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A CHANGING GLOBAL GAS ORDER 3.0

BY AKOS LOSZ, TIM BOERSMA, AND TATIANA MITROVA*
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This is the third edition of the annual Changing Global Gas Order series by the scholars researching natural gas at Columbia University's Center on Global Energy Policy.[1] The review discusses the trends and developments that emerged in the global natural gas market in 2018.

1. Supply Unchained

Conventional Discoveries

Natural gas is a prolific resource that faces no real resource constraints, only monetization constraints in a world of investment uncertainty and growing policy pressure to decarbonize the energy system. Indeed, since the publication of the previous year's review, major gas discoveries were made in Cyprus, South Africa, Indonesia, and near the Shetland Islands in the United Kingdom, underscoring the abundance of untapped and yet to be monetized natural gas reserves around the world.

Progress on Monetization

2018 not only saw further additions to the reserve base but also some progress on solving the monetization challenge and bringing more of the world's natural gas deposits to market. The recent turnaround in Egypt's natural gas fortunes indicates how quickly such monetization efforts can bear fruit, given the right conditions. Four years ago Egypt—faced with booming domestic demand and dwindling production—suspended most of its contracted natural gas exports and became one of the fastest-growing importers of LNG in 2015. But the giant Zohr natural gas field in the Mediterranean, which was discovered in the same year and sanctioned for development in 2016, managed to boost production to over 2 billion cubic feet per day (Bcf/d) by the second half of 2018[2] and is now expected to reach a peak production level of 3.2 Bcf/d by the end of 2019.[3] Thanks to this transformative monetization success, Egyptian LNG imports ceased completely by October 2018, and the country is now expected to ramp up LNG exports once again at its existing facilities from 2019.

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Monetization via LNG Exports

In 2018 the long-awaited next wave of LNG supply investment finally started with three high-profile final investment decisions (FIDs) at Cheniere's Corpus Christi train 3, Shell's LNG Canada, and BP's Tortue floating liquefaction (FLNG) projects, totaling 21 million tons per annum (mtpa) of liquefaction capacity. This is three times more than the committed new LNG capacity during the previous two years combined, though still far short of the previous record year of 2005, when more than 45 mtpa of LNG liquefaction capacity was sanctioned in a single year. Some prominent forecasters now expect 2019 to break all previous records in LNG FIDs and reach—or even exceed—60 mtpa of new capacity as the investment wave gathers further momentum.[4]

Both LNG Canada and Tortue FLNG are monetizing previously stranded natural gas resources, the former in the Montney shale in Western Canada and the latter on the shared maritime border between Senegal and Mauritania in West Africa. Meanwhile in Russia, Novatek's Yamal LNG plant reached full capacity one year ahead of schedule in December 2018, proving to the rest of the world that the vast natural gas resources in the Russian Arctic can be effectively monetized via LNG exports and setting the template for a succession of additional Arctic LNG projects in the not-too-distant future. Qatar raised its LNG ambitions further by increasing the size of its planned expansion project from 23 to 32 mtpa in 2018. The earlier plan was already upsized from a more modest initial debottlenecking project put forward in the previous year. As of March 2019, partner selection and a final investment decision were still pending at Qatar's expansion megaproject, but given the industry-beating economics and the considerable interest among international oil companies (IOCs) to participate, there is little doubt that more gas from the giant North Field will soon find its way to the global market.

Debottlenecking US Gas Supply

The United States, which has now firmly established itself as the world's largest natural gas producer, saw a record 8.5 Bcf/d increase of natural gas output in 2018. This annual increase in a single year is roughly equivalent to the entire gas production of Algeria, the tenth-largest producer in the world. The majority of this growth (about 4.5 Bcf/d) took place in the Appalachia region in the US Northeast, where several major gas pipeline projects entered service since late 2017,[5] effectively debottlenecking the most prolific dry gas play in North America. Other basins, notably the Haynesville and associated gas from the Permian, also contributed to America's supply boom last year, but production growth in the midcontinent remains constrained by takeaway capacity bottlenecks for the moment. One of the most visible signs of insufficient pipeline capacity in the Permian was a sharp rise of gas flaring in 2018, which hit an all-time high level of 0.4 Bcf/d by the third quarter, twice the average rate during the previous year.[6] Permian producers expect these infrastructure bottlenecks to ease by the second half of 2019,[7] just in time to direct more US gas to the newly commissioned LNG facilities in the US Gulf Coast, where export capacity is projected to more than double this year. The relationship between US gas and global commodity markets is evolving as production increases. More associated gas is being produced in the United States, meaning that a growing volume of gas production is being influenced by oil market dynamics. Meanwhile, LNG export is now a major outlet for US gas supply, which means that domestic

producers will be increasingly exposed to the fundamentals of the global gas market as well. US pipeline gas exports to Mexico continue to expand gradually, nearing 5 Bcf/d by the second half of 2018. But bottlenecks on the Mexican side will continue to slow the monetization of Permian gas across the southern border in the near future.

