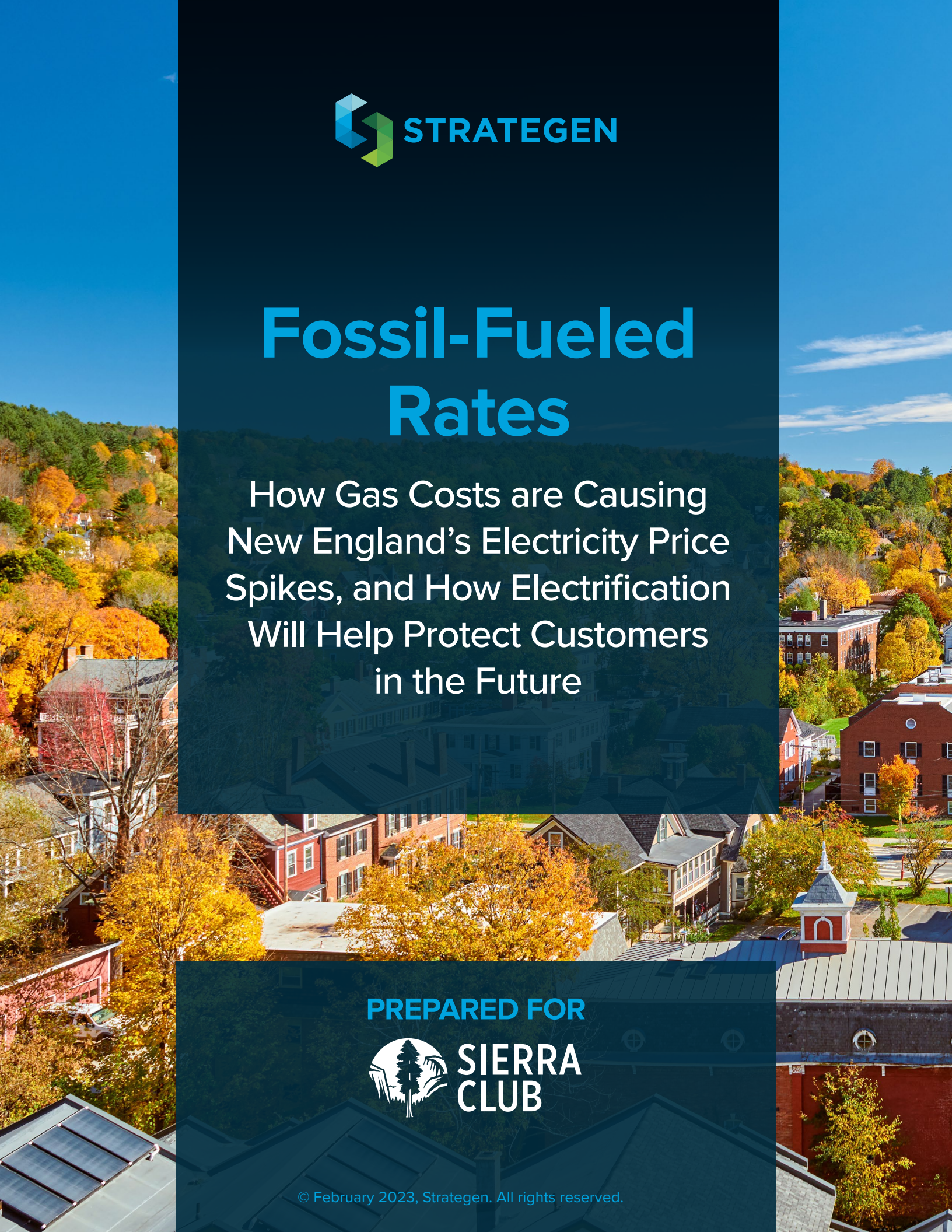

STRATEGEN

Fossil-Fueled Rates

How Gas Costs are Causing New England's Electricity Price Spikes, and How Electrification Will Help Protect Customers in the Future

PREPARED FOR

SIERRA CLUB

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Executive Summary

As New England states move towards deep decarbonization of their economies, electrification of both heat and transportation have been identified as key strategies to achieve their ambitious carbon reduction goals. However, recent spikes in electricity prices across the U.S. – and particularly in New England – have raised concerns among regulators and policymakers that efforts to electrify greater portions of the region's economy will ultimately raise costs for customers. What these concerns fail to take into account, though, is the close connection between electricity costs and those of fossil gas (commonly called natural gas), which ensures that the recent price spikes in electricity will eventually be reflected in gas rates as well. Over the long term the ongoing transition of New England's electricity generation to clean energy resources ensures that electrification will be the most effective way to protect customers from fossil gas-driven price spikes in the future.

Over the long term, the ongoing transition of New England's electricity generation to clean energy resources ensures that electrification will be the most effective way to protect customers from fossil gas-driven price spikes in the future.

In New England's deregulated electricity sector, wholesale electricity prices are determined in real time via an auction-style bidding mechanism that occurs every five minutes of the day. Prices in this "Real Time Energy Market" are set by the highest marginal-cost resource that is selected to provide power in any given auction.[1] Due to the rapid growth of fossil gas generation plants in New England over the past 20 years,[2] as well as the near-zero marginal costs for clean energy resources like wind and solar to provide electricity, fossil gas plants tend to be the highest marginal-cost resource "bidding in" to New England's power market at any given time – and the costs for these plants have been skyrocketing in line with recent increases in the commodity costs of fossil gas.[3]

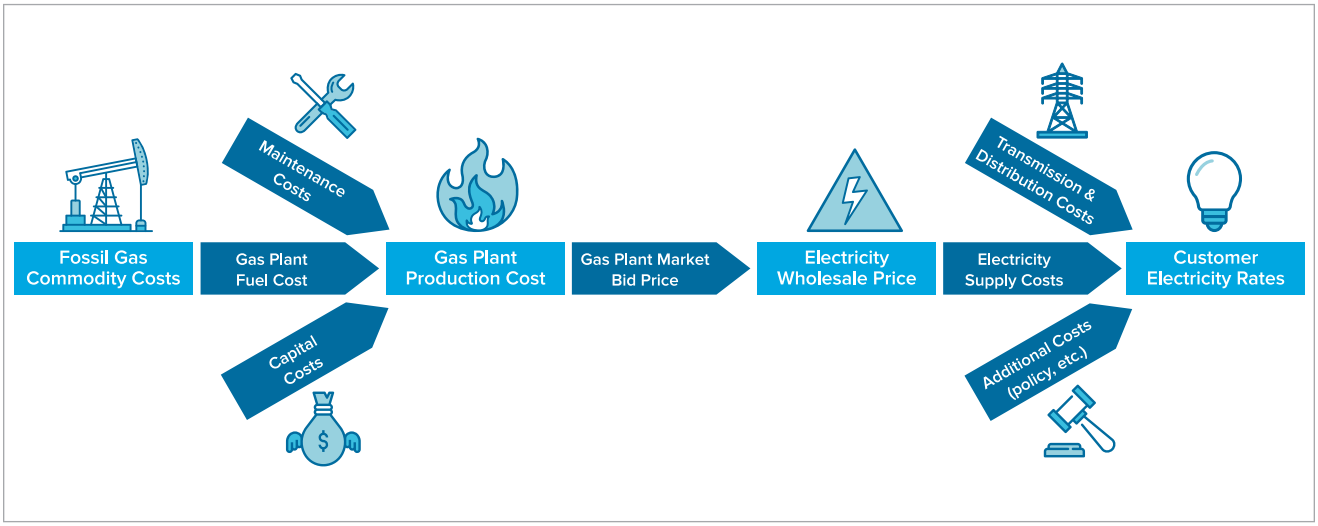

FIGURE 1: Simplified Process By Which Fossil Gas Commodity Costs Impact Electricity Rates
Source: Strategen Consulting

Fossil gas commodity costs have been increasing across the country, driven by Russia's invasion of Ukraine, the lasting effects of the Covid-19 pandemic, and cold-weather conditions that have stressed gas supplies. In January 2022, benchmark fossil gas prices in the U.S. were 62% higher than they were the previous year.[4]

1 "How Resources Are Selected and Prices Are Set in the Wholesale Energy Markets," ISO New England, accessed February 6, 2023.
2 "Key Stats: Markets," ISO New England, accessed February 6, 2023.
3 Ethan Howland, "Power prices jumped 51% in PJM, 85% in New England in Q1 due to rising gas prices," Utility Dive, May 13, 2022
4 Ibid.

