

THE NEW ROUTES OF GAS





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WHERE IT ALL BEGAN

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EUROPE HAS REDISCOVERED THE MEDITERRANEAN:
THE CRADLE OF OUR CIVILIZATION IS NOW
THE EPICENTER OF A HIGH-STAKES ENERGY GAME
WHERE ITALY DEMONSTRATES ITS STRATEGIC
STRENGTH AND COMPETENCE

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Vincenzo Maria Coronelli [1650-1718], map of the Mediterranean, c.1690.

THE MEDITERRANEAN IS ONCE AGAIN a hotbed of activity, recalling ages past when great powers vied for influence. After a period of calm, the region is turbulent again, with major events looming on the horizon. The modern world has revived the 19th century Great Game, as outside powers renew their struggle for dominance. The Mediterranean basin is a stage for geopolitical drama once more. The Mediterranean region, stretching from the Strait of Gibraltar along the African coast to the Persian Gulf, is transforming rapidly. This “enlarged Mediterranean” now spans to the Indo-Pacific, linking Europe and the Middle East to the Far East. Though the sea seems confined from the air, maritime travel expands its horizons immensely. Distances stretch, time dilates, and possibilities multiply across its waters. The symbolic Mare

Nostrum is now a global crossroads, bridging continents and cultures as great powers look to exert influence. The Mediterranean has become the epicenter of the global energy game, with producers, processors, distributors, and consumers all converging. Gas pipelines are the circulatory system, reservoirs the nerve centers of a geostrategic organism undergoing rapid change. The Ukraine war and Europe’s split from Russian gas – a conflict forcing necessity – have spurred the most dramatic strategic shift in 30 years. Europe has rediscovered the Mediterranean, Africa, and itself. Mental maps are switching from West-East to North-South, but now South is above North. Europe can no longer treat Africa as a repository of extractable assets, nor revive colonial models. With aging populations, migration is essential, though

in need of regulation. The world needs energy, and I am not just referring to raw materials: I mean, first and foremost, the energy of the young people who build the nations of tomorrow that overlook the shores of this Mare Nostrum. The page is turning, and the impetus is coming from Italy, which stretches out into the Mediterranean, lives it and remains attuned to it. The Mediterranean cradled humanity’s journey to civilization, weaving an endless aquatic tapestry. From its waters, energy pathways now extend northward along great rivers to European capitals, with the scent of Carthage and Alexandria lingering in Hamburg and Paris. This interplay of geography and history is our shared biography, told through pipelines or new discoveries, visionaries, and wars. One such visionary was Enrico Mattei, founder of Eni, who saw

links between Europe, Africa, and the Middle East before their time. Italy now champions a “Mattei Plan” for equitable North-South cooperation. History’s cycles suggest such opportunities will come again after today’s transition, where Italy already demonstrates its maritime strengths – anticipating winds, charting courses, unfurling sails. With the wisdom of ancient mariners, Italy leads where others stall, proving its intelligence and competence as the Mediterranean’s risky “Great Game” resumes. This is no myth; it is a far-seeing strategy springing from a nation whose identity was forged on this Middle Sea.

We

A FOUR-POINT

REVOLUTION

by Robin M. Mills

THE INTERSECTION OF SLOW BUT LONG-LASTING MARKET TRENDS WITH RAPID EVOLUTIONS IN TECHNOLOGY, INTERNATIONAL POLITICS, AND CLIMATE POLICY HAS RESHAPED THE WORLD GAS SCENE, WIPING OUT WHAT HAD SEEMED TO BE PERMANENT FEATURES



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THE GAS INDUSTRY usually moves slowly: it takes many years, even decades, for new pipelines and LNG plants to go from concept to first production. The tectonic shifts unleashed by Russia's invasion of Ukraine are very different. Four great changes have been either unleashed or accelerated. By 2030, the full implications of these upheavals will be clear.

A HARD STOP FROM RUSSIA

First is the elimination of Europe as a sizeable market for Russian gas, at least delivered by pipeline. Between 2021 and 2022, Russian pipeline supplies to its "far abroad" (outside neighboring former Soviet countries such as Belarus) dropped by about 85 billion cubic meters (bcm). Supplies to China rose 5.4 bcm, so the reduction in volumes to Europe and Turkey was about 90 bcm. Just 11 bcm have gone to Europe so far this year.

In just under a year, the nearly five-and-a-half-decade-long saga of Soviet and Russian gas exports to Western Europe, which began with Austria in 1968 and withstood the challenges of the Cold War, the disintegration of the USSR, and subsequent Russian coercion of Ukraine, has come to a close. Even in the event of a swift resolution to the conflict, Europe will never return to relying heavily on its eastern neighbor for energy. Currently, LNG accounts for two-thirds of the continent's gas imports, marking a significant shift from a time when LNG served merely to supplement pipeline deliveries.

Russia's pipeline trade to Europe accounted for about a third of all inter-regional pipeline gas trade globally. Including LNG, its European gas sales represented about 18 percent of the entire global gas market. Such a huge and rapid redistribution is unprecedented. Where will this gas go now? Five avenues can be envisioned: reducing production, increasing industrial use in Russia, exploiting other avenues into Europe, expanding LNG capacity, and pivoting to Asia.

If there is no market outlet, existing fields will simply be shut in, and exports and production will fall – as they have done so far. Russia can use some spare gas domestically to make export products, such as fertilizers. These would likely mostly have to go to Asia in view of likely further European sanc-



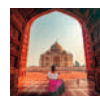
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China wants to diversify gas supply sources, increase domestic production and increase imports of liquefied natural gas (LNG). Pictured is an LNG terminal operated by the China Petrochemical Corporation (Sinopec Group) in Qingdao, Shandong Province, China.



Importers of LNG from the global South and Southeast Asia, despite having suffered in 2022 due to high prices and unavailability of supply, remain a key component for growth in long-term demand. Pictured is Ninh Binh, Hanoi, Vietnam.



India's liquefied natural gas imports could grow by 35 billion cubic meters by 2030. Pictured is Taj Mahal, Uttar Pradesh state, northern India.

tions and the practicalities of market size.

Russia can find new ways into the European market. Some of its gas is already re-routed through Turkey, to markets including Greece, Bulgaria, and Serbia, where the mix of Azeri, Iranian, and LNG imports obscures its origin. Bear in mind, though, that Turkey's own domestic output is set to ramp up with new discoveries in the Black Sea.

Russia can also expand its LNG capacity. Its LNG deliveries to Europe rose from 16 bcm in 2021 to 22 bcm in 2022, now representing about half its total exports, and offsetting some of the loss in pipeline sales. The Arctic LNG 2 project was projected to start shipments this year and reach its full capacity of 19.8 million tonnes by 2026. Further projects could expand market access from the Yamal Peninsula, and East Asian markets are reachable via the northern sea route through the Arctic.

However, the EU is considering a ban on imports of Russian LNG. And future plants would face challenges with regard to financing and technology access. What's more, Arctic LNG 2 has already been hampered by the departure of the French engineering contractor Technip and TotalEnergies has expressed its intention to likewise withdraw. Novatek, the developer of the Yamal LNG plants, has its own liquefaction technology, but its reliability is unproven.

Finally, Russia can seek new pipeline markets in a pivot to Asia – most obviously, China. And this brings us to the second great shift in global gas trade unleashed by the war.

LONG-TERM DEMAND SHIFTS TO THE EAST

Gazprom has intended to cultivate the Chinese market for more than a decade. The Power of Siberia pipeline began deliveries in late 2019. With a planned capacity of 38 bcm by 2027, it carried 15 bcm last year and is expected to deliver 22 bcm this year. It runs from the East Siberian field of Chayanda, with a new link from Kovykta, and crosses the Chinese border at Blagoveshchensk.

In January 2023, Beijing and Moscow signed an intergovernmental agreement on a smaller deal, the Far Eastern Route, to deliver 10 bcm from the island of Sakhalin.

Russian prime minister Mikhail Mishustin visited Beijing in May but he returned without an agreement on the main prize: the planned 50 bcm Power of Siberia 2 pipeline, which would finally give Russia the ability to switch gas from its former Western markets to the East.

However, Moscow faces major competition. On May 19th, at the inaugural China-Central Asia Summit in Xian, President



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Xi Jinping urged the acceleration of the Line D pipeline from Turkmenistan. The three existing pipelines from the Central Asian republic to China run through Uzbekistan and Kazakhstan and have a combined capacity of 55 bcm per year. They delivered more than 40 bcm in 2022. Line D, with a planned capacity of 30 bcm, would run across Uzbekistan and then the mountainous republics of Tajikistan and Kyrgyzstan into western China.

China wants to diversify its sources – to play Russia off against its Central Asian suppliers to seek better terms, boost domestic output, and increase LNG imports while managing the exposure to vulnerable maritime supply routes. High prices and Covid lockdowns saw Chinese LNG imports drop to 87 bcm from 109 bcm in 2021, while domestic consumption in 2021 was 379 bcm, of which domestic output met 209 bcm.

Growing gas use is important if China is to reduce urban air pollution and make progress toward decarbonization. With total Chinese demand by 2032 estimated at about 550 bcm, if production remains at current levels, the existing and planned pipelines at full capacity, plus 150 bcm of LNG imports, would be enough. More likely, China would aim for higher production and to retain some surplus pipeline capacity, taking over the role of balancing the global LNG market that Europe previously held.

Meanwhile, the leading traditional Asian LNG importers will overall see a drop in requirements to the early 2030s, with maturing economies, more use of renewables and hydrogen, and, in South Korea and Japan, a revival of nuclear power.

Europe's new-found LNG demand will also start dropping away by the 2030s. Latin American imports are small, volatile, and will probably be flat or shrinking too.

South and south-east Asian importers who had bet on LNG were stung by high prices and unavailable supply in 2022. Nevertheless, with China, they will be the key component of longer-term demand growth. Their expanding requirements in the early 2030s will see the LNG trade shift east again after its westward turn. India's LNG imports alone may grow by about 35 bcm. Pakistan, Bangladesh, and Singapore are smaller markets, and the Philippines and Vietnam are new entrants. Their demand can grow quickly, but affordability against coal is essential.

NEW TRADE WILL BE IN THE FORM OF LNG

The third change is where this gas will come from. Apart from China, new gas trade will overwhelmingly take place as LNG.

Pipeline expansions into Europe from the Caspian, Middle East, or East Mediterranean, are commercially and technically feasible but face political barriers and the continent's unwillingness to promote new fossil fuel infrastructure.

After a period with very few investment decisions, higher prices and the drive for supply security have finally revived interest in new liquefaction plants.

Most of this new supply will come from the US and Qatar. By 2027, the North Field East and North Field South expansions will take Qatari capacity from 105 to 171 bcm per year. Scale, existing facilities, associated hydrocarbon liquids, and a carbon capture project make this the world's lowest-cost LNG, and also among its least carbon-intensive.

Doha is driving hard bargains with buyers, demanding long-term contracts that are difficult for European players. In November 2022, Sinopec of China agreed to a 27-year, 4 million ton per year purchase deal and, in April 2023, took a 1.25% stake in the North Field East project, a first for a Chinese company in Qatar.

By the time these expansions come online, however, the US will be the world's biggest supplier, with about 230 bcm of capacity spread across numerous projects. Mexico, using re-exported American gas, and Canada are also emerging suppliers. North American supply will be flexible on destination but has to manage challenges of upstream feedstock costs, pipeline capacity, government policy shifts, and greenhouse gas footprint. It also links Henry Hub to the global market more tightly: US LNG output

can be flexible when the spread drops too low, as happened in the early days of the Covid pandemic, providing something of a price floor.

Africa, collectively, is the third major growth area, led by Mozambique, if it can overcome security problems in its north, joined by Mauritania, Senegal, the Republic of Congo, the long-awaited Train 7 in Nigeria, and recent progress in long-stalled plans for Tanzania. African output may double by 2030. Expansion in the UAE, debottlenecking in Oman, and some new projects in Australia, such as Scarborough, Barossa and perhaps Browse, and south-east Asia complete the medium-term global picture.

COMPETITION FROM NEW ENERGY CARRIERS

Finally, there is competition for gas from new energy vectors. Long-distance high-voltage direct current electricity cables, such as those being built or proposed from interior China to



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The new gas trade will be mainly in the form of LNG. After a period with very few investment decisions, rising prices and the push for security of supply have revived interest in new liquefaction plants. Pictured is an LNG plant in China.



According to the International Energy Agency's (IEA) Net Zero scenario, global demand for hydrogen will reach 180 million tons in 2030 compared to the current demand of around 100 million tons. Pictured is a hydrogen bus, London.

the coast, Morocco to the UK, or Australia to Singapore, may help replace some gas and coal with renewables.

Most notably, the new energy system introduces hydrogen as a major traded commodity for the first time. The lightest element may be transported as the gas itself, most likely through short or medium-range pipelines, as synthetic methane, or as derivatives, including ammonia, methanol, or synthetic liquids.

“Blue” hydrogen is made from natural gas with carbon capture and storage, and therefore would actually increase gas demand while mostly eliminating its carbon footprint. “Green” hydrogen from the electrolysis of water, using renewable energy, is a more popular contender in Europe. The US's Inflation Reduction Act provides very generous incentives for hydrogen production. Several important gas producers, such as Australia, Norway, Egypt, Saudi Arabia, Oman, and the UAE, also wish to be leading hydrogen exporters. They face competition from other states in Africa and Latin America with favorable renewable conditions.

Hydrogen would compete with natural gas in heavy industry, notably fertilizers, iron and steel, and oil refining. It could displace oil in long-range shipping and aviation. Its future in power generation seems mainly for long-duration storage for seasonal needs, supporting renewables, while its role in home heating or ground transport is much less promising.

Europe, Japan, and South Korea will make some hydrogen at home but will be lead the way as importers. A low-carbon, diversified source seems a welcome contribution to improved energy security. Production costs remain high but should come down, and are well below the frightening peaks that gas scaled in 2022.

The International Energy Agency sees global hydrogen demand by 2030 reaching 180 million tonnes in its net-zero scenario, versus about 100 Mt today, virtually all made using fossil fuels. The increase in “green” hydrogen is equivalent to about 300 bcm of natural gas, making it a serious competitor.

The intersection of long-running but slow market trends with rapid moves in technology, international politics, and climate policy, has reshaped the global gas terrain. What seemed permanent features of the landscape have been wiped away. As we chart a new course, we may think we know where we are going, but only by 2030 will it be clearer whether we have the right destination and the right course.

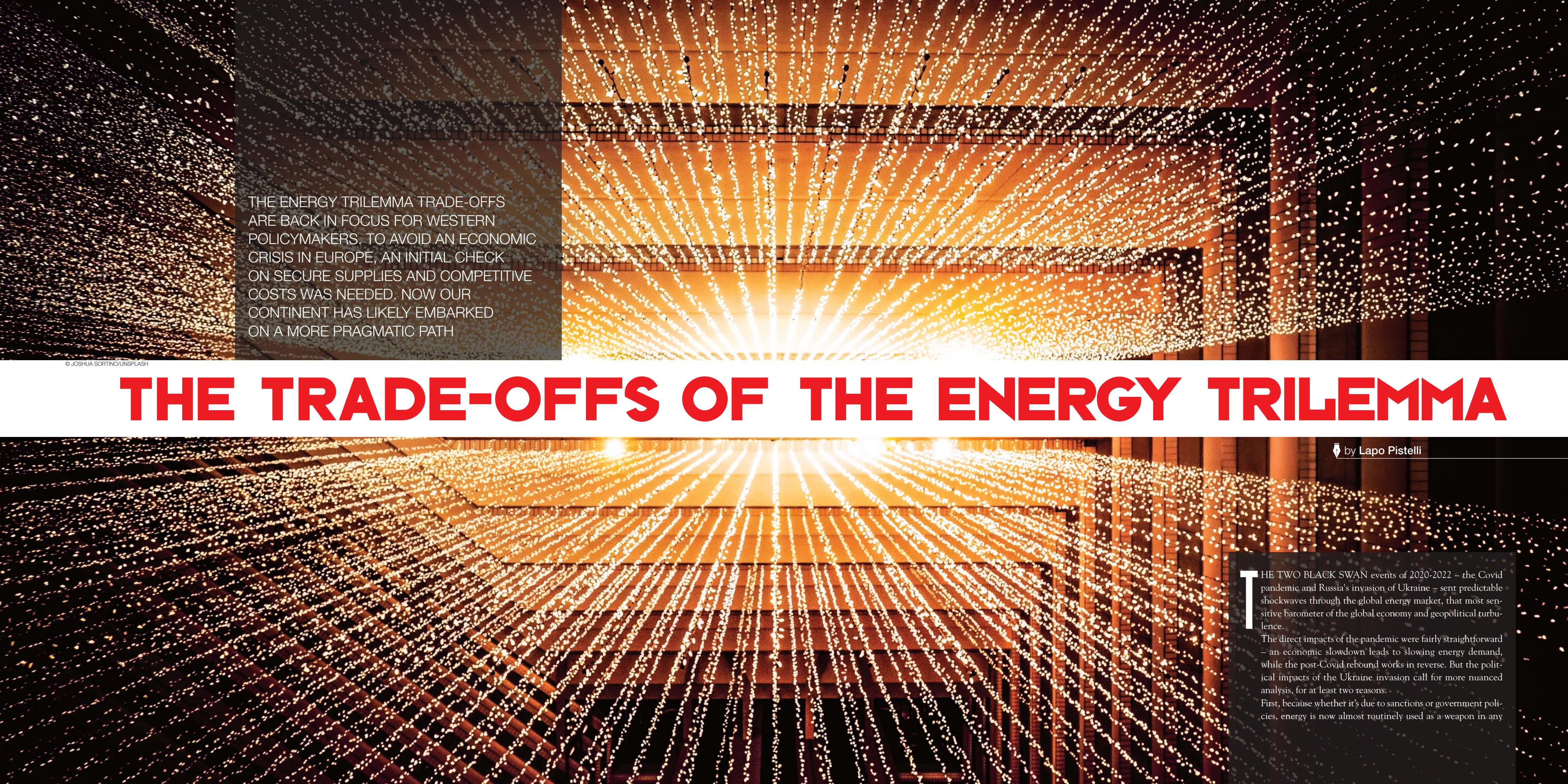
We

ROBIN M. MILLS

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THE ENERGY TRILEMMA TRADE-OFFS ARE BACK IN FOCUS FOR WESTERN POLICYMAKERS. TO AVOID AN ECONOMIC CRISIS IN EUROPE, AN INITIAL CHECK ON SECURE SUPPLIES AND COMPETITIVE COSTS WAS NEEDED. NOW OUR CONTINENT HAS LIKELY EMBARKED ON A MORE PRAGMATIC PATH

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THE TRADE-OFFS OF THE ENERGY TRILEMMA