Unlocking Shale Gas outside North America

The monetization of the world's substantial shale gas resources outside North America is pacing ahead—albeit less quickly than expected a decade ago. Production has surged at Argentina's Vaca Muerta shale play, which enabled the country to resume pipeline gas exports to neighboring Chile in 2018 following an 11-year hiatus in cross-border gas trade. Argentina also released one of its two floating storage and regasification units (FSRUs) in October 2018 and replaced it with a small-scale FLNG barge in the port of Bahia Blanca, thus taking the first step toward becoming an LNG exporter on the back of a large shale gas resource base. While China's shale gas production will likely miss both the initial 100 bcm (9.7 Bcf/d) as well as the scaled-back 30 bcm (2.9 Bcf/d) targets for 2020, the country's shale gas output is nonetheless expected to double between 2017 and 2020 to reach approximately 17 bcm (1.6 Bcf/d) by the end of the decade, according to the latest industry estimates.[8] China's old plans, now dusted off, to form an independent national pipeline company could also boost production prospects by opening access for smaller shale gas producers to a sizeable domestic market.[9]

Unexpected Tightness in LNG Shipping

Last year has also demonstrated that bottlenecks can emerge suddenly and unexpectedly along the entire natural gas supply chain. LNG shipping was a fairly uneventful business during the 2015–2017 period, and spot charter rates remained depressed as the market struggled to absorb excess shipping capacity. But in the second half of 2018, the LNG tanker market tightened, and daily shipping rates shot up to almost $200,000 by the end of the year, an all-time high for the LNG industry and more than four times higher than the 2017 average. There were some structural drivers behind the tightening of the shipping market, such as the ramp-up of LNG supply in the US Gulf Coast and the Russian Arctic, which are farther away from the main LNG markets—and thus require more shipping capacity than the average exporter. Record-high LNG re-exports from Europe to Asia—a highly shipping-intensive activity—also contributed to rising tanker rates in 2018, especially in the third quarter. But the most immediate cause of the LNG vessel crunch in late 2018 was China's new LNG purchase strategy ahead of the winter. To avoid another winter gas shortage, China built substantial floating storage of LNG by the final quarter of 2018. Commercial players in other parts of Asia also parked LNG cargoes on the water in anticipation of higher prices during the winter months. But lower-than-expected demand in East Asia (due to mild winter weather in parts of the region and other bearish factors) meant that LNG in floating storage took longer to absorb, and thus a significant portion of spot LNG tanker capacity remained tied up for several weeks. Some analysts speculated that sky-high shipping rates could be the new normal, while others warned that an acute LNG shipping market tightness could be a risk to supply security. The authors argued that the system can adjust[10]—as it has since then—and charter rates have dropped significantly in recent months. But greater volatility

in spot LNG rates is a distinct possibility in the near term, at least until a new wave of vessel deliveries hits the market in a few years' time, setting the stage for another boom-bust cycle in LNG shipping. It is yet to be seen whether China's front-loaded purchase strategy and use of LNG tankers as floating storage ahead of the winter season will be a one-off experiment or a recurring phenomenon in the global gas market. If the pattern continues in the years ahead, it could have profound implications for spot LNG tanker rates and spot LNG markets alike.

2. Strong Demand Growth Continues—for Now

Global Demand

Global gas demand expanded by nearly 5 percent and global LNG demand by about 9 percent last year,[11] very strong growth rates by any historical standard. As in previous years, this demand expansion—particularly on the LNG side—was primarily driven by clean air policies in China, coal and nuclear restrictions in South Korea, fuel switching (combined with declining production) in Europe, and broad-based growth across South and Southeast Asia.

China

After a year of record growth and seasonal gas shortages in 2017,[12] Chinese natural gas and LNG demand growth continued at a rapid rate last year. Natural gas consumption increased by 18 percent (vs. 15 percent in 2017),[13] while LNG imports increased by a whopping 41 percent in 2018.[14] As in 2017, the biggest driver of China's gas and LNG demand growth was the policy-driven coal-to-gas switching in the residential and industrial sectors, which was complemented by strong pent-up demand and storage build after the previous year's shortages, and—to a much lesser extent—by a continuing expansion of gas-fired power generation and the LNG-fueled vehicle fleet. As in the previous year, it fell primarily on LNG to meet China's growing natural gas demand, although domestic production also expanded at an 8 percent rate last year, which is not bad for a mature producing country with a large declining production base. The concerted effort by China's government and its energy companies to avert another winter gas shortfall led to a lopsided seasonal pattern with advance purchases of LNG cargoes in the second and third quarters of 2018 boosting demand during what's normally a shoulder season, and a relatively mild winter causing a slowdown during the usual peak season.

