Energy, S&P Global Commodity Insights, ©2025 S&P Global Inc., Chart: American Gas Association | Data subject to revision

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 versus Reliability

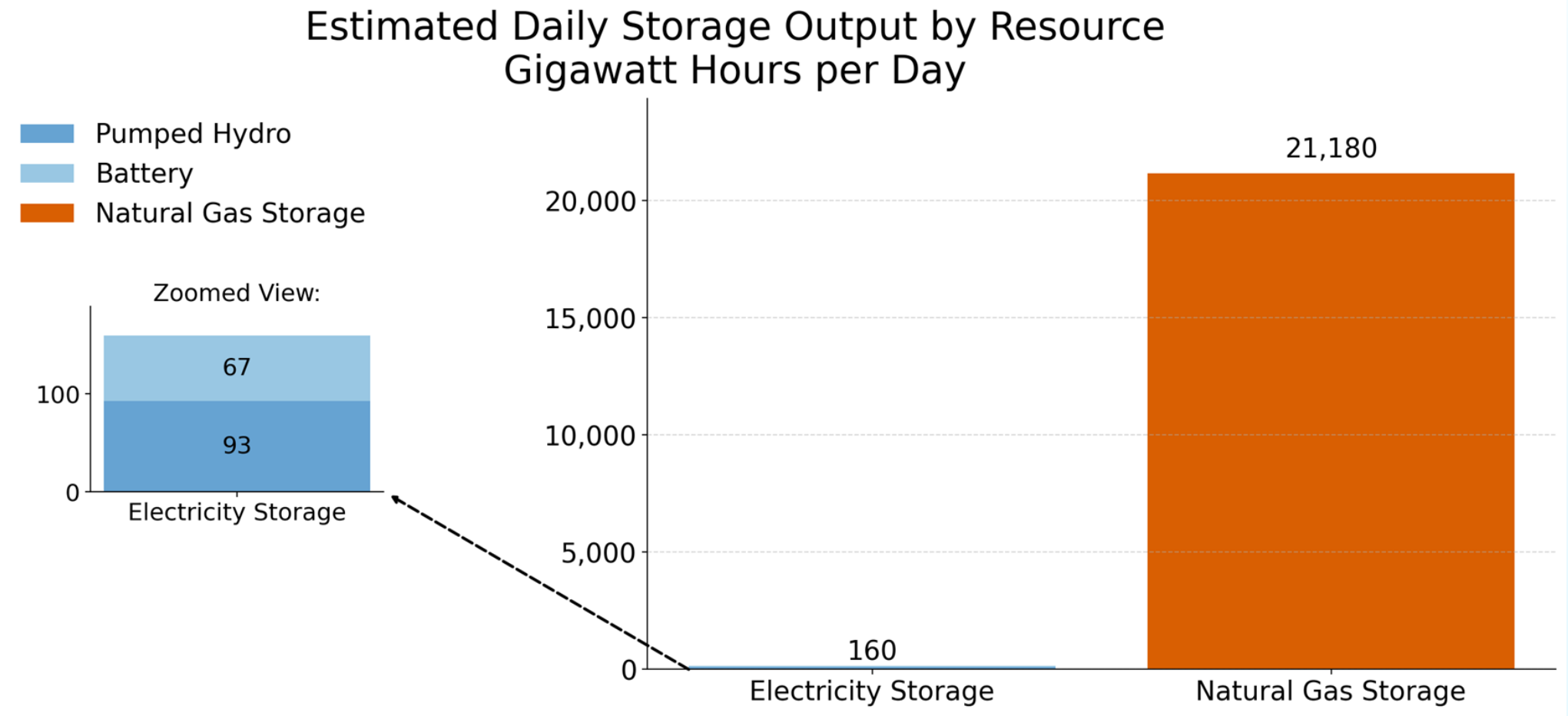
- **Reliability**: the ability of a system to anticipate, prepare, prevent, withstand, adapt to, and quickly recover from high probability, low impact events

- **Resilience**: the ability of a system to anticipate, prepare, prevent, withstand, adapt to, and quickly recover from low probability, high impact events

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.
- 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 in the face of rapidly increasing energy demand.

Gas Storage is the Principal Balancing Tool in the US

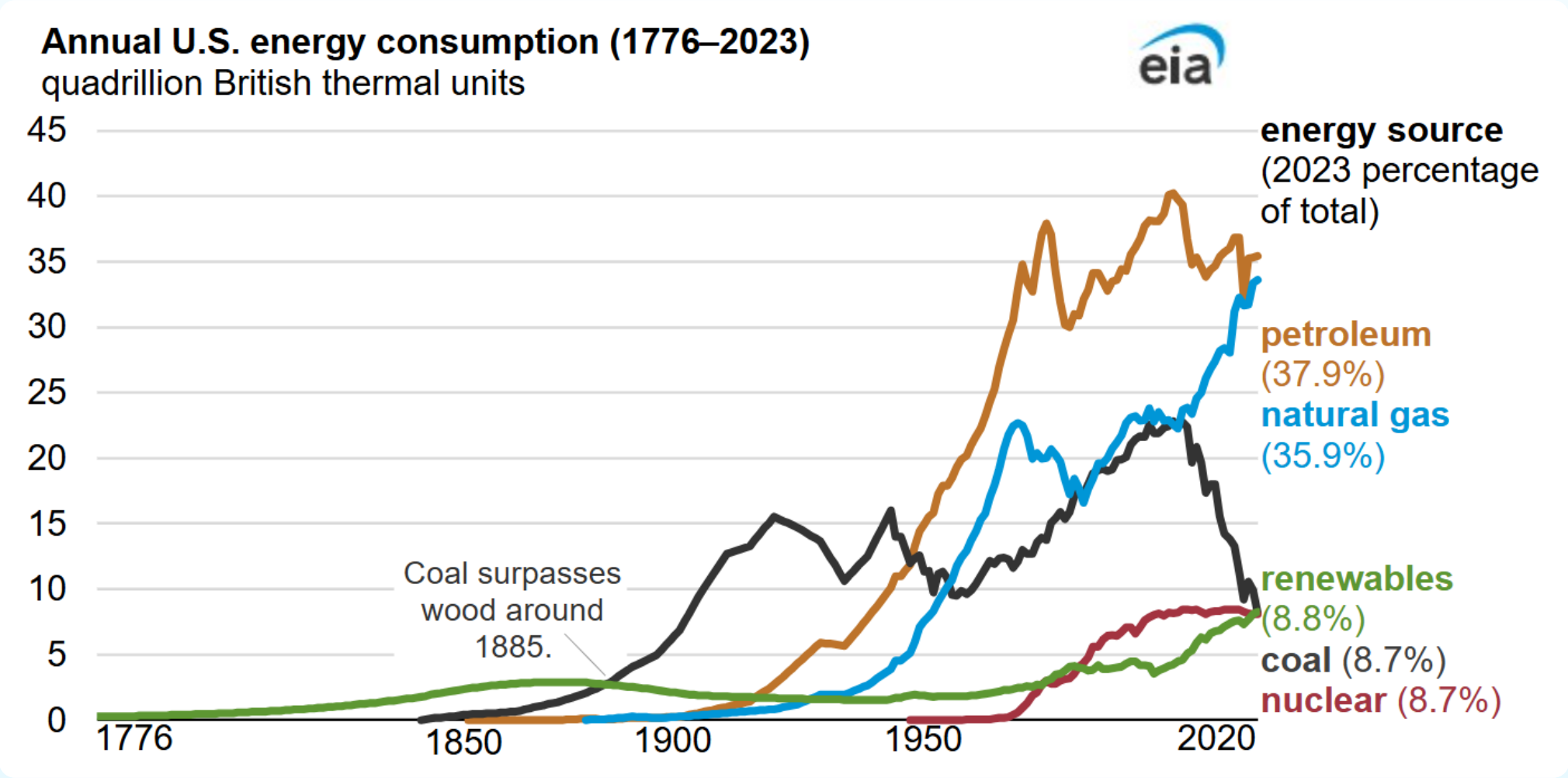


Source: Energy Information Administration, S&P Global Commodity Insights, Data as of Sept 11, 2025. NG output on Jan 21, 2025. Electric output estimated using EIA June 2025 maximum nameplate capacity * maximum daily dispatch capacity.

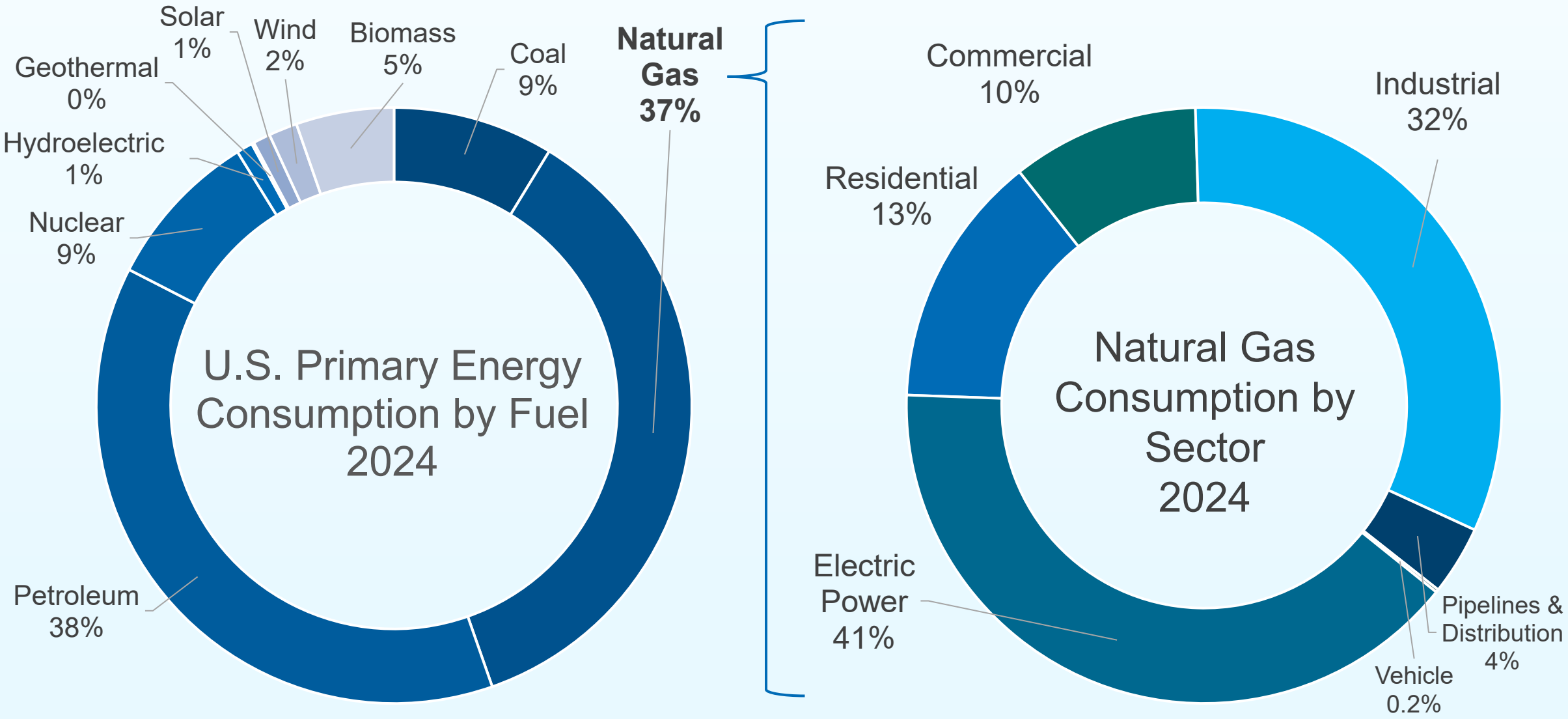
Additional Research Insights – Impacts to the Energy System

- Lack of efficient and transparent coordination between the electric and gas industries creates 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.
- Resilience of the overall energy system rests upon gas system resilience since **natural gas accounts for more than 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.
- Direct use natural gas is the primary peak electric shaving mechanism across the country.