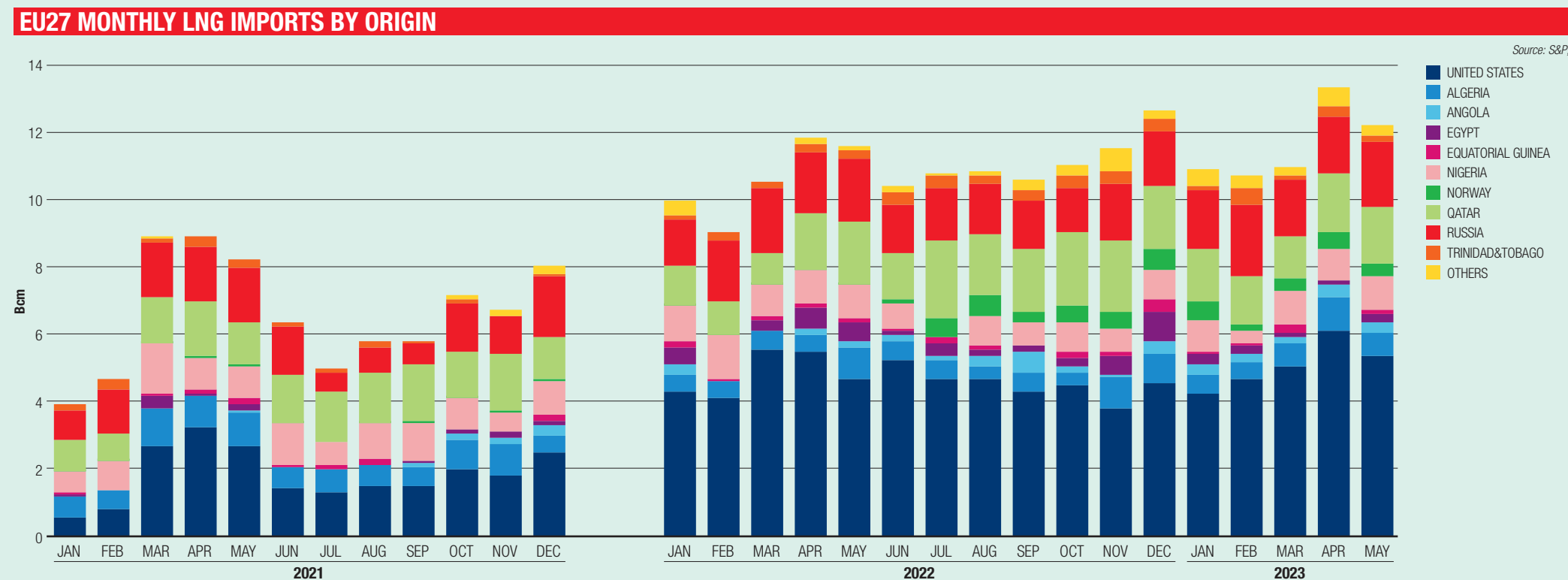
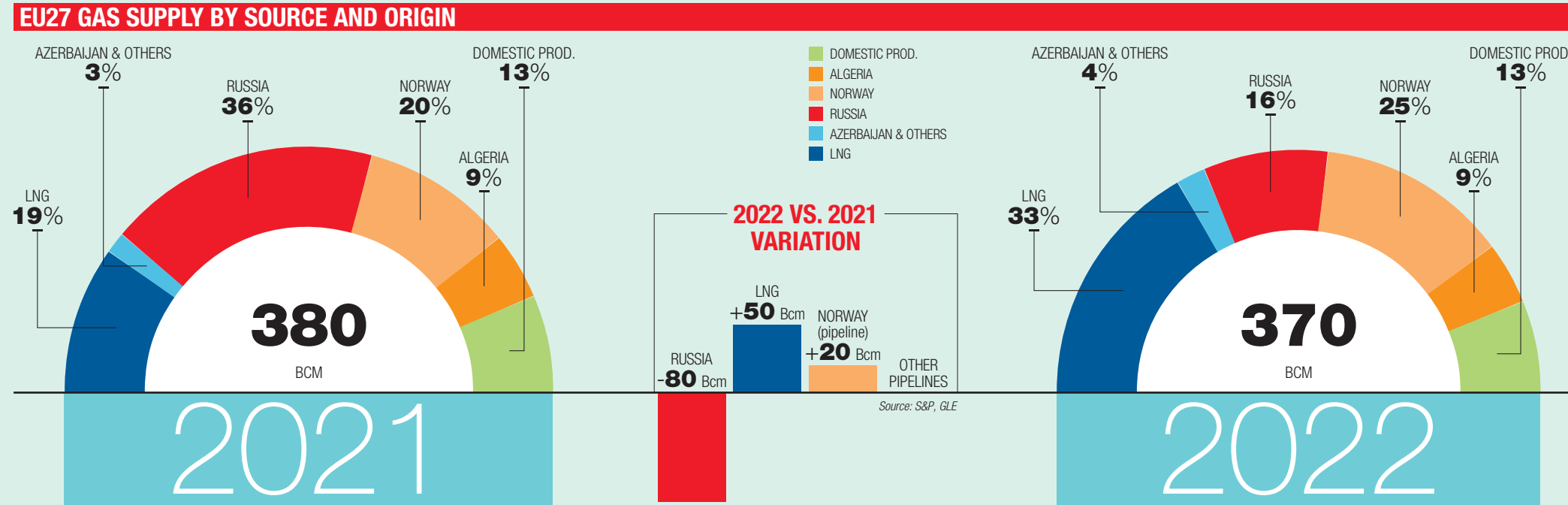
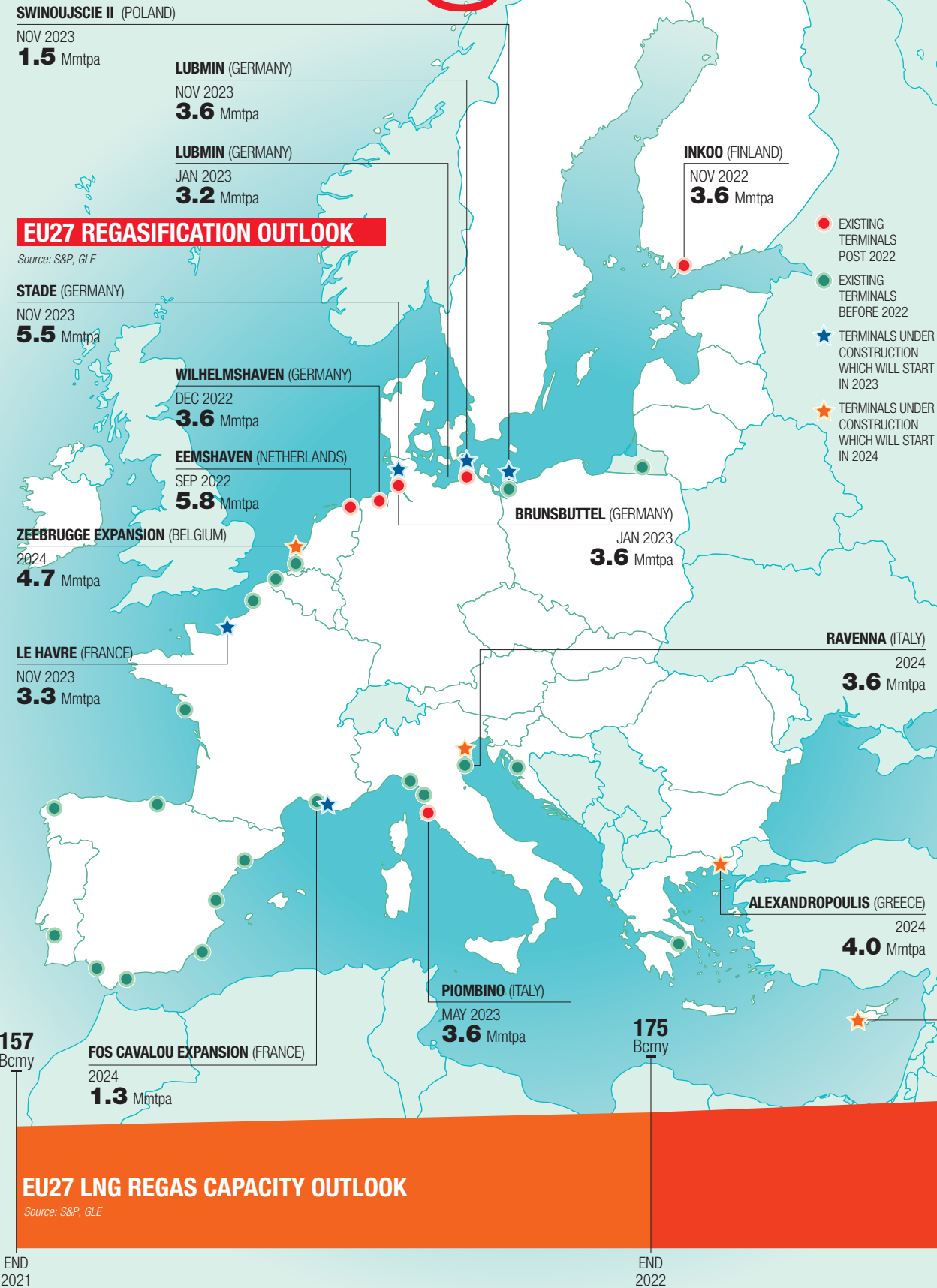
by Lapo Pistelli

THE TWO BLACK SWAN events of 2020-2022 – the Covid pandemic and Russia's invasion of Ukraine – sent predictable shockwaves through the global energy market, that most sensitive barometer of the global economy and geopolitical turbulence.

The direct impacts of the pandemic were fairly straightforward – an economic slowdown leads to slowing energy demand, while the post-Covid rebound works in reverse. But the political impacts of the Ukraine invasion call for more nuanced analysis, for at least two reasons.

First, because whether it's due to sanctions or government policies, energy is now almost routinely used as a weapon in any

Eurogas



conflict (the so-called “weaponization of energy”). Second, because both the pandemic and the war took place amid a global energy transition, with the ongoing switch from fossil fuels to renewables as a key theme. This brings into play new considerations: the phase-out of coal, the transitional role of gas, and new geological dependencies on critical minerals needed for the infrastructure of the new energy model. These economic and political earthquakes have brought back to the forefront of Western policymakers’ minds the energy trilemma: a set of trade-offs on how to manage the competing demands of transition, supply security, and economic competitiveness while minimizing costs and disruptions. This trilemma has cost Europe alone several hundred billion euros in just a few years, between the Green Deal and stopgap measures to cushion the impact of high energy prices on businesses and households.

HOW THE EUROPEAN GAS MARKET HAS CHANGED

So far, so well known: WE has covered these concerns plenty in the past. How then has the European gas market changed two years on, along with its positioning within global commodity flows? Let’s first say that in terms of overall demand, the EU market dropped from 380 to 370 bcm between 2021 and 2022 - a fairly limited reduction considering two seasons with favorable weather and the approval of very strict savings rules by the Commission and Member States. This confirms a well-understood point: policymakers can adopt robust decisions on the nature of supply and its “renewable” substitution, but demand has its own inelasticity until a new energy model is stably implemented. It is also worth remembering that gas imports from Russia have never been included in the 11 sanctions packages approved so far (just three months of intense debate on contracts in euros or rubles), and therefore the replacement of Moscow’s supplies happens by a political choice to break free of a “dependence” (which accounted for about 40 percent of total EU supply) that also guaranteed Russia huge revenues to finance its military campaign against Kyiv. The most interesting developments are seen instead on the European routes. With Nord Stream 2 commissioning blocked, Nord Stream 1 sabotaged, the pipeline through Belarus closed, the paradox of paradoxes is that currently, only the pipeline crossing the battleground in Ukraine itself remains operational. In fact, between 2021 and 2022 volumes even increased slightly (from 16.1 bcm to 16.8 bcm), while the second Ukrainian pipeline – Soyuz – closed in October 2022. Much of the Siberian gas, accustomed to traveling westward, is therefore technically unused at the moment. A “pivot to Asia” (read: China) of these resources in the future is not difficult to imagine, especially since in China alone, demand has risen – and will continue to rise – from 80 bcm of gas to about 10 times that, 800 bcm, in about

30 years in order to gradually reduce the weight of coal in its domestic mix. However, while the main Power of Siberia pipeline on the Chinese route is currently operating at full capacity with 38 bcm of gas transported annually, expanding its reach by thousands of kilometers to reabsorb the 80 bcm lost in the European market in a single year will take time and money. In addition, it will supply a market that is hungry, yes, but also commercially aware that Russia has no alternative. Prices will reflect this.

Norway has been the main beneficiary of the dramatic reduction in Russian supply (from 36 percent in 2021 to 16 percent in 2022), rapidly jumping to become the number one supplier to Europe (from 20 percent to 25 percent of the total) and positioning itself to expand its role further. Oslo is a unique political case to study: a very green domestic energy mix, continuous exploratory upstream rounds aimed at export production, 6000 km of offshore pipelines, \$18 billion in newly announced investments, and the world's richest sovereign wealth fund, now over \$2 trillion.

THE SHARP RISE OF LNG AND US GAS

The eastern pipeline crisis has obviously boosted the LNG market, jumping in one year from 19 percent to 33 percent of total European supply. Within this segment, the role of the US has grown. American gas, which until a few years ago was almost nil in our markets and which former US Energy Secretary Rick Perry urged European friends to buy, is now the number one liquid supply source with over 50 percent of the total. Beyond transatlantic partnership, the record price in the European market over the past two years, which took the “premium market” crown from Asia, was certainly a contributing factor. But this contingency also raises concerns for the near future: with gas prices back at acceptable levels (not yet pre-crisis but still...), will American suppliers still be willing to come to Europe or will they return to more lucrative ancient Asian routes and partners willing to engage in long-term contracts that European political rhetoric sees as incompatible with our accelerated transition timeline? In European LNG supplies, however, Russian Yamal gas still lurks, arriving at Dutch, Belgian and Spanish regasification plants. Exiting Russian dependence totally still requires at least a couple of years, the time needed to further increase Norwegian North Sea production, find more realistic agreements with American suppliers, and fully develop the Mediterranean and sub-Saharan African corridor. In summary, Europe had gotten used to seeing gas supply routes from North to South and especially East to West. Two years later, the East-West has almost stopped working, the North-South has been further strengthened, the South-North has finally been rediscovered and valued, and the West-East has entered the scene.

To enable this new framework of routes and liquid supplies, the EU has given a major boost to its regasification infrastructure,



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some 30 among existing plants, plants being upgraded, and new constructions. The numbers speak for themselves: 157 bcm of regasification capacity by the end of 2021, 175 by 2022, 207 by the end of this year year, rising to 228 by the end of 2024, and finally, 270 bcm by 2030. Much still remains to be done to uncork some bottlenecks – the most notable between Spain and France across the Pyrenees – and to work in reverse flow on other sections. Italy, for example, will only be able to leverage

its aspiration to become a southern hub supplying continental countries like Austria, Slovakia, the Czech Republic, etc. by further boosting gas inflows from Africa and the Mediterranean to redirect them towards destinations previously supplied by Moscow's pipelines.

To prevent the trilemma trade-offs from bringing Europe's economy to its knees required an initial reality check on supply security and cost competitiveness. Even if these choices don't

make headlines, our continent has likely embarked on a more pragmatic path.

we

LAPO PISTELLI

Since July 1, 2020 he is Director of Public Affairs at Eni. Deputy Minister of Foreign Affairs and International Cooperation from 2013 to 2015, he resigned from his position in the government and in Parliament, joining Eni in July 2015.



TRANSFORMATION

A STRUCTURAL

by Gergely Molnar

THIS STRUCTURAL TRANSFORMATION OF GAS MARKETS WAS CAUSED BY THE 2022 GAS SUPPLY SHOCK. THE GLOBAL CRISIS TRIGGERED BY RUSSIA HAS SEVERELY DAMAGED THE MEDIUM- AND LONG-TERM GROWTH PROSPECTS OF NATURAL GAS DEMAND, AND THE SHARP RISE IN NATURAL GAS PRICES HAS REDUCED ITS COMPETITIVENESS

RUSSIA'S INVASION OF UKRAINE profoundly transformed European and global gas markets. The immediate effects of last year's supply shock have eased in recent months, yet the structural changes which emerged in 2022 will persist for years.

LNG: A NEW BASELOAD SUPPLY FOR THE EUROPEAN MARKET

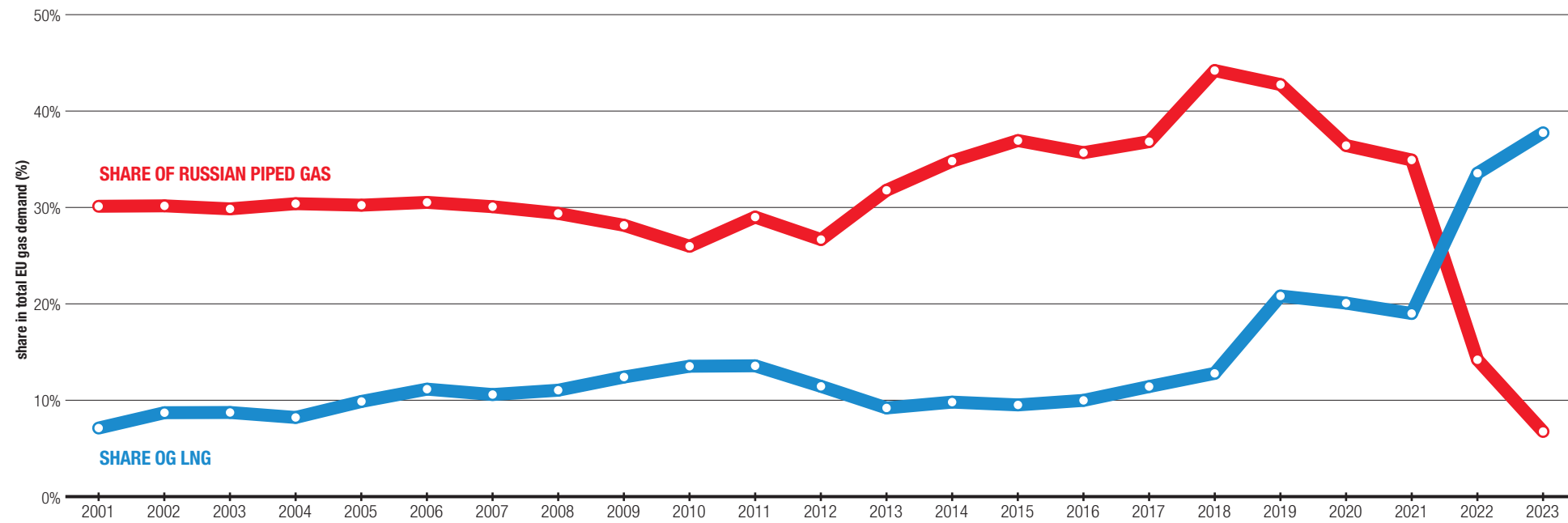
The steep decline in Russian piped gas deliveries to the European Union – a drop of close to 120 bcm through 2022-23 – reconfigured global LNG flows toward Europe.

As a result, the role of LNG in the European market drastically shifted. LNG cargoes once supplied the marginal molecule, but today LNG is acting as baseload, in a similar fashion as Norwegian or North African piped gas. The share of LNG in the European Union's gas demand rose from an average of 12 percent over the 2010s to close to 35 percent in 2022 – a share similar to Russia's piped gas before the invasion of Ukraine.

