LNG

AFTER THE PANDEMIC

MICHAEL D. TUSIANI & GORDON SHEARER

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Introduction

We agreed to write this book, *LNG: After the Pandemic*, in the summer of 2020, some five months after the first reported outbreak of Covid-19 in China. At the time, we believed the pandemic would quickly run its course once quarantine measures and other medical interventions brought it under control. Naively, we thought it would fast become a footnote in medical history. As the following years showed, Covid-19 would not be so easily defeated. In the summer of 2022, the latest variant of the virus, known as Omicron, BA.2.12.1, led to the sixth wave of the disease in the United States, with infection rates conservatively climbing above 100,000 per day.

The pandemic may not be over as this book is being finalized, but the lessons for the LNG (liquefied natural gas) industry have become clearer. Since 2020, LNG and the entire energy industry have experienced not just one but two "black swan" events: the pandemic, followed just two years later by the Ukraine crisis. Both are ongoing as this is being written. This combination has roiled the energy markets and upended the debate on global warming. Energy security, a topic not given serious consideration since the end of the First Gulf War in 1991, has moved to the forefront of the news.

In just 18 months, the LNG industry has experienced a period of extreme volatility, with prices reaching record highs and lows. LNG exports from the United States, a mere footnote in 2016, have surged, putting the country on the verge of passing Qatar for the role of the world's leading supplier. Europe, recently seen as a fading market for natural gas as renewables push out fossil fuels, now must deal with its dependency on Russian energy in the aftermath of the invasion of Ukraine, and it is turning to LNG as the only near-term solution. The global push to end the use of fossil fuels has not stopped. But, for the moment, it has been sidelined as economic and political realities shift the focus to the short term. Global warming and the need to eliminate carbon emissions have not gone away and remain existential threats to the hydrocarbon industry. Natural gas is no longer embraced as a "transition fuel" on the way to a green future but finds itself increasingly being lumped with coal and oil as a problem, not a solution. However, as reality sets in, it is clear that LNG will be needed for decades.

We will consider the implications of these trends, but first we need to set the stage by looking at the fundamental changes in the industry that have occurred since we last wrote about it in 2016. This new LNG landscape may help us discern where the industry's future lies. But, as Bob Dylan sang in "The Times They Are A-Changin'": *For the wheel's still in spin/ And there's no tellin' who that it's namin'/ For the loser now will be later to win.*

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The Outbreak

The announcement from the Wuhan Municipal Health Commission (WMHC) on New Year's Eve 2019 comprised just a few paragraphs. It noted that doctors at Wuhan hospitals had identified twenty-seven cases of an unusual pneumonia linked to a seafood market and stated that seven patients were seriously ill. This was the first time that the Chinese public or the international community heard about the outbreak of a new disease that scientists would subsequently name Covid-19. It would soon turn into the most serious and disruptive global health crisis in more than a century, unleashing forces that shocked energy markets and, bolstered by Russia's invasion of Ukraine in February 2022, pushed the LNG industry into a new phase of transformative expansion.

The disease had emerged at least a few weeks before. Doctors in Hubei Province and its capital city, Wuhan, had observed cases of pneumonia of an undetermined origin in early December and began investigating the outbreak. Fluid and tissue samples were taken from people sickened by the new disease, genomics laboratories were working to sequence the virus, and doctors handling the earliest cases took careful case notes and started working on academic papers describing the illness.

Even though the number of people affected appeared to be low, Chinese public health officials were clearly concerned. On December 30, the WMHC had issued an "urgent notice" to local hospitals, highlighting the outbreak, and had ordered them to report any new cases to local centers for disease control and the WMHC. A second notice in the afternoon of the same day gave hospitals less than an hour to report back with any new information or new cases. An investigation by local anticorruption officials found that the notice—intended only for hospital administrators—had been leaked to the press within minutes of being issued, which may have played a part in the decision by the WMHC to issue their public statement the following day.

Press reports began to spread word of the disease. Chinese media reported the WMHC alert, and international media picked the story up quickly, as there was little other breaking news over the holidays. International infectious disease monitoring systems, including the US-based Program for Monitoring Emerging Diseases, posted the first Chinese media and official reports online. The World

unemployment rate rose from 3.1% in 2019 to 5.2%. The United Kingdom's economy also was severely affected, with GDP dropping nearly 10% in 2020 as tourism, transportation, and other key industries suffered. The fact that trade there was already disrupted during the runup to Brexit on January 1, 2021, did not help. Significant intervention by the UK government kept millions of workers on private sector payrolls. Nevertheless, unemployment rose from 3.4% in 2019 to 5% by the end of 2020. As of August 2021, 18 months after the start of the pandemic, the FTSE 100 Index still had not fully recovered and was more than 5% below pre-pandemic levels.