Natural gas is on the verge of becoming the #1 U.S. energy source

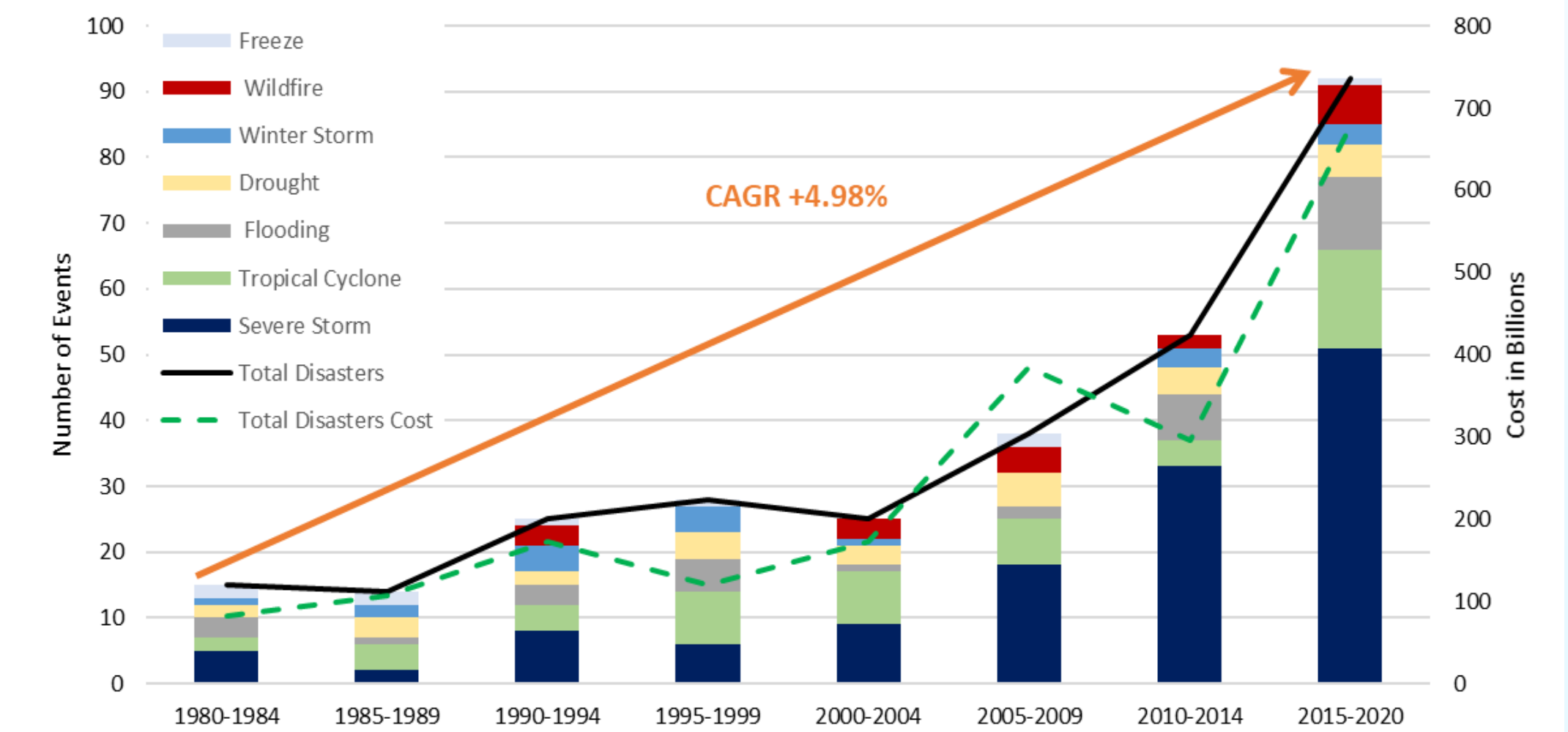


Natural gas provides one-third of U.S. energy across the economy



Research Insights – Extreme Weather Events

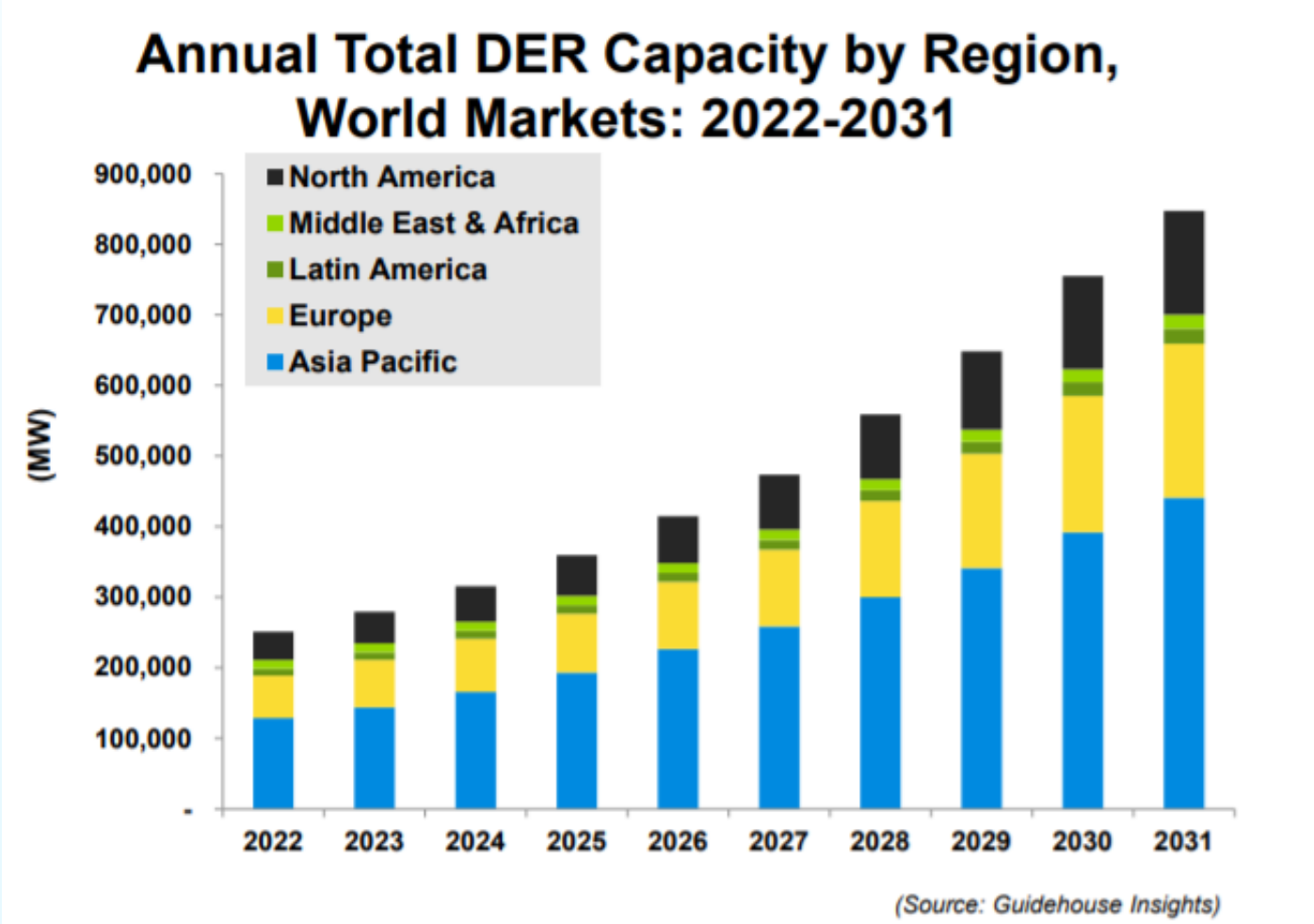
Growth of U.S. Billion-Dollar Weather and Climate Disasters



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

Research Insights – Market Response to Resilience

- Customers are mitigating energy system risk by installing gas-powered distributed energy resources.
- 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 resilience events - increased net sales of **122.5%** from 2017 to 2021.



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

Inadequate political and regulatory support for resilience in the gas system.

Few state regulatory initiatives specifically address gas system resilience.

Resilience is often indirectly referenced and embedded within reliability and safety standards.

Lack of regulatory mechanisms to compensate participants for resilience investments.

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Recommendations – Resilience Investments

Upstream of the City Gate

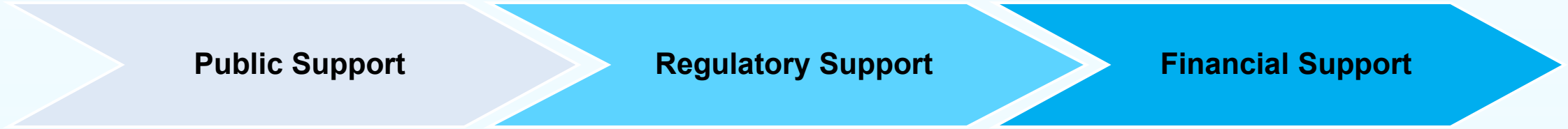
- **Ensure preparation for extreme weather.** Increase investments in the weatherization of well-heads, gathering, and processing systems, gas transmission networks, and storage facilities.
- **Continue replacing aging pipelines and interconnections** with long-lived assets that support broader energy 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

- **Increase investments** in pipeline and storage infrastructure to enhance the resilience of the overall pipeline distribution system
- **Expand integration of alternative fuels** (e.g., hydrogen) or locally produced LNG
- **Modernize infrastructure** to lower emissions and enhance safety, reliability, resiliency and affordability

Recommendations - Implementing Resilience

Principles for Implementing Resilience



- Public acceptance for resilience investment costs
- State and Federal political support

- Regulations and frameworks emphasizing reliability and resilience
- Collaborative actions across the natural gas and electric industries