Europe has repositioned itself as the new premium LNG market. In 2022, TTF was trading at USD 6/MBtu above Asian spot LNG prices. The price signal provided by TTF and other liquid European hubs was crucial to attract the necessary vol-

EU MARKET: COMPARISON BETWEEN LNG AND RUSSIAN GAS

Sources: IEA analysis based on ENTSOG (2023), Transparency Platform; Eurostat (2023), Energy Statistics; Gas Transmission System Operator of Ukraine (2023), Transparency Platform; ICIS (2023), ICIS LNG Edge; IEA (2023), Natural Gas Informator.



LNG has become a new baseload for the European market. The share of LNG in EU gas demand increased from an average of 12 percent in the decade starting 2010 to nearly 35 percent in 2022 – similar to the share of Russian-sourced pipeline gas before the invasion of Ukraine.

umes of flexible LNG to Europe. Forward curves at the end of June 2023 suggest that the European premium is here to stay in the coming years, with TTF's premium over Asian spot LNG prices averaging USD 0.3/MBtu through 2023-25.

THE EUROPEAN UNION'S EXPOSURE TO THE SPOT MARKET

Through the past two decades, long-term contracts, together with domestic production, met some 80-90 percent of EU gas demand on an annual basis. Non-observance of Russian piped gas contracts steeply increased the European Union's reliance on spot procurements, rising from just 20 percent in 2021 to over 50 percent in 2023. The share of spot volumes is expected to increase to more than 70 percent by 2030 – if expiring contracts are not renewed and no new contracts are signed.

This will naturally increase Europe's exposure to more volatile spot markets over the medium-term. A fine balance should be struck between non-Russian long-term contracts and procurements from an increasingly liquid spot market. A higher share of long-term contracts could potentially provide greater price and supply stability. Natural gas producers and consumers should work closely to reduce the emission intensity of gas and LNG supply, to hedge against tightening emission regulations.

GAS SUPPLY FLEXIBILITY OPTIONS NEED TO BE REASSESSED

Russian piped gas contracts included significant intra-annual and inter-annual flexibility, with the nomination rights ultimately lying with the buyers. This flexibility – underpinned by the country's huge swing fields – played a key role in meeting short-term demand variability and seasonal swings. This con-

tributed to balancing European and global gas markets. Overall, the inter-annual flexibility provided by Russian piped gas averaged close to 10 bcm on an annual basis through the 2010s. Intra-annual swings averaged close to 200 mcm/d between 2016-21, amounting to over 10 percent of EU gas demand on a cold day.

This structurally lower gas supply flexibility means that other flexibility options, such as storage and LNG peak-shaving and demand response, will have to play a greater role in coming years. Based on projects currently in development, global natural gas and LNG storage capacity in import markets is expected to expand by 10 percent (or 45 bcm) in 2023-28. In addition, a closer dialogue between producers and consumers should facilitate the development of innovative commercial offerings, new procurement mechanisms and cooperation frameworks favouring a more flexible supply of LNG. A prime example is the coordination mechanism agreed between Japan and Thailand, building on seasonal differences in natural gas demand between the two countries.

CHINA'S ROLE AS A BALANCING MARKET

Prior to the 2022 gas supply shock, Europe played a key role in balancing the global gas market. This role was underpinned by several unique features of the European market, including: 1) flexible piped gas supply from Russia; 2) coal-to-gas switching potential in the power sector; 3) spare LNG regasification capacity; 4) vast underground storage capacity; 5) open, non-discriminatory third-party access to natural gas infrastructure and 6) liquid, well-traded gas hubs.

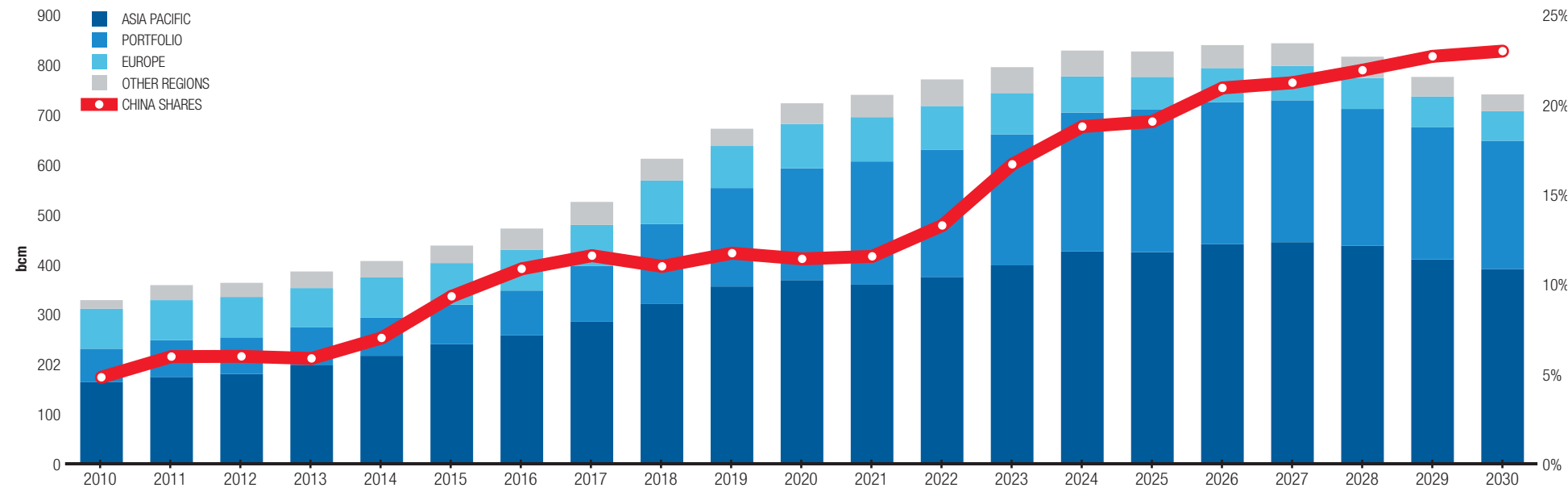
Russia's steep gas supply cuts in 2022 eroded Europe's role as a balancing market. The unprecedented 20 percent drop in

© EROL AHMEDUNFLASH



LNG: CHINA'S SHARE OF ACTIVE CONTRACTS IN THE PERIOD 2010-30

Sources: IEA analysis based on ICIS (2023), ICIS LNG Edge



China's active contracting strategy is set to strengthen its position in LNG trade and the future optimization of global LNG.

China's LNG imports – reflecting lower spot procurement and destination flexibility rights in long-term LNG contracts – was a key factor in enabling more LNG shipments to reach the European market.

In contrast to Europe, China's role as a balancing market is expected to increase over the medium term, especially due to the country's active role in securing LNG contracts. China alone accounted for 30 percent of all LNG sales and purchase agreements (SPAs) signed in the past five years. As a result, China's share of active LNG contracts is expected to rise from 12 percent in 2021 to close to 25 percent by 2030. This is set to boost the role of Chinese companies in LNG trading and the optimization of global LNG flows. Nevertheless, China's role as a balancing market will have ripple effects, both in terms of energy supply security and energy transitions:

- China has limited underground storage capacity. At the end of 2022, China's working gas storage capacity was estimated at 18 bcm, accounting for just 5 percent of the country's annual consumption – well below the level in mature markets. This contrasts with the European Union's 100 bcm of working storage capacity (accounting for over 25 percent of annual gas demand), although China relies to a larger extent on its domestic production and portfolio of LNG contracts.
- China does not have the same access to flexible piped gas supplies that Europe had in the past. Central Asian flows displayed often-negative seasonal swings due to cold spells during the winter seasons, while Russian deliveries via the Power of Siberia pipeline system have limited flexibility in absolute terms.
- A key contributor to China's gas demand flexibility is the country's significant gas-to-coal switching potential. In 2022, coal-fired generation rose by an estimated 1.9 percent, largely

at the expense of gas-fired power plants, which reduced their output by close to 10 percent y-o-y. This translated into higher emissions (estimated at 15 Mt CO₂-equivalent), further straining its clean energy transition goals.

- The majority of China's LNG importers are state-owned companies. Market-driven decision-making might be overwritten by supply security concerns or geopolitical considerations.

THE MEDIUM- TO LONG-TERM OUTLOOK FOR NATURAL GAS DEMAND

The global gas crisis triggered by Russia deeply damaged the medium- to long-term growth prospects for natural gas demand. The sharp increase in natural gas prices reduced its competitiveness vis-à-vis other sources of energy supply, while its image as a “reliable” fuel has been called into question by steep supply cuts of Russian piped gas.

Global gas demand growth for the period between 2020 and 2024 was reduced by 40 percent compared to projections prior to Russia's invasion of Ukraine. The IEA's Gas 2021 Report forecast an increase of 350 bcm through 2020-24, which is revised down to just below 200 bcm in our latest estimate. Europe alone accounts for more than half of this downward revision. This reflects more stringent energy efficiency standards, the accelerated deployment of renewables, and quicker electrification of heat, as well as a reduced role of natural gas in industry.

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The growth in global gas demand for the period 2020 to 2024 has been reduced by 40 percent compared to projections prior to Russia's invasion of Ukraine. Top: the Tokyo Skytree. On the previous page: One World Trade Center, New York. Right: lobby of the Four Seasons in Guangzhou.



THE GAS MARKET

by Francesco Gattei

IS ALL GROWN UP



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THE EVENTS OF THE PAST DECADE, INCLUDING FRACKING, THE NUCLEAR CRISIS, AND ASIAN DEMAND, HAVE SEEN GAS GROW UP. EUROPE, PREVIOUSLY RELIANT ON A REBOUNDED ECONOMY, HAS NOW BECOME VULNERABLE DUE TO THE WAR IN UKRAINE. THE PREDOMINANT ENERGY SOURCE WILL BE LIQUEFIED NATURAL GAS (LNG), WHICH BEHAVES INCREASINGLY LIKE OIL IN INTERNATIONAL MARKETS

OVER THE PAST DECADE, the natural gas industry, once considered the sleepy cousin of the tempestuous oil market, has been beset by transformation. The initial catalyst was the introduction of fracking, an innovative extraction technique that enabled the retrieval of gas from previously inaccessible shale deposits. George Mitchell, a visionary with a name that hinted at his expertise in working with rocks, played a pivotal role in this revolution. Under his guidance, the United States transitioned from being a net gas importer to becoming the world's leading exporter of liquefied natural gas (LNG). An even bigger seismic event reverberated across the industry occurred in the Far East. The Fukushima nuclear disaster disrupted Japan's reliance on nuclear power, elevating the sig-

nificance of the Asian market as the primary consumer of LNG, which was crucial for powering the world's third-largest economy. In the span of just a decade, the United States, once a major gas import market, vanished from the scene, while Asian demand experienced a dramatic surge. However, Europe found itself in a different position, grappling with the aftermath of these shifts.

THE STABILIZERS OF THE EUROPEAN UNION

Until 2022, the European Union had remained relatively passive amid these unfolding dynamics. Initially, Europe suffered from the absence of imports from the United States, as the redirection of American gas flows towards Asia depressed the spot market.

The spot price had gradually replaced the traditional model, which linked gas prices to long-term contracts based on oil prices. Additionally, Europe had to contend with the ripple effect of the purchasing patterns in Asian markets, effectively becoming the residual destination for global LNG exports. The energy landscape of the previous decade had provided Europe with a stable framework, ensuring a balance between gas supply and demand. Three key stabilizers played a crucial role in the European natural gas market during this period:

- The enormous Groningen gas field emerged as a significant factor in the 1960s, initiating the development of Europe's most energy-intensive industry. This colossal deposit accounted for over a tenth of the continent's gas consumption



and, in conjunction with gas production in Britain, served as a substantial source for spot trading, notably fueling the local TTF (Title Transfer Facility) market.

- French nuclear power made a consistent contribution to the region's electricity base load, effectively curbing the demand for gas in Central Europe. By providing a stable and reliable source of electricity generation, nuclear power played a role in limiting reliance on gas.
- The availability of Russian gas played a vital role in the European gas market. Covering approximately one-third of the region's consumption, Russian gas helped mitigate the need for heavy dependence on LNG and the ensuing international competition. Moreover, Russia's extensive network of gas pipelines, spanning thousands of kilometers, served as a form of implicit storage due to the gas already contained within them. This stored gas proved essential in meeting the heightened demand during winter cold spikes.

This model gradually lost ground, leaving the European gas market vulnerable to volatility, further exacerbated by the rapid growth of intermittent electricity sources.

The initial blow came from the seismic tremors experienced in Groningen, prompting Dutch authorities to demand a significant reduction in gas production. In less than a decade, production levels plummeted from 60 billion cubic meters per year to a mere 4 billion cubic meters per year. Some speculate that the field may face a complete shutdown even before the originally anticipated deadline, which adds to the uncertainty surrounding its future.

Simultaneously, the French nuclear power industry encountered its own crisis due to aging plants and a maintenance plan that led to a decrease in output from 400 to 300 terawatt-hours (TWh) between 2015 and 2022. This marks the lowest production level since 1993 and necessitated France to import electricity from other countries, consequently intensifying the demand for gas. Although the situation has improved to some extent, the aging French nuclear system, exceeding 50 years of service, requires substantial investments in maintenance to ensure its continued operation.

The war in Ukraine did away with the last remaining shock absorber. The disruption in transit through Ukraine, combined with underwater explosions affecting the Nord Stream pipelines, devastated gas supplies from Russia, eroding the inherent flexibility provided by these pipelines. In a little over 12 months, Europe suffered a loss of nearly 120 bcm of pipeline supply, with some countries, including Germany, experiencing a complete halt in their gas supply. Consequently, a transformative shift has impacted all three major gas markets, and the crucial export infrastructure linking Siberia to Central Europe has ef-

fectively vanished. West Siberian gas, once a vital resource, is now stranded.

HOW THE GAS MARKET WILL CHANGE

The year 2022 marked a significant shift towards a market primarily driven by liquefied natural gas (LNG) transported by ships. Back in 2000, LNG carriers accounted for only 20 percent of the total volume of exported gas. However, by 2021, this figure had already surged to 40 percent, and over the next two to three years, it is expected to surpass the 50 percent mark. While large pipelines will continue to transport Russian gas supplies to the east due to limited geographic alternatives for reaching consumer markets, the majority of new gas production will be liquefied and exported.

The major players in the LNG market will be the United States and Qatar, vying for the top position. Australia, on the other hand, faces limited room for expansion and higher costs, placing it at a disadvantage. Smaller quantities of LNG will emerge from new producers such as Mozambique, Congo, and the Levant basin encompassing Egypt, Israel, and Cyprus.

The integration of the LNG market will further connect various regions, eventually reducing geographical differentials (excluding transportation cost variations). However, this integration may also lead to increased price volatility. Unlike pipelines, which offer near-immediate supply flexibility through stored gas and compression modulation, the transportation of LNG via ships involves larger quantities and longer delivery times. For the European market

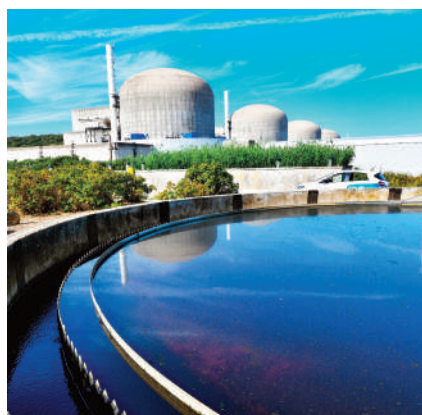
(whereas the Asian market is already predominantly reliant on LNG), this transition will be akin to shifting from email to traditional mail delivered by a scooter-riding postman.

The gas map is hardly recognizable from its state a decade ago. A staggering 120 billion cubic meters has vanished from the equation, prompting the development of new production and infrastructure to make up for this shortfall. The dominant form of gas transportation and trade will be LNG, intensifying the competition between consumer markets in Europe and Asia. Additionally, apart from the lost volumes, the industry has also bid farewell to the substantial storage and modulation capacity that was offered by extensive pipeline networks. In essence, gas has become much more like oil: a volatile and globally interconnected commodity. In short, gas has come of age.

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FRANCESCO GATTEI

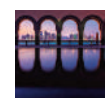
He is Chief Financial Officer at Eni. Previously he was the Americas Upstream Director of Eni, Vice President of Strategic Options & Investor Relations at Eni and, before that, in charge of the E&P portfolio at Eni.



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French nuclear power has for years limited the demand for gas in central Europe. Now, however, it is having to face the crisis of an aging fleet of reactors, which require heavy investments in maintenance to ensure their continuity. Pictured is a nuclear power plant in France.



The year 2022 marks the transition to a market dominated by gas carried by ship. The big suppliers, competing for the top spot, will be the United States and Qatar. Pictured is the Doha skyline as seen from the Museum of Islamic Art.



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THE NEW ENERGY STAR

by Ira B. Joseph

TODAY, LIQUEFIED NATURAL GAS HAS ASSUMED THE ROLE OF GLOBAL EQUALIZER PREVIOUSLY HELD BY RUSSIAN GAS; WITHIN THE LNG WORLD, U.S. EXPORTS ARE THE MAIN SUPPLY-SIDE GAME CHANGER, WHILE EUROPEAN GAS STORAGE IS THE KEY DEMAND-SIDE

THE RUSSIAN INVASION OF UKRAINE thrust liquefied natural gas (LNG) into the energy spotlight in 2022, and it has since played a central role in replacing lost Russian pipeline gas in Europe. Most notably originating from the US, the massive shift of LNG into Europe, a 65 percent increase to 151 Bcm in 2022, accelerated two trends already well underway: Europe's increasing reliance on LNG imports to balance and the world's adaptation of LNG as the primary source of cross border gas trade. The billion-dollar question now facing LNG buyers and sellers is how to balance energy security and market flexibility through a mix of long-term contracts versus spot trade. With the "if, when, and how much Russia will return" question unanswerable, buyers and sellers remain far apart on this issue despite the significant surge in LNG supply that's about to come this decade.

STANDALONE LNG

Apart from natural gas, LNG is now a commodity unto itself. Its ability to shift among broader regional markets offers a preview of future LNG trade when global gas prices will more closely align around freight differentials among the major markets. While long-term contracted LNG will remain the bedrock of LNG flows, the tide of spot LNG trade will grow higher and shift more aggressively when price signals emerge.

More LNG supply also means a tighter connection among the world's regional balances. Global gas storage capacity is evolving alongside the role of LNG as a determinant of price, with European gas storage at the center of the discussion as the world's premier balancing point. Europe gas balances on incremental LNG imports in the winter and helps to balance low seasonal gas use by Asian buyers in the summer by storing unwanted LNG in Q2 and Q3. Growth in storage capacity will need to occur in conjunction with additional LNG supplies, as the primary markets for growth in Asia lack the ability to consume the same volume of gas year-round. With investments already made, China will help rectify this seasonal gap by building its own storage, but the rest of Asia will struggle to accommodate LNG demand growth in the same way.