In New England, where fossil gas prices are generally more volatile than the rest of the country, these price hikes have been closer to 400%.[5] This difference is a result of a number of system conditions endemic to New England, including the region's outsized reliance on natural gas for both power generation and heating,[6] existing constraints in the region's pipeline capacity,[7] and global competition for the liquified natural gas (LNG) supplies that the region typically relies on to meet peak demand periods for fossil gas.[8]

> These price increases for fossil gas have had a direct impact on the region's wholesale electricity prices and, by extension, its rising retail rates.

These price increases for fossil gas have had a direct impact on the region's wholesale electricity prices and by extension its rising retail rates. On January 1, 2023, Eversource Energy roughly doubled its residential electric supply rate from the previous month for customers in Massachusetts and Connecticut, citing fossil gas costs as the most significant factor driving this price increase.[9] Wholesale electricity costs are one component of customers' electric supply rate, which, for residential and small commercial customers, are generally adjusted every six months to take into account changes in the costs that utilities incur to purchase power from the wholesale market.[10]

In comparison to electricity rates, the short-term impact on fossil gas rates for residential and commercial customers has been more muted, largely due to the way that fossil gas rates are set. Gas utilities across the United States are often allowed to recover energy costs through a fuel clause adjustment mechanism, in which utilities forecast the cost of gas over the year and then "true up" the difference between the forecasted costs and actual costs later on, with the differential either credited or debited to customers.[11]

This "true up" period for fuel adjustment clauses can be several months – or, in some states like Connecticut, up to a year – after the utility incurs the actual cost, meaning that customers may not see the impact of increasing fossil gas costs on their gas bills until up to a year after the initial cost increase. In addition, the adjustment periods for electricity and gas rates are not always aligned. For example, in Connecticut, electricity rates are adjusted in January and July, but gas rates don't need to be adjusted until the end of the regulatory year in September. As a result, increases in gas rates can lag behind electricity rate hikes by over half a year.[12]

> The increasing penetration of clean energy resources like wind and solar in New England's power generation mix will reduce the impact from fossil gas costs on the region's wholesale power prices.

However, despite this regulatory lag, both electricity and gas rates in New England will be impacted by increases in gas commodity costs in the short/medium-term. Over the long term, however, the increasing penetration of clean energy resources like wind and solar in New England's power generation mix will reduce the impact from fossil gas costs on the region's wholesale power prices.

5 "New England Dashboard," U.S. Energy Information Administration, 2023.
6 "U.S Energy Facts Explained," U.S. Energy Information Administration, accessed February 6, 2023.
7 "State to State Natural Gas Pipeline Capacity," U.S. Energy Information Administration, 2022.
8 Morgan Evans, "New England, New York Utilities Warn Natural Gas Prices Could Cause Bills to Soar Up to 38% from 2021," Natural Gas Intelligence, October 6, 2022.
9 "Global Demand Drives Winter Energy Supply Prices to Historic Highs," Greenwich Free Press, November 18, 2022.
10 "Understanding your electric bill: Electric Bill and Rate Components," Connecticut Office of Consumer Council, 2022.
11 "Frequently Asked Questions: Purchased Gas Adjustment Clauses," Connecticut Public Utilities Regulatory Authority, accessed February 6, 2023.
12 Ibid.

Today, roughly 95% of new energy resources set to be interconnected with New England's power grid are renewable energy resources like wind, solar, and batteries.[13] As these resources make up a larger share of New England's power supply, they will put downward pressure on power prices, and provide more price stability, thereby reducing the impact that increasing fossil gas costs will have on power market prices.

As wholesale power prices become less heavily influenced by fossil gas costs, customers will have an opportunity to further reduce their exposure to gas cost spikes by electrifying appliances that currently run on fossil gas directly. Other potential replacements for fossil gas, such as renewable natural gas (RNG) or green hydrogen, fail to provide the same level of protection due to constraints on their supply (for RNG)[14] and technical ability to be blended into the gas network (for hydrogen).[15] Due to these constraints, they're only capable of replacing a relatively small portion of a customer's fossil gas use – and their prices are already higher than even the exceptionally expensive fossil gas available on the market today.[16]

> Electrification can eliminate up to 100% of a customer's direct gas demand, providing a pathway to completely remove New England residents' dependence on the fuel.

By contrast electrification can eliminate up to 100% of a customer's direct gas demand, providing a pathway to completely remove New England residents' dependence on the fuel. As New England's power sector continues on its current trajectory towards cleaner resources with lower marginal production costs, electrification will provide the greatest opportunity for customers to untether themselves from fossil gas costs and avoid similar price spikes in the future.

13 "Key Stats: Resource Mix," ISO New England, accessed February 6, 2023.

14 Based on comparison of AGF's "High Resource Potential" scenario to average U.S. fossil gas use from 2009-2018. See: ICF, Renewable Natural Gas: Supply and Emissions Reduction Assessment (Fact Sheets), American Gas Foundation, December 2019.

15 Sara Baldwin, Dan Esposito, and Hadley Tallackson, *Assessing the Viability of Hydrogen Proposals: Considerations for State Utility Regulators and Policymakers*, Energy Innovation, March 2022

16 ICF, *Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment*, American Gas Foundation, December 2019.

Introduction

Over the past year, electricity prices have skyrocketed across the U.S. In the first three months of 2022, wholesale power prices in the eastern U.S. jumped to $137/MWh, an 83% increase compared to the $75/MWh price for the same time period in 2021.[17] These price spikes have been particularly pronounced in New England, creating significant month-to-month cost increases for electricity customers. In January 2023, Eversource Energy, citing historically high power prices, roughly doubled its residential electric supply rate from 12.1 cents per kWh to 24.2 cents per kWh for customers in Massachusetts and Connecticut.[18]

This recent trend of high wholesale power prices, and subsequently high retail electricity prices for consumers, have troubled regulators and policymakers as more and more homes and commercial buildings reduce their carbon emissions by electrifying their heating and cooking systems. Electricity price spikes have called into question the consumer benefits of electrification, creating concern that a greater reliance on electric appliances will make customers more exposed to price shocks and sustained higher electricity prices.

What these concerns miss are the underlying ties between prices for electricity and fossil gas (commonly referred to as natural gas). This connection is particularly strong in New England due to the large share of electricity that the region sources from fossil gas power plants. The recent spikes in electricity prices are in large part caused by the increasing cost of fossil gas globally, driven by a number of factors including Russia's invasion of Ukraine, lasting economic impacts of the COVID-19 pandemic, longstanding fossil gas supply constraints, and extreme weather conditions. Ultimately, the only way to mitigate these price spikes in the future is to move away from fossil gas use broadly, both in the power sector and directly in our homes.

The recent spikes in electricity prices are in large part caused by the increasing cost of fossil gas globally. Ultimately, the only way to mitigate these price spikes in the future is to move away from fossil gas use broadly, both in the power sector and directly in our homes.

This white paper explores recent trends and investigates the major drivers of high electricity prices in New England. It outlines how fossil gas costs contribute to higher electricity prices, describing the market mechanisms that cause fossil gas plants to set the clearing price in New England's wholesale power market. It provides more context on why gas prices have seen such significant increases in recent years, as well as the mechanisms that cause customers' electricity bills to increase more quickly than their fossil gas bills. Finally, it addresses potential solutions that can truly remove customers' exposure to fossil gas price spikes over the long term.

How are wholesale electricity costs in New England determined?

New England's electric grid is deregulated, which means that the electric utilities do not own the electricity generation plants that are used to power homes and businesses. Electric utilities in New England only own the transmission and distribution grid that delivers electricity to customers. Each of the New England states are

17 Ethan Howland, "Power prices jumped 51% in PJM, 85% in New England in Q1 due to rising gas prices," Utility Dive, May 13, 2022.
18 "Global Demand Drives Winter Energy Supply Prices to Historic Highs," Greenwich Free Press, November 18, 2022.

served by ISO New England (ISO-NE), an independent regional transmission operator responsible for managing the electric grid in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. ISO-NE's responsibilities include organizing a competitive wholesale energy market and coordinating the regional grid.[19]

The wholesale energy market provides a platform for the buying and selling of power between the generators and the resellers, including load serving entities like the electric utilities.[20] ISO-NE serves several key functions, including ensuring economic dispatch and setting a uniform clearing price (explained in more detail below).[21] "Economic dispatch" essentially means ensuring that the least-cost generation resources are used first, which is determined through an auction-style market that is conducted every five minutes of every day.[22] In this "Real-Time Energy Market," different generation resources submit the prices at which they can produce power, and ISO-NE selects the necessary amount of electricity for the least price based on real-time load deviations from the load forecast.[23]

