

# THE EMERGING GLOBAL NATURAL GAS MARKET AND THE ENERGY CRISIS OF 2021-2022

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## EXECUTIVE SUMMARY

The ongoing energy crisis of late 2021 looks sure to move into 2022. It has already had wide-ranging impacts on economics, the environment, and security. This essay considers a few of the tensions arising for government policy, investors, and consumers. The crisis has three distinct elements: COVID-19 and supply chain disruptions, greater interconnectedness of natural gas markets, and signs of energy price volatility during the energy transition away from fossil fuels.

As the global economy continues a halting recovery from the COVID-19 pandemic, energy prices and availability threaten to derail it. The pandemic brought about a historic drop in energy demand and prices, but recovering demand is now straining fossil fuel markets for oil and gas, and even coal. Prices are skyrocketing as demand chases fuel supply that has not yet recovered from the pandemic drop.

Past global supply crises have typically been limited to oil, but fast-changing natural gas markets are in crisis as well. A growing and more flexible liquified natural gas (LNG) market has enabled global competition for gas supply, a situation that wasn't possible when gas was supplied by pipeline or LNG under long-term contracts. Europe and Asia are competing for the same LNG supply, pushing prices up in both markets and extending today's tight market to the United States. In a sense, natural gas is a victim of its own success: displacement of coal-fired power generation for economic or environmental reasons has been an important source of gas demand. However, with coal-fired generation on the decline in the United States, an important buffer for gas demand and prices is disappearing. With less ability to use coal for power generation when natural gas demand is high, gas demand is becoming less elastic and prices more volatile.

Energy markets are naturally price-inelastic and thus volatile. Nonetheless, recent emphasis on the environment and affordability during the early part of the energy transition may have led to less attention to energy security. The new interconnectedness of energy markets across fuels and geographies has also changed how crises spread. Measures like strategic reserves and demand response may need more attention, along with programs to help lower-income consumers, who are always most affected when energy prices are high. Diversifying energy supply with renewables will also help, as once built, these sources are not subject to the whims of global markets.

## THE COVID-19 CRISIS BEGETS AN ENERGY CRISIS

As the world continues to struggle with the COVID-19 pandemic, concurrent energy crises threaten the global economic recovery. Skyrocketing energy prices are paralyzing Europe.<sup>1</sup> Power outages are exacerbating supply chain and recession fears in China.<sup>2</sup> Rising natural gas prices are disrupting markets in the United States.<sup>3</sup> Less than two years after the pandemic caused a spectacular crash in global energy demand, a confluence of factors could cause one of the most severe global energy supply shocks ever witnessed. Cracks in the deeply interconnected global economy are being revealed in real time. Energy access for many vulnerable populations, already struggling due to pandemic job losses, will be further harmed by high prices.

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As with past cycles, the current energy shortages arise from the last bust – the energy market and investment disruptions of early 2020, when oil prices went negative and LNG prices hit record lows.<sup>4</sup> Energy demand was so low that air pollution briefly seemed to disappear. Investment dried up, workers were laid off and dispersed, and ripples started in just-in-time supply chains. As two of us warned then, energy security planning based on supply-side considerations is not equipped to handle a demand-side crash.<sup>5</sup> The pandemic crash compounded other recent energy price crashes that caused continuing underinvestment in infrastructure outside the U.S., including the commodity price bust in 2008 that accompanied the Great Recession and the 2014-2016 arrival of U.S. shale oil to world markets. Now the situation has changed direction and demand for durable goods is rising due to widespread economic

stimulus and delayed consumption related to the pandemic, in turn driving strong energy demand worldwide.

These acute supply and investment challenges are compounded by a fundamental long-term change in energy markets: the emergence of natural gas as a global commodity. Europe and Asia are suddenly competing for the same gas supplies, due to U.S. export destination flexibility, shortfalls in Europe, and the demise of bilateral oil-tied contracts. The rapid increase in U.S. natural gas export capacity means that U.S. prices and availability are already shaping the future of markets and emissions, from Baton Rouge to Beijing. The newly foundational role of LNG trade and its impacts on energy systems increases the volatility that must be managed during the next several decades of the energy transition.

The world may now be hurtling towards a black swan event in energy markets: a weak global recovery and struggling supply chains influenced by an energy price and supply crunch unparalleled in modern history. Historically, global energy security crises were primarily limited to oil. Increasing fuel market integration now risks interlinked crises in natural gas, oil, coal, and power markets. Gridlock in sea transportation threatens resupply of energy, even if fuels can be obtained at high prices. Energy market design in Europe,<sup>6</sup> and to a lesser degree the United States, focused on short-term marginal markets and was not sufficiently concerned with ensuring long-term supply security across multiple sectors. Even China's command-and-control approach to minimizing consumer energy prices created shortages.

World economies are not just facing an energy supply shortage. Rather, they are facing mutually reinforcing energy supply shortages and global trade disruptions continuing from the pandemic. At a macro level, higher energy prices and energy-induced product shortages may exacerbate so-called “transitory inflation” from pandemic disruptions. Thus, energy shortages threaten to spill into all sectors of the economy.

## FUEL SHORTAGES AMIDST SUPPLY CHAIN DISRUPTIONS

A long-term shift towards natural gas in Europe with continued dependence on gas imports has led to a severe energy crisis on the continent. For years, European countries have switched from coal to natural gas in power generation to reduce greenhouse gas emissions and meet other environmental objectives. The United Kingdom is a particularly stark example, having almost completely replaced coal with natural gas (and some renewables) in its power sector in less than 10 years.<sup>7</sup> This growth has been met in past years by increases in LNG imports, Russian imports, and Norwegian production. However, supply finally appears insufficient, especially following gas storage deficits from last year.<sup>8</sup> A combination of robust demand, stiff Asian competition for LNG imports, lower Russian flows, and relatively low storage at the start of the winter heating season<sup>9</sup> is causing a natural gas supply crunch.

This short-term crisis reveals the growing long-term dependency of European gas markets on imports. As the season for injecting natural gas into storage ended, storage levels across the continent were at decade lows.<sup>10</sup> For months now, gas and power prices have set new records each day as companies rush to cover the portion of gas demand not covered by long-term contracts on the very tight spot market.<sup>11</sup> Further, carbon dioxide emissions prices in the European Union's cap-and-trade program have grown from relatively insignificant levels in the 2010s to more than 70 euros a ton.<sup>12</sup> With limited ability to quickly increase gas supply, European countries are now facing the prospect of high energy prices slowing or reversing the economic recovery from the COVID-19 shock — not at all the result the region was seeking.

The crisis has further elevated debate about the continent's dependence on Russian natural gas supply. Despite the focus on Nord Stream 2, specific pipeline routes and their associated geopolitics are not a major driver of the current shortage.<sup>13</sup> Rather, it appears that Russia is simply limited in how much

more gas it can provide to Europe, regardless of the route, due to field maintenance, low domestic storage, and related issues. Russia also does not appear to be leveraging the situation to apply geopolitical pressure.<sup>14</sup> Russia's market power in European natural gas supply undoubtedly poses a threat to energy security to individual countries and perhaps the broader EU, but that is not a key driver of the current challenges. Rather, insufficient system resilience, gas supply planning, and fuel supply flexibility overshadow geopolitics in this crisis.

Meanwhile, high energy demand in Asia is straining global gas, coal, and oil markets. China's voracious demand for energy to power its economic recovery is a primary factor, with coal consumption on track to set a new annual record. Since the beginning of the pandemic, poorly thought-out market interventions in China laid the groundwork for insufficient coal supply.<sup>15</sup> In an effort to support industry and keep the population happy, China capped how much utilities could charge customers.<sup>16</sup> At the same time, the country still depends primarily on coal-fired power generation. As coal demand and prices rose, power plants could not make money at the capped prices and it no longer made sense for them to secure coal supply or operate. As a result, factories are facing energy shortages as coal generation is insufficient to meet grid demand.<sup>17</sup> Even as coal remains the primary cause of China's woes, the effects are rippling into other parts of the country's energy markets, with high LNG prices also leading to factories slowing production or even shutting down entirely.<sup>18</sup>

As the world's largest energy consumer, China's market chaos is spilling into other Asian energy markets. India is also facing a coal crisis.<sup>19</sup> Following severe demand decline in early 2021 as the delta variant ravaged the subcontinent, India's power producers failed to secure supply contracts, hoping for lower coal prices. Now, as prices have climbed instead, coal stockpiles are very low, with many plants only having several days of supply. Rolling outages are reported as plants seek to ration their remaining supplies.

Compared to many countries, strong domestic production and diversified energy supply mean that the United States is withstanding the global energy crisis relatively well so far. Nevertheless, energy prices are at some of the highest levels in years, with natural gas breaking \$6 per million British Thermal Units (mmbtu), oil breaking \$80 per barrel, and electricity prices this fall \$10 to \$30 per megawatt-hour higher than usual for the season. However, the country has yet to see the shortages, outages, and stockpile fears prevalent in other nations. The Department of Energy has rejected imposing a crude oil export ban,<sup>20</sup> while no one is seriously proposing curtailing gas exports. The U.S. worked to coordinate a global release of strategic oil reserves but the ultimate effect on oil prices remains unclear, while natural gas and power markets remain subject entirely to the volatility of market forces.

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The world could either be at the peak of the current energy crises or just in the early stages. Winter weather across the Northern hemisphere, particularly in China, Russia, Europe, and the U.S., will determine whether prices head much higher, glide lower, or ride a roller coaster of volatility. Severe winter weather could change energy supply shortages from a mere economic concern to a full-blown humanitarian crisis resulting from insufficient energy access. In the U.S., natural gas contracts could break \$10 per mmbtu for the first time in almost 20 years. U.S. power markets could face major prices spikes. Further, the risk of outages in severe scenarios should not be discounted if systemic stress from high prices and exports is compounded by severe winter weather, such as the severe cold snap in Texas in February 2021.<sup>21</sup>

Despite pundits jumping to use this crisis to attack the energy transition or renewable energy, the world is still primarily supplied by fossil fuels. In fact, the addition of renewable power to electricity grids is likely easing the crisis, as these power sources are not subject to the whims of global energy markets. Concerns about climate have not yet created meaningful policy restraints on global production of coal, oil, and natural gas. Furthermore, more drilling or mining would not have prevented this crisis because demand-based prices and market behavior are what caused it in the first place. Volatility is an inherent characteristic of fuel-based commodities, especially given the seasonal nature of energy demand. Even separate from climate concerns, greater energy diversification would have increased resilience for many countries that currently face widespread energy security challenges.<sup>22</sup>

## **NATURAL GAS FURTHER INTEGRATES GLOBAL ENERGY MARKETS**

The characteristics of natural gas make it uniquely suited to play an outsized and catalytic role in global energy markets. Whereas coal is primarily used in electricity generation, and oil is the dominant transportation fuel, natural gas can be found in many sectors of the economy. Natural gas is often a marginal fuel in the power sector, meaning that natural gas prices are often key determinants of electricity prices.

Historically, natural gas prices and markets were regional, rather than global. Natural gas is difficult to store and transport, with underground cavern storage in short supply and liquefaction for marine transportation both costly and energy intensive. Pipelines or expensive LNG infrastructure tied producers and consumers together with long-term contracts. Today, with rapid growth in the LNG market and greater long-distance pipeline integration, regional natural gas markets and prices are increasingly linked, making electricity market outcomes, and to a lesser degree overall energy availability, more globally integrated than ever before.

From 2010 through 2020, the volume of global LNG trade increased more than 60%.<sup>23</sup> As a new LNG supplier, U.S. exports provided more than one third of this global growth.<sup>24</sup> In the last 12 months, new terminals coming online have further increased U.S. exports by almost 50%.<sup>25</sup> The U.S. is now the world's third largest exporter, with around a fifth of the market,<sup>26</sup> and additional export terminals could make it number one soon.<sup>27</sup> U.S. LNG is not priced based on oil markets like most other sources of LNG, but on the deep and liquid U.S. spot market for natural gas. Contracts also tend to be more flexible, without clauses that limit the resale of gas. This dramatic rise in U.S. gas production altered not only how gas is priced and traded, but also changed key geopolitical relationships, including the gas relationship between Europe and Russia.<sup>28</sup>

Across the world, robust LNG demand is now leading to record high prices, with heavy competition especially in Asian markets.<sup>29</sup> Historically, natural gas prices in Asia were closely tied to oil prices due to fuel substitution and reliance on oil-linked long-term contracts. The entrance of the U.S. to LNG markets caused a significant shift towards buying LNG on the spot market. LNG prices are now decoupling from oil prices, not only on the downside (as LNG boosters long emphasized)<sup>30</sup> but also on the upside, as seen in today's record high prices. As Asian and European importers now compete for LNG, prices are rising rapidly as supply is unable to keep up. Given the gas-focused nature of the European energy crisis, these LNG prices are especially challenging to the continent. Additionally, over the last decade, American policymakers and companies used fears of Russian market power in Europe to justify building U.S. LNG export facilities to create "optionality" for Europe to buy U.S. LNG to avoid Russian pressure.<sup>31</sup> However, higher LNG prices in Asia have drawn away American and other cargoes,<sup>32</sup> undermining the effectiveness of that optionality.

Domestically, American politicians and energy companies have touted the economic and environmental benefits of low-cost natural gas over the last decade. Almost to a fault, these predictions

focused on the supply curve, which is responsive in the mid- and long-term. They ignored the role of the demand curve and seasonal storage in setting actual short-term gas prices.

For the last 10 years, U.S. gas prices have been generally low and steady. However, annual gas demand has varied greatly as a result of the inconsistent severity of winter weather. Competition between coal and natural gas in the power sector has played a key role in stabilizing short-term marginal gas prices between \$2 to \$4.50 per mmbtu amid this changing demand. But today, coal-fired power plants in the U.S. are in a death spiral as a result of competition with low-priced natural gas and concerns about climate change. Thus the buffer that switching between coal and gas provides for short-term market balancing is increasingly constrained.<sup>33</sup> Further, the ability of combined cycle power plants to buy low-priced spot gas from existing pipelines without costly firm contracts is rapidly disappearing as regulators realize the grid reliability risks of relying on natural gas without firm contracts. The sum of these factors is a gas market more subject to volatility, as gas consumers increasingly have nowhere else to turn in times of high demand and constrained supply.

When oil and LNG prices crashed during the early part of the pandemic, low global prices rippled into U.S. markets, severely impacting U.S. producers. Today, the opposite is happening as high global prices are driving U.S. prices higher amidst relatively flat production.<sup>34</sup> Despite high near-term prices, the long-term price curve remains relatively low, discouraging additional supply investment.<sup>35</sup> For most of the shale revolution, investors and companies chased market share and volume growth at the cost of profitability. Investors now demand profitability and are not willing to invest at low prices. Therefore, once buoyant hopes for perpetually low-cost natural gas in the U.S. are now in doubt. The narrow range of natural gas prices in the 2010s created a false sense that U.S. gas prices had broken free from boom-bust cycles and volatility. Rather, the volatility was masked by the

conditions of the moment — ample coal generation to allow trade-offs in the power sector and no strong links to global gas markets.

With reduced short-term balancing from less coal-fired power capacity, rapid increases in LNG export capacity, an uncertain outlook for oil, and an intensifying global energy transition, the future level and stability of U.S. natural gas prices are in doubt. The ability to switch to other fuels quickly to match short-term storage or demand cycles is exceptionally limited. Diesel may provide the best option at around \$10 per mmbtu, but capacity is limited, concentrated regionally, and subject to substantial environmental regulations. Critically, as the United States is one of the largest LNG exporters and in recent years has had among the lowest domestic natural gas prices, volatility in American markets will affect global trade just as global trade shapes U.S. prices.

## **THE CURRENT CRISIS DEMONSTRATES THE NEED FOR MORE ROBUST ENERGY SECURITY POLICY**

Already, politicians are looking to blame speculation and market manipulation for rising energy prices. The reality is that short-term volatility is inherent in energy markets because they are mostly price inelastic. Indeed, one of the starkest paradoxes present now, and one likely to surprise many a hungry investor, is that a large portion of global energy demand is hedged and contracted. Such contracts often have limited, if any, exposure to the current price spikes.

Volatility is neither accidental nor a bug in current energy systems; it is a feature, created by energy system design choices that value short-run marginal optimization, largely ignore interconnected markets, and fail to balance between central regulatory control and decentralized market forces. While energy security analyses often consider energy systems like electric or gas grids independently, their behavior can be convergent, not coincidental, when outcomes have the same root causes.

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In weighing energy systems options, policymakers and stakeholders should remember the energy trilemma of economics, environment, and security. Has the trilemma become unbalanced for many countries? Energy security appears to have taken a back seat to economics, in part due to low inflation and relative slack in the global economy that brought low energy prices. Security also may be undervalued relative to environmental concerns. Markets are powerful tools to minimize prices, send investment signals, and catalyze innovative clean energy technologies — but there are important attributes of an energy system that markets will not deliver.

Rebalancing energy systems to prioritize energy security could further both economic and environmental goals. Concrete tactical measures, like strategic gas reserves,<sup>36</sup> well-structured demand response, and cross-sector resilience standards could minimize the extreme downside and upside volatility seen the last two years. Accelerating energy supply diversification with clean energy and reducing the share of fossil fuels in primary global energy consumption could meet economic, environmental, and security goals. If we embrace the risks of volatility, policy must remain laser focused on energy access and protecting vulnerable populations. Furthermore, we should recognize that demand crises, like those seen earlier in the pandemic, are closely linked to supply crises.

As countries reevaluate risk during this tumultuous time, governments and energy companies need to apply an integrated perspective to natural gas price stability and supply security, particularly

how it influences multiple demand sectors. Unlike coal, natural gas is a fossil fuel playing a central role in decarbonizing certain energy markets while balancing renewable energy. The rapid and relatively understudied shift to globally driven gas markets creates complexities in both security and environmental outcomes.

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