- Cost recovery mechanisms for LDCs to recover resiliency investments

An Evolving Energy Market

System reliability and resiliency is critical

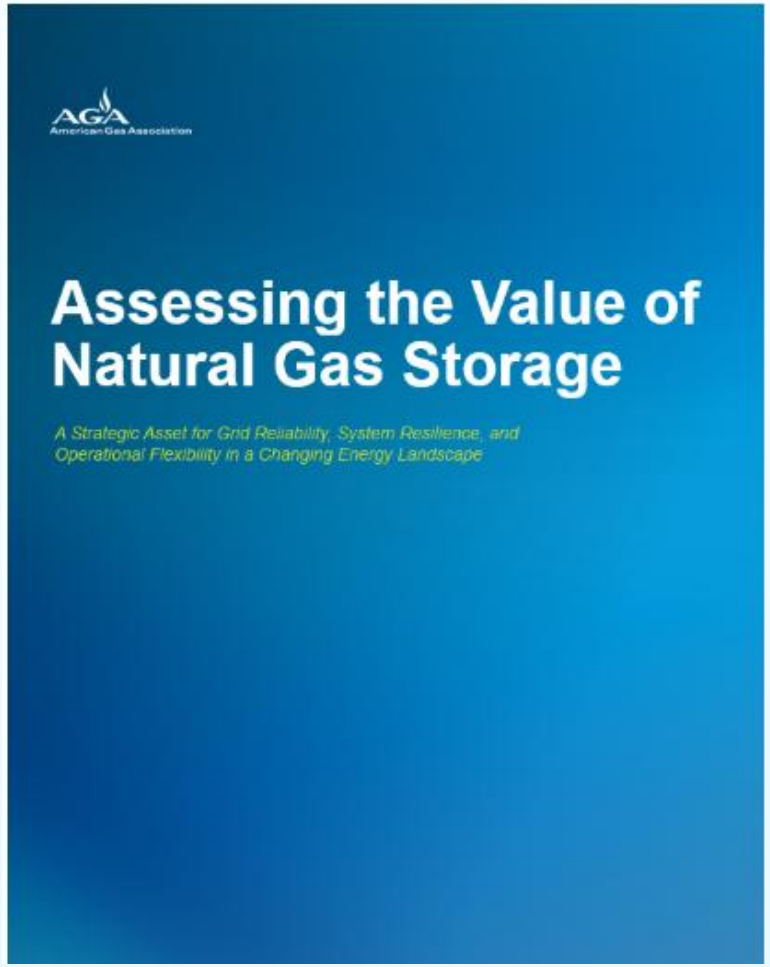
U.S. is world's largest LNG exporter

Domestic Demand is Growing

What is the role of storage in this changing landscape?

Report Overview

- **Purpose:** evaluate the operational, economic, & strategic value of natural gas storage
- **Scope:** underground storage, LNG, linepack, CNG
- **Lens:** market fundamentals, valuation frameworks, regulatory context, future outlook
- **Outcome:** identify gaps & actions that safeguard reliability, resiliency, and flexibility



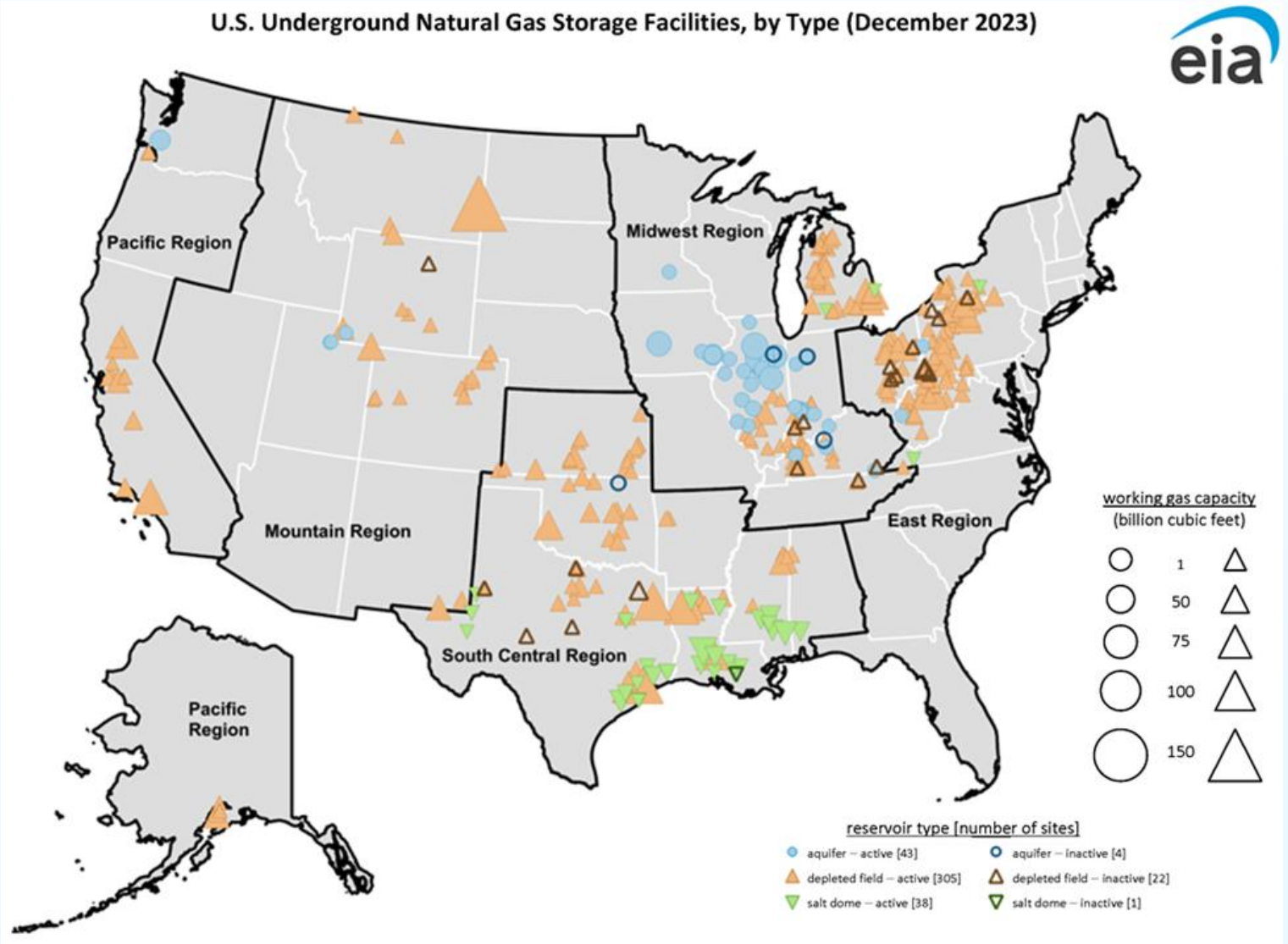
https://www.aga.org/research-policy/resource-library/assessing-the-value-of-natural-gas-storage/

What is Natural Gas Storage?

- **Underground -** depleted fields, aquifers, salt caverns
- **LNG -** import/export, peak-shaving, satellite, mobile/temporary
- **Linepack -** inherent feature of pipeline systems
- **CNG -** high-pressure cylinders

Underground Storage

- **413** active fields
- **4,772** Bcf working gas capacity
- Cushion gas vs. working gas
- Regional geologies
- Typical cushion gas requirements
  - Salt caverns: 20-30%
  - Depleted fields: ~50%
  - Aquifers: 50-80%



Merchant Storage Facilities Hold 76% of Daily Deliverability

U.S. Underground Storage Capacity by Owner Type

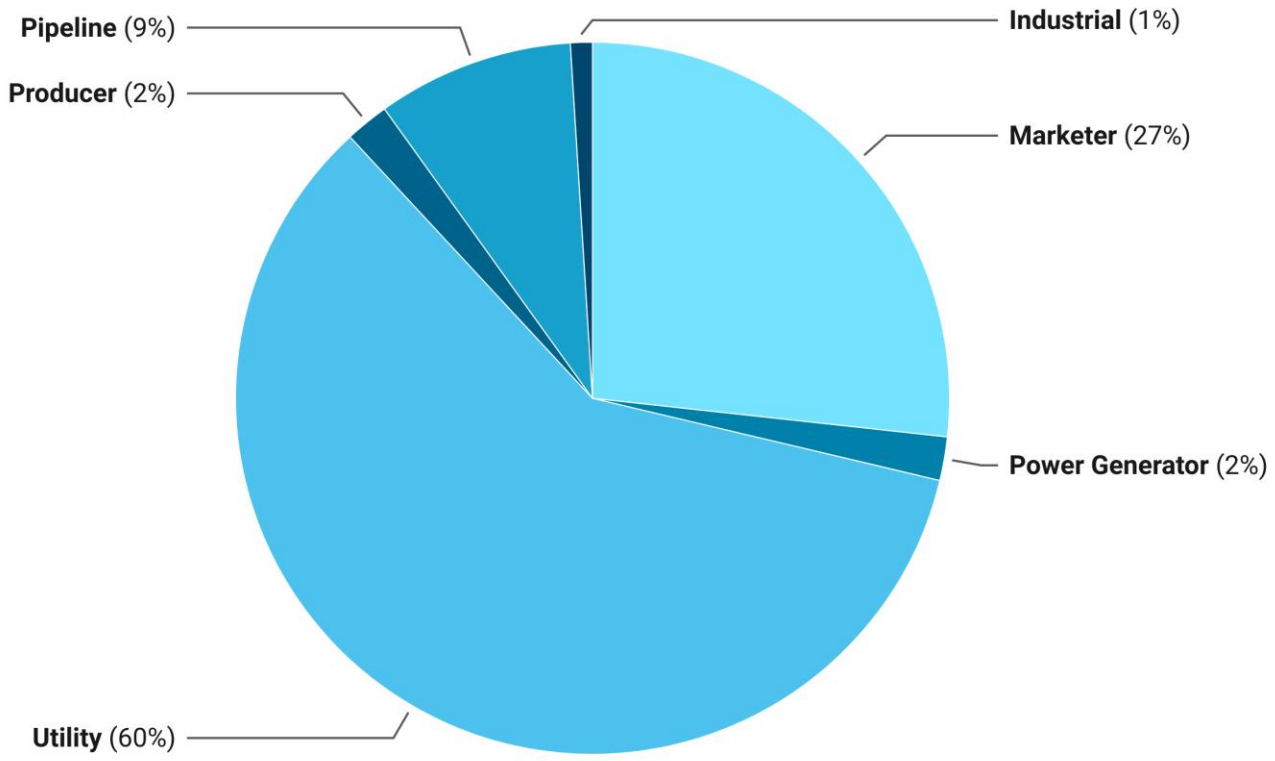
Billion Cubic Feet (Bcf)

	Working Gas Capacity (Bcf)	% of Total	Maximum Daily Delivery (Bcf/d)	% of Total
Pipeline	2,534	53%	50	43%
LDC	1,058	22%	29	24%
Independent	1,207	25%	39	33%
Total	**4,799**	**100%**	**117**	**100%**

Table: American Gas Association • Source: Energy Information Administration • Created with Datawrapper