In this auction process, the price paid to each generator is set by the highest-cost resource selected to meet load. ISO-NE organizes all bids in the auction from least to most expensive operating costs to create the supply stack. It then determines which units are needed to match demand, choosing from the least-cost units in the supply stack first. The cost of the last unit selected in the stack sets the clearing price, which then becomes the price that all selected resources are paid in that auction. The figure below illustrates how this uniform clearing price is set.[24]

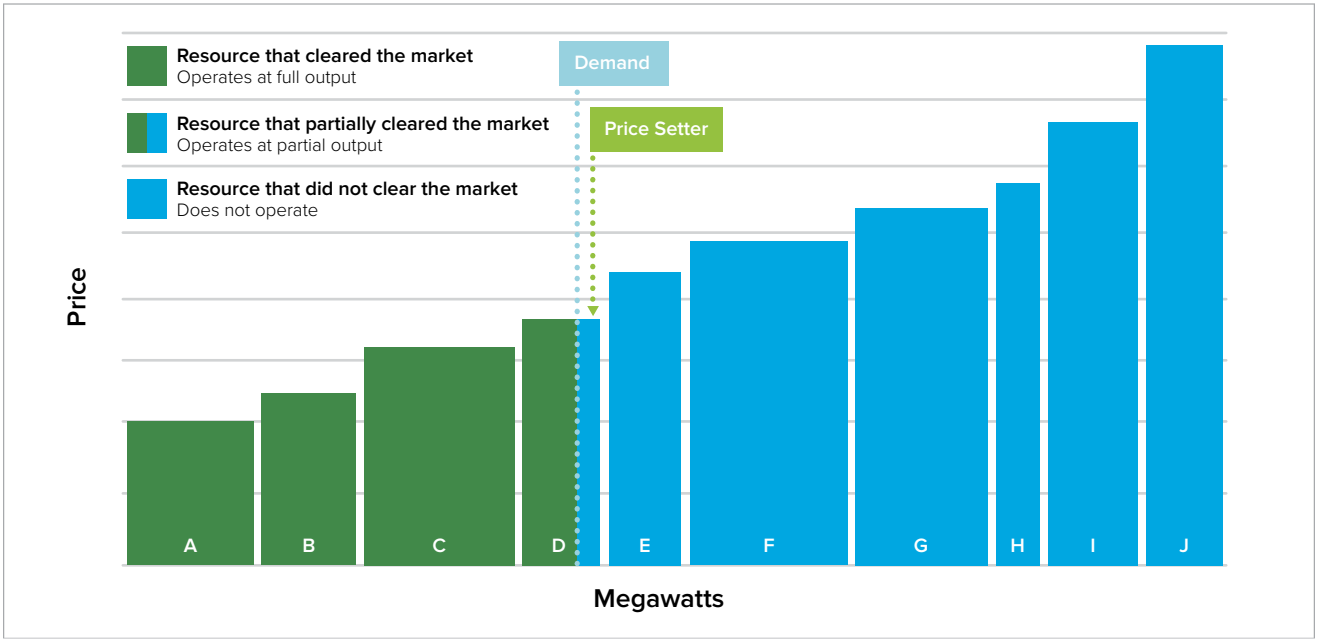

FIGURE 2: Example Supply Stack for ISO-NE Wholesale Power Market
Source: ISO New England

In the figure above, Resources A-J are sorted by cost and create the supply stack. The blue dashed line indicates the demand in megawatts (MW). Consequently, Resources A, B, C, and a part of Resource D clear the market. Because Resource D is the last resource selected in the supply stack, it is the marginal unit that sets the uniform clearing price that is then paid to Resources A through D.

19 "Our Three Critical Roles," ISO New England, accessed February 6, 2023.
20 "Learning Center: Market for Electricity," PJM, accessed February 6, 2023.
21 "How Resources Are Selected and Prices Are Set in the Wholesale Energy Markets," ISO New England, accessed February 6, 2023.
22 ISO-NE also operates a "Day Ahead Energy Market," which operates similarly to the Real-Time Energy Market but occurs 24 hours in advance and provides a way for ISO-NE to schedule resources to be dispatched the next day.
23 Ibid.
24 Ibid.

An important function of ISO-NE is to dispatch resources economically in real time. When demand increases, ISO-NE will call on the next least-cost resource in the supply stack to come online. When demand decreases, ISO-NE will pull the most expensive resource first. These real-time deviations in demand trigger changes in the uniform clearing price as resources either get called on or pulled from the auction process in response to demand changes. In all cases, the last resource in the stack (known as the "marginal resource") will set the price of electricity in each five-minute time period in which the auction is run.

How do fossil gas commodity costs impact electricity prices?

Fossil gas prices and electricity prices have a closely correlated relationship, particularly in New England, where fossil gas generation plants typically set the wholesale market price as the marginal resource. Since ISO-NE opened regional wholesale electricity markets in 1999,[25] companies have invested billions of dollars in fossil gas power plants to sell power on this wholesale market.[26] Over time, fossil gas became a cheaper and more efficient resource than coal, which led fossil gas plants to replace coal plants throughout New England. In 2021, 53% of electricity in New England was produced by fossil gas power plants.[27] The figure below, taken from ISO-NE's website, demonstrates how closely electricity prices follow fossil gas prices in New England,[28] showing clearly that when extreme conditions cause fossil gas prices to rise, electricity prices closely follow.

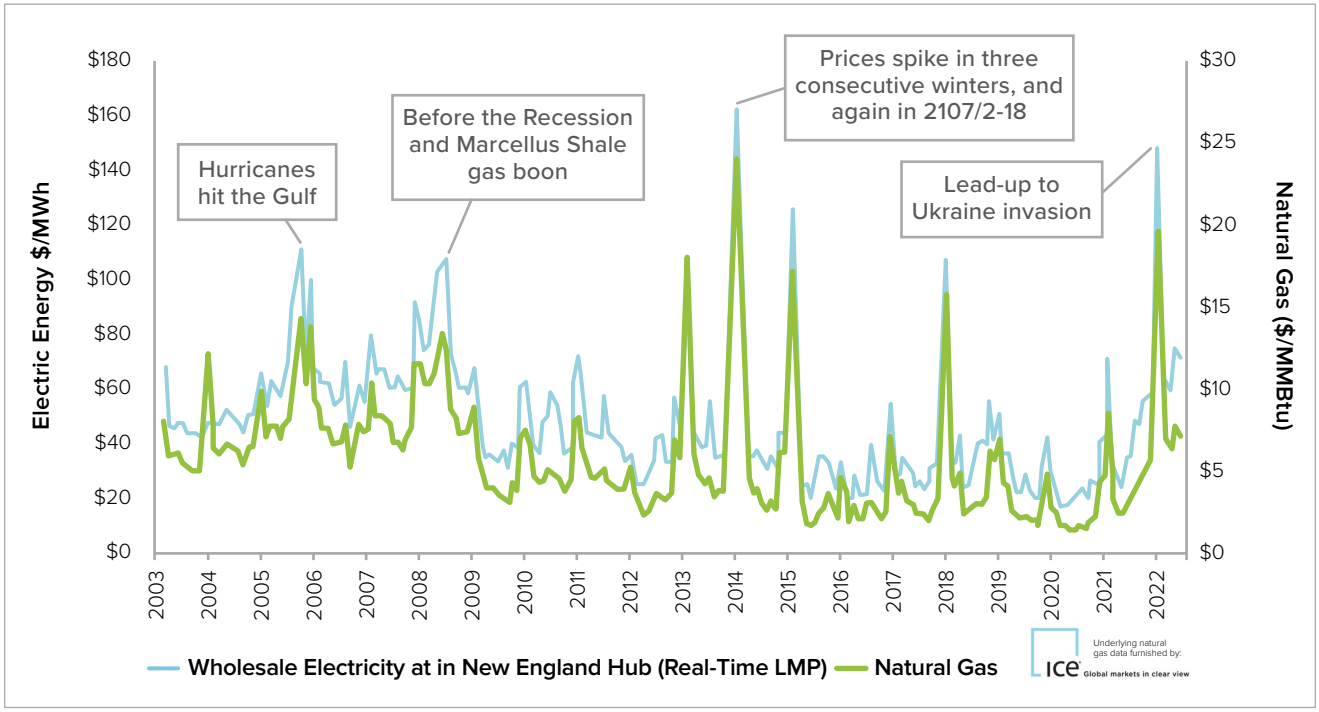

FIGURE 3: Monthly Average Wholesale Electricity Prices and Fossil Gas Prices in New England
Source: ICE / ISO New England

Although the operating costs for fossil gas power plants are generally lower than coal or oil, they are still higher than wind, solar, or nuclear plants. As a result, gas plants typically fall to the right of wind/solar/nuclear in the supply stack.[29] In addition, fossil gas plant's operating costs are directly impacted by fossil gas commodity costs;

25 "What We Do: Our History," ISO New England, accessed February 6, 2023.
26 "Key Stats: Markets," ISO New England, accessed February 6, 2023.
27 Ibid.
28 Ibid.
29 Operating costs can also vary between natural gas power plants, with combined cycle gas turbines typically having lower operating costs than peaker plants due to their higher efficiencies. However, even combined cycle plants have higher operating costs than wind, solar, and nuclear as the latter three have almost no marginal cost for fuel.

increasing gas prices will raise the price at which gas plants can supply electricity to the power market, leading them to hike the price at which they "bid in" to the Real-Time Energy Market.