There is considerable hope in the global gas industry that China will remain one of the primary engines of global LNG demand in the foreseeable future,[15] and a draft government plan to nearly quadruple regas capacity along the Chinese coast by 2035 gives some credence to long-term optimism.[16] Toward the end of 2018, however, some observers began to question the durability of China's LNG demand boom in the face of a slowing economy and a more permissive government attitude toward coal burning in the near term and the lack of a clear demand driver beyond the replacement of inefficient coal boilers over the longer term.[17] While government policies will provide strong support for gas and LNG demand over the next two to three years, it is much less obvious what will drive the next phase of expansion once the current coal-to-gas switching policy in the residential and industrial sectors has run its course. The combination of slowing gas demand growth, rising pipeline imports, and growing domestic production can squeeze—or even reverse—LNG demand in the early 2020s in some

scenarios, though policy might once again come to the rescue and create additional demand in other sectors of the economy. Overall, it appears that China is not only the biggest demand driver at the moment but also the biggest demand uncertainty for the global LNG market in the medium term.

India

Given its similarities with China with respect to a coal-heavy energy sector, severe air pollution problems, and ambitious government targets to boost the share of natural gas in the energy mix, India is sometimes seen as the "next China" for global LNG demand.[18] 2018's numbers do not quite support this comparison—gas demand in India increased by about 4 percent and LNG imports by about 16 percent (or 3 mtpa in absolute terms), a small fraction of China's demand boom by any measure. Over the longer term, a cautious optimism may be more warranted than all-out enthusiasm. Unlike China, India has very little coal-to-gas switching potential in residential heating, and much of the country's natural gas demand outside the subsidized fertilizer sector is highly price sensitive. Developing India's import and domestic pipeline infrastructure is a painstaking process. India's regasification capacity could double by 2022, but as previous projects illustrate, pipeline connectivity issues may limit the utilization of India's import infrastructure even years after the completion of the terminals. The government has been planning to roughly double the country's domestic pipeline infrastructure—and complete the so-called national gas grid[19]—for many years, but progress has so far been slow, and more significant additions are only expected post-2020. If India can successfully address its infrastructure constraints, and if the price is right, then the country can emerge as another engine of global LNG demand. But such a high-growth scenario will likely require seamless execution, reforms, and substantial policy support for natural gas consumption in the years ahead.

Democratization of LNG Trade and Emerging Importers

After a period of breakneck growth, LNG demand creation using floating storage and regasification units has suffered some setbacks, and LNG imports via FSRU terminals decreased in 2018 for the first time in many years. The democratization of LNG trade and new demand from emerging LNG-importing countries was a major theme in the previous years, as was captured in a Center on Global Energy Policy study titled "They Might Be Giants" in November 2017.[20] Floating storage and regasification units played a very significant role in opening new markets for LNG in the 2015–2017 period. Three new countries—Panama, Bangladesh, and Russia—joined the LNG-importing club in the past 12 months,[21] two of them using FSRU technology,[22] and Turkey added a second FSRU to its growing LNG import infrastructure earlier in 2018. There is considerable interest in LNG imports, with multiple credible (and less credible) projects proposed in a host of new countries, including in Germany, Croatia, Cyprus, Lebanon, Australia, and Ireland, to name just a few. But this was not enough to sustain the rapid expansion of FSRU-based LNG demand growth last year, and the total volume of LNG imports via FSRU terminals actually declined in 2018.

There are many reasons for the reversal of fortunes for FSRU projects, especially in poor developing countries. Higher oil and gas prices over the past two years did not help. The ramp-up of FSRU-based imports turned out to be slower than expected (and several proposed

projects have recently been canceled) even in the most promising emerging markets like Pakistan and Bangladesh, where pent-up demand is huge and downstream markets and infrastructure already exist. Developing FSRU projects in other emerging economies across Southeast Asia is even more challenging, and sub-Saharan Africa—despite the obvious appeal of cheap and flexible FSRU technology to bring energy access to millions in the region—seems impenetrable for LNG at the moment. Some prominent FSRU markets have also retreated from LNG imports recently. Egypt, thanks to its domestic production renaissance, has now completely withdrawn from importing LNG, while the UAE and Argentina each released one of their two FSRU vessels last year due to reduced demand for imports.

Abundant supply and lower prices in the 2019–2020 period as well as the rapidly growing footprint of trading houses in global LNG trade could rekindle some appetite for FSRUs in emerging markets. But absent more credit support from development banks and more successful demand creation in downstream markets (e.g., via LNG-to-power projects), the second wave of FSRU-based infrastructure development may turn out to be more heavily focused on developed markets (like Australia and Germany) and large existing LNG importers (like India and China) instead of opening up new frontiers for LNG in emerging economies.