LDCs Contract the Majority of Merchant-Operated Storage Capacity

Contracted Underground Storage Capacity by Shipper Industry, Q1 2025

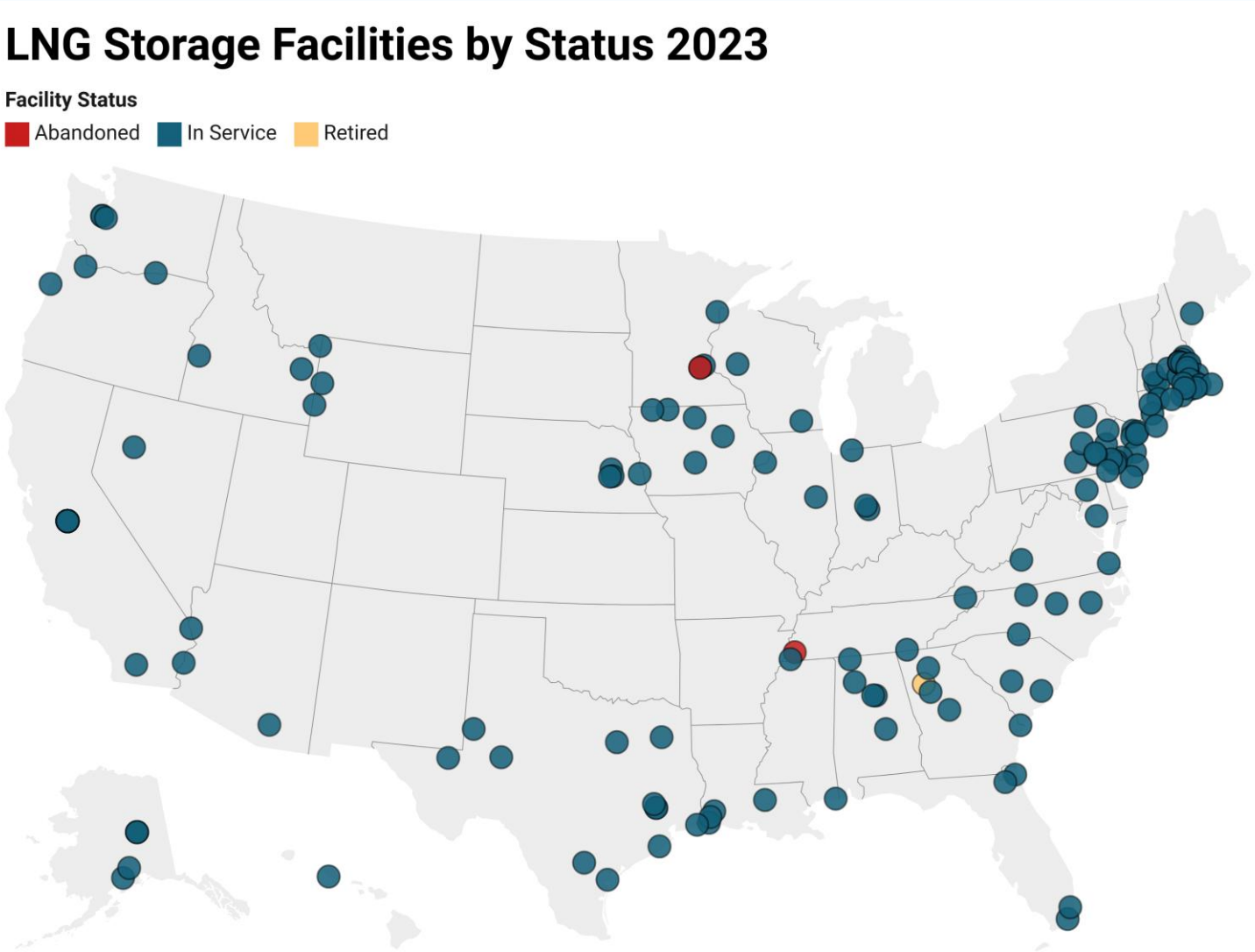


Percentages may not foot due to rounding.

Chart: American Gas Association • Source: Hitachi Energy Velocity Suite, ICF International • Created with Datawrapper

LNG Storage

- **182 sites**
- **68** Bcf capacity in service
- Domestic peak shaving
- Geological optionality



LNG Storage Utilization Varies by Region

Average Annual Withdrawals from LNG Storage, Lower-48

Billion cubic feet (Bcf)

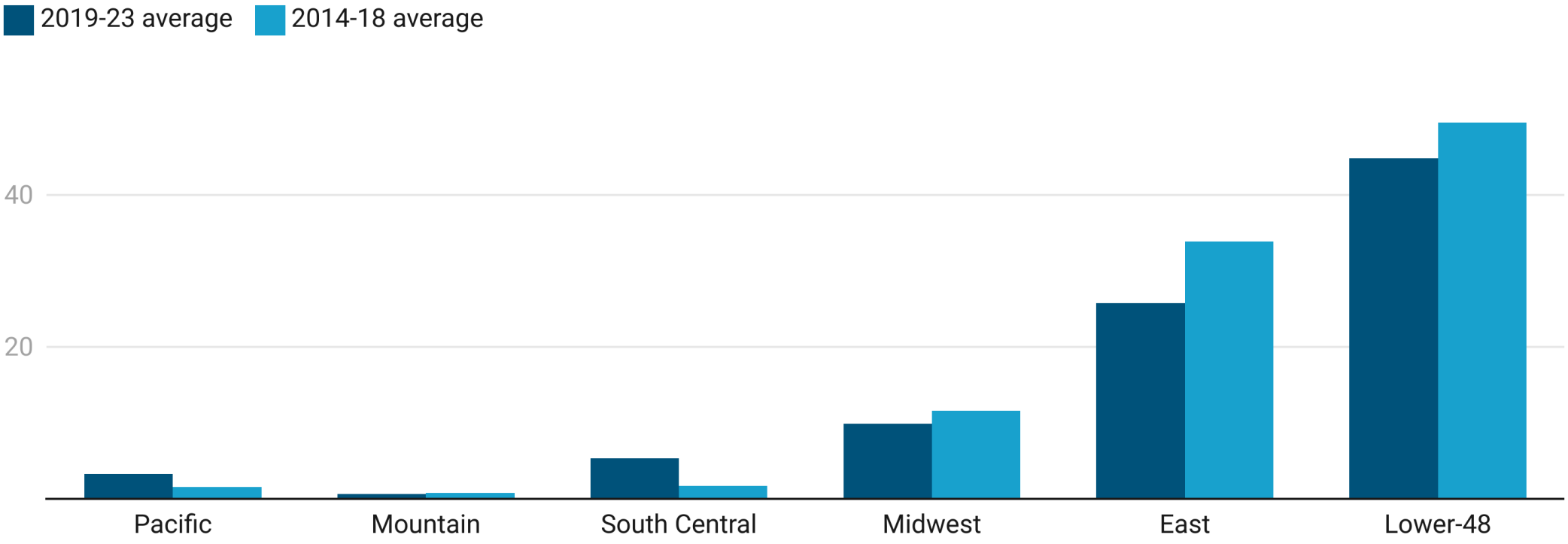
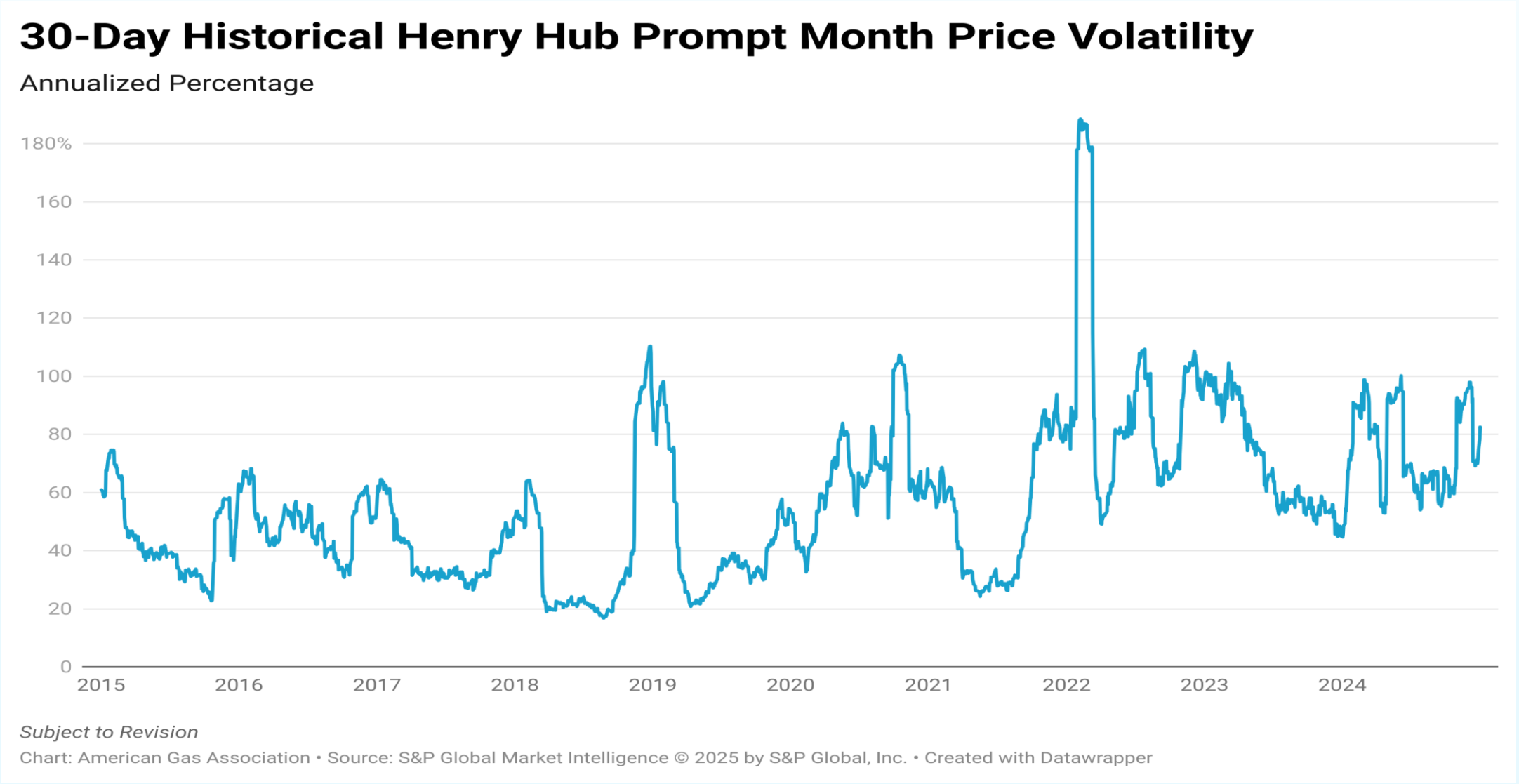


Chart: American Gas Association • Source: Energy Information Administration • Created with Datawrapper