> For a region like New England, where fossil gas power plants account for 53% of the electricity produced, this dependency on gas generation poses a significant risk for high electricity costs that are ultimately passed on to consumers.

If a market does not have enough lower-cost generation (e.g. wind, solar, nuclear) to meet demand, these higher-cost fossil gas units will still be relied upon for power and included in the supply stack, raising the uniform clearing price and driving up wholesale electricity prices. For a region like New England, where fossil gas power plants account for 53% of the electricity produced, this dependency on gas generation poses a significant risk for high electricity costs that are ultimately passed on to consumers.[30]

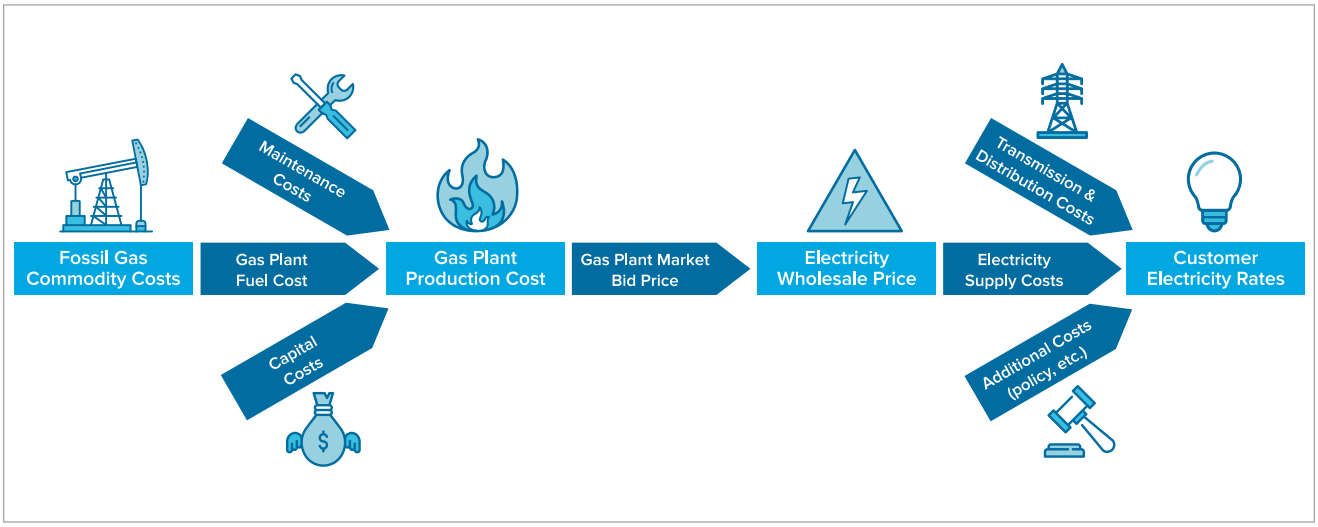

FIGURE 4: Simplified Process By Which Fossil Gas Commodity Costs Impact Electricity Rates
Source: Strategen Consulting

States in the Northeast have already begun to experience the impacts of high fossil gas prices from the past year. As Figure 3 shows, as fossil gas prices sharply rose between 2021 and 2022, wholesale electricity prices followed. In the first three months of 2022, wholesale electricity prices jumped to $137/MWh, an 83% increase compared to the $75/MWh price for the same time period in 2021.[31] This means that utilities in New England must spend more money to purchase power from these wholesale markets and ultimately pass that cost on to their customers.

For example, effective January 1, 2023, Eversource Energy has roughly doubled residential electric supply rate from 12.1 cents per kWh to 24.2 cents per kWh for customers in Connecticut.[32] In general, the retail rates that customers in New England see on their utility bills are a combination of several costs, including the cost utilities paid to purchase that power, as well as the cost to transport that power to customers. However, Eversource stated that spikes in fossil gas prices were the biggest driver of this increase, which are expected to increase the average customer's bill by around 48%.[33]

30 Ibid.
31 Ethan Howland, "Power prices jumped 51% in PJM, 85% in New England in Q1 due to rising gas prices," Utility Dive, May 13, 2022.
32 "Global Demand Drives Winter Energy Supply Prices to Historic Highs," Greenwich Free Press, November 18, 2022.
33 Stephen Singer, "Connecticut, Massachusetts regulators call on Eversource to defend sharply higher rate," Utility Dive, January 4, 2023.

What are the recent trends in fossil gas prices?

Global increases in gas prices have increased significantly over the past few years, compounded by factors that include Russia's invasion of Ukraine, lasting impacts of the COVID-19 pandemic, and extreme weather conditions. In January, the average settlement price of fossil gas at Henry Hub, a fossil gas hub in Louisiana whose settlement prices are regularly used as benchmarks for the North American gas market as a whole,[34] was up almost 62% from January 2021, with prices averaging $4.38/MMBtu in January 2022 compared to $2.71/MMBtu in January 2021.[35]

In New England, this rise in fossil gas prices is especially steep. Gas prices in New England in January 2022 were approximately 400% higher than they were in January 2021 (described in more detail in the next section).[36] Figure 5 below is a comparison of gas prices between 2021/2022 and 2022/2023 at the Algonquin citygate in New England, the primary interconnection point where the gas utilities take physical possession of fossil gas from the interstate pipeline system.[37]

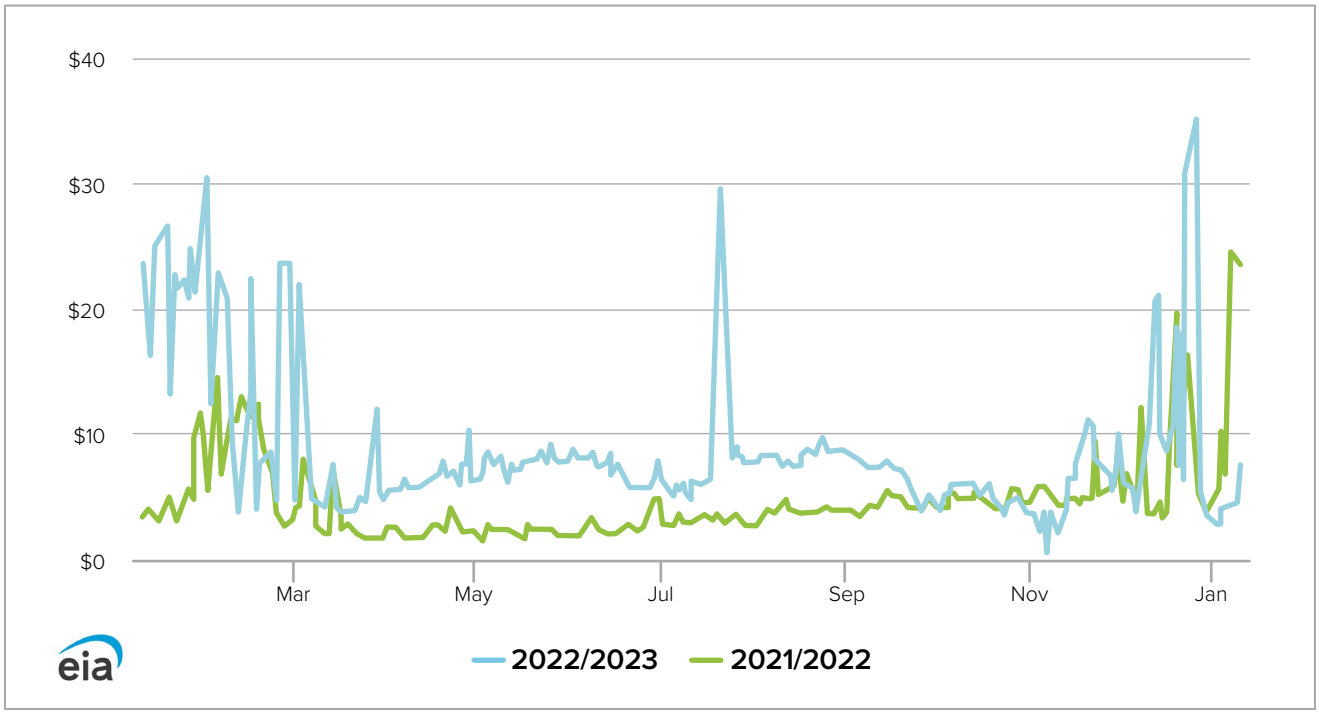

FIGURE 5: Algonquin Citygate Gas Prices ($/MMBtu)
Source: EIA / S&P Global Market Intelligence

Although gas prices are increasing across the country, New England's fossil gas infrastructure and reliance on fossil gas for both heating and electricity has created conditions that have made New England consumers particularly vulnerable to spikes in fossil gas prices. Figure 6 compares the average fossil gas citygate prices for the U.S. and New England. For this comparison, an unweighted average of fossil gas prices in states in the region was taken. The figure above demonstrates not only that New England experiences higher fossil gas prices as compared to the rest of the country, but it also experiences greater price variability month to month.