Mature Markets

More mature natural gas and LNG markets also showed notable dynamism in 2018. Defying all expectations, South Korea turned out to be the second-biggest growth market for LNG last year (after China), registering a 17 percent annual increase and accounting for nearly a quarter of global LNG demand growth in 2018. This unexpected boom was largely the result of new reactor delays and extended maintenance and safety inspections at existing nuclear plants as well as the government-mandated shutdown of old coal-fired plants during the low season, which boosted gas-fired power generation.[23]

While European gas demand declined last year, domestic production continued to slide at a higher rate, which ensured strong import demand throughout the year. Much of Europe's indigenous production decline was due to the self-imposed cuts to Dutch production at the Groningen gas field, where natural gas output dropped to 21.6 bcm (2.1 Bcf/d) in 2018, almost 60 percent below the 2013 production peak of 54 bcm (5.2 Bcf/d). A growing share of Europe's gas import demand was met by Russia, which delivered a record volume of gas to its European customers in 2018 and achieved an all-time high market share of 37 percent last year.[24] LNG imports have also spiked sharply in the last quarter of 2018 and the first quarter of 2019, especially in the most liquid markets in Northwest Europe. This was partly the result of supply push as the global LNG market appeared to have entered a period of excess supply—with Europe acting as the market of last resort. High shipping rates in late 2018 and early 2019 also kept the incremental LNG supplies from Yamal and the US Gulf Coast in the Atlantic Basin, which primarily meant Europe. But the steep rise of LNG deliveries was also driven by price signals—namely, the near-complete disappearance of the Asian price premium—as well as a genuine demand pull in Europe as seasonal winter demand set in and natural gas enjoyed strong support in power generation due to high coal and carbon prices.[25] There is substantial room for fuel switching in continental Europe, although there are wide variations across the various EU member states.[26] With more LNG coming in 2019, and the global gas

market looking increasingly oversupplied, Europe appears well positioned to absorb excess LNG cargoes, which, in turn, could set the stage for renewed competition between Gazprom and LNG.[27]

LNG Demand in Shipping and Road Transportation

The marine transportation sector is generally seen as one of the most promising growth segments for LNG in the decades ahead, and the IMO's tighter sulfur emission standards on bunker fuels from 2020 are perceived by many as a near-term catalyst for growing LNG demand in international shipping. But IMO regulations raise two potential problems for LNG demand. In the short term, the IMO sulfur cap will squeeze out 2 to 3 million barrels per day of high-sulfur fuel oil from the shipping sector almost overnight. Depending on how the system adjusts, some of this rejected fuel oil may be burned in the power generation sector for a period of time, until refineries find a way to destroy it cost efficiently. This dirt-cheap fuel oil could squeeze out direct crude burning in the Middle East, but it can equally squeeze natural gas in countries where oil-fired power plants compete with LNG, such as Pakistan, Bangladesh, and parts of the Caribbean, for example. The longer-term problem for LNG in the marine transportation sector is that the fuel will fall far short of meeting the IMO's 50 percent GHG-reduction target by 2050.[28] Some leading shipping companies like Maersk are already recognizing this[29] and plan on switching their fleets to fully carbon-neutral fuels rather than LNG post-2030. The outlook for LNG in marine transportation is probably good over the 2025–2030 horizon—with the majority of forecasts expecting about 20 mtpa of demand by 2030. But LNG may very well remain a bridge fuel at best, until cleaner fuels come about for large oceangoing vessels.

While shipping receives most of the attention when it comes to gas use in the transportation sector, LNG is quietly making inroads into heavy-duty transport in certain geographies. Shell's 2019 LNG outlook pointed out that LNG-fueled trucks and buses already consume nearly 7 mtpa of LNG in China, about as much as the combined LNG imports of the UK and the Netherlands last year. In parts of Europe, like Scandinavia, state companies are also investing in infrastructure to support a switch to natural gas in road transportation, but a more meaningful rollout requires state support and massive infrastructure investment, which means that gas- and LNG-fueled vehicles will only gain a meaningful foothold in a select group of countries.

3. Financing the Next Wave: Two-Speed Market Ahead?

On the back of strong LNG demand expectations and a looming LNG market tightness from the early 2020s, the long-anticipated LNG investment wave got underway in 2018, and 2019 will likely see several additional final investment decisions around the globe. The approval of the Golden Pass LNG project in Texas in February 2019 set the year off to a good start, and further announcements could be forthcoming from the United States, Russia, Mozambique, Qatar, Papua New Guinea, and other countries within the next year. One interesting trend among the recently sanctioned and prospective projects has been the prominence of LNG projects with portfolio backers and strong balance sheets, which can take final investment decisions without the need to secure long-term offtake agreements. Both LNG Canada and Golden Pass chose this path to commercialization, and a few others—such as Qatar's

expansion project—could follow the same pattern later on in the investment cycle. Some investors are now questioning whether such portfolio-backed projects could completely dominate the current LNG wave and undermine the independent-backed projects' more traditional model, which still needs long-term contracts and project finance debt to move forward. In private conversations, major LNG buyers in Asia also voice concerns about the growing dominance of portfolio players in new supply projects,[30] which—in their view—could tilt the playing field decisively in favor of sellers over time.