In many countries, despite government support to mitigate the effects of the pandemic, millions of workers still lost their jobs. Employees in service industries such as tourism, transportation, retail, and restaurants were among those most affected. Travel was essentially halted, and consumers saw in-person shopping and dining as too risky. By mid-2020, over six million cases of Covid-19 had been reported worldwide. More than half the global population (4.2 billion) had been subject to full or partial lockdowns. Forecasters estimated that these factors would lead to 20–40% declines in economic activity while they were in effect. In the United States, total employment dropped by over 20 million workers, with almost half from the leisure and hospitality sector, while unemployment soared from under 4% to almost 15% (Figure 7).

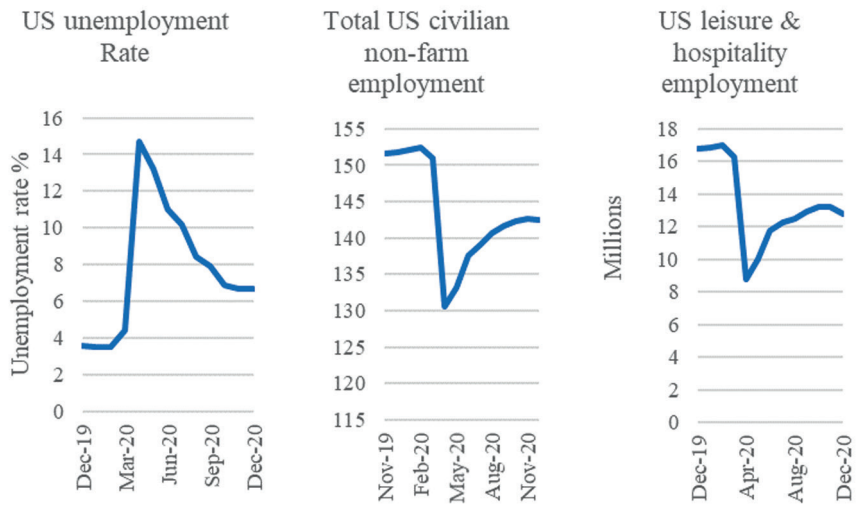

Fig. 7. US Unemployment and Employment Rates[20]

A sharp decline in travel hurt many lower-income countries, particularly those that depended on tourism for jobs, hard currency earnings, and tax revenues. With restrictions starting in March and in many cases stretching through the

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The Initial Impact on Natural Gas and the LNG Market

Even as it weakened before Covid-19 began to spread, the international gas market remained subject to vestiges of government regulation that shaped its history. Despite deregulation by most North American and European governments, rigidity still characterized many LNG contracts, especially in Europe and Asia. Loosening had begun, however, stimulated by competition from emerging US LNG suppliers and eventually to be accelerated by pressures exerted by the pandemic. The changes, past and future, are inevitable products of market liberalization that began decades ago, when governments lifted price controls and, eventually, other market constraints and thereby accommodated expansion of the global gas market, with LNG as its engine of growth.

The LNG industry evolved in response to an unyielding geological reality: Gas tends to exist in nature at some distance from where it can be put to economic use. Sometimes that distance is great. The complexities of moving gas by pipelines over long distances make location a priority consideration in decisions about gas-resource development. Furthermore, gas deposits are unevenly distributed. Natural gas reserves are heavily concentrated among relatively few countries. Three of them, Qatar, Iran, and Russia, account for half of the global total (Figure 13).[43]