34 Henry Hub is a pipeline in Louisiana that serves as the official delivery point for fossil gas futures on the New York Mercantile Exchange (NYMEX). The settlement prices at Henry Hub are regularly used as a benchmark for the North American natural gas market as a whole. See: James Chen, "What Is Henry Hub? Definition, Location, Owner, and Connections," Investopedia, June 3, 2022.

35 Ethan Howland, "Power prices jumped 51% in PJM, 85% in New England in Q1 due to rising gas prices," Utility Dive, May 13, 2022

36 "New England Dashboard," U.S. Energy Information Administration, 2023.

37 The Algonquin citygate is the point at which natural gas utilities in New England receive natural gas from the Algonquin Gas Transmission Pipeline that delivers gas to the region. The citygate is typically the connection point in which the local gas utility takes physical control over the gas. See: Link System Information Postings, "Algonquin Gas Transmission," Enbridge, accessed February 6, 2023.

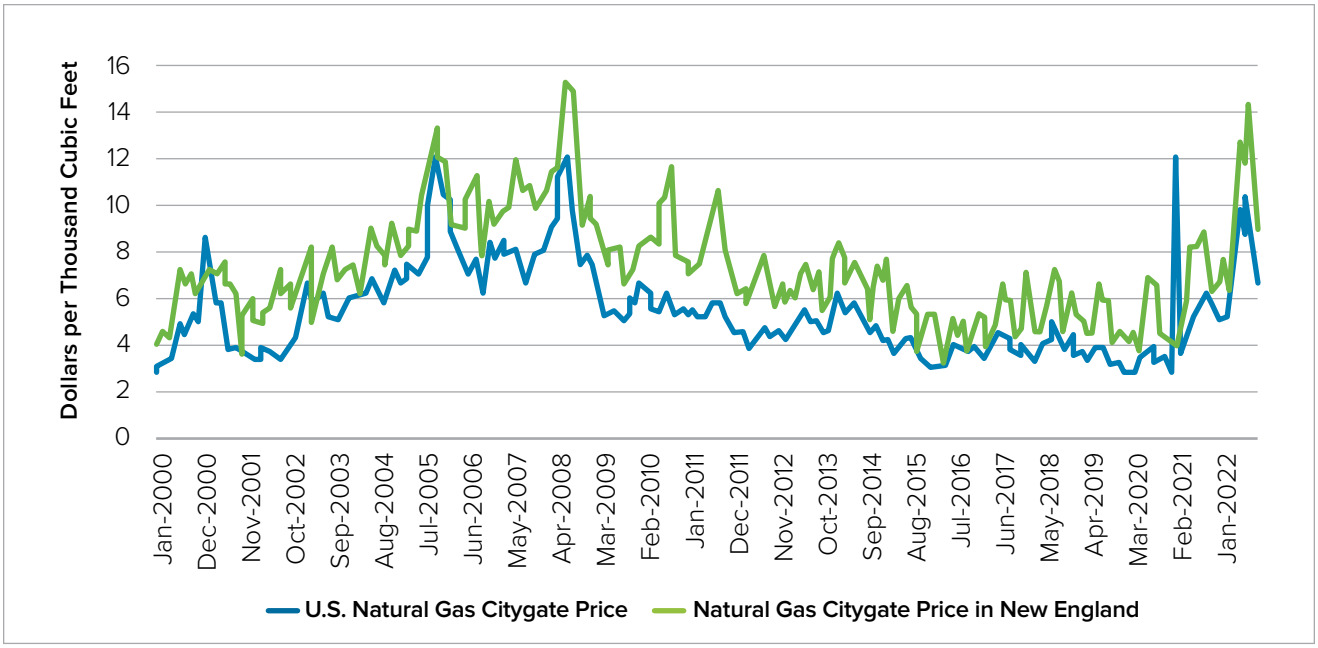

FIGURE 6: Fossil Gas Citygate Prices[38]
Source: U.S. Energy Information Administration

This has translated into greater average prices of fossil gas delivered to residential consumers in New England compared to the rest of the U.S., as can be seen in Figure 7 below. The interconnection between electricity and fossil gas prices also causes New England to experience higher electricity costs than the rest of the country. The U.S. Energy Information Administration (EIA) forecasts that New England customers will have to pay on average 26.94 cents per kWh for electricity in January 2023.[39] This is in stark contrast with the rest of the United States, where on average customers are projected to pay 14.47 cents per kWh in January 2023.[40]

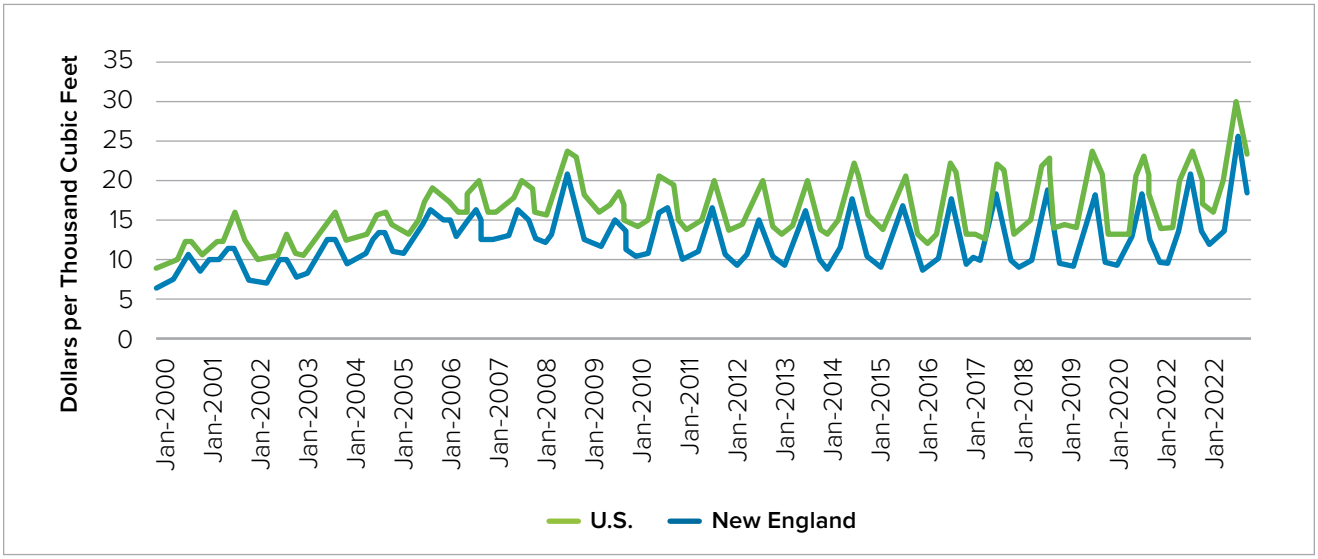

FIGURE 7: Fossil Gas Delivered to Residential Consumers Prices[41]
Source: U.S. Energy Information Administration

38 "Natural Gas Prices," U.S. Energy Information Administration, 2023.
39 "Short Term Energy Outlook Data Browser," U.S. Energy Information Administration, 2023.
40 Ibid.
41 "Natural Gas Prices: Residential Prices," U.S. Energy Information Administration, 2023.

Why is New England more impacted by fossil gas price volatility than other states?

New England as a region is especially vulnerable to the volatility of fossil gas prices due to three key factors: global competition for liquefied natural gas (LNG) imports, constraints on New England's fossil gas infrastructure, and New England's higher dependence on fossil gas compared to the rest of the United States.