It is not clear that portfolio-backed projects can completely take the wind out of the sails of independent projects for a number of reasons. First, the universe of major IOCs and LNG companies that have strong enough balance sheets to advance projects without offtake agreements is very small, consisting of only a handful of companies, and some of these (like Chevron) have little appetite for taking on additional LNG project risk at the moment. Second, capital discipline—by and large—is still the mantra for major oil and gas companies,[31] which makes it unlikely that they will develop several LNG megaprojects simultaneously on a somewhat speculative basis. Finally, buyer appetite for long-term LNG contracts has returned in force since the start of last year. This means that there will probably be room for both independent and portfolio-backed projects in the next investment wave, although buyer interest in long-dated contracts could dissipate again, if the global LNG market becomes oversupplied in the months ahead.[32] While it is unlikely that "deep-pocketed" portfolio players will completely monopolize new LNG investments in this cycle, the emergence of a two-tier supplier market is a real possibility, and the signs of this are already visible in the recent spate of LNG FIDs.

4. The Question of Market Balance: Return of the Glut?

Until about 2017, most industry analysts expected an LNG market oversupply that could last well into the next decade. The long-anticipated LNG glut has not materialized as demand turned out to be stronger and net supply growth more spread out than assumed by the forecasters. But just when the dominant market narrative decisively shifted from a looming glut to a looming shortage in the next decade, signs of a near-term oversupply have started to appear in the real-time data. LNG deliveries to the most flexible European hubs have skyrocketed in recent months as excess cargoes had nowhere else to go, and spot prices in Europe and Asia stayed fairly depressed during the height of the winter peak demand. The market could come under further pressure later this year, as a record amount of new supply is scheduled to come online in 2019,[33] while the risks on the demand side are mainly to the downside due to a weakening global economy. A looser market could once again give rise to speculation about US LNG capacity shut-ins, although the US LNG supply is probably more resilient to short-term market imbalances than simple netback economics would suggest.[34]

In the medium-term, the baseline expectation within the LNG industry is still one of a gradually tightening LNG market by the first half of the next decade,[35] but the outlook depends crucially on the pace of Chinese growth and the health of the global economy. Global LNG demand has been in high gear for the past two years, but the risk of overbuilding supply capacity in the next investment cycle can be significant, if developers stick to their bullish assumptions while demand growth turns out to be disappointing. If China's demand

trajectory reaches a turning point or a major recession hits the global economy shortly after the current investment wave is completed, for example, the industry could be on course for a prolonged glut in the 2020s. This could be a nightmare scenario for LNG suppliers, especially if they sanctioned the majority of their new LNG projects without firm offtake commitments from end users. Such periods of excess liquidity, however, can be highly conducive to market development and the commoditization of global natural gas trade. But when it comes to the market balance, nothing is set in stone. As the past few years have clearly demonstrated, new demand from unexpected places can come to the rescue, and the dominant market narrative can take a 180-degree turn surprisingly quickly.

5. Gas Pricing and the Commoditization of LNG Trade Continues to Evolve

While talk of establishing an LNG trading hub in Asia has cooled off a bit, the global gas market has nonetheless continued its progress toward greater liquidity and commoditization in recent years. Developing a well-functioning hub for LNG is a long and difficult process.[36] But the need for a reliable LNG price benchmark remains strong among market participants, and such benchmarks can develop much sooner than a full-fledged LNG trading hub. It remains an open question whether price formation in the global LNG market will take place closer to supply, like in the case of crude oil, or closer to demand, as is the case with iron ore, for example. Signs of both emerged over the past year. Closer to supply, CME Group announced last year that it will develop an LNG futures contract with a physical delivery point at Sabine Pass in Louisiana, as the LNG is loaded onto tankers.[37] If it proves successful—which is far from assured at this point—then the contract can be a meaningful first step toward creating a global LNG price benchmark based in the US Gulf Coast. Closer to demand, the liquidity and reliability of the Japan-Korea Marker (JKM)—the spot LNG benchmark in Asia—has improved considerably, potentially laying the foundation for its future use as a pricing index in long-term LNG contracts. The first vote of confidence could come from Vitol, a prominent trading house, which signed a 15-year MoU with Tellurian linked to the JKM. If the contract is executed, it could be the first long-term LNG sales purchase agreement with a JKM index.[38] It is important to note that the development of multiple LNG price benchmarks is not mutually exclusive. Ultimately both a US-based and an Asian LNG price benchmark can develop simultaneously. The first would be reflective of the value of US LNG in the global market, wherever the netback price for US exporters is highest at the time, while the second would reflect the value of LNG in Asia, regardless of where the LNG is coming from.