In this capacity, Russia's gas production used to swing on a seasonal basis as the world's chief balancing mechanism. This is no longer the case. This role of global gas balancer has shifted from Russian pipeline gas to LNG. Within the world of LNG, US exports are the primary agent of change for supply, while European gas storage has become the critical component for demand. With most of the US volume contracted on a free-on-board (FOB) basis, US LNG exports rapidly shifted from Asia to Europe in 2022 in search of higher netbacks at even higher prices. Other regions produced little change in trade, although in all cases, small volumes of incremental LNG flowed to Europe that were not headed there before. The shift was striking, given that only three years ago, in 2020, U.S. exporters canceled 177 cargoes due to weak prices in Europe and Asia rela-

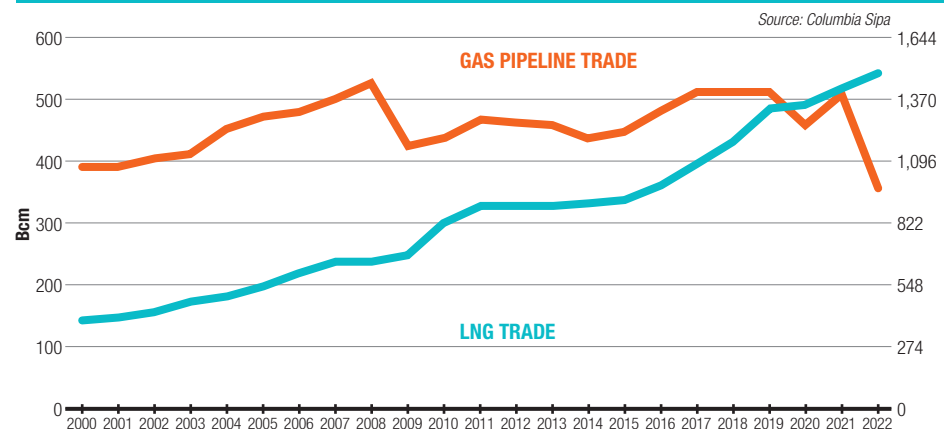
tive to the US.

Spot market liquidity is set to skyrocket at the dawning of the next wave of LNG supply, with Qatar and the US providing a massive injection of new volume in the second half of this decade. The size of the overall market will expand by 50 percent by 2030 to just over 600 MTPA, conservatively increasing the size of the spot market by 60 MTPA to 180 MTPA alone if we assume a 30 percent market share. It could be more. Just how much spot market liquidity emerges will depend on how successful producers will be in signing up long-term contracts

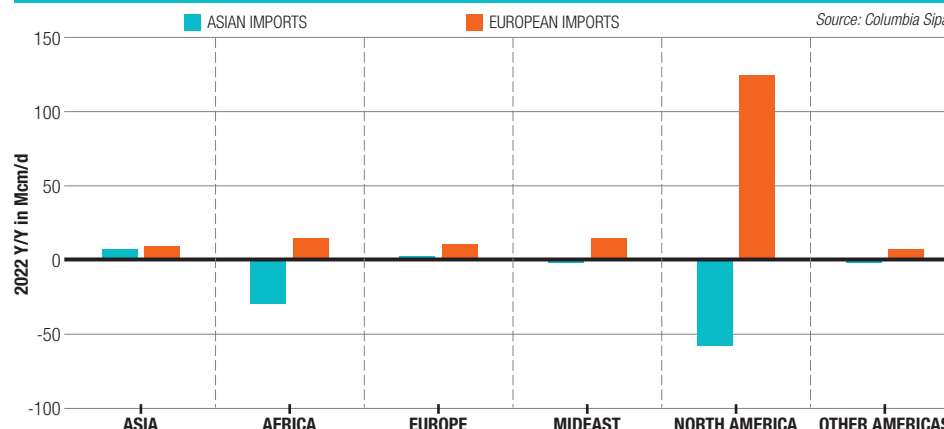


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GAS PIPELINE VS. LNG TRADE



LNG IMPORTS TO EUROPE AND ASIA BY REGIONAL SOURCE



over the next 24-36 months. Qatar alone needs to lock down over 40 MTPA (54 bcm/yr.) of new volumes and is also facing 20 percent of its existing 77 MTPA (105 bcm/yr.) of contracts expiring by 2030.

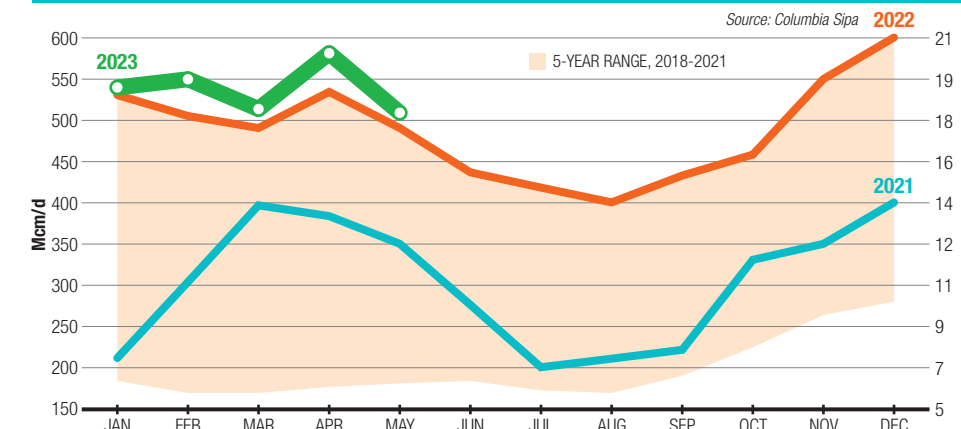
THE RUSSIAN GAS WILDCARD

The unknown fate of future Russian pipeline gas sales to Europe creates immense uncertainty for LNG, with significant knock-on effects. Russia will be sitting on 150-180 bcm/yr. (110-132 MTPA) of gas it used to export, which drastically influence the

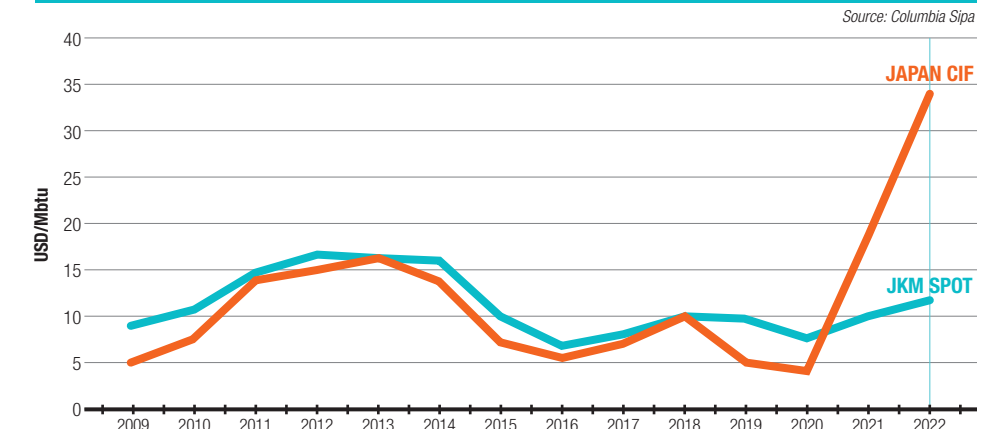
amount of LNG that Europe will need to balance. In turn, Europe's need and willingness to pay up for LNG volumes also influences LNG demand growth in Asia. If Asia cannot access the LNG it needs at the pricing point it can afford, the role of coal and renewables will increase drastically.

Sellers are pushing LNG as a form of enhanced energy security, while buyers are reluctant to sign long-term deals without more clarity on when and how much Russian gas will return to the market. Energy security has rapidly returned to the market as a central organizing principle for trade. What exactly energy se-

EUROPEAN LNG IMPORTS



SPOT VS. CONTRACTS PRICES IN ASIA





for contracts playing a role in LNG buying comes from the experience of 2021 and 2022, although in 2023, JKM spot prices in Asia are now below contract levels once again.

Two types of sellers are emerging that will separate the contract and spot markets. Contract sellers will be dominated by producers such as QatarEnergy, while spot sellers will increasingly be dominated by portfolio players. The size of the portfolio market, led currently by Shell, BP, and Total, is likely to grow, as a growing number of players in this space appear willing to take on the risk of intermediary length. This strategy has paid off handsomely in recent years. Not every year will be a winner among portfolio traders. Like owning storage, it does not pay off every year, but the years in which it pays off, it can be magnificent. Think of portfolio players as the LNG market's floating storage option. Although they do sometimes sign contracts with end users, these players are more usually net long and trade against this position.

THE SPOT MARKET AND PRICING

With the absolute size of the LNG market growing from 400 MTPA in 2023 to over 600 MTPA by 2030, the depth of the spot is going to increase. Whether the spot market accounts for 30 percent of the market or 50 percent, the number of cargoes traded each day will increase. Meanwhile, large producers are scrambling to secure as much LNG under long-term contracts as possible. The role of spot LNG as a price setter is growing, although contract prices being signed by Qatari and US producers must still be considered the pricing channel for global gas. In a tight market, spot prices will drift above, and outside this channel, and in a loose market, it will sink below.

Finally, LNG's role in gas pricing is moving from seasonal to annual. Its influence on spot prices in the winter has been in place for some time, as it provided the marginal cubic meter to two major consuming regions – northern Europe and NE Asia. Between the loss of most Russian pipeline gas exports to Europe and the additional LNG volumes emerging this decade, LNG's role in price formation will now also be more significant in the summer, as it accounts for a much larger portion of European gas storage injections, which has become the destination of last resort for Q2/Q3 gas in the world.

we



Since most US cargoes of LNG are contracted on a free-on-board (FOB) basis, US exports quickly shifted from Asia to Europe in 2022 in search of higher net returns. Pictured is the commercial port of Barcelona.

curity means, in reality, is still a matter of debate. Sellers offer LNG as a security blanket, but buyers have recently been exposed to the potential for holes in this blanket, no matter how binding the agreement seems. Recent legal adventures with force majeure clauses only heightened the paranoia of buyers, in that even signing a long-term contract is only as good as the price majeure alternative available elsewhere. LNG's new role in the market will be creating an environment

that serves the needs of both contract and spot preferences. Both buyers and sellers have different levels of tolerance when it comes to contract needs and spot market exposure. On the sell side, most US projects cannot be exposed because of the non-recourse financing that must be in place prior to having the project built. Alternatively, while Qatar probably craves long-term contracts more than any other seller on the planet, it is also in the best position of any producer – as the world's

low-cost producer – to benefit from the vagaries of spot market fundamentals. Qatar will never face the risk of cargo cancellations that are a central factor in the future of US LNG exports. Contracts offer supply security at a premium, while spot markets offer flexibility on volume and price. Spot markets also have a history of offering a price discount to contract levels, but only until something goes wrong, which can quickly wipe out the accumulated savings of the previous years. The best case

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OUT OF THE STORM

by Dennis Hesseling and Mitja Maletin

THANKS TO LNG, LOWER CONSUMPTION, POLICY INTERVENTIONS AND A ROBUST AND FLEXIBLE INFRASTRUCTURE SYSTEM, EUROPE HAS SUCCESSFULLY OVERCOME THE GAS CRISIS. THE EUROPEAN ENERGY MARKET, IF WELL-INTEGRATED, OPEN AND COMPETITIVE, IS DESTINED FOR SUCCESS

LAST YEAR, the European gas market faced the unprecedented challenge of sudden and significant reductions of Russian flows. Thanks to a well-integrated European gas market, demand reductions and new LNG supplies, Europe came through the winter of 2022-23 without shortages.

THE DRAMATIC CHANGE IN FLOW PATTERNS TO EUROPE

Starting in the second half of 2021 and during 2022, particularly following Russia's invasion of Ukraine, Gazprom diminished its flows to Europe, in an apparent attempt to target certain routes and destinations. The reduction ended up being as



The evolution of gas flows

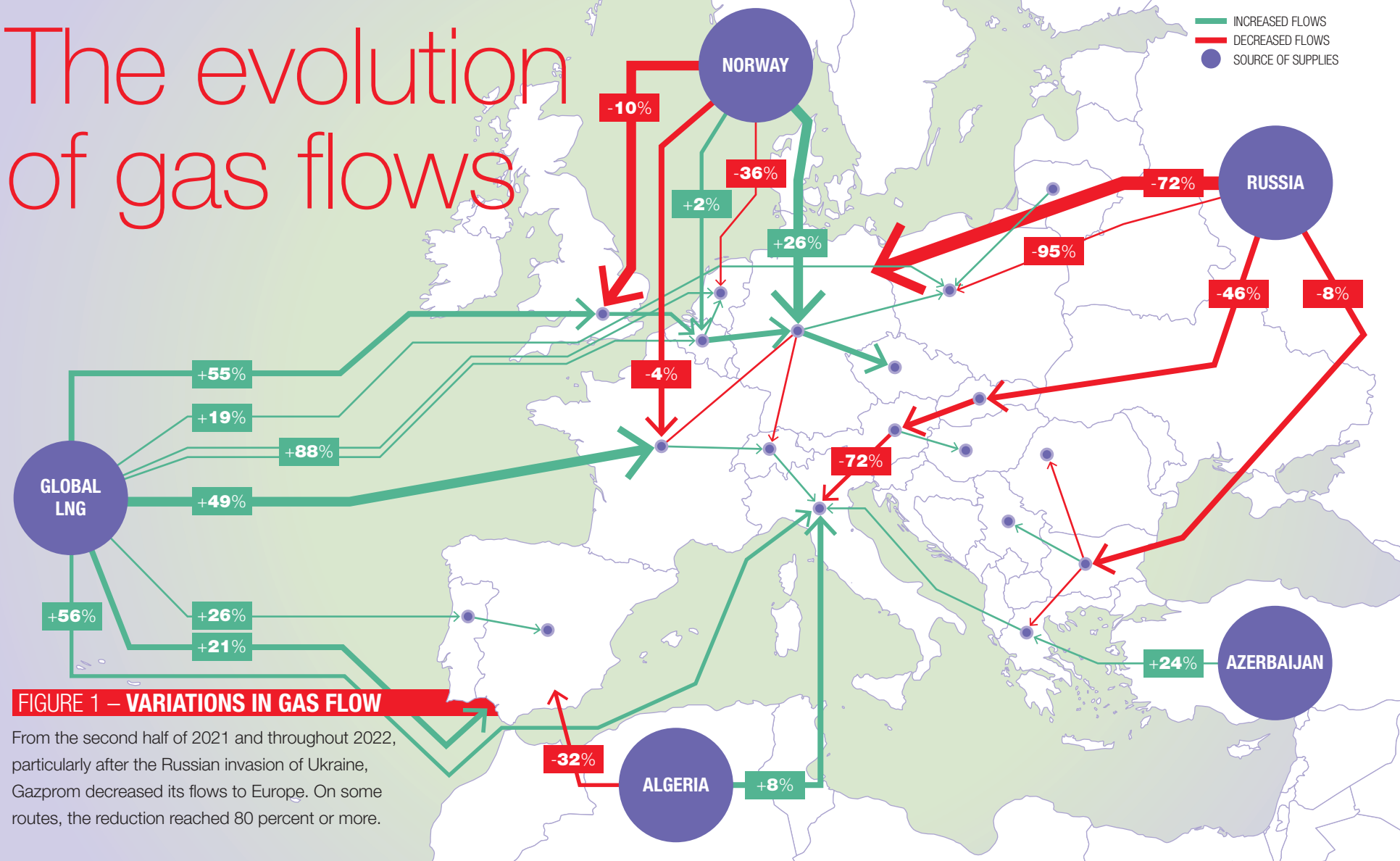
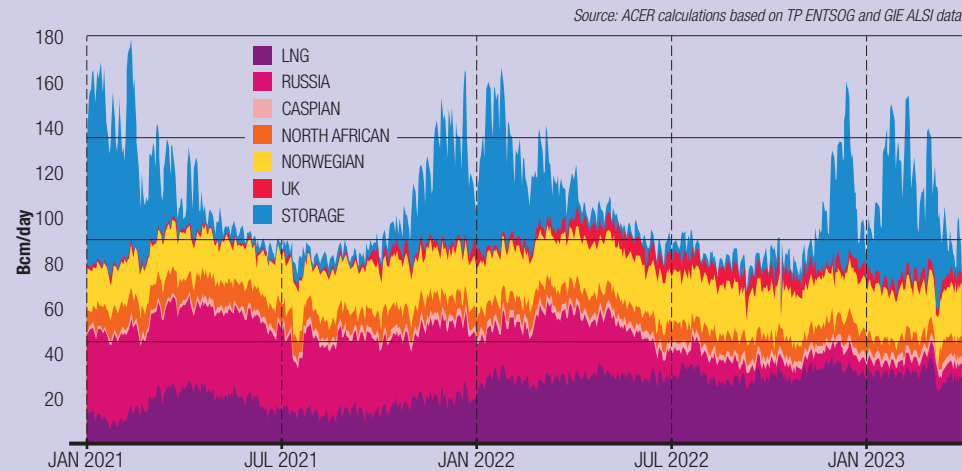
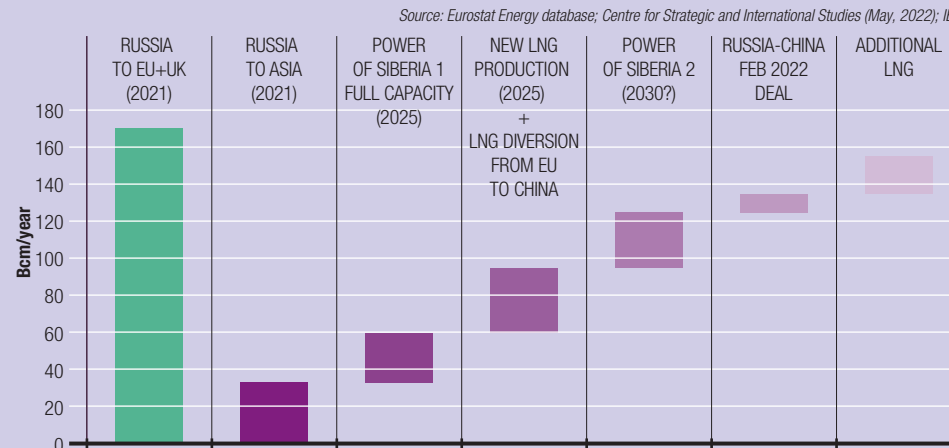


FIGURE 2 – DAILY TRENDS IN IMPORTS



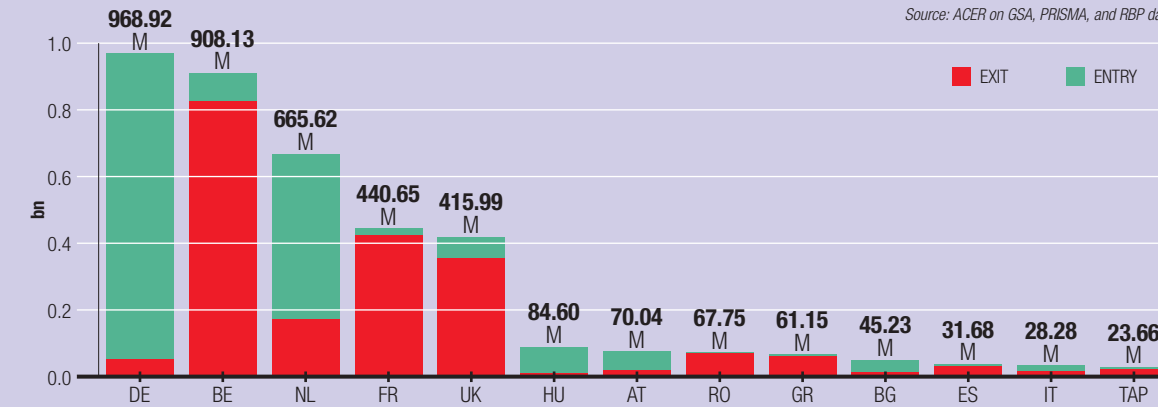
In 2022, EU LNG imports increased by 75 percent year-on-year. US LNG and Norwegian pipelines have become the main source of gas for the EU. In contrast, Russian gas went from covering more than 40 percent of supplies to Europe in January 2021 to supplying less than 10 percent in March 2023.