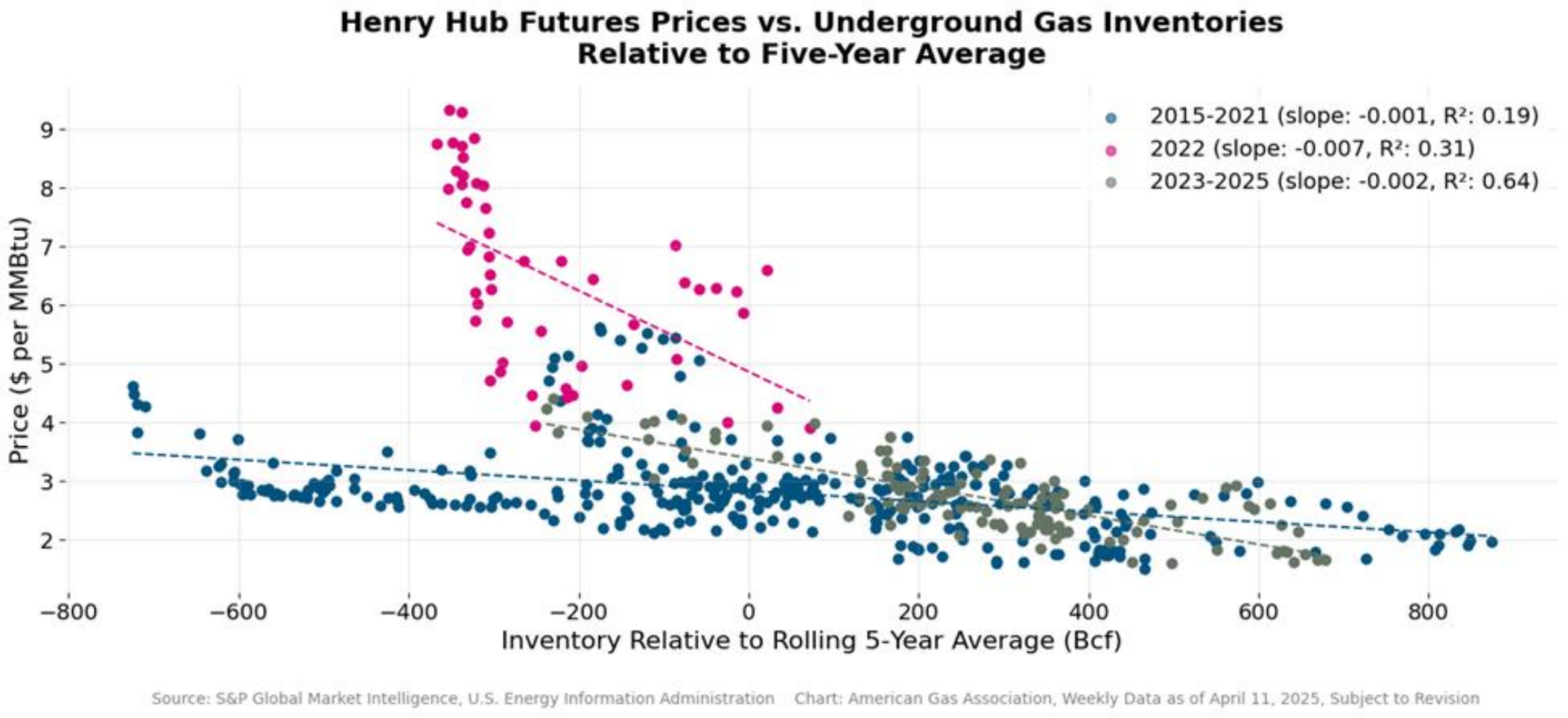
The Strategic Value of Storage

- Tempering Price Volatility
- Seasonal Balancing
- Emergency Supply
- Grid Flexibility
- Renewable Integration

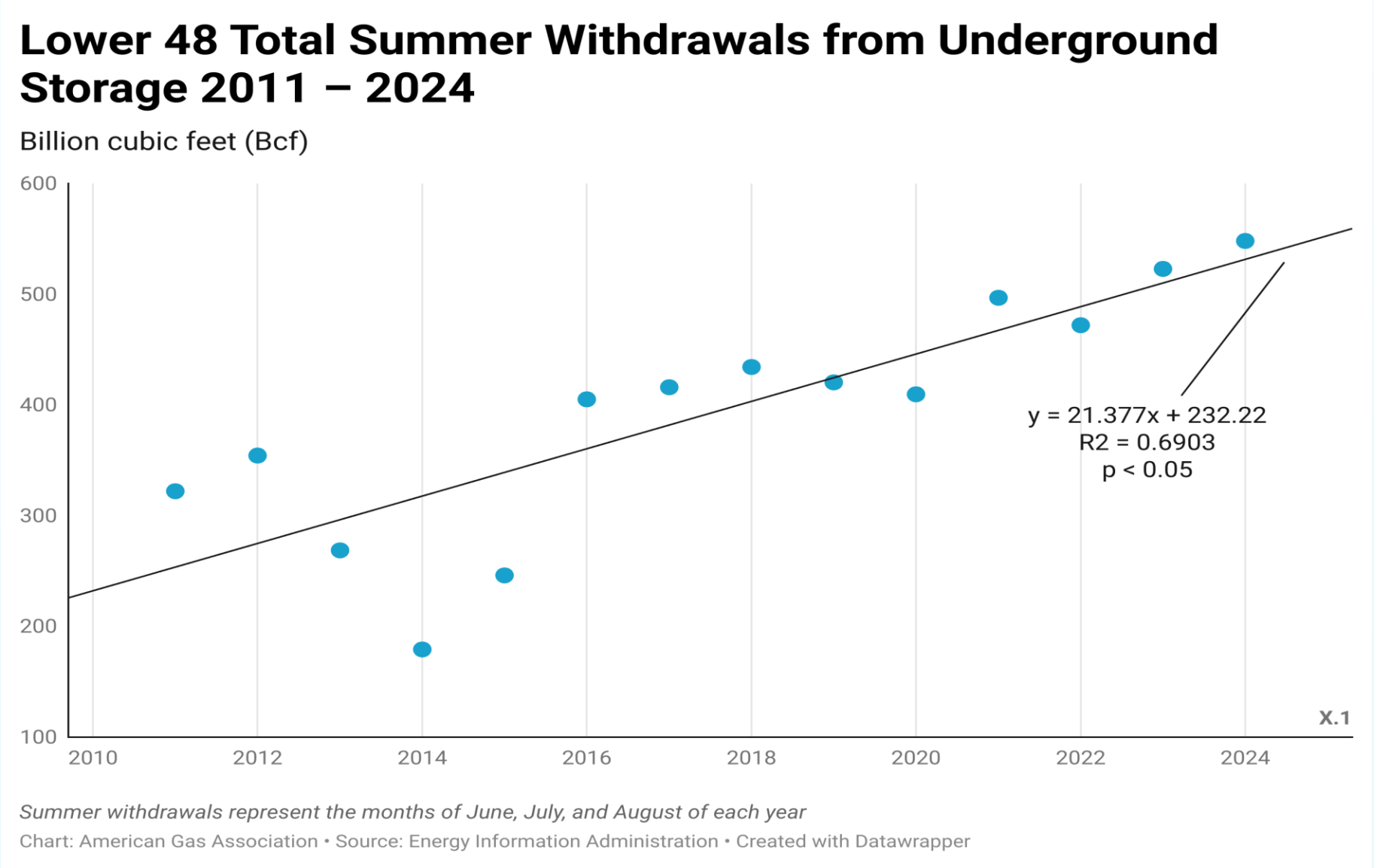
Volatility is a Defining Characteristic of the Natural Gas Markets



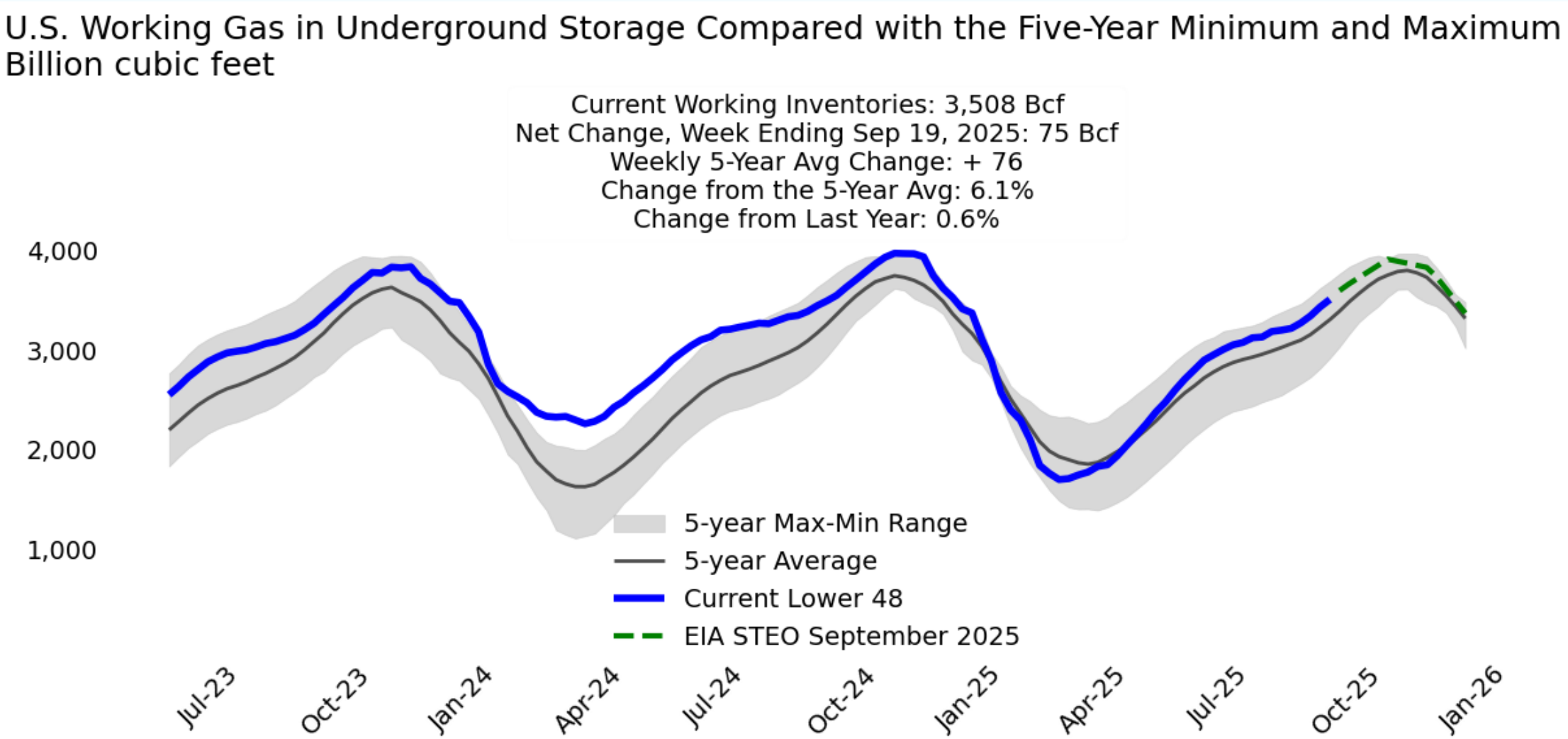
Prices are Responsive to Storage Inventory Levels