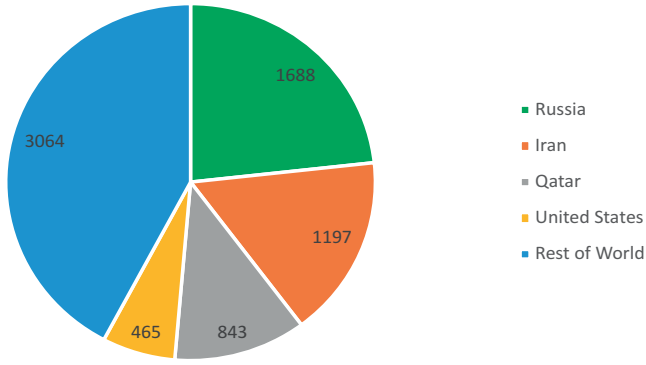

Fig. 13. Global Gas Reserves (Tcf), 2020[44]

exception was the Jordan Cove project in Oregon, which was voted down by FERC in November 2021, causing Pembina Corporation of Canada to cancel the project after an investment of over $500 million in just the permitting process. This underscores the risk taken by many US developers, who must invest at least $100 million to conduct the engineering, safety, and environmental studies for the EIS. Many projects fail to reach this stage given the length and complexity of the permitting process, and the difficulty of securing funding. Since the late 1990s, the FERC's requirements have become increasingly stringent under growing scrutiny from environmentalists, who have challenged the agency's decisions through administrative processes and the courts.

Tragedy Benefits the LNG Markets

Already pushed by surging supplies of natural gas, development of US exports received a surprise pull from a disaster across the Pacific. On Friday afternoon, March 11, 2011, a massive earthquake of magnitude 9.0 occurred off the coast of Japan. The quake was the most powerful ever recorded in the country and caused extensive damage to the island of Honshu. It triggered a major tsunami, which came ashore at the Fukushima Daichi nuclear power plant. Of the six units at the station, three were offline, and automatic safety systems shut the other three down when the quake was detected. But four units required power to circulate the cooling water in their reactors. When the plants shut down, backup diesel generators kicked on to power their critical safety systems. Less than an hour later, a tsunami surged over the sea walls designed to protect the facility. The water flooded the backup generators. With the emergency power disabled, the cooling pumps no longer operated, and the cores of three reactors melted down. Over the next few days these units were further damaged by explosions caused by the accumulation of hydrogen inside the reactor containment.

Releases of radiation and debris prompted the evacuation of more than 340,000 people in the vicinity. While there were no casualties directly attributed to the nuclear accident, the government established an exclusion zone of 20 kilometers around the plant. Authorities estimated the direct costs of the earthquake and tsunami at more than $120 billion.

Several other nuclear plants were also affected, but none on the same scale. Most of Japan's nuclear reactors were undamaged. Nevertheless, public concerns and subsequent evidence that operators had ignored safety warnings prompted the government to order the closure of all 55 nuclear plants in the country. Most remain offline at this writing, given strong popular opposition to nuclear energy. The loss of these plants, which accounted for 30% of Japan's generating capacity, led to serious power shortages. Utilities scrambled to bring idle coal- and oil-fired power plants online. But these were not enough to offset the lost nuclear capacity.

eventually add another 12 MMt/y of capacity. All the feedgas would come from the United States via existing pipelines. Sempra was promoting another venture on Mexico's Pacific Coast, Vista Pacifico, a 3 to 4 MMt/y export project. The appeal of projects on Mexico's Pacific Coast is that they can access US feedgas while bypassing the Panama Canal. With shorter distances to Asia and no canal tolls, these projects offer lower shipping costs than their competitors on the US Gulf Coast.

A project by Sempra to export LNG from Port Arthur, Texas, was suspended in mid-2021 after potential offtakers ended contract discussions. Questions about costs of the project appeared to have prompted Poland's PGNiG to switch its 2 MMt/y offtake commitment to Cameron LNG. However, in May 2022, the project began to show renewed signs of life when PGNiG and Sempra announced a heads of agreement (HOA) for 3 MMt/y—2 MMt/y from Cameron and an additional 1 MMt/y from Port Arthur. PGNiG had the right to switch its Cameron volume to Port Arthur. Signing of the HOA enabled Sempra to begin preliminary site work and infrastructure development. Shortly after signing the PGNiG HOA, Sempra announced further HOAs with RWE (2.25 MMt/y), Ineos (the European chemical company, 1.4 MMt/y), and ConocoPhillips (5 MMt/y), with the latter agreement encompassing a broad strategic alliance covering equity investments and other expansion possibilities.

Freeport LNG was also looking to expand. A fourth 5 MMt/y train would bring its total capacity to 20 MMt/y. But finding customers was challenging. The existing three trains had experienced technical issues since the project entered service. Partly to blame were hurricane-related disruptions to the power grid that provides the project's primary energy. On June 8, 2022, the Freeport facility suffered an explosion and fire after an LNG loading line ruptured, and it was expected to be offline for several months. Depending on the root cause of the incident, this made further delay of Train 4 possible.