New England Is Reliant on Fossil Gas Generation for Producing Electricity

For New England, these recent price increases have posed a serious threat to the region's power system due to the region's reliance on fossil gas for power generation. The proportion of fossil gas in New England's total fuel mix (53%)[42] is roughly 20% higher than the percentage of fossil gas in the total fuel mix for the United States as a whole.[43] This dependence on fossil gas is a relatively new development for New England's power system. In 2000, fossil gas accounted for only 15% of the region's total fuel mix.[44]

> The proportion of fossil gas in New England's total fuel mix (53%) is roughly 20% higher than the percentage of fossil gas in the total fuel mix for the United States as a whole.

The deepening dependence on fossil gas for electric generation creates a significant supply risk in the winter when demand for fuel increases significantly, driven by higher needs for heat in the region. In colder periods, gas utilities in New England have had to use most of the pipelines' capacity to ensure sufficient gas was available for heating demand.[45] These gas utilities typically commit to long-term contracts for fossil gas with clauses that require "firm," or guaranteed, delivery. By contrast, fossil gas plants, which can't always predict how often they will run in a given year, typically avoid these "firm" contracts and purchase gas on an as-needed basis in order to keep their operating costs as low as possible.[46] As a result, in many recent winters, there has been limited, if any, pipeline capacity available for electricity generators. This has raised concerns regarding reliability risks and price volatility.[47]

For instance, in the 2017-2018 winter period, there was a 16-day period of extremely cold temperatures that resulted in greater demand for heating fuel, specifically fossil gas. This led to a spike in prices in the energy market, with the wholesale energy market for New England being valued at $992 million between December 26 to January – over four times higher than the same period the previous year.[48] This ultimately translated to larger retail electricity rates for consumers.

42 Morgan Evans, "New England, New York Utilities Warn Natural Gas Prices Could Cause Bills to Soar Up to 38% from 2021," Natural Gas Intelligence, October 6, 2022.
43 "U.S Energy Facts Explained," U.S. Energy Information Administration, accessed February 6, 2023.
44 "Natural Gas Infrastructure Constraints," ISO New England, accessed February 6, 2023.
45 Ibid.
46 Ibid.
47 Ibid.
48 Ibid.

New England has Limited Fossil Gas Pipeline Capacity

New England's fossil gas pipeline capacity is relatively small compared to its overall demand. EIA estimated that in 2019, pipeline capacity into New England from New York and Canada was 5,200 MMcf/d.[49] This is notably smaller than other regions with similar levels of fossil gas demand.[50] Aside from four pipeline projects to be completed in 2023, which will add 350 MMcf/d of pipeline capacity,[51] there are few projects set to increase pipeline capacity in New England. Furthermore, the region is located at the end of the North American pipeline system, which limits its capacity to access out-of-state supply.[52]

It's also unlikely that pipeline capacity in the region will be expanded in the future. States in New England have passed nation-leading climate policies aimed at mitigating the worst effects of climate change, which will require significant reductions in the amount of fossil gas used in each state. This in turn will decrease usage rates for fossil gas infrastructure, causing many states to re-think building new fossil-fuel infrastructure that may become under-utilized or even stranded before it reaches the end of its life. Regulators, concerned with meeting state and federal climate goals, are hesitant to approve pipeline expansion projects that will continue to foster fossil gas dependence in the region.[53]

There has also been significant public opposition and permitting challenges for previous pipeline expansion projects in the region. The Algonquin Incremental Market (AIM) project, which went into service in 2017 and added another 342 MMcf/d of capacity, was the subject of legal challenges from opponents.[54] The Atlantic Bridge project completed in 2021[55] brought on an additional 132 MMcf/d and was the subject of strong opposition from the public[56] and political figures.[57] The pipeline capacity expansion projects ultimately did not solve the region's capacity constraint nor the price volatility during peak demand periods, which continued to persist into 2022.[58]

Even if New England's regulators and policymakers were more willing to approve large-scale pipeline projects, regulators in New York appear to be unlikely to allow for pipelines to be expanded within the state to transport fossil gas into New England. Between 2016 and 2018, the New York State Department of Environmental Conservation (NYSDEC) blocked applications for a water quality permit to begin construction on two pipeline expansion projects, Constitution and Northern Access.[59] In 2020, NYSDEC blocked a third application from Transcontinental Gas Pipeline Co. LLC for a water permit, preventing the company from developing its pipeline project.[60] Driven by many of the same climate and environmental goals as New England states, New York is also conscientiously moving away from a heavy reliance on fossil fuel infrastructure.

49 "New England Dashboard," U.S. Energy Information Administration, accessed February 6, 2023.
50 "State to State Natural Gas Pipeline Capacity," U.S. Energy Information Administration, 2022.
51 Ibid.
52 Ibid.
53 Pat Knight, et al., *New England's Shrinking Need for Natural Gas*, Synapse Energy, February 7, 2017.
54 Kimberly Redmond, "Algonquin Pipeline expansion opponents urge residents to get informed," Lohud.com, December 5, 2017.
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57 Press Release Senator Elizabeth Warren, "Senators Market and Warren Call on FERC to Rescind Authorization for Spectra's Atlantic Bridge Pipeline," February 1, 2017.
58 "Natural Gas Prices," U.S. Energy Information Administration, 2023.
59 Nicole Greenfield, "New York's Fossil Fuel Fight," National Resource Defense Council, 2018.
60 Tom DiChristopher, "New York rejects permit for Transco's gas pipeline expansion project," S&P Global, May 15, 2020.

There is Global Competition for LNG Exports

Although North American LNG production has reached an all-time high, New England has limited ability to rely on this resource.[61] LNG imports make up approximately 35% of New England's fossil gas supply.[62] Due to New England's constrained access to the North American pipeline system and the 1920 Jones Act,[63] which limits access to domestic LNG cargo imports in the Northeast, the region is dependent on foreign LNG imports to meet demand for fossil gas.[64] This makes New England at risk of being disproportionately impacted by recent world affairs compared to the rest of the United States.

Unfortunately, global events have made foreign LNG supplies particularly strained. Russia's invasion of Ukraine sparked an extreme energy crisis in Europe. In response to Russia's invasion, western countries imposed economic sanctions which led to Europe severely reducing fossil gas imports from Russia, the world's largest fossil gas exporter. Consequently, European countries were forced to look to other markets, which has pushed up fossil gas prices in the global market. For example, in November 2022, Constellation Energy Corp's Everett LNG import terminal in Massachusetts received its first LNG vessel since August 2022, and eleventh shipment overall for 2022.[65] From January to November in 2022, the terminal imported only 16.7 million cubic feet of LNG, less than half of its average imports over the same period over the past five years (2017-2021).[66] The terminal is forced to compete with European buyers that are willing to pay approximately $35/MMBtu, nearly 6 times higher than the $6/MMBtu prices seen in the United States.[67]

How are electric and fossil gas rates in New England adjusted?

Spikes in fossil gas commodity prices will increase retail electric and gas rates that customers pay to their utility. However, customers may not experience this impact for many months due to how utilities are regulated, and may experience the impact on their electric and gas bills at different times of the year. Typically, electric and gas utilities are required to demonstrate that the money they spent on behalf of customers is "used and useful" before a public utility commission allows the utility to recover the costs from customers. The period of time between when a utility spends money and when it can recover those costs from customers is called "regulatory lag." However, because energy costs are generally considered to be outside the control of the utility, and the utility does not earn a return on the costs, many electric and gas utilities across the United States are allowed to recover energy costs through a unique regulatory mechanism called a fuel clause adjustment mechanism.

Under fuel clause adjustments mechanisms, utilities forecast the cost of energy over the year, and the Commission sets rates to collect the forecasted energy costs. At the end of the regulatory year, the differentials between the forecasted costs and actual costs are "trued up." Then for the next year, this differential is either credited or debited to customers depending on whether an over- or under-collection occurred. In New England, all gas utilities have a fuel clause adjustment mechanism, but they are generally less common among electric utilities.[68]

61 Erin M. Blanton, "Q&A | The Role of Liquefied Natural Gas in the US Gas Market," Columbia SIPA Center on Global Energy Policy, November 1, 2021.
62 Morgan Evans, "New England, New York Utilities Warn Natural Gas Prices Could Cause Bills to Soar Up to 38% from 2021," Natural Gas Intelligence, October 6, 2022.
63 The Jones Act of 1920 requires that only U.S.-flagged vessels that are owned and operated by U.S. citizens transport goods between U.S. ports. However, no LNG vessels meeting this criteria exist at this time. As a result, New England cannot import U.S. LNG into any of its LNG import facilities, making it dependent on foreign LNG imports to supplement its limited pipeline infrastructure. See: Morgan Evans, "Eversource CEO Urges Biden to Waive Jones Act as New England Facing Possible 'Severe Natural Gas Shortage'," Natural Gas Intelligence, November 7, 2022
64 Morgan Evans, "New England, New York Utilities Warn Natural Gas Prices Could Cause Bills to Soar Up to 38% from 2021," Natural Gas Intelligence, October 6, 2022.
65 "U.S. New England set to get first LNG cargo since Summer," Reuters, November 21, 2022.
66 Ibid.
67 Ibid.
68 Russell Ernst, et al., "RRA Regulatory Focus: Adjustment Clauses," S&P Global, September 12 2017.