Rising Summer Withdrawals from Underground Storage



Storage Stocks Follow a Fairly Predictable Pattern

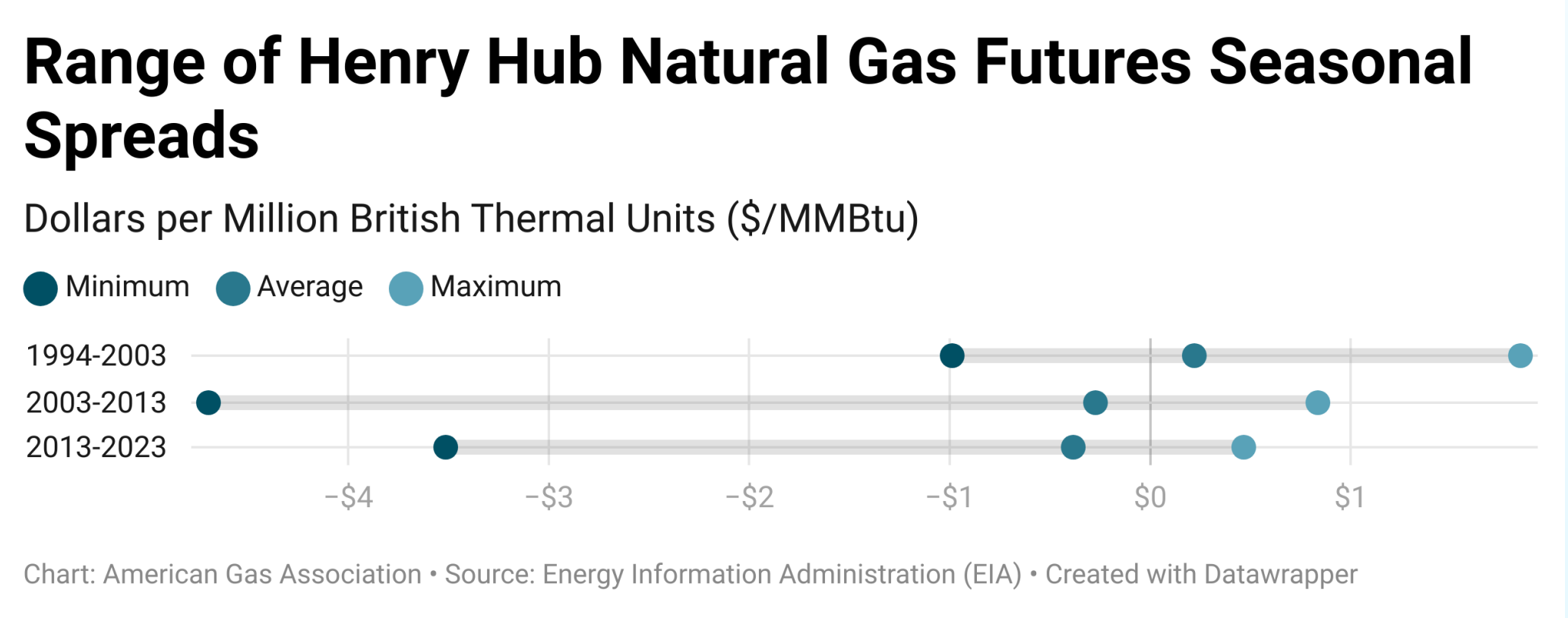


Source: U.S. Energy Information Administration, Chart: American Gas Association, Data as of Sep 25, 2025, Subject to Revision
The shaded region represents the five-year range relative to the reporting period for the historical data. Projections utilize current five-year data available. EIA STEO Release: September 2025

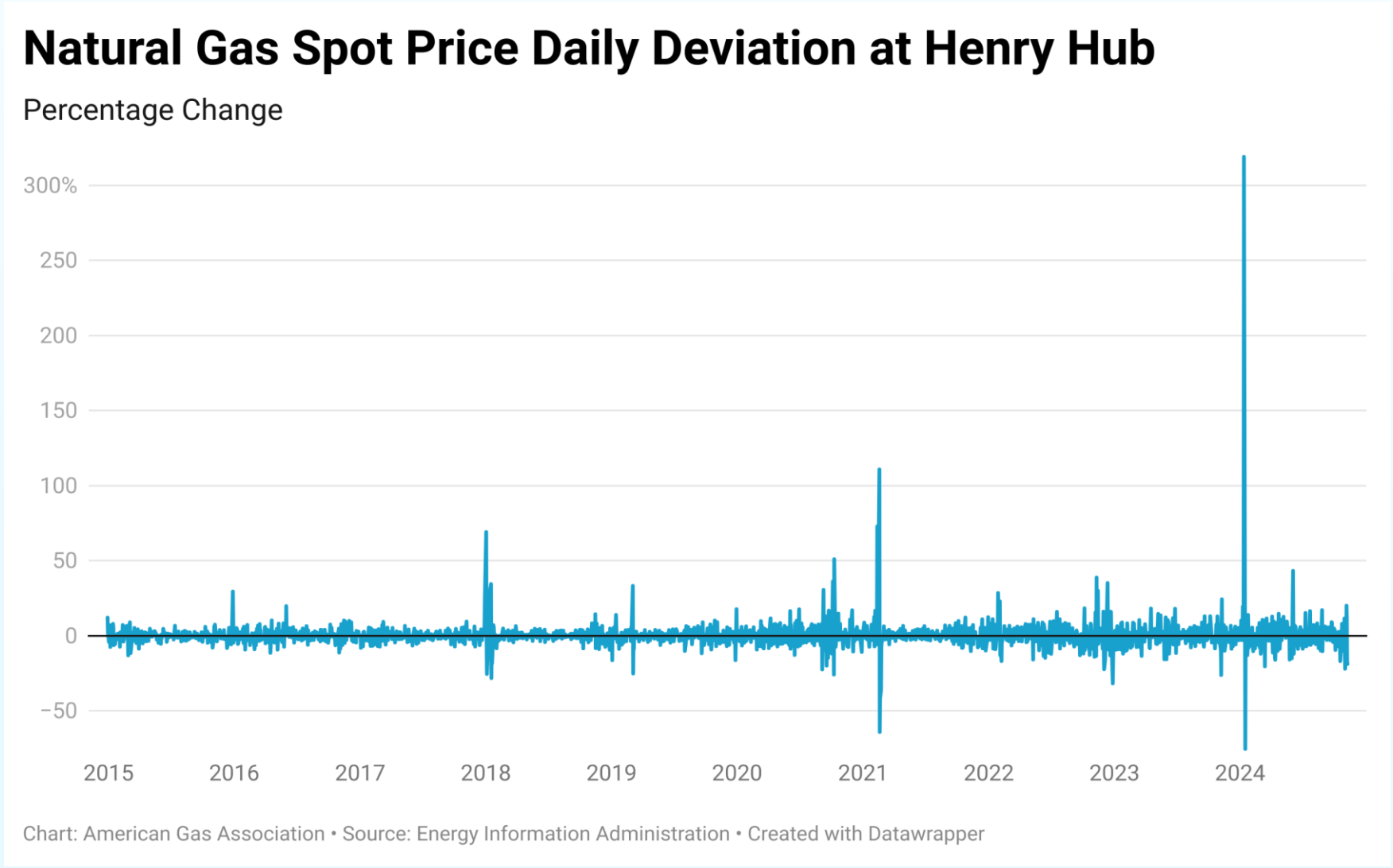
What is the Economic Value of Natural Gas Storage?

- Market Valuation (*Merchant-Owned Storage)*
  - Intrinsic Value: Seasonal price differences
  - Extrinsic Value: Short-term market opportunities
- Regulatory Valuation *(Utility-Owned Storage)*
  - Valued through regulatory approval process

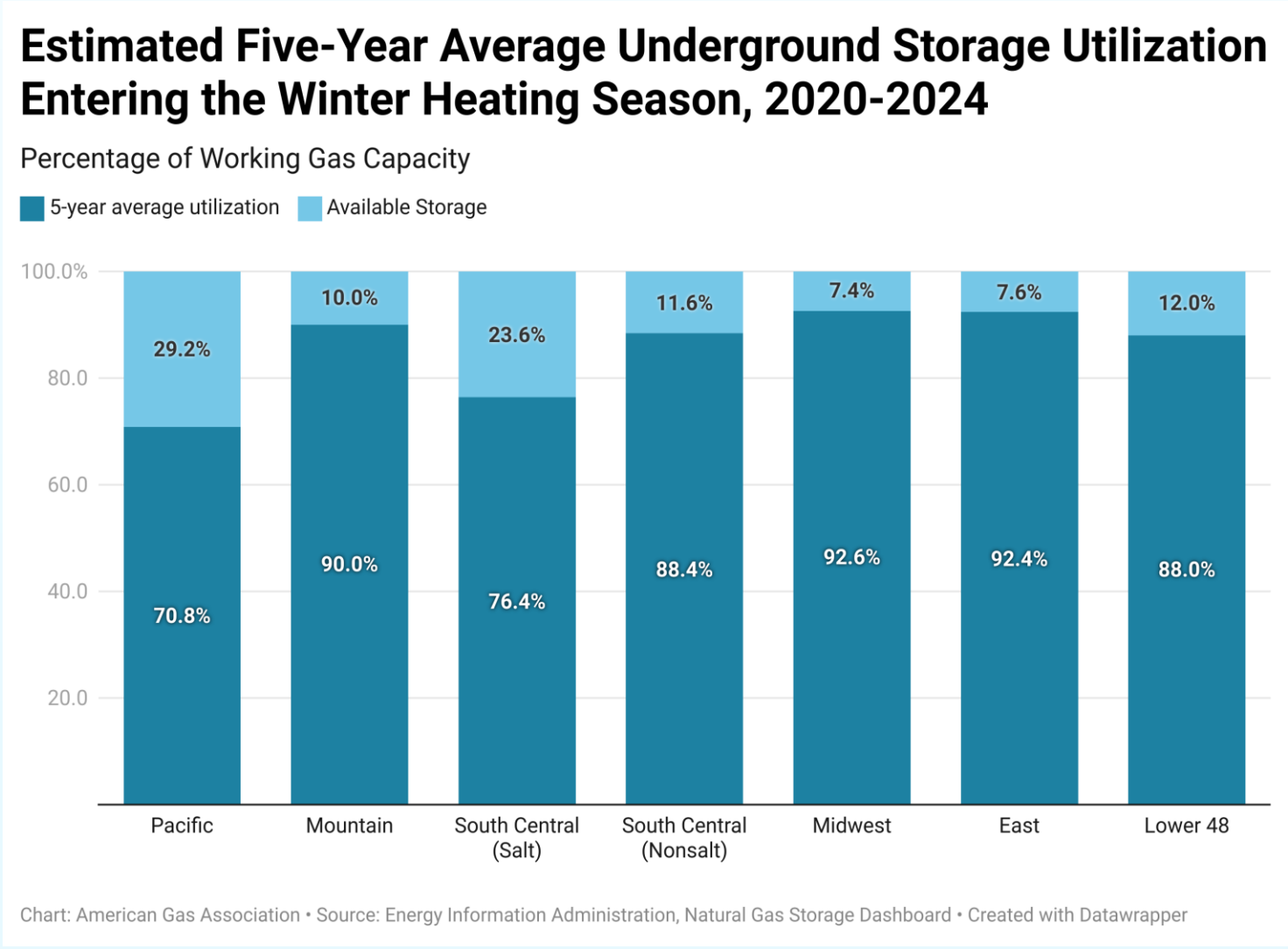
Seasonal Price Spreads Have Declined Since 2003, Diminishing the Intrinsic Value of Storage