FIGURE 3 – RUSSIAN EXPORTS: ASIA VS EU + UNITED KINGDOM



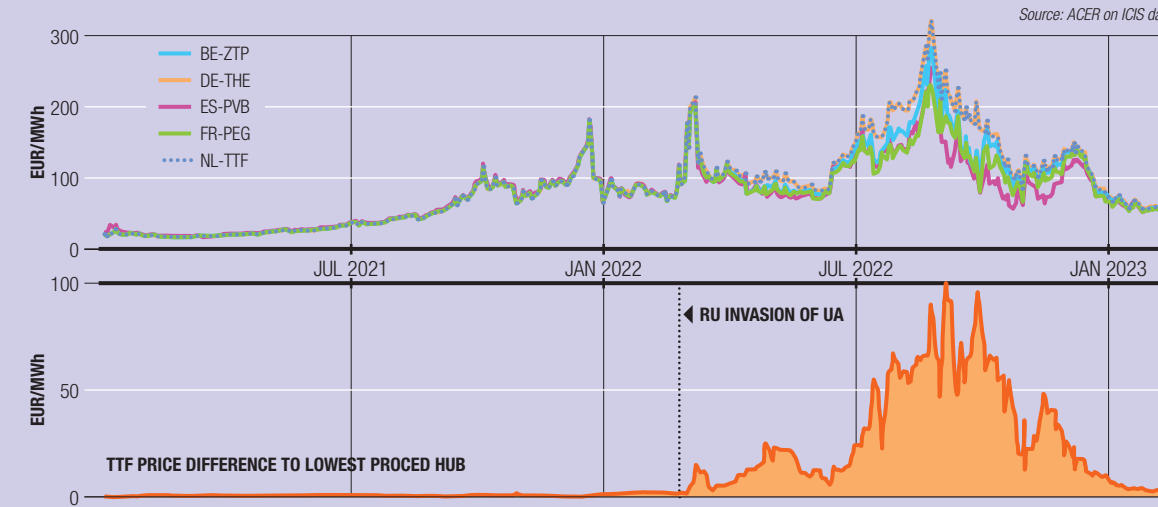
It is not easy for Russia to divert gas supplies that previously reached Europe via pipeline to other routes and destinations. The volumes that have been diverted to Asia (and may be delivered via pipeline in the next few years) are very small compared to those typically sent to Europe.

FIGURE 4 – CONGESTION REVENUES (EUR)



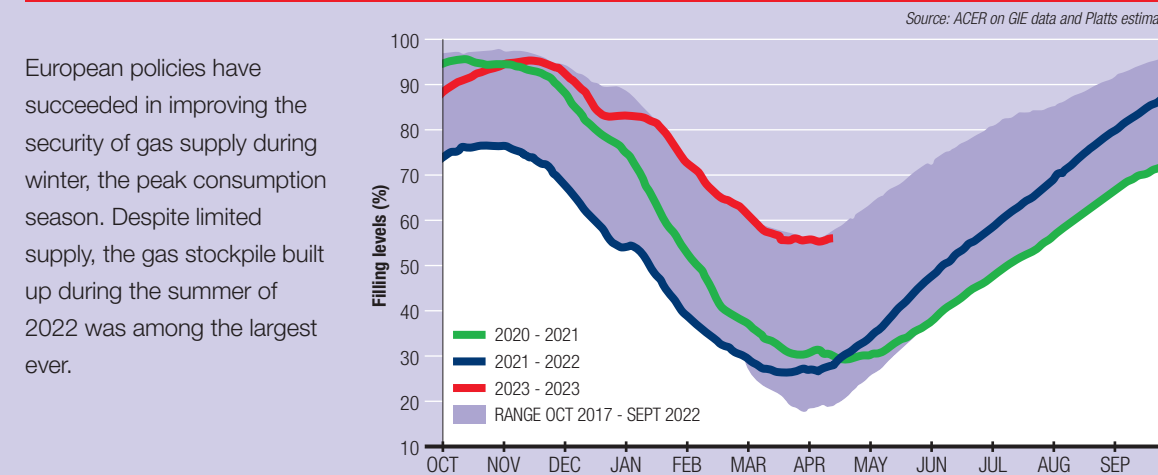
In 2022, congestion revenues increased significantly. These revenues clearly showed where and in which direction congestion was most concentrated: the most congested entry points were in Germany and the Netherlands, while the most congested exit points were in Belgium and France.

FIGURE 5 – PRICE DIFFERENCES



The first graph shows the daily evolution of day-ahead prices traded in the five listed hubs, while the second graph shows the daily price differential between the Dutch hub TTF and the hub with the lowest price among the other four. The Russian gas supply shock has affected some EU markets much more than others, disrupting the strong convergence between hub prices observed in the past.

FIGURE 6 – GAS STORAGE LEVELS IN THE EU



European policies have succeeded in improving the security of gas supply during winter, the peak consumption season. Despite limited supply, the gas stockpile built up during the summer of 2022 was among the largest ever.

high as 80 percent or more on particular routes, with Gazprom currently delivering pipeline gas mainly via Turkstream and the Ukrainian corridor (figure 1). Since such flow reductions constitute prima facie a breach of Gazprom's contractual supply obligations, Gazprom justified these cutbacks by claiming that they were carried out in the context of new regulations established by the Russian government, for instance, the requirement to pay for gas exports in roubles. Apart from such "contractual" supply curtailments, the unexplained explosions on the Nord Stream pipelines in September 2022 rendered inoperative three of the four Nord Stream strings, thus diminishing the possibilities for physical Russian gas pipeline supplies to Europe as well.

While ENTISOG had modeled Russian gas supply disruptions for years as part of its standard risk analysis, such disruption scenarios were typically limited to one major supply route at a time and for a limited duration (up to two months). What happened in 2022 was not only unprecedented but largely unforeseen. With Europe unprepared, there was much uncertainty about whether the European gas market would be able to navigate the crisis and continue to supply gas across the continent without interruption. A few factors explain its success, the most important of which are: new LNG supplies, price-induced demand reduction, and a well-established, flexible system of gas transportation capacity allocation. Furthermore, the Gas Storage Regulation, requiring the mandatory filling of gas storage facilities, played a significant role.

First, LNG: EU LNG imports rose 75 percent year-on-year in 2022, mainly from the US. Together with Norwegian pipeline supply, it has become the biggest source of gas for the EU. Conversely, Russian gas declined from more than 40 percent of European supplies in January 2021 to less than 10 percent in March 2023 (figure 2).

Next, significant gas demand reductions, including through changed consumer behavior, played a key role in balancing supply and demand. Driven by extremely high prices, EU gas demand fell by 55 bcm in 2022, a 13 percent year-on-year drop. Mild winter weather contributed to lower heating needs. The highest contributions came from industry (-26 percent year-on-year), part of it in the form of demand destruction (meaning a reduction of industrial production due to the extremely high gas prices). The power sector contributions varied per Member State, driven by the need to increase gas use for power generation – despite its high price – in countries where nuclear or hydro faced severe limitations.

Finally, thanks to a well-established and flexible system of standard transportation capacity products, it was possible to react at short notice to the need to reroute gas supply flows. In this system, gas capacity products varying in duration from yearly all the way down to daily and within-day are offered through auctions on capacity booking platforms. This means that in

case of shortage, the capacity will be sold to the highest bidder. The system was set up more than a decade ago and is harmonized at EU-level, helping immensely to secure flexible gas flows within the EU.

Russian gas supplies that formerly reached Europe by pipeline could not easily be diverted to another route or destination. For example, while it is possible to send Russian gas by pipeline to China, (a) the volumes pale in comparison to what was traditionally sent to Europe (figure 3) and (b) the gas exported to China is mostly produced at different fields. This means that the gas supply shortage not only affected Europe but also the finely balanced global gas market. Furthermore, this global imbalance in gas supply and demand occurred in a situation of extremely high geopolitical uncertainty. In consequence, gas that could flow in different directions (in particular LNG) ended up flowing to the highest bidder (which in 2022 usually were European buyers). Hence, the gas shortage that Europe was facing was “exported” to other parts of the world, notably countries like Pakistan and Bangladesh, which could not afford to pay such premiums. While some of these flow changes reflect a normal global LNG market response, in other instances, they reflect a willingness of some LNG suppliers to pay the penalty to breach the contractual deliveries to Asian countries, in order to divert those LNG cargoes to Europe in response to its high-prices.

INFRASTRUCTURE BOTTLENECKS

While it was possible, given enough time, to accommodate the new flow patterns to Europe, it was far from easy. The European gas pipeline system was primarily built to flow large quantities of Russian pipeline gas from East to West. The sudden and unforeseen shift in the flow patterns meant that the infrastructure now had to accommodate the opposite: large quantities of LNG landing in the West needed to be transported to consumption centres more in the East. The infrastructure did not always have enough capacity to accommodate such flows, resulting in congestion at specific interconnection points.

Since capacity at interconnection points is sold through auctions, such congestion becomes visible in the form of congestion rents: the additional amount of money paid by shippers, and received by Transmission System Operators (TSOs), as a result of auction premiums. These congestion revenues rose sharply to EUR 3.4 billion in 2022, compared to EUR 55 million in 2021. Furthermore, the congestion rents also showed clearly where most congestion was located, and in which direction: the most congested entry points were in Germany and the Netherlands, while the most congested exit points were in Belgium and France. In other words, shippers were trying to flow gas from Member States that are well-connected to the global LNG market (e.g., France and Belgium) to Member States with much more limited access to LNG (e.g., Germany and the Netherlands) (figure 4).



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Furthermore, investments in new LNG receiving terminals located ‘behind’ the congested interconnection points not only increased security of supply but also helped address congestion. This is exactly what the new LNG terminals in the Netherlands and Germany have done.

At an operational level, the congestion also revealed itself in the utilization rates of the congested interconnection points, which were often close to 100 percent, and sometimes even higher. This required TSOs to take operational measures to maximize the offer of transmission capacity, for instance through increased compression power or through offering interruptible capacities.

PRICES REACTED TO, AND STEERED, FLOW DEVELOPMENTS

For years, locational hub price spreads in the European gas market were seen as low, with their upper limit commonly set by the price of short-term transportation capacity. As a result, on most days, the spot gas price differences between interconnected markets were lower than this limit. This was especially

where the supply shortfall and the demand to replenish storages were highest. Since the end of 2022, price spreads between hubs have returned to pre-war levels.

GAS STORAGE STAYED HIGH THIS WINTER BUT CAME AT A PRICE

European gas storage reserves, or lack thereof, have been one of the crucial factors in determining price outcomes throughout the energy crisis. The Russian invasion of Ukraine elicited a strong policy response both at EU and Member State level aimed at ensuring sufficient gas storage levels come winter. These policies proved highly effective in achieving the objective of improving security of gas supply during winter, the peak consumption season. The gas stock build over the gas summer 2022 was one of the highest on record, despite limited supply (figure 6).

However, in contrast to the effectiveness, questions around the efficiency of the measures as well as their potential role in driving gas spot and futures prices remain to be fully investigated. What is beyond question is that the cost of the gas in storage build was several orders of magnitude higher than any that came before, especially when assessed on a mark-to-spot-market basis.

THE SUCCESS OF THE EUROPEAN MARKET

The European gas market found itself at the centre of a global energy crisis in 2022. Russian attempts, in the wake of its invasion of Ukraine, to use its “gas weapon” against Europe have backfired: while 2022 was tough in terms of extremely high energy prices, Europe navigated the crisis without supply interruptions. Thanks to new LNG supplies, demand side response, policy interventions and a robust and flexible infrastructure system it has weathered the storm. As of early June 2023, wholesale gas prices have come down to below 25 EUR/MWh, reaching levels similar to autumn 2021. In the meantime, the Russian gas supply share to Europe has shrunk to less than 10 percent, meaning that Russia not only has significantly less influence on Europe’s energy market, but also significantly lower gas export earnings. A well-integrated, open and competitive European energy market goes a long way.

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Last year, the European gas market found itself at the center of a global energy crisis, but Europe managed to deal with it without disruptions in supply.

In early June 2023, wholesale gas prices fell below 25 euro per megawatt hour, reaching levels similar to those in the fall of 2021.

THE EU RESPONSE

by Brahim Maarad



SUPPLIER DIVERSIFICATION, ENERGY SAVING, JOINT PURCHASING. THIS IS HOW EUROPE SUCCESSFULLY COMPENSATED FOR THE COLLAPSE IN RUSSIAN GAS SUPPLIES. “WE DID NOT GIVE IN TO THIS BLACKMAIL. WE MADE IT,” SAID THE PRESIDENT OF THE EUROPEAN COMMISSION

BEFORE THE RUSSIAN INVASION of Ukraine, the European Union imported more than 40 percent of its gas from Russia. A year later, that share has plummeted to below 9 percent. This is the result of the strategy of supply diversification, consumption saving, and joint purchasing.

“Russia has cut 80 percent of its pipeline gas supplies, but Europe has been able to compensate all that,” said European Commission President Ursula von der Leyen in a recent speech to the European Parliament. “We have diversified towards our trusted partners, like for example Norway and the United States,” she continued. “We have increased the savings. And it is good, we achieved in September a reduction of 15 percent. We filled our storages up to 92 percent... And I think we can be proud of that. We resisted.”

OLD AND NEW SUPPLIERS

Friends are the suppliers —new and old— that stepped in to compensate for the methane that was no longer arriving from

Russian pipelines. Moscow cut 80 percent of its supply, totaling one hundred billion cubic meters. In response, Norway increased its European production from 78 billion cubic meters (bcm) to 90 bcm; Azerbaijan signed an agreement to increase supplies from 8 bcm to 20 bcm in a few years, and to 12 billion in the first year. The United States increased LNG by ship to European ports by 15 billion cubic meters, bringing the total to 56 bcm, more than twice as much as in the whole of 2021 (22 bcm).

More than a quarter of the gas bought by the EU is LNG, mainly from the United States, Qatar and Nigeria. Algeria, for its part, increased its share of supplies to 12 percent, totaling 44 bcm (nearly half of its total production).

The European Commission has signed a Green Alliance with Norway to cooperate even more closely on renewable energy—particularly offshore wind—and critical raw materials. This guarantees that Norway will maintain its “high level of supply” of gas to the EU in the years to come.

The EU signed a memorandum of understanding last July with Azerbaijan for the expansion of the Southern Gas Corridor. The goal is to increase its capacity from the current 8 billion cubic meters per year to 20 billion in a few years. The agreement also aims at solid cooperation on offshore wind and green hydrogen. As the West repositions itself to counter the Russian threat, the transatlantic energy alliance with the United States is growing stronger. In a joint statement signed by President von der Leyen and the US President Joe Biden at the end of their bilateral meeting at the White House last March, the two sides reconfirmed their “commitment to Europe’s energy security and to accelerating the global transition to clean energy,” adding that “energy security and sustainability for the EU and Ukraine are essential for peace, freedom and democracy in Europe. The EU has confirmed its objective to reach independence from Russian gas well before the end of the decade while working to ensure reliable, affordable, and clean energy supplies to citizens and businesses in the EU and its neighborhood. The United States

intends to partner with the EU on these efforts. We understand that the rapid transition to clean energy is essential to advancing EU independence from Russian fossil fuels and are committed to meeting the goals of the Paris Agreement, the objective of net zero emissions by 2050, and keeping a 1.5-degrees Celsius limit on temperature rise within reach. In line with this vision, the European Commission and the United States will establish a joint Task Force to address the immediate energy security needs of the EU and accelerate the clean energy transition,” the two leaders concluded.

THE PRICE CHALLENGE

During 2022, as the energy crisis worsened, the EU became keenly aware that the challenge is not only the availability of gas but also its price. “The message must not get through that we are willing to buy gas at any cost,” the EU made clear. And that is also why they pushed for the joint procurement mechanism, to “give weight to the market power of the 27.”



“So with a joint procurement mechanism and with a joint outreach to supplying countries. This way, we can secure the energy imports we need without the competition between our Member States – that is something we do not need,” President von der Leyen pointed out.

On April 25, the Commission launched the AggregateEU mechanism for joint gas purchasing. Member states have committed to participate in demand aggregation for at least 15 percent of their national gas storage targets of about 13.5 billion cubic meters per year. Just over 100 companies have subscribed to the joint purchasing mechanism, and 77 have submitted applications already at the first tender for a total of 11.6 bcm of gas: 2.7 bcm of LNG and 8.9 for pipeline methane. By the end of the auction, 25 suppliers had made offers totaling more than 13.4 billion cubic meters (20 percent for LNG and 80 percent from pipeline).

To bring its weight to bear on the market, the European Union introduced a new benchmark against the speculative pressures that had caused the Amsterdam TTF (Title Transfer Facility) to skyrocket in the summer of last year. This benchmark refers to the LNG that the EU is increasingly banking on to compensate for the gas that is no longer arriving through pipelines from Russia. The introduction of the new parameter, provided for in an EU regulation introduced last year to address the high energy prices, means that LNG will be assigned a value using a more transparent method in order to shield companies and consumers from unjustified price variations. The new daily benchmark will take as its reference several indicators, such as the price of LNG “delivered ex-ship” (DES) and the prices of Dutch TTF futures.

Diversification, though essential, is not enough. Supply cannot be controlled, but demand can. That is why the EU Council, at the proposal of the Commission, used emergency instruments to approve a voluntary 15 percent reduction in gas demand.

SAVING ENERGY

President Von Der Leyen sees the challenge clearly. “If in the European Union, over a year, we decrease the average heating temperature by only 2 degrees Celsius,” she recently said, “this is the equivalent of the whole supply of Nord Stream 1 – only 2 degrees Celsius. And this shows the power of energy savings and energy efficiency.”



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In 2022, member states indeed saved nearly 20 percent of consumption, though not without difficulty. The success of the measure led to the extension of the target to 2023. The regulation retains the possibility for the Council to declare an “EU state of alert” for security of supply. If invoked, the reduction in gas demand would turn from voluntary to mandatory.