Market development and the commoditization of global LNG trade is continuing in other respects as well. The EU Commission's antitrust ruling against Gazprom effectively connected all of the company's European natural gas sales to spot prices at liquid European hubs, even if formal oil indexation remains in some long-term agreements, effectively replicating what was already happening in Gazprom's Western European contracts. To adapt to the more competitive pricing environment, Gazprom has set up its own electronic trading platform and started to play a more active role in hub trading in Europe once again, after years of subdued activity.[39] Meanwhile, the forward march of trading houses in the LNG market continues: the top three players (Vitol, Gunvor, and Trafigura) increased their delivered volumes by almost 40 percent in 2018 (and they expanded their combined share of global LNG trade to about

10 percent last year).[40] Additional supply in the global LNG market over the next one or two years could provide a further boost to trading house participation, which, in turn, plays a crucial role in the democratization of natural gas trade,[41] enabling smaller-scale and more decentralized uses of the fuel in a wider range of markets. A further catalyst to this trend could be the development of several competing online LNG trading platforms,[42] which would enable smaller, less creditworthy market participants to transact LNG in small quantities on highly flexible terms. Blockchain technology could further reduce transaction costs and simplify regulatory compliance on these platforms, although concerns about cybersecurity could slow the adoption of blockchain-based applications in LNG trading.[43]

The consumer-led drive to rid long-term LNG contracts of destination restrictions globally has retained momentum in 2018. The EU Commission launched a formal investigation into potential destination clauses in Qatar Petroleum's European LNG contracts in June.[44] Japan's Ministry of Economy, Trade and Industry—in conjunction with the EU—has developed a model clause to help buyers get rid of destination restrictions in their LNG contracts, while ASEAN member states have been working on a standardized LNG contract template to promote destination-free LNG trade across the region.[45] That said, it can be argued that the global gas market is on a seemingly inexorable path to greater liquidity and flexibility. In the foreseeable future, this process will mainly be driven by growing exports of destination-flexible LNG from the United States, the determination of large LNG buyers to eliminate further rigidities in LNG trade, and the expiration of more than 200 mtpa of legacy LNG contracts by 2030, which will most likely be renewed on more flexible terms—and on a more short-term basis.

6. Outlook for Russian Gas and LNG

2019 will be a pivotal year for Russian gas with the Nord Stream 2, TurkStream, and Power of Siberia pipelines all scheduled to enter service by the year's end,[46] the gas transit contract between Russia and Ukraine set to expire, and Russia's second Arctic LNG megaproject, the Arctic LNG 2, probably taking a final investment decision within the year.

The successful delivery of Novatek's Yamal LNG project ahead of time and on budget earlier in 2018—notwithstanding Western sanctions and the challenging construction environment—is a remarkable feat that has boosted Russia's credibility on the LNG stage considerably. Arctic LNG 2, the company's second LNG project, has also enjoyed strong momentum and received significant interest from potential buyers—including from Saudi Aramco—since last year. Novatek has recently increased its long-term LNG production target from 57 mtpa to 70 mtpa by 2030,[47] which implies that the company is planning to add another two large-scale plants over the next decade—and secure Russia's place as the world's fourth major supplier of LNG in a rapidly growing market. The resource base (in excess of 3 trillion cubic meters, or 100 Tcf) is surely no constraint in the Russian Arctic—nor, apparently, are continued Western sanctions against Russia's energy sector. To isolate its new LNG projects from sanctions even further, Novatek plans to build most of the components (including some of the liquefaction modules and the giant gravity-based platforms upon which the Arctic LNG 2 plant will stand) in Russia, which could bring novel challenges during the execution phase. Novatek is also testing a newly developed proprietary liquefaction technology (the so-called Arctic cascade process) at a small-scale expansion train at the Yamal LNG terminal. If it proves successful,

then the Russian LNG industry will no longer depend on foreign process technology, which is typically licensed by a handful of Western firms to LNG plants around the world. The most immediate challenge to Russia's LNG ambitions is to resolve shipping logistics in the Arctic Sea. Navigation in the easterly direction (via the Northern Sea Route) to Asia remains closed outside a narrow summer season, and year-round LNG transportation even in the less profitable westerly direction (via Europe) requires special, more expensive ice-class carriers. To resolve the shipping bottlenecks around Russia's Arctic LNG hub, Novatek started temporary LNG transshipments in Norway and proposed to build two large transshipment facilities in Murmansk and the Kamchatka peninsula for billions of dollars as a longer-term solution to optimize the costly ice-class fleet.[48] In spite of these logistical challenges, however, it appears likely that Novatek will remain Russia's LNG champion for the foreseeable future, while Gazprom will continue to lag behind.

Instead, Gazprom's primary focus remains pipeline gas exports, and its position appears fairly strong in its traditional business. The company's European deliveries broke new records in 2018, and Gazprom Export has recently increased its European market share target from 33 percent to 35 percent or higher.[49] However, if the global LNG market enters a soft patch, and more surplus LNG flows into Europe in 2019–2020, then Gazprom might once again face fierce competitive pressures in its core European market. Moreover, the company's spare capacity has substantially dwindled over the past two years from around 150 bcm (14.5 Bcf/d) in 2016 to less than 40 bcm (3.9 Bcf/d) in 2018,[50] and bottlenecks around the Baumgarten hub will limit Gazprom's ability to bring significantly more gas to Europe even after the completion of the Nord Stream 2 and TurkStream pipelines.[51] Despite these changes, Gazprom is still well positioned to wage a price war, although it is not clear the company would desire such a war.[52] Whether it will do so will depend on whether revenues from hydrocarbon sales will decline as competition in the EU soars. If they do, this may provide an incentive to start a price war. If not, Gazprom might assess that the abundant availability of LNG may be a temporary phenomenon, after which the company can return to selling record volumes again. The chances of fundamental gas market reforms in Russia, such as unbundling or the liberalization of pipeline exports, are still modest. If they do occur, then domestic power struggles rather than a genuine desire to liberalize will be the primary driving force behind them.

Gazprom's eastern strategy will also reach an important milestone at the end of 2019, when Russian gas deliveries begin to flow to the Chinese market via the Power of Siberia pipeline. Once the pipe ramps up to its full 38 bcm (3.7 Bcf/d) design capacity by 2025, Gazprom can capture almost 15 percent of China's natural gas imports, by one estimate.[53] There is further room for Russia to increase its gas exports to China in the second half of the next decade. One relatively simple way would be to add further compressor stations along the Power of Siberia line, which could boost its capacity to about 50 bcm (4.8 Bcf/d) at relatively little expense. Building the 30 bcm (2.9 Bcf/d) Power of Siberia 2 pipeline (previously known as the Altai pipeline or the Western Route) connecting Western Siberia to China's western border would be a more complex undertaking requiring extensive negotiations and massive construction on the Chinese side. But if Chinese gas demand surprises to the upside, or a heavy reliance on LNG imports becomes unpalatable for Beijing for geostrategic reasons, then additional pipeline gas from Russia offers a convenient diversification option at a relatively predictable cost.

7. Geopolitics: Rivalry Takes Center Stage

Geopolitics have loomed large over the global gas market in recent years. The Trump administration's trade war on China cast a long shadow over US-China LNG trade, which was previously seen as a match made in heaven between the fastest-growing exporter and importer of liquefied natural gas. This relationship was off to a promising start when US spot LNG cargoes helped China meet its booming natural gas demand during a period of shortages in the winter of 2017–2018, and CNPC signed a pair of long-term LNG contracts with Cheniere Energy at the beginning of 2018, essentially kick-starting the second LNG investment wave in the United States. But the ensuing tariff war in 2018 poured cold water on US-China LNG relations and has reportedly frustrated ongoing negotiations between Chinese and American companies as well. The number of spot LNG cargoes delivered from the United States to China dropped to near zero in the second half of 2018 as the tariff war ratcheted up,[54] and at least one US LNG project openly blamed the trade war for its failing to finalize agreements with interested Chinese buyers and reach a final investment decision within the targeted time frame last year.[55] LNG deals between the two countries are not dead, however. In October 2018, a Chinese independent city gas distributor (ENN Holdings) decided to purchase a large LNG contract from Toshiba, which—if approved—would give the Chinese company access to 2.2 mtpa of US LNG from the Freeport LNG terminal in Texas at a discount. A possible trade deal between the United States and China could rekindle Chinese companies' interest in adding more US LNG to their procurement portfolio, and US companies have expressed confidence that significant export growth to China is likely once the trade spat has been resolved.[56] But the long-term strategic rivalry between the two great powers—which will likely persist beyond the trade war—should caution against pinning too much hope on the beginning of a beautiful LNG friendship.

Geopolitics infused natural gas dealings in other parts of the world as well. Qatar Petroleum's partner selection for its giant LNG expansion project at home and its recent decision to invest in the Golden Pass project in Texas—as part of a broader plan to spend at least $20 billion in America[57]—are believed to be at least partially motivated by Qatar's desire to strengthen ties with Western allies. Saudi Aramco's simultaneous interest in Russia's Arctic LNG 2 and multiple US LNG projects is also easy to see through a geopolitical lens as an effort to cement Riyadh's complex relationship with both countries at the same time. Meanwhile, US sanctions against Tehran once again forced international energy companies—including Total—out of Iran's capital-starved natural gas sector,[58] and the December 2018 arrest of Huawei's chief financial officer in Canada (for violating US sanctions against Iran) may have darkened the prospects for Canadian LNG exports to China in recent months.

Russian gas and the controversial Nord Stream 2 pipeline project did not escape the attention of geopolitical buffs in 2018 either. Despite repeated threats of US sanctions and political bickering in Europe, the construction of the Nord Stream 2 pipeline moved full steam ahead in 2018, and the project seems to have passed the point of no return. Denmark can still delay the operation start by withholding permits and forcing the consortium to reroute the project around Danish territorial waters (and the upcoming general elections in June will only increase the likelihood of permitting delays in Denmark this year). But absent a dramatic unforeseen turn of events in 2019, the pipeline will be very difficult to stop at its advanced

stage of development, even though the recent amendment of the EU gas directive could impact pipeline operations and economics, depending on the timing of the final legislation. Moreover, takeaway capacity expansions from Northern Germany to the rest of Europe will probably not be ready in time, which will likely slow the ramp-up of Nord Stream 2 deliveries in the early years. The future of Russian gas transit through Ukraine remains as uncertain as ever, with only a few months left to negotiate a new gas transit agreement before the current contract expires at the end of 2019. The EU-mediated negotiations have been complicated by payment disputes, disagreements over tariffs and transit volumes, as well as by the 2019 Ukrainian elections and the ongoing military conflict between Russia and Ukraine. On top of this, European elections, and the start of a new European Commission this coming fall, mean that two out of three parties that are negotiating a new deal will have other issues on top of their agenda in the coming months. None of this bodes well for a timely resolution. The silver lining from the Ukrainian perspective is that a delay in the start-up of Nord Stream 2 looks likely, given the regulatory uncertainties, which means that some Russian gas transit through Ukraine will remain inevitable in 2020. In addition, currently only the first line of the TurkStream pipeline targeting the Turkish domestic market is on track for timely completion, while the second line to Europe still faces challenges, particularly around the financing of the pipeline section through Bulgaria.[59]

Dependence on Russian gas remains a concern across Central and Eastern Europe, and several countries have stepped up efforts to build diversification infrastructure, partly financed with public funds. Poland decided in 2018 to expand its LNG terminal and construct an undersea pipeline to Norway. LNG Croatia took a final investment decision to build a floating regasification terminal on the Adriatic Sea, using a combination of EU funds and Croatian government support to complete the project. Various companies proposed at least four LNG import terminal projects in Germany, and the German federal government—to the surprise of many—offered political and financial support to develop the country's LNG import infrastructure.[60] In theory, German companies could import LNG by using regas terminals in France, Belgium, or the Netherlands. But diversification and supply security considerations have increasingly pushed Germany toward developing its own LNG import infrastructure in recent years—partly to replace Dutch supply as Groningen declines, partly to reduce dependence on Russian pipeline gas as Nord Stream 2 enters service, and partly to meet growing structural demand as nuclear and coal plants are phased out and LNG bunkering takes off in Northern Europe. Energy geopolitics also plays an important part in Germany's LNG ambitions. As economy and energy minister Peter Altmaier has put it, building an LNG terminal on German soil is, first of all, "a gesture to our American friends."[61]

8. The Role of Gas in a Low-Carbon Energy System

While industry outlooks about the growth prospects of natural gas and LNG demand remain buoyant, gas sits increasingly uncomfortably in long-term projections of a decarbonized energy system that is consistent with the Paris Agreement's climate goals and conforms to many politicians' preferences for a fossil-free electricity system dominated by renewable energy sources.[62] Rapidly declining costs for renewables and battery storage already pose an existential threat to gas-fired peaker plants in some electricity markets, particularly where renewable resources are abundant, retail electricity rates are high, and fossil fuels are

unpopular, such as California. Rapidly growing zero-marginal-cost wind and solar generation also hurts gas-fired CCGTs in liberalized electricity markets by depressing wholesale electricity rates for all fossil fuel plants, especially in markets where overall power demand is already flat or declining. If near-zero wholesale electricity prices become the norm during certain parts of the day as renewables reach critical mass in the generation mix, electrification could also threaten natural gas in more defensible niches such as space heating over time, making the outlook for gas much more uncertain than today's confident projections suggest.

To reconcile the vision of a decarbonized energy system with projections of growing natural gas use, the industry started to embrace the idea of "greening" natural gas, either by using more biomethane from organic sources or by producing hydrogen from water using renewable electricity and blending it in with the natural gas stream. Green gas was one of the recurrent themes in June 2018 at the World Gas Conference, and Europe is clearly emerging as a leader in this field. One recent study by Ecofys estimated that the potential for green gas production—namely, biomethane and renewable hydrogen—is in excess of 120 bcm per annum (11.6 Bcf/d) within the European Union on a 2050 horizon.[63] This is roughly equivalent to the current natural gas consumption of the United Kingdom and France combined. Other studies, however, believe that the long-term supply potential of such renewable sources of gas is much lower even in Europe,[64] where the desire to clean up the gas supply mix appears to be the strongest at the moment.

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About the Author

Akos Losz is a senior research associate for the Center on Global Energy Policy. Prior to joining Columbia, Losz was senior analyst at Westwood Global Energy Group. Previously, he worked on the strategy development team of MOL Group, a Hungary-based international energy company.

Tim Boersma is a Senior Research Scholar and Director of Global Natural Gas Markets at the Center on Global Energy Policy. Prior to joining CGEP, Boersma was a Fellow and Acting Director of the Energy Security and Climate Initiative at the Brookings Institution, and worked in the Dutch electricity sector.

Tatiana Mitrova is a Fellow at the Center on Global Energy Policy and Director of the SKOLKOVO Energy Centre in Moscow. From 2011-2012 she was Head of Global Energy at the SKOLKOVO Energy Centre, and from 2006-2011 she was Head of the Center for International Energy Markets Studies in ERI RAS.

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