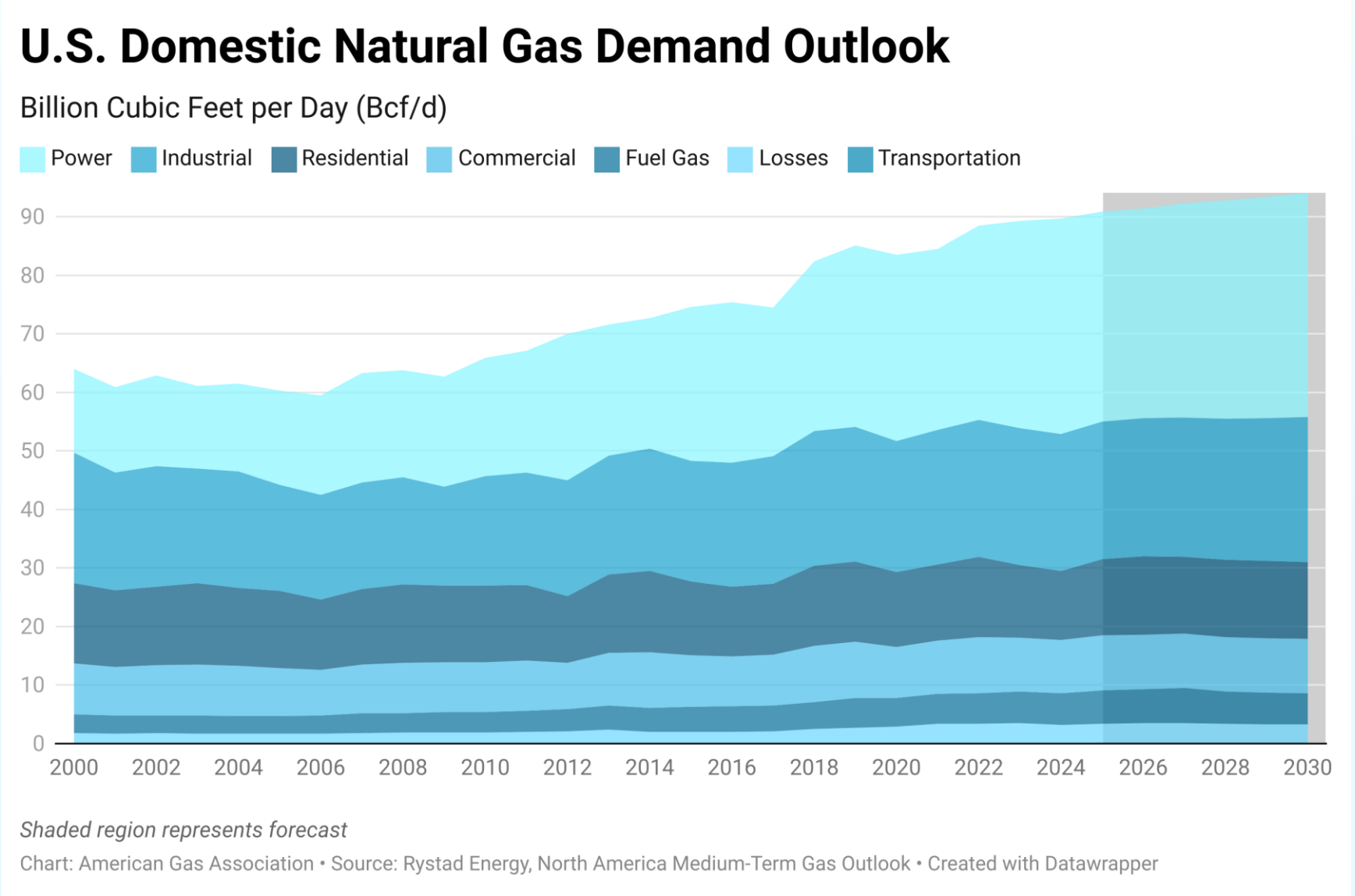
Price Volatility has Increased the Extrinsic Value of Storage



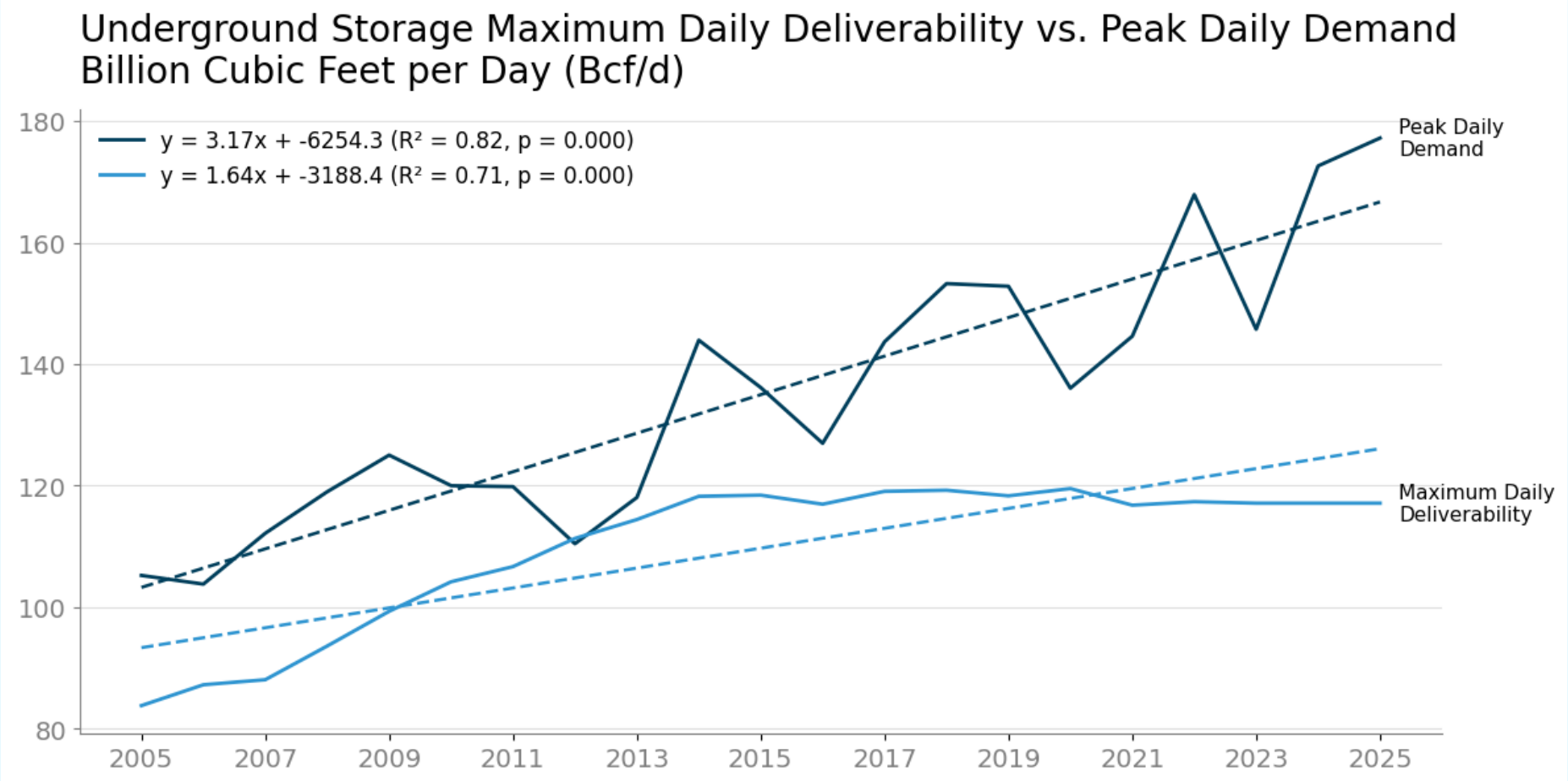
Is There Enough Natural Gas Storage?



Domestic Demand Forecast to Rise by 4.5 Bcf per Day by 2030



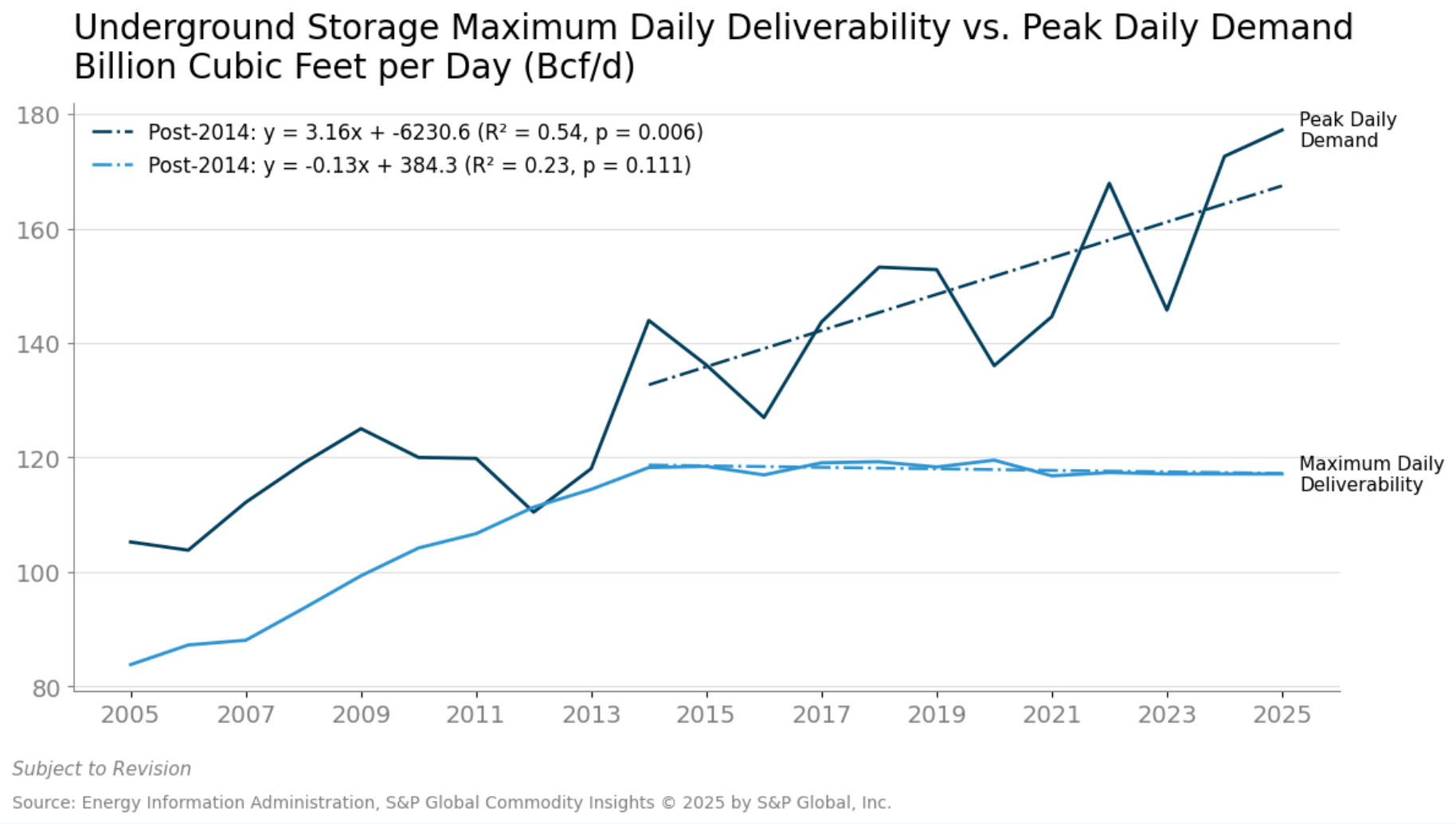
Peak Daily Demand Growing 2x Faster than Maximum Daily Deliverability of Underground Storage