To an extent, fuel clause adjustment mechanisms help avoid "regulatory lag" by allowing utilities to adjust costs between rate cases, rather than having to wait for the next rate case proceeding. However, there is still a period of time between the utility incurring the commodity costs, triggering the fuel clause adjustment mechanism, and the regulatory agency overseeing the utility granting the price adjustment.

For example, in Connecticut, the Public Utilities Regulatory Authority (PURA) has a purchased gas adjustment clause (PGA) for each utility which appears as a PGA factor on customer bills.[69] During the course of the year, each utility will submit monthly and annual PGA filings for PURA to review. During the regulatory year (September 1 – August 31), gas utilities track fossil gas expenses and customer consumption on a monthly basis to determine if any over- and under-collection occurs. Even though this mechanism allows for a more efficient method to reflect fossil gas prices in customer bills than traditional rate case proceedings, utilities are only able to true up actual fossil gas costs at the end of the regulatory year, which means customers may not experience the impacts of increased fossil gas prices in their gas rates for several months – or up to a year – after prices initially spike on commodity markets.[70]

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In Massachusetts, there is a cost of gas adjustment factor (GAF) in place for Massachusetts gas companies to recover fossil gas costs on a semiannual basis.[71] While GAFs are approved for a 6-month period, companies are allowed to file for revisions at any time throughout the year in response to changes in market prices for fossil gas.[72] While this mechanism significantly alleviates the regulatory lag that occurs in response to fossil gas price changes, there is still a period of time between the moment a company experiences a cost burden due to rising fossil gas prices and the approval of a GAF by the Massachusetts Department of Public Utilities.

The costs from wholesale electricity purchases, however, are usually passed on to customers on a more frequent basis than gas costs. In Massachusetts and Connecticut, distribution companies procure basic service supply for their customers through competitive solicitations in tranches at regular intervals.[73] The utilities' energy procurement practices must reflect market prices over time so as to best ensure that resulting retail rates to customers are fair, just, and reasonable.

These wholesale electricity prices are then passed through to customers as a component of their basic service rates, also known as standard service rates.[74] Utilities in Massachusetts offer two pricing options for the basic service rate: a monthly variable rate[75] and a fixed rate that is set for three or six months, depending on the customer class. In Connecticut, rates are set for a six-month period, with adjustments occurring in January and July.[76]

As a result, depending on the type of basic service an electric customer takes, wholesale electricity price increases may be passed onto electric customers on a more frequent basis than fossil gas cost increases are passed onto gas customers. In addition, because adjustments to electricity and gas rates happen at different

69 "Frequently Asked Questions: Purchased Gas Adjustment Clauses," Connecticut Public Utilities Regulatory Authority, accessed February 6, 2023.
70 Ibid.
71 "Cost of Gas Adjustment Factor Rates and Information," Massachusetts State Gas Division, accessed February 6, 2023.
72 Ibid.
73 Christopher Bernard, *Procuring Electric Supply in a Dysfunctional Electric Generation Market*, Filed in Docket No. 17-12-03RE10, "PURA Investigation Into Distribution System Planning Of The Electric Distribution Companies – Building Blocks Of Resource Adequacy And Clean Electric Supply," Eversource Energy, December 30, 2022.
74 While retail choice exist in states such as Massachusetts and Connecticut, most customers remain with the basic service/default service from the utility.
75 The monthly variable rate is determined by the winning monthly bids in the two solicitations where 50% of the supply was procured.
76 "Understanding your electric bill: Electric Bill and Rate Components," Connecticut Office of Consumer Council, 2022.

times, the latter can lag significantly behind the former. For example, in Connecticut, electricity rates are adjusted in January and July, but gas rates don't need to be adjusted until the end of the regulatory year in September – meaning that increases in gas rates can occur over half a year after electricity rates are increased.

How can New England mitigate the risk to electricity rates from volatile fossil gas prices in the future?

Rising electricity prices pose a significant threat to the energy security of New England's customers, damaging the ability for residents to access a critical service at affordable price points. This is especially true for low-income and disadvantaged communities that experience high energy burden (defined as the percentage of household income spent on energy costs).[77] High energy burden is typically characterized as spending 6% or more of a household income on energy. The state-level average household energy burden in New England ranged between 3% and 5% across the region.[78] However, low-income communities experience a much higher energy burden compared to statewide averages, spending as much as 10% of their income on energy.[79] In some areas, the energy burden accounts for almost a third of household income.[80],[81]

Rising energy costs also have implications for racial equity, as race and ethnicity play a role in energy burden inequity as well. The median energy burden for Native American, Black, and Hispanic households is higher than the energy burden for white households. Across the country, Native American, Black, and Hispanic households experience energy burdens of 4.2%, 4.1%, and 3.5%, respectively, compared to the 2.8% energy burden experienced by white households.[82]

As a result, increasing energy costs, which negatively impact every household but disproportionately affect low-income households and households of color, are a key issue for policymakers to address. There are several policy options regulators and policymakers can take to alleviate households' high energy burden, such as expanding heating bill and weatherization assistance. However, a key measure to address future fossil gas price spikes is to decouple New England's energy prices from the volatility of fossil gas commodity costs.

Step 1: Transition New England's power system away from fossil gas

As long as New England's power system remains dependent on fossil gas generation, volatile commodity prices will continue to drive spikes in electricity costs, posing significant risks for New England's consumers.

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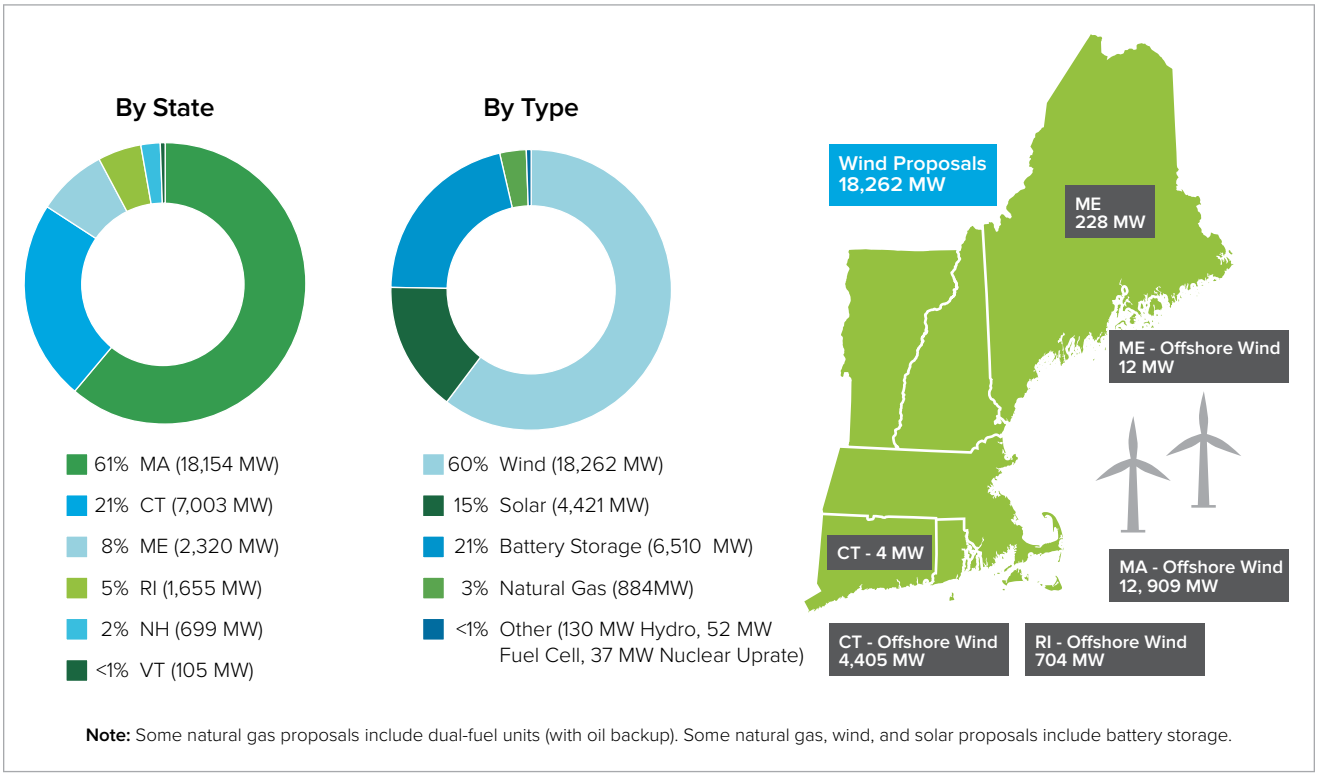
Recent events that have disrupted fossil gas supply chains have demonstrated how unstable commodity prices for fossil gas really are. The only way to mitigate this risk over the long term is to move the region's power sector to resources that don't require fuel inputs, such as wind, solar, and battery storage. Increasing the capacity of renewable energy will enable wind and solar to operate as marginal resources for more hours in the day, leading to significantly lower market clearing prices compared to fossil gas generating units, especially during periods of gas price spikes.