The goal is to reduce natural gas consumption by 15 percent between April 1, 2023, and March 31, 2024, compared to their average consumption during the period April 1, 2017 and March 31, 2022. Member states can choose the measures they rely on to achieve the target, according to each member’s own energy mix.

And, to limit speculation and fluctuations in the price of methane, in February, the difficult price cap was introduced after months of negotiation among EU states. This market correction mechanism is automatically triggered when the price of one-month Title Transfer Facility derivatives exceeds 180 EUR/MWh for three working days and is EUR 35 higher than a reference LNG price in world markets for the same period of three working days.

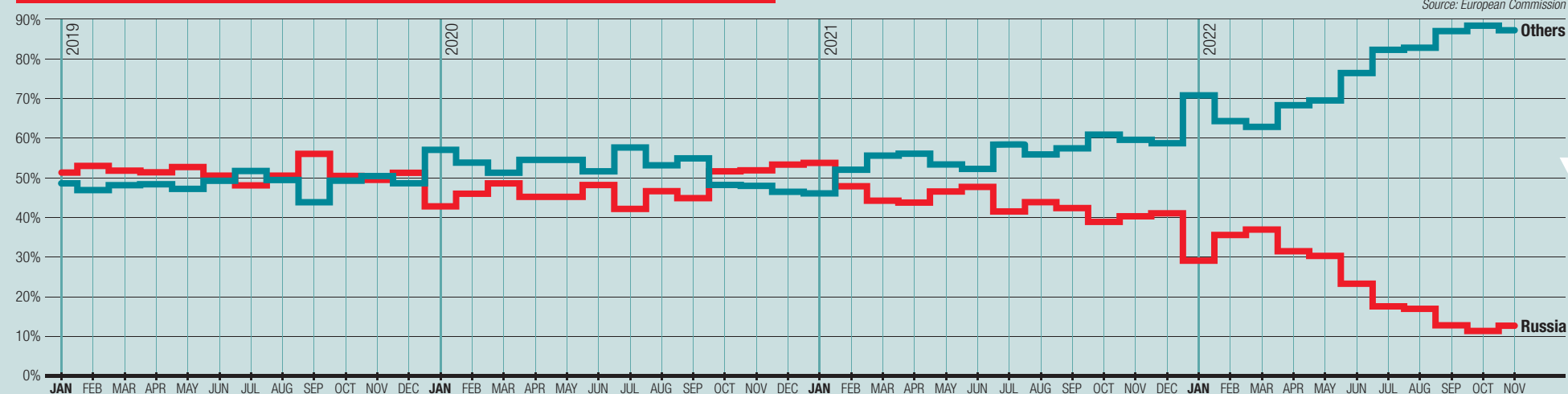
EUR 180 is the trigger price for the mechanism; the actual cap is dynamic. It is calculated as EUR 35 above the average LNG price: so the base case is EUR 145 plus 35. But if LNG is over EUR 145, say EUR 170 (with the TTF at EUR 250 per megawatt hour, for example), the cap will be at EUR 205 (170+35). However, even if LNG falls below EUR 145, the cap will still

remain at EUR 180. This is to maintain the attractiveness of the European market and protect supplies. Once activated, the mechanism will be applied for at least 20 days. If the dynamic threshold falls below EUR 180, it will be automatically deactivated. It can also be automatically deactivated at any time if the European Commission declares a European or regional emergency. An additional safeguard is provided: the mechanism is deactivated if gas demand increases by 15 percent in one month or 10 percent in two months, LNG imports decrease significantly, or the volume traded in the TTF falls significantly compared to the same period in the previous year.

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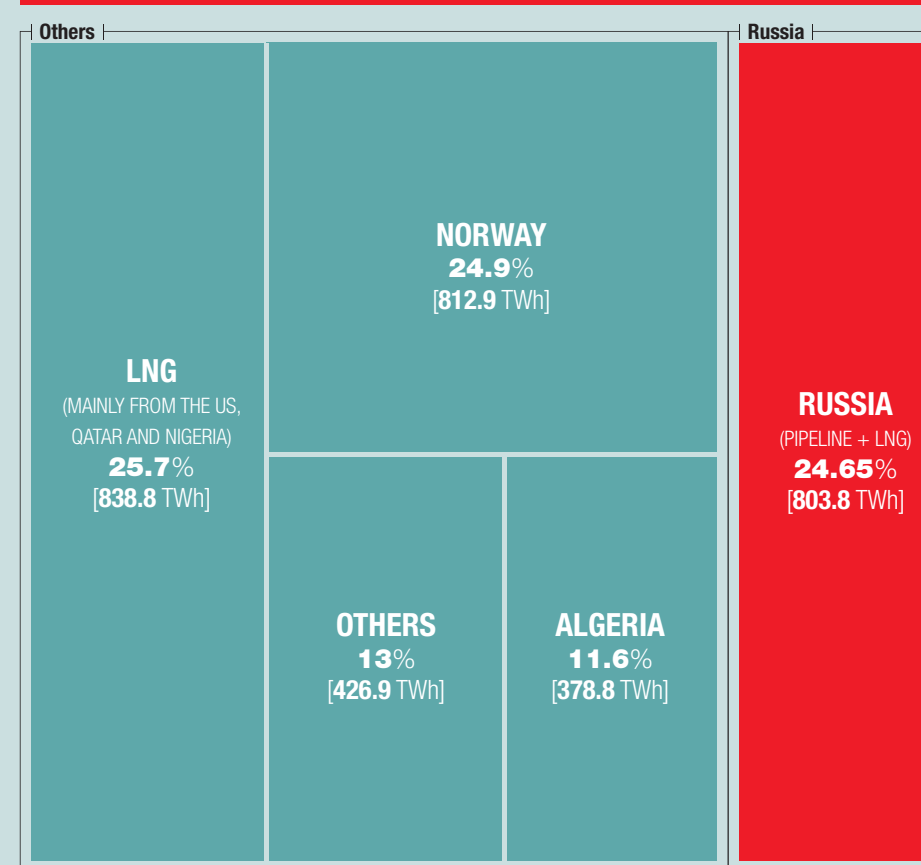
BRAHIM MAARAD
AGI reporter. Brussels correspondent.

EUROPEAN IMPORT DIVERSIFICATION



Monthly share of gas delivered to the EU by Russia and that of other suppliers between January 2019 and November 2022. Russia’s market share was about 50 percent until the second half of 2021. Since then, the share of Russian gas has declined rapidly and the market shares of other countries has grown. This process accelerated in particular in 2022. Since June 2022, Russia’s share of EU gas imports has been less than 20 percent. In November, it was 12.9 percent.

SUPPLIER MARKET SHARES IN 2022



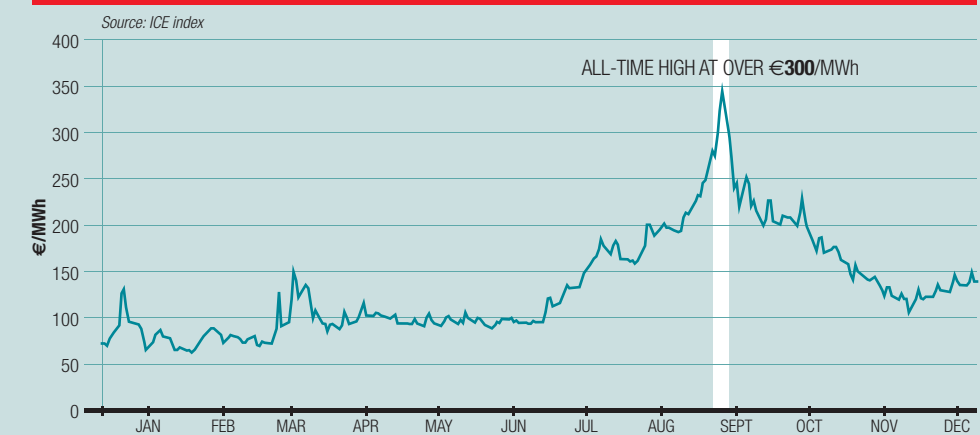
Between January and November 2022, Russia (pipeline + LNG) accounted for less than a quarter of EU gas imports. Another quarter came from Norway and 11.6 percent from Algeria. LNG imports (excluding Russia) came mainly from the United States, Qatar and Nigeria and stood at 25.7 percent.

MONTHLY VOLUMES OF GNL IMPORTS FROM THE US



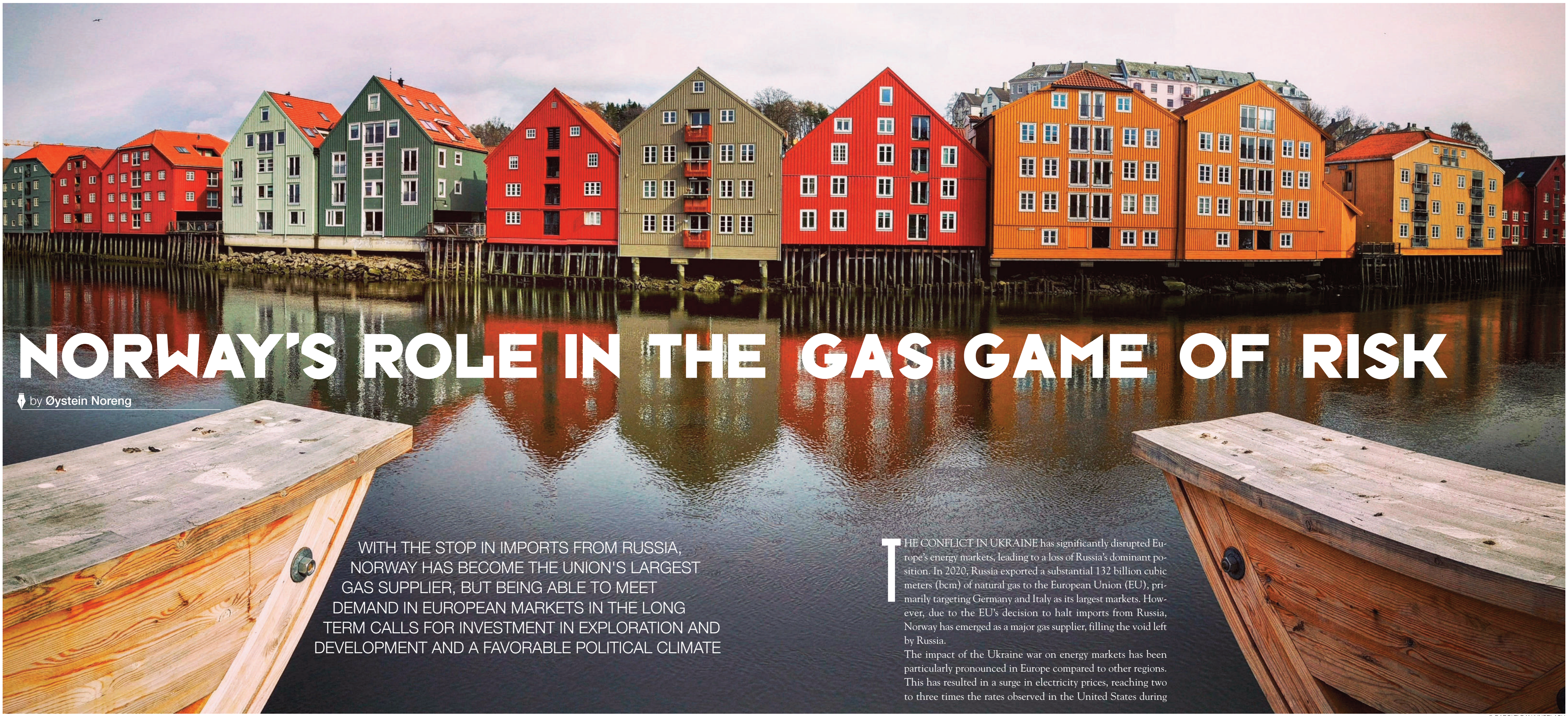
In 2021, EU LNG imports from the United States increased from less than 1 billion cubic meters (bcm) per month in January and February to a peak of more than 3 bcm in April. Between July and December of that year, imports grew from 1.27 bcm to 2.53 bcm. Imports also increased significantly in 2022, starting from about 4 billion cubic meters in January and February and reaching 5.87 bcm in April and 5.37 bcm in June.

THE SURGE IN PRICES



In August 2022, gas prices in the European Union saw an unprecedented spike, with a 1,000% increase over prices in previous decades. Over the past decade, the average gas price has ranged between 5 €/MWh and 35 €/MWh. In August 2022, monthly and daily TTF prices reached an all-time high of over 300 €/MWh.

The European Commission has signed a Green Alliance with Norway to cooperate more closely on renewable energy—particularly offshore wind—and critical raw materials. Wind turbines, Smøla, Norway.



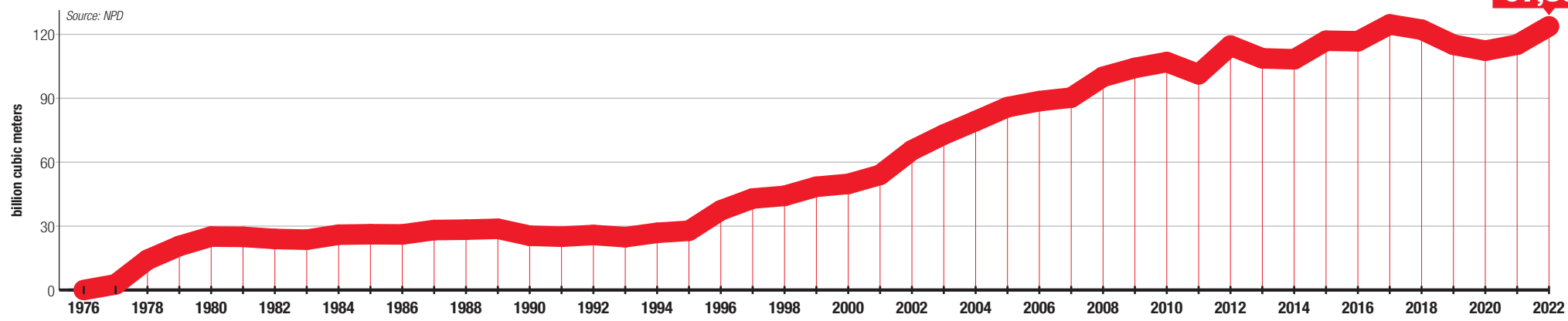
NORWAY'S ROLE IN THE GAS GAME OF RISK

by Øystein Noreng

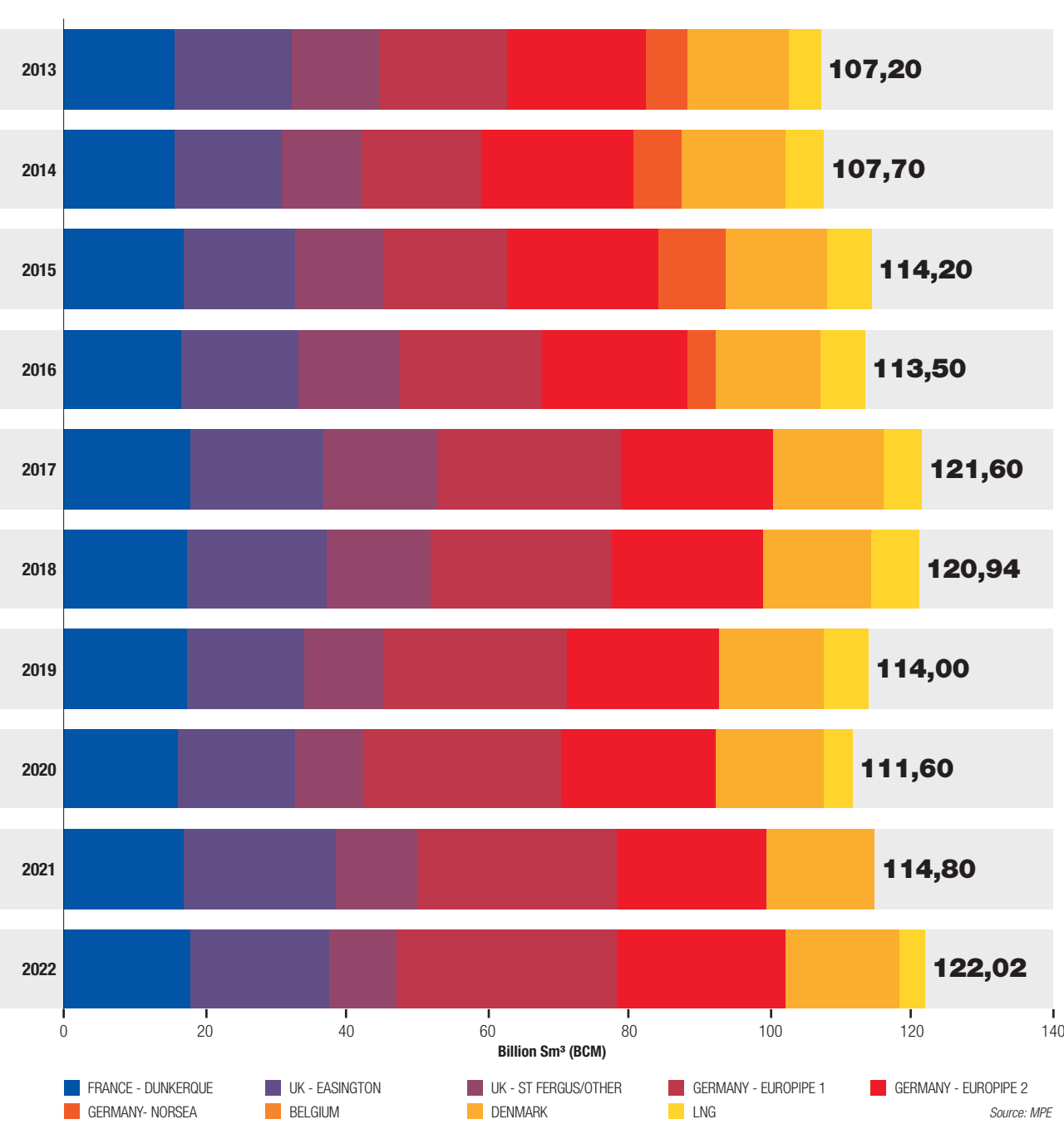
WITH THE STOP IN IMPORTS FROM RUSSIA, NORWAY HAS BECOME THE UNION'S LARGEST GAS SUPPLIER, BUT BEING ABLE TO MEET DEMAND IN EUROPEAN MARKETS IN THE LONG TERM CALLS FOR INVESTMENT IN EXPLORATION AND DEVELOPMENT AND A FAVORABLE POLITICAL CLIMATE

THE CONFLICT IN UKRAINE has significantly disrupted Europe's energy markets, leading to a loss of Russia's dominant position. In 2020, Russia exported a substantial 132 billion cubic meters (bcm) of natural gas to the European Union (EU), primarily targeting Germany and Italy as its largest markets. However, due to the EU's decision to halt imports from Russia, Norway has emerged as a major gas supplier, filling the void left by Russia. The impact of the Ukraine war on energy markets has been particularly pronounced in Europe compared to other regions. This has resulted in a surge in electricity prices, reaching two to three times the rates observed in the United States during

NORWEGIAN NATURAL GAS PRODUCTION 1976-2022



NORWEGIAN NATURAL GAS EXPORTS IN 2013-2022 BY FIRST DELIVERY POINT



the summer of 2022, especially in key countries such as Germany, Italy, and the United Kingdom. Expensive electricity presents a significant economic challenge for Europe. In the absence of Russian gas in the market, the focus now shifts to determining the extent to which Norway can meet Europe's gas supply needs.

NORWAY'S POTENTIAL

Norway currently operates its oil and gas production at nearly maximum capacity. However, there is potential for increasing exploration activities and developing new discoveries over time. To realize this potential, Norway would require a political agreement to accelerate petroleum activities and meet the long-term demand in European markets.

In response to the COVID-19 crisis, the Norwegian parliament, with a substantial majority, approved tax relief measures to prevent setbacks in the oil and gas industry. These measures have effectively safeguarded the supply chains and industrial capacity, resulting in a resurgence of oil and gas investments in 2023.

Maintaining and expanding the capacity of the petroleum industry is crucial, given Norway's vast maritime territory, which spans 2 million square kilometers. To put it into perspective, the Gulf of Mexico covers 1.6 million square kilometers. Approximately half of Norway's territory is estimated to contain sedimentary rocks with potential petroleum deposits. Despite having witnessed approximately 1,200 wildcat wells over nearly sixty years, the Norwegian continental shelf remains a relatively immature oil province. Moreover, the Norwegian part of the North Sea has seen less extensive exploration compared to the UK sector, while the Norwegian Sea and the Barents Sea remain largely unexplored.

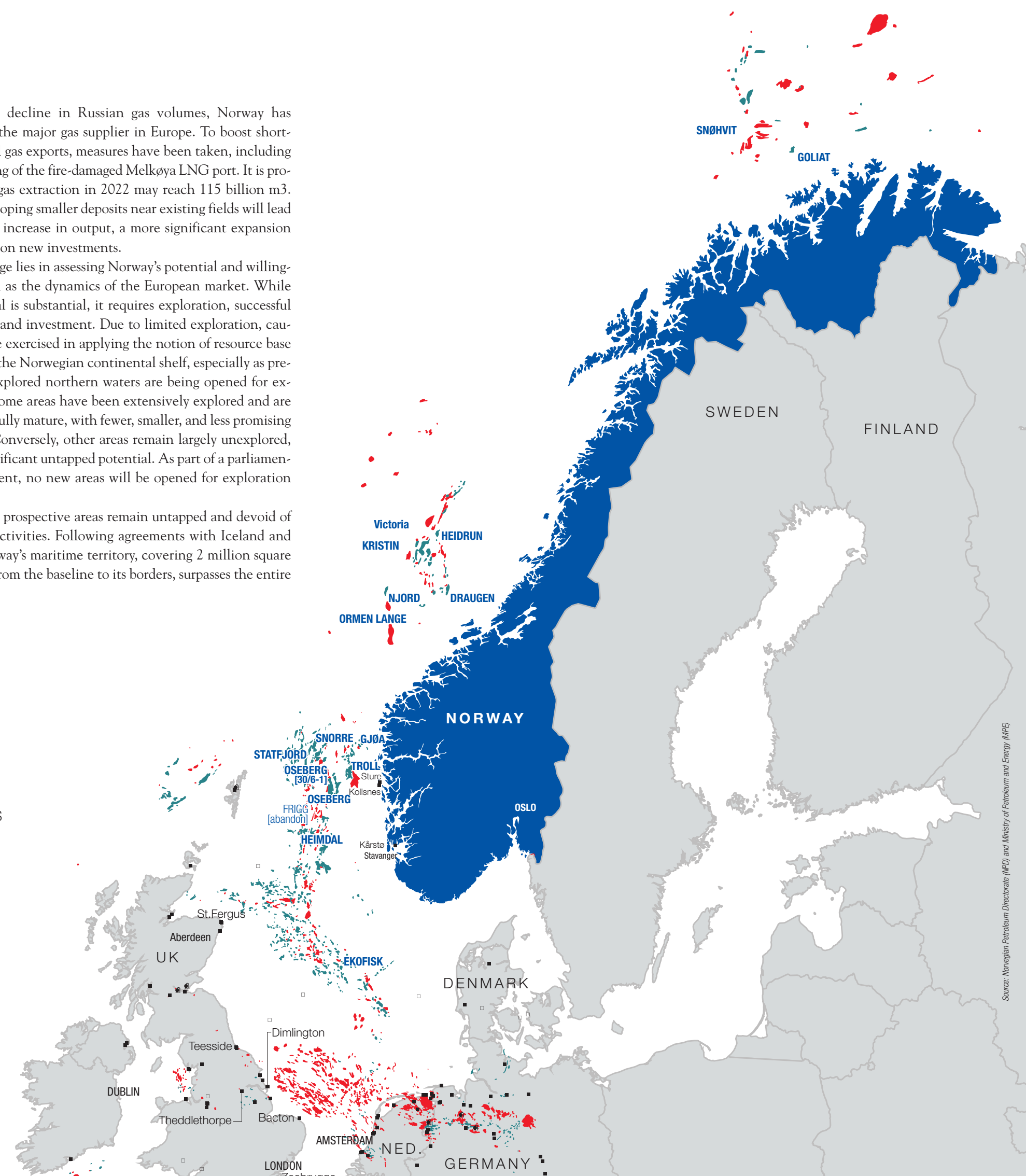
According to government estimates, the remaining volume of oil and gas resources in Norway is comparable to what has been extracted since 1970. This indicates that Norway could continue to be a significant exporter of oil and gas for several more generations. However, the key consideration lies in the market's demand and dynamics.

Amidst the decline in Russian gas volumes, Norway has emerged as the major gas supplier in Europe. To boost short-term natural gas exports, measures have been taken, including the reopening of the fire-damaged Melkøya LNG port. It is projected that gas extraction in 2022 may reach 115 billion m3. While developing smaller deposits near existing fields will lead to a modest increase in output, a more significant expansion will depend on new investments.

The challenge lies in assessing Norway's potential and willingness, as well as the dynamics of the European market. While the potential is substantial, it requires exploration, successful discoveries, and investment. Due to limited exploration, caution must be exercised in applying the notion of resource base maturity to the Norwegian continental shelf, especially as previously unexplored northern waters are being opened for exploration. Some areas have been extensively explored and are considered fully mature, with fewer, smaller, and less promising prospects. Conversely, other areas remain largely unexplored, offering significant untapped potential. As part of a parliamentary agreement, no new areas will be opened for exploration until 2026.

Indeed, vast prospective areas remain untapped and devoid of petroleum activities. Following agreements with Iceland and Russia, Norway's maritime territory, covering 2 million square kilometers from the baseline to its borders, surpasses the entire

OIL FIELDS
GAS FIELDS



Gulf of Mexico, which spans 1.6 million square kilometers. According to estimates by the Norwegian Petroleum Directorate, approximately half of this area, equivalent to one million square kilometers, contains rocks with petroleum potential. Most of this expanse remains unexplored, referred to as fallow acreage. Additionally, roughly 600,000 square kilometers, more than half of the opened territory, have yet to be fully explored. Unopened areas include portions of the Barents Sea, coastal regions of the Norwegian Sea, territories surrounding Jan Mayen, offshore territories of the Lofoten and Vesterålen islands, and the majority of Skagerrak, the sea connecting Norway with Denmark and Sweden.

Since 1965, approximately half of the prospective acreage in Norway has been licensed, but a significant portion has been relinquished to the government. Exploratory drilling has been conducted on blocks representing a small fraction of the potential territory, covering less than 50,000 square kilometers. Notably, Norway has achieved a historical cumulative finding rate of 43 percent, surpassing the 23 percent rate observed on the UK continental shelf. Despite fewer drilling activities, Norway has discovered more resources compared to the UK.

The Norwegian part of the North Sea, located in the southernmost region of the continental shelf, has been relatively underexplored compared to its neighboring UK counterpart, but has yielded more discoveries. The Norwegian Sea, situated in the middle section, exhibits indications of oil and natural gas potential comparable to that of the Gulf of Mexico, albeit with significantly less exploration. However, technical challenges and higher costs, partly due to a basalt layer, pose substantial obstacles. The Barents Sea, located in the northernmost part, showcases promising geology with recent oil and natural gas finds. Geologically, it is a composite area, with the eastern slice sharing structures with adjacent Russian maritime regions, holding a higher potential for natural gas. On the other hand, the western slice shares structures with other Norwegian areas, indicating a higher potential for oil.

The petroleum resource potential of the Barents Sea remains uncertain, primarily due to its distinct geological formation, differing from the southern parts of the Norwegian continental shelf. While some portions of the Barents Sea have undergone seismic studies and exploration drilling, a large portion of the area lacks up-to-date seismic surveys and exploration activities. The regional geology is characterized by substantial structures that theoretically possess oil and gas potential. However, in practice, tracing oil and natural gas resources has proven challenging, as migration may have occurred.

Optimistic assessments suggest that Norwegian oil and natural gas production will increase until the 2030s, surpassing the previous peak observed in 2000. Conversely, pessimistic assessments indicate that combined oil and natural gas output will remain at current levels until 2039, followed by a decline.



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These projections primarily consider the potential yields from the Barents Sea, including the formerly disputed area and the northern waters. However, unexpected discoveries in the mature North Sea or less mature Norwegian Sea cannot be completely ruled out. As of spring 2023, several smaller prospects were under consideration for development, primarily as satellites to existing fields.

RUSSIA AND NORWAY'S HISTORIC DUOPOLY

The North-West European gas market is primarily dominated by a duopoly consisting of Russia and Norway, each with its own distinct terms of supply. Russia possesses the largest proven gas reserves and potentially lower costs. The relationship between the two has been characterized by both competition and reciprocity. Historically, Norway and Russia, through the development of new pipelines and increased volumes, have been key drivers of the gas market. However, they have also taken into account each other's interests and the desire of German buyers to diversify their risks and purchases. Price competition has been tempered by strategic considerations and agreements with buyers. For a long time, Russia seemed to understand that it should not aim to monopolize the entire market, while Norway appeared content with a lower market share within a stable and predictable gas market, where Russia served as a stabilizing factor. However, since February 23, 2022, this dynamic has

changed, as Putin's war in Ukraine no longer aligns with Russia's gas interests.

Norwegian gas supplies the United Kingdom and continental Northwestern Europe, and the infrastructure is now in place for Norwegian gas to enter the markets of Poland and the Baltic states, posing a challenge to Russian gas. Depending on resources and market conditions, Barents Sea gas could be transported via pipeline to the coast of Northern Norway, passing through Finland and connecting with the Baltic networks and Poland. Short-term measures to increase natural gas exports include the reopening of the fire-damaged Melkøya LNG port. It is projected that gas extraction in 2022 may have reached 115 billion m³. Developing smaller deposits adjacent to existing fields will lead to a marginal increase in output, but a more significant expansion will depend on new investments. Exploration efforts will intensify, and infrastructure will be developed, potentially including new LNG facilities. However, these endeavors will come at a cost and require several years to materialize. Once again, the key uncertainties lie in the market dynamics and the state of relations between Europe and Russia. A sustainable increase in Norwegian gas volumes will likely take at least 5 to 7 years, depending on market conditions, company interests, and Norwegian politics—three factors that introduce a level of uncertainty.

In Norway, environmental advocacy groups oppose any expansion of oil and gas activities. Although they are a minority, they

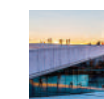
hold considerable influence in the fragmented political landscape, which often relies on coalition governments. Economic concerns also play a role in the debate. Norway's sovereign wealth fund, which is well-balanced and valued at about three times the gross domestic product (GDP), diminishes the financial imperative for expanding oil and gas production. Instead, the risks of overinvestment and falling oil and gas prices argue for caution. Moreover, even with the sovereign wealth fund serving as a buffer against abrupt cash flow changes, fears of economic overheating and reliance on a single industry are arguments against a rapid expansion of the oil and gas sector. Additionally, concerns regarding industrial accidents, pollution, fishing, and environmental damage are valid considerations. The fundamental question revolves around Europe's actual demand and willingness to embrace Norwegian gas, as well as the duration and quantity of such demand, and the price expectations attached to it. Until 2022, a significant objective of the European Union (EU) and the United Kingdom's (UK) energy policies has been to phase out natural gas by 2050. This objective has created disincentives for Norway and other countries to explore and invest in oil and gas ventures. However, it remains to be seen if there has been a shift in this stance. From Norway's perspective, 2050 represents a relatively short time horizon for the revival of an industry that has been deemed close to obsolescence. The key question is the level of risk that the EU and the UK are willing to bear concerning Norway's potential expansion in the oil and gas sector.

One argument could be made that, in the current context, any additional CO₂ emissions from Norway would replace Russian CO₂ emissions. However, the EU's energy policy may face challenges in responding to potential political changes in Russia. Are the EU and the UK, as well as the industry, prepared to adjust their climate targets to facilitate the expansion of the oil and gas industry in Norway? Norway can assist Europe in securing energy supply, but it will take time. Russia's war in Ukraine has altered the economic, climate policy, and security policy conditions for gas trade in Europe and Norway. The critical question is whether the EU and the UK can practically create an environment that encourages long-term investments in energy beyond solar, wind, or nuclear power. The long-term liquefied gas agreement between Germany and Qatar might provide some insight into this matter. Another significant factor is the future trajectory of relations with Russia.

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As a result of declining volumes of gas exported from Russia, Norway has become Europe's largest supplier. Pictured is the Oslo Opera House.

THE OPPORTUNITIES

OF A CRISIS

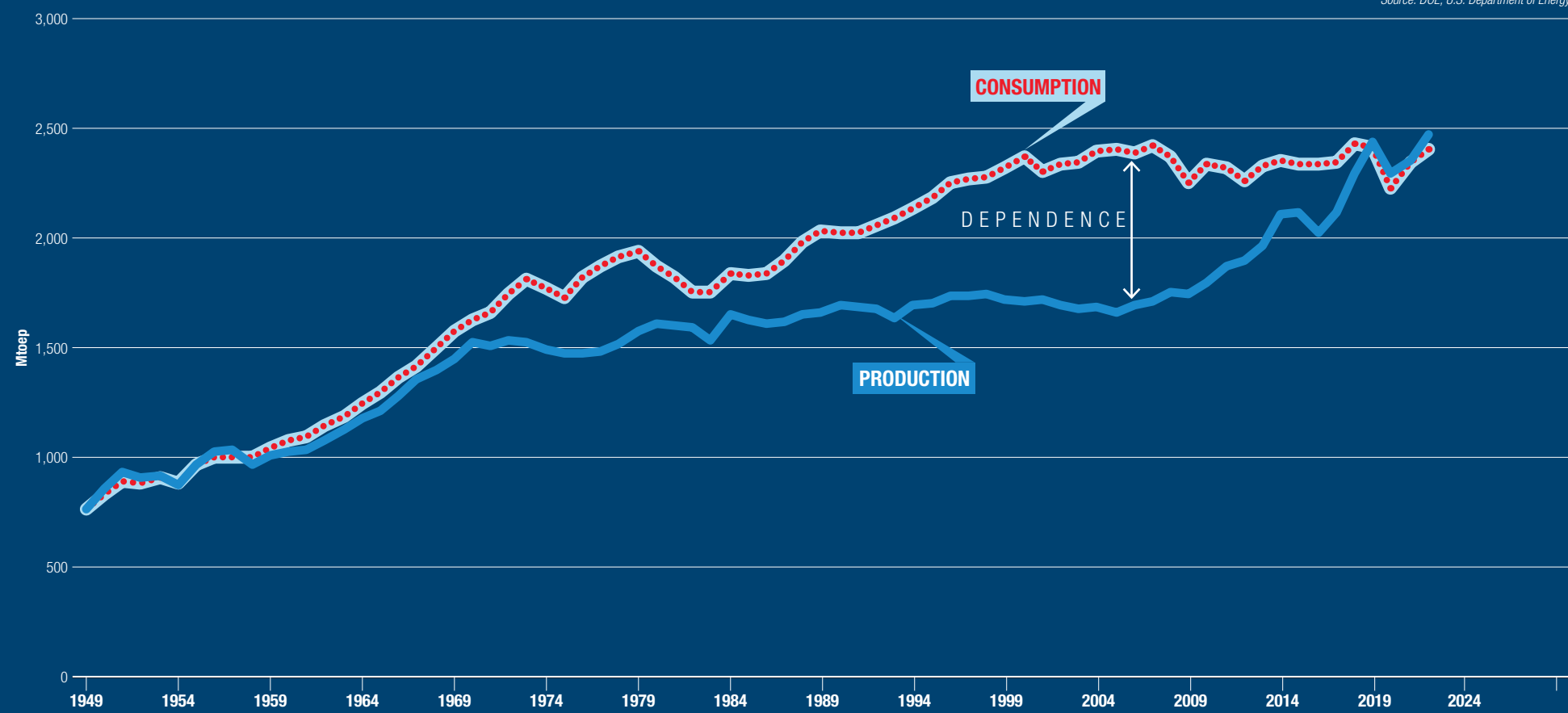
by Davide Tabarelli

THE REDUCTION IN GAS FLOWS FROM RUSSIA HAS ACCELERATED TECHNOLOGICAL INNOVATION IN LIQUID GAS TRANSPORTATION. LNG – ABUNDANT IN THE US – SECURES SUPPLIES AND HELPS REDUCE CO₂ EMISSIONS

CRISES OFTEN GIVE RISE to disruptions and upheavals, which can sometimes serve as a catalyst for innovation. These innovations, however, are not typically groundbreaking, but rather involve accelerated enhancements of existing techniques. In the 1970s, the energy crises led to the exploration of offshore oil production and the exploitation of the North Sea involving both Britain and Norway. The subsequent abundance of gas facilitated its integration into various consumer sectors and spurred the adoption of gas-powered combined cycle plants for energy generation. Moreover, the high oil prices during that time compelled the United States to seek methods for extracting more oil from de-

pleted fields. This led to the implementation of assisted recovery techniques, such as fluid injection to increase underground pressure. Additionally, the development of guided horizontal drilling, combined with assisted recovery methods, set the stage for the emergence of hydraulic fracturing, commonly known as fracking, in the 2000s. This technological breakthrough played a pivotal role in enabling the United States to achieve its long-desired energy independence. Notably, this newfound energy independence has had a significant impact on the European gas market, which has been grappling with the aftermath of the 2022 crisis, by providing a much-needed source of relief.

US ENERGY INDEPENDENCE



The United States achieved energy independence a few years ago, primarily due to the significant increase in production resulting from fracking. This achievement marked the resolution of a major foreign policy issue that had plagued the country since the 1970s.

IT ALL STARTS WITH FRACKING

The advent of fracking marked the beginning of a new era in the global gas industry, particularly in relation to Europe. The region experienced a decline in gas flows from Russia due to the war, while simultaneously witnessing an increase in gas exports from the United States in the form of liquefied natural gas (LNG). This shift in dynamics redefined the gas landscape, which was made possible by the rapid advancement of technology in the transportation of liquid gas.

Traditionally, large facilities were used for gas transportation, but technological innovation allowed for a shift towards smaller, more flexible infrastructure. This involved the utilization of large LNG carriers that transported gas to regasification terminals situated at consumption centers. Recent years have seen a significant innovation in this area, primarily driven by the crisis. Smaller facilities, such as floating ships with liquefaction plants near offshore platform wells or at ports in importing and consuming countries, have gained prominence.

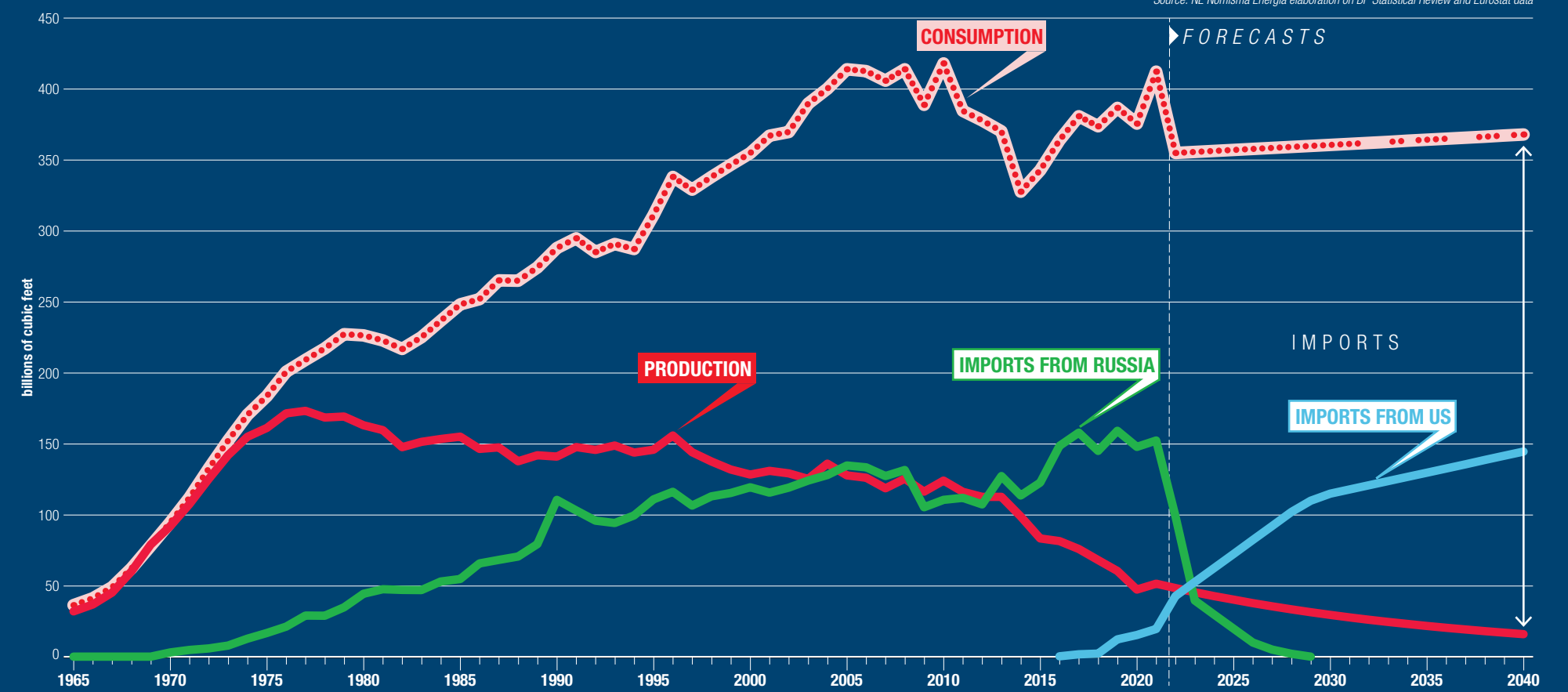
This innovative approach to gas transportation led to the rapid conversion of transport ships into floating storage structures, primarily in consumer countries across Europe. As of mid-2023, two floating storage regasification units (FSRUs) have been constructed in the Netherlands, with three more planned in Germany and one in Italy, to be followed by another in 2024.

These FSRUs offer several advantages, including lower annual transit compared to large onshore regasification plants. They have a capacity of 3-5 billion cubic meters (bcm) per year, in contrast to 8-10 bcm for traditional onshore regasification plants that have been in operation for decades in consumer countries, such as Barcelona in Spain, Teesside in Britain, and Zeebrugge in Belgium.

Italy has faced significant challenges in establishing regasification terminals despite being an ideal country for such facilities due to its high gas imports and extensive coastline spanning over 7,000 kilometers. While an onshore plant was constructed in Panigaglia near the port of La Spezia in 1973 with a capacity of 3 bcm per year, subsequent attempts to build numerous other terminals, such as Montalto di Castro, Monfalcone, Brindisi, Priolo, Ancona, Ravenna, Gioia Tauro, and Porto Empedocle, proved unsuccessful over the years.

However, Italy did manage to construct two regasification terminals at sea, far from the coastline, highlighting the challenges of implementing conventional projects within the country. One such terminal is located off the coast of Livorno and began operations in 2013 with a capacity of 3.5 bcm per year. The other, Adriatic LNG, situated off the coast of the province of Rovigo, is a unique structure—a massive concrete island placed on the seabed that houses the regasification

EU: IMPORT AND PRODUCTION OF GAS



plants. Its capacity was increased from 8 bcm to 9 bcm in 2022. The construction of the Adriatic LNG terminal, costing nearly USD 3 billion, was marred by years of difficulties and local environmental opposition, costing twice as much as an onshore facility would have.

In the past, these terminals seemed almost unnecessary as Italian gas demand continued to decline. However, the gas crisis in 2022 prompted a significant shift in circumstances. Remarkably, Italy managed to construct a regasification terminal in just over a year at the port of Piombino, featuring a Floating Storage Regasification Unit (FSRU) with a capacity of 5 bcm per year. The urgency of the crisis compelled the construction of a terminal in the country where it was most needed, despite not having built a single onshore terminal in the previous five decades. This achievement was made possible by leveraging converted ship technology, with the Golan Tundra FSRU symbolizing how technological innovation and the resolution of the crisis are transforming gas transportation even in challenging countries like Italy.

Similar floating units, known as Floating Liquefied Gas Units (FLGUs), have been deployed off the coast of Congo. These FLGUs, created from ships equipped with liquefaction plants, quickly transport gas extracted from offshore fields to LNG carriers within a year. These solutions were necessary to address

the urgent need for gas in Europe, where a shortage occurred after the crisis, leading to a tenfold increase in prices. The agility and versatility of these smaller, mobile floating units make them suitable for adapting to different locations as needed. In the case of the Piombino terminal, the FSRU will be relocated after a three-year commitment to the current port, with the North Tyrrhenian Sea off the coast of Liguria likely to be its next destination. Without the flexibility of a floating terminal, such displacement would have been impossible.

LNG IS KEY TO OFFSETTING THE DECLINE IN IMPORTS

Just as Italy experienced increased LNG imports to compensate for the decline in Russian imports, the same trend occurred across Europe. Imports of liquefied natural gas (LNG) surged from various sources, including Qatar, Egypt (particularly to Italy), Norway, South America, and, notably, the United States. The technique of hydraulic fracturing, also known as fracking, played a pivotal role in the US doubling its gas production over a span of 20 years since the initial experiments with shale gas. From 2000 to 2023, production rose from 510 billion cubic meters (bcm) to nearly 1,000 bcm, with a substantial portion of gas flowing to Europe from this abundant source. The surplus of gas in the US facilitated one of the most significant global environmental advancements – the reduction of

Prior to the war, in 2021, the European Union relied on Russia for the import of 170 billion cubic meters (bcm) of gas, which accounted for 41 percent of Europe's total gas demand. However, as part of efforts to reduce dependency on Russia, imports from the country are projected to gradually decrease and reach zero by approximately 2027. On the other hand, LNG imports from the United States are expected to continue their upward trajectory. Already in 2022, LNG imports from the US doubled from 22 to 43 bcm.



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This abundance of gas in the US has enabled one of the most important environmental improvements globally—the reduction of the nation’s CO₂ emissions—by substituting coal for gas in power generation. Pictured is Austin, Texas.

CO₂ emissions through the substitution of coal with gas in power generation due to its cost-effectiveness. This emission cut, in addition to the US being responsible for 14 percent of global emissions, holds great significance for the future of gas worldwide. The United States often serves as a harbinger of trends in the global energy industry. Addressing the rising carbon emissions from fossil fuel consumption necessitates concerted efforts, including increased utilization of gas in power generation, particularly in Asia, where coal remains the pri-

mary local resource and electricity demand is projected to surge in the coming decades. Consequently, gas exports to Asia will continue to grow, driven in part by environmental concerns. The United States achieved energy independence some years ago, resolving a long-standing foreign policy issue. This achievement was primarily attributed to increased oil exports, a priority for the US government. Furthermore, the export of LNG, particularly to Europe, contributed to the United States’ dominant position in the international market. This domi-

with gas prices in Europe falling below EUR 30 per megawatt hour in mid-2023, compared to EUR 6 per megawatt hour at Henry Hub. In 2022, the average price for the Title Transfer Facility (TTF) in Europe was EUR 132, whereas in the US, it stood at EUR 22. These disparities are redefining the global geography of gas, favoring the United States due to its low prices, which remain close to production costs, owing to intense competition resulting from innovative fracking technology.

THE END OF THE WAR AND THE MODERNIZATION OF RUSSIA

The gas crisis in Europe during 2022 necessitated a reevaluation of energy supplies, as the region aimed to reduce its dependence on Russia, although only partially successful by mid-2023. Declining domestic gas production within the European Union, notably in countries like the Netherlands and Italy, had led to an increase in imports. Given the geographical proximity and cost advantages, Russia became the primary supplier for Europe. However, the unfolding war and the need to sever ties with Russia altered this dynamic.

In 2021, before the war, the European Union imported 170 billion cubic meters (bcm) of gas from Russia, accounting for 41 percent of Europe’s total gas demand. In 2022, imports declined but did not reach zero, amounting to 100 bcm, which falls short of a complete embargo. Pipeline imports reduced from 155 to 75 bcm, but this decline was compensated by a doubling of liquefied natural gas (LNG) imports to 22 bcm. Once again, the benefits of flexible ship transportation exceeded political proclamations. In 2023, the decline in imports from Russia is expected to be even more pronounced, reaching approximately 50 bcm, gradually diminishing to zero around 2027. Meanwhile, LNG imports from the United States will continue to rise, having already doubled in 2022 from 22 to 43 bcm, with a new record of around 60 bcm anticipated for 2023.

Looking ahead, the long-term goal is to achieve an end to the war, allowing Russia to resume a path of modernization. Gas is viewed as a key element for economic growth, which is crucial for ensuring stability and the eventual development of a Western-style democracy. Russia possesses the largest conventional gas reserves globally, eliminating the need for complex and invasive extraction techniques like fracking. Additionally, Russia heavily relies on gas exports, particularly to its European neighbors, who will continue to need gas for decades to come.

we

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nance, facilitated through LNG, is poised to strengthen further in the coming years with the construction of new liquefaction facilities along the Gulf of Mexico coast. The region already hosts a dozen terminals, some of which are expanding, while others are newly constructed. These terminals receive substantial gas volumes from fracking operations in the US interior, located not far from the Henry Hub, a crucial distribution center setting the world’s most influential prices. Presently, prices at Henry Hub are extraordinarily lower than those in Europe,



Mare nostrum

by Pier Paolo Raimondi

THANKS TO EXISTING INFRASTRUCTURE, GEOGRAPHIC PROXIMITY, AND ABUNDANT GAS RESERVES, THE MEDITERRANEAN IS ONE OF THE MOST PROMISING AREAS FOR EUROPE'S ENERGY SECURITY ARCHITECTURE

GLOBAL GAS MARKETS are undergoing significant transformations in the wake of Russia's invasion of Ukraine. The weaponization of energy supplies as a result of the war has led EU member states to seek alternative energy sources to avoid supply disruptions.

This search for non-Russian gas supplies has triggered a shift in flows both in Europe and globally, influencing the trade of liquefied natural gas (LNG) and piped gas. REPowerUE foresees increased LNG imports from the U.S., Qatar, and Egypt, along with more limited pipeline contributions from countries such as Norway, Azerbaijan, and Algeria. As a result, several gas-producing nations and regions have seen a rise in their political

and energy prominence. The Mediterranean region, in particular, has emerged as one of the most promising areas for Europe's energy security framework, thanks to several key factors: an existing export infrastructure, longstanding political ties, geographic proximity, and abundant gas reserves. With energy security regaining salience, new infrastructure projects connecting the two shores are now in play, including new pipelines and LNG terminals.

Despite the encouraging outlook, each Mediterranean gas-exporting country must tackle and surmount numerous challenges, both short-term and long-term, to bolster its role in European gas markets.

FLOWS FROM NORTH AFRICA AND THE ROLE OF ITALY

Before 2011, Mediterranean countries played a pivotal role in the European gas markets as significant suppliers. For instance, North African countries, fueled by gas pipelines from Libya and particularly Algeria, supplied half of Italy's gas. However, gas flows from Algeria and Libya diminished due to increased domestic demand, falling production, and in some cases, political instability following the "Arab Spring." For example, the political turmoil post-2011 significantly disrupted production and exports in Libya and Egypt. Indeed, Egypt became a net importer for several years (2015-2019) as it couldn't sustain production through exploration activities to meet the rising

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domestic consumption. As a consequence, Russia strengthened its dominant position in the European market, accounting for 40 percent of EU gas imports. During this period, the development of new and alternative infrastructure projects was severely constrained by low gas prices and escalating climate ambitions, thereby intensifying Europe's overdependence on Russian gas. In the aftermath of Russia's invasion of Ukraine, Mediterranean countries have predominantly contributed to Italy's energy security. However, Mediterranean gas-producing countries could potentially increase their exports to Europe – particularly to Central and Eastern Europe – through Italy. Italy is well-positioned to benefit from the overall reshuffling of energy flows to and within Europe due to several factors. Its geographical location positions the country as a potential transit hub and bridge between Mediterranean energy imports and European energy demand. This would put Italy at the forefront of the supply chain.

To realize this objective, Italy would need to improve its gas infrastructure to allow higher volumes to flow from south to north and reach continental markets. Moreover, it will need to overcome numerous challenges and constraints, such as uncertainty regarding future European gas demand, as well as designing future energy relationships and projects that align with European climate goals.

CHALLENGES AND OPPORTUNITIES FOR ALGERIA

Algeria could be one of the most significant beneficiaries of the new energy landscape following Russia's invasion of Ukraine. The North African gas-producing country has enhanced its relationship with one of its key, long-standing energy partners: Italy. Owing to its geographical proximity to European markets, existing interconnections, and substantial gas reserves, Algeria has become integral to Italy's efforts to reduce its reliance on Russian gas. As a result, Italy and Algeria agreed to increase gas volumes by utilizing the spare capacity of the 34 bcm TransMed pipeline, which stood at 13 bcm in 2021. This approach is also cost-effective as it does not require infrastructure investment. In 2022, Algeria regained its position as Italy's primary gas supplier, exporting 23.6 bcm. The new political context has also prompted the Algerian government to reconsider the feasibility of the GALSI gas pipeline to Sardinia, which is expected initially to transport surplus gas and then hydrogen.

These developments underscore two vital aspects related to the Algeria-EU gas relationship. Firstly, Algeria primarily focuses on pipeline exports, sending around 80 percent of its gas to Europe, predominantly to Italy and Spain. Algeria has two LNG terminals with a combined capacity of 38 bcm/y. These facilities have ample underutilized capacity for additional exports without the need for infrastructure investments. However, Algeria's LNG exports dropped to around 13 bcm in



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2022, compared to 17 bcm in 2021, highlighting the challenges the country faces in increasing export volumes. Despite the rising volumes to Italy in 2022, Algeria's overall gas exports declined due to a slump in volumes to Spain and LNG exports. Algeria's exports to Italy soared to a 12-year high in 2022. Nonetheless, amid dwindling pipeline exports to Spain and a drop in LNG exports, leading to a reduction in total gas exports compared to 2021's 11-year high. The decrease in volumes to Spain is attributed to the closure of the GME line via Morocco. In 2022, Algeria exported 9 bcm (up from under 8 bcm in 2021) through the Medgaz pipeline, but total gas volume fell by more than 35 percent in 2022 compared to 2021. Mean-

while, Spain has boosted its LNG imports, accounting for around one-third of EU regasification capacity. Unfortunately, Algeria has not been able to capitalize on this new scenario. Despite having regained its position as Italy's primary gas supplier, Algeria must confront chronic and well-known issues to truly benefit from the current context, both short-term and long-term. Indeed, rising domestic consumption, regulatory constraints that impede investments in exploration and production activities, and environmental issues remain key barriers to increasing Algerian gas exports, as demonstrated by the persistent spare capacity of Algerian export infrastructure. Algeria needs to attract international energy companies to invest in its

upstream sector, which has traditionally been hindered by a restrictive regulatory framework. The development of Algeria's vast shale gas reserves, estimated at 20,000 bcm, could be a game-changer, especially with the potential collaboration of major US oil companies like Chevron and ExxonMobil.

LIBYA AT A TURNING POINT

Libya is another Mediterranean country intricately connected to European gas markets. The North African nation only has one feasible export route – the 12 bcm Greenstream pipeline – as its only LNG terminal in Marsa el-Brega has been inactive since 2011. With the onset of the civil war in 2011, Libya plunged into political and security chaos, heavily impacting its ability to maintain consistent gas exports. Despite its favorable conditions such as underutilized infrastructure, geographical proximity, and vast resources, Libya has been largely overlooked in Europe's diversification strategy. Gas production has seen in steady decline over the past decade, dropping from 17 bcm in 2013 to 14 bcm in 2022. Political instability, coupled with rising domestic demand – primarily in the power sector – has eroded gas export volumes. In 2022, Italy imported only 2.6 bcm from Libya, down from 3.2 bcm in 2021. Without new gas production coming online, Libya will not be able to enhance its significance for Italy and Europe.

A potential breakthrough came in January 2023, with the signing of an \$8 billion deal between Italy and Libya aimed at revitalizing Libya's energy sector. If implemented, this deal would represent a significant leap forward for the country, as it will boost domestic gas production for both the growing domestic market and European markets. However, energy investments, and by extension Libya's exports, are deeply intertwined with the country's political and security context.

THE SOUTH EAST MED

The need to diversify both sources and routes has thrust the Eastern Mediterranean area back into the spotlight, as it could bolster European energy security and provide alternative gas volumes. For over a decade, the Eastern Mediterranean has been marked by high hopes and ambitions concerning the potential transformation of the area into a gas export hub. However, these ambitions have been substantially undermined by economic and geopolitical challenges.

In April 2022, the Italian energy company Eni inked a deal with the Egyptian company EGAS for up to 3 bcm of LNG in 2022 for Italy and Europe. Similarly, in June 2022, the European Commission, Egypt, and Israel signed a trilateral memorandum of understanding aimed at