Subject to Revision

Source: Energy Information Administration, S&P Global Commodity Insights © 2025 by S&P Global, Inc.

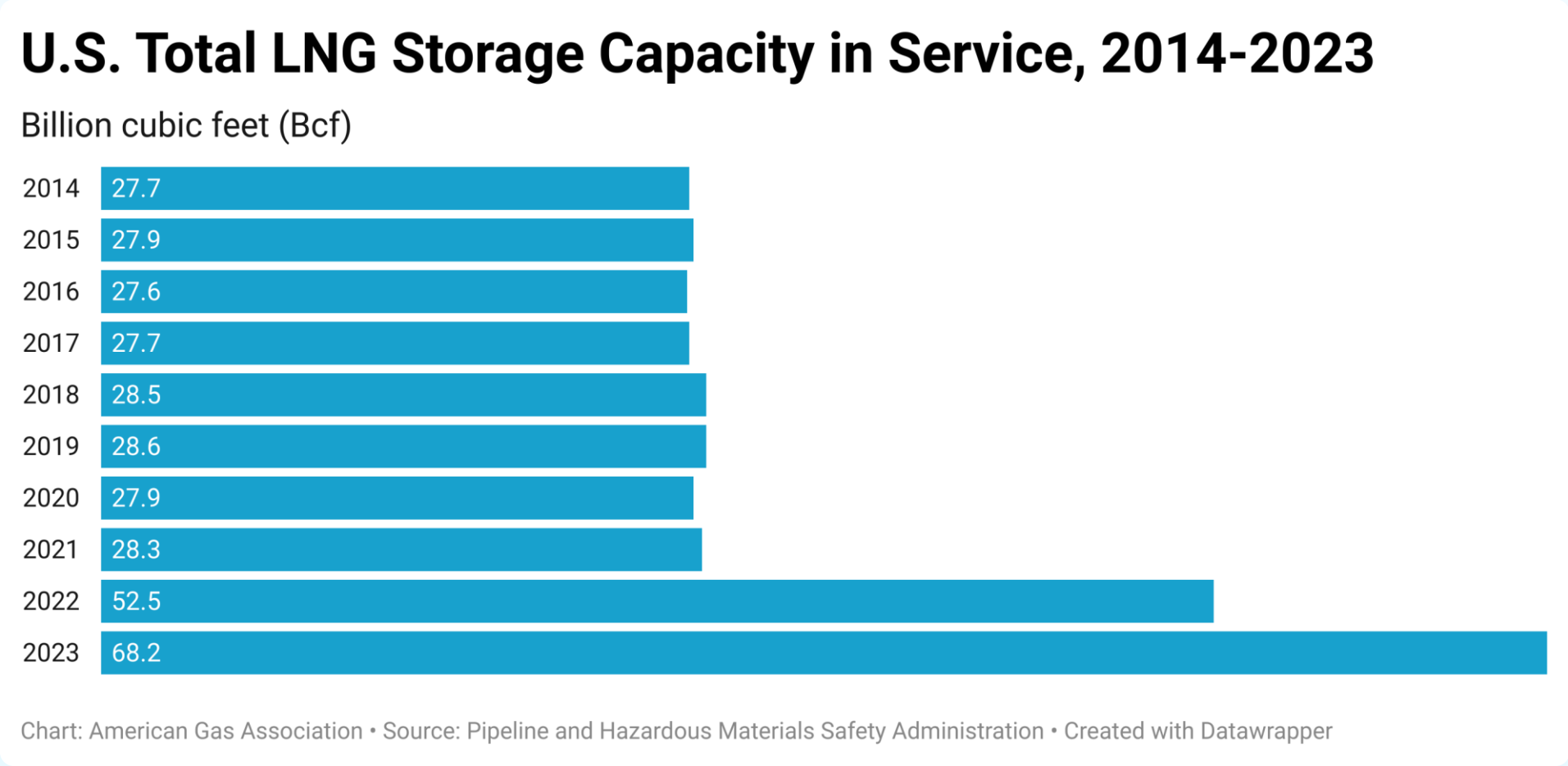
Peak Daily Demand Growing 3x Faster than Maximum Daily Deliverability of Underground Between 2014 and 2025



Subject to Revision

Source: Energy Information Administration, S&P Global Commodity Insights © 2025 by S&P Global, Inc.

LNG Storage Capacity Increase 142% Between 2021 and 2023



Underground Storage Capacity Growth Lags Other Infrastructure and Market Expansion Rates

Natural Gas Infrastructure and Market Expansion Rates

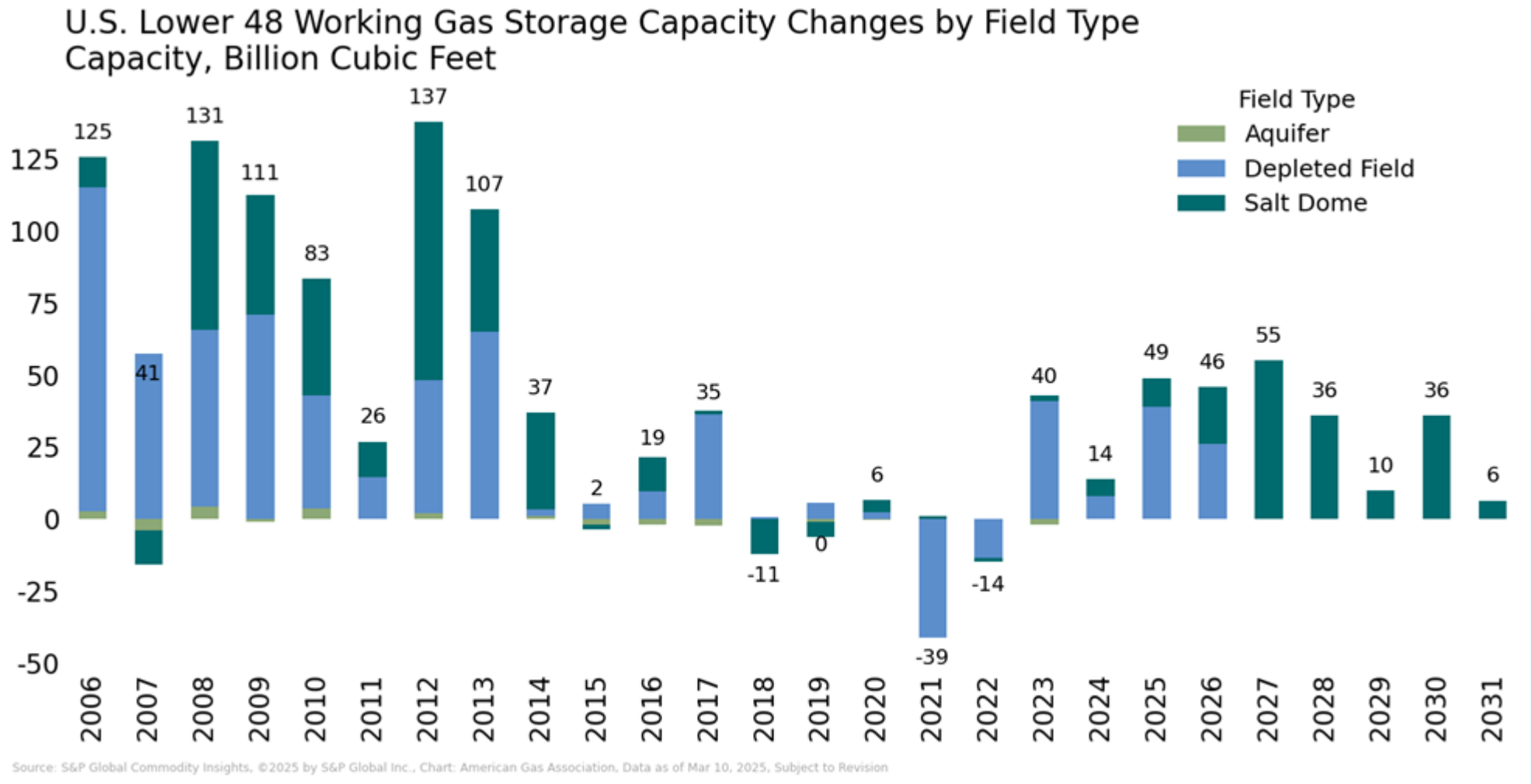
2013-2023 Compound Annual Growth Rate*

Region	LNG Storage Capacity	Underground Storage Capacity	Intrastate Pipeline Capacity	Interstate Pipeline Capacity	Production	Demand
East	18.3%	0.0%	3.6%	4.6%	11.4%	2.8%
Midwest	0.3%	0.1%	1.6%	6.4%	-3.3%	2.1%
Mountain	7.0%	0.2%	8.7%	1.1%	2.6%	2.4%
Pacific	0.6%	0.2%	0.8%	0.5%	-6.3%	-0.8%
South Central	0.0%	0.2%	6.8%	4.3%	3.0%	2.7%
Lower-48	10.5%	0.1%	5.8%	4.0%	5.0%	2.2%

**LNG Storage Capacity CAGR by region represents 2014-2023*

Table: American Gas Association • Source: Energy Information Administration, Pipeline and Hazardous Materials Safety Administration • Created with Datawrapper

253 Bcf of Underground Storage Capacity Changes are Expected by 2031



Policy Considerations and Strategic Action

Targeted Expansion

Faster, Clearer Project Approvals

Improved Integration with Energy Planning

Recognition of Storage's Full Value

Support for Low-Carbon Pathways

Thank You!

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