77 Office of State and Community Energy Programs, "Low-Income Community Energy Solutions," U.S. Department of Energy, accessed February 6, 2023.
78 Danielle Goldberg, "New Tool: Compare Energy & Emissions Data Across Northeast States," Synapse Energy, May 24, 2022.
79 Kimberly Clark, "Reducing Energy Burden: Resources for Low-Income Residents," Metropolitan Area Planning Council, January 28, 2022.
80 Ibid.
81 Ariel Drehobl, Lauren Ross, and Roxana Ayala, *How High Are Household Energy Burdens? An Assessment of National and Metropolitan Energy Burden across the United States*, American Council for an Energy-Efficient Economy, September 2020.
82 Ibid..

Fortunately, this transition is already in motion. Over the next twenty years, New England is set to experience a massive energy transition. About 95% of resource projects proposed for New England are grid-scale renewable resources.[83] Grid-scale wind projects make up the majority of new proposals (60%), followed by battery storage (21%).[84] Additionally, grid-scale solar projects make up 15% of the proposed resource projects. As of January 2022, approximately 28,500 MW of clean-energy resources have been proposed.



Note: Some natural gas proposals include dual-fuel units (with oil backup). Some natural gas, wind, and solar proposals include battery storage.

FIGURE 8: Planned Resource Additions in ISO-NE[85]
Source: ISO Generator Interconnection Queue (January 2022), FERC and Non-FERC Jurisdictional Proposals, Nameplate Capacity Ratings

Figure 8 illustrates the incoming shift away from fossil gas in New England, a vital step in transitioning New England's wholesale electricity markets to be less dependent on fossil gas and offer greater price stability for consumers. This transition also means that the impact of the recent fossil gas price spikes on regional electricity costs will ultimately be short-lived, lending confidence that a future that uses electricity more extensively in the heating and transportation sectors will not expose customers to higher price volatility. In fact, as described in more detail in Step 2 below, this transition will likely leave customers better shielded from price swings in fossil gas and other commodities than they are today.

Step 2: Electrify more appliances in customers' homes

As electricity prices become decoupled from fossil gas costs, customers can further mitigate their risk from volatile gas prices by electrifying other systems in their homes that currently use fossil gas directly. Chief among these are space and water heating. In a power sector with a high penetration of renewable energy and battery storage, customers that switch to electric appliances will be exposed to fewer price spikes than those that remain dependent on a volatile commodity like fossil gas.

83 "Key Stats: Resource Mix," ISO New England, accessed February 6, 2023.
84 Ibid.
85 Ibid

By contrast, avoiding or delaying the electrification of home appliances will keep customers exposed to similar price shocks in the future. Even incorporating higher levels of non-fossil fuels like renewable natural gas (RNG) and green hydrogen into the gas network can only slightly mitigate this exposure, as neither of these resources can fully remove customers' dependence on fossil gas on their own. In addition, both RNG and green hydrogen cost significantly more than fossil gas and are expected to continue to command a price premium far into the future that would exceed even the high-cost fossil gas available on the market today.[86]

According to a 2019 study published by the American Gas Foundation (AGF), a fossil gas industry group that is traditionally bullish on RNG, the majority of RNG that could be made available on the market would cost over $12/MMBtu – roughly 3 times higher than Henry Hub fossil gas prices during the commodity price spike in January 2022.[87] In addition, limitations on available supply of RNG mean that, even under optimistic assumptions of its availability, this resource would be able to replace less than 30% of national fossil gas use across the residential, commercial, and industrial sectors (not including use in power generation).[88]

Similarly, technical constraints on the amount of hydrogen fuel that can be blended into fossil gas networks limit the degree to which hydrogen can replace fossil gas before extensive equipment retrofits are needed. Current estimates place the maximum potential blend rate at around 7% by energy content (20% by volume),[89] although analysis in California has suggested that the blend rate could be as low as 1.7% by energy (5% by volume).[90] It follows that a decarbonized heating system would require fossil gas use to be reduced by more than 63% – a reduction that could likely only be achieved by widespread adoption of electric heating systems.

Several utilities in New England have recognized these constraints, proposing decarbonization plans that lean on electrification for the majority of emission reductions in residential and commercial heating. National Grid's "Clean Energy Vision," which fully eliminated fossil fuels from the gas network, proposed a hybrid approach that involved installing heat pumps in the majority of its customers' homes, reserving gaseous fuel primarily for use at lower temperatures and in buildings that are technically challenging to electrify.

In this proposal, even under optimistic assumptions around the availability and technical blending potential for RNG and hydrogen, these resources only supplied around one-sixth of total emission reductions. Energy efficiency and electrification were the primary decarbonization tools in this scenario, which envisioned 75% of gas customers switching to either all-electric or hybrid electric heating systems.[91] This demonstrates the importance of continuing – and in fact, accelerating – heat electrification in tandem with a power sector transition away from fossil gas in order to effectively reduce customers' exposure to future fossil gas price spikes.

86 Nima Simon, Mike McCurdy, and Heidi Marie Larson, "Examining the current and future economics of hydrogen energy," ICF, August 13, 2021.

87 ICF, "Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment," American Gas Foundation, December 2019.

88 Based on comparison of AGF's "High Resource Potential" scenario to average U.S. fossil gas use from 2009-2018. See: ICF, "Renewable Natural Gas: Supply and Emissions Reduction Assessment (Fact Sheets)," American Gas Foundation, December 2019.

89 Sara Baldwin, Dan Esposito, and Hadley Tallackson, "Assessing the Viability of Hydrogen Proposals: Considerations for State Utility Regulators and Policymakers," Energy Innovation, March 2022.

90 Arun SK Raju, Alfredo Martinez-Morales, and Oren Lever, "Hydrogen Blending Impacts Study," California Public Utilities Commission, July 18, 2022.

91 "Our Clean Energy Future," National Grid, 2022.

Conclusion

Far from being a reason to delay or avoid electrification, the recent electricity price spikes in New England ultimately demonstrate the risks of continuing to depend on an energy system reliant on volatile commodities like fossil gas. The price spikes in electricity and fossil gas that have rippled across the globe over the past year have shown how global events can substantially disrupt fossil gas supplies and push prices up. These price spikes in turn disproportionately impact New England due to its location and heavy reliance on fossil gas for both heating and power generation.

The price spikes in electricity that customers are experiencing today are a result of that reliance, reflecting the fact that fossil gas power plants still set the clearing price in ISO-NE's wholesale market. These electricity rate increases will eventually be mirrored in gas rates as utilities' fuel adjustment clauses are triggered to incorporate the jump in gas commodity costs. Over the long term, however, efforts to change the regional power mix to incorporate greater amounts of wind, solar, and energy storage should reduce the number of periods where fossil gas plants serve as the marginal resource, helping to decouple electricity costs from gas prices.

Once this happens, heat electrification offers a promising pathway to further protect customers from commodity price hikes. Today, customers that use fossil gas for heating or cooking will still be exposed to fossil gas price swings regardless of how quickly the power sector transitions. Decarbonizing the gas network without electrification can't address this issue, as low-carbon fuels like RNG and hydrogen are priced significantly higher than even today's high-cost fossil gas – and neither is able to fully replace the levels of fossil gas used today.

By contrast, electrification can eliminate up to 100% of a customer's gas use, providing a pathway to completely remove New England residents' dependence on the fuel. As New England's power sector continues on its current trajectory towards cleaner resources with lower marginal production costs, electrification will provide the greatest opportunity for customers to untether themselves from fossil gas costs and avoid similar price spikes in the future.

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