In August 2019, Venture Global, a new entrant to the industry, took FID on its 10 MMt/y Calcasieu Pass project at the mouth of the Calcasieu River in Louisiana. The company had been able to secure SPAs for its LNG on the strength of very low liquefaction fees, underpinned by fast and low-cost modular construction. This technology has been used in many industries, including a few LNG projects—notably, Pluto, Yamal, and Elba Island. The concept employs standardized and better-controlled construction in assembly yards, rather than building on-site. The completed modules are then shipped to the site by barges or heavy-lift vessels. This can materially reduce labor costs and improve the construction schedule. Pluto and Yamal used modularization to offset the challenges of their remote locations. Elba Island used very small modules that could be trucked to the site. However, Elba suffered from an overly complex construction process, causing significant delays and cost overruns. Each of Venture Global's 18 liquefaction trains (0.625 MMt/y capacity) was delivered as a single module.

In a riskier move intended to lower costs, Venture Global dispensed with the standard model of signing a lump-sum turnkey EPC contract. Acting as its own

this, the United Kingdom introduced clean air legislation to combat air pollution, but progress to eliminate coal's use, even in homes, was slow.

By the 1980s, concern around coal focused largely on emissions of SO_2 and nitrogen oxides (NO_x). They were responsible for acid rain, formed when SO_2 and NO_x react in sunlight with oxygen and water and turn into sulfuric and nitric acids. Acid rain damages lakes and streams and kills plant and animal life. Huge swaths of forests in the midwestern United States and Canada were damaged by acid rain. In 1990, the US Clean Air Act mandated that nitrogen dioxide (NO_2) and SO_2 emissions from power generation be cut substantially.

US regulators chose to reduce SO_2 emissions through a "cap-and-trade" system known as the Acid Rain Program. Power plants were given allowances equal to their 1980 emissions. Over time, the amount of SO_2 that each plant could emit was lowered. Each power company could either reduce its own emissions below the "cap" or continue to emit SO_2 by purchasing allowances ("trade") from companies that had reduced their emissions by more than the required amount. The system essentially commoditized air pollution control. It created incentives for companies to invest in pollution control technologies or cleaner fuels, such as natural gas.

This program was extremely successful. SO_2 emissions fell by 93% between 1990 and 2020 (Figure 44). The decline was far greater than required under the law, driven largely by the falling price of natural gas, causing it to displace coal in power generation.[153] The combustion of natural gas produced SO_2 and NO_x but at far lower levels than coal. The European Union also adopted a cap-and-trade program to address emissions.[154] The outcomes were similar to those in the United States.

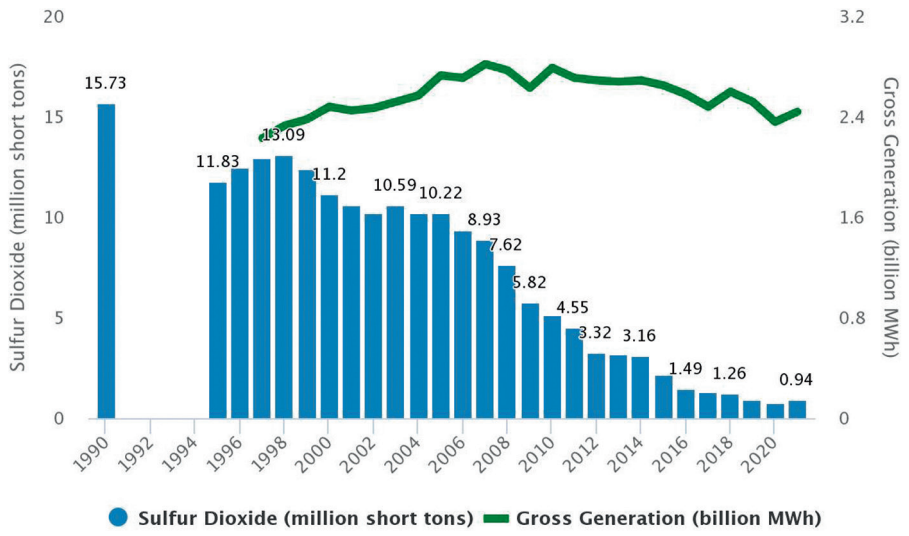

Fig. 44. Annual Sulfur Dioxide Emissions, 1990–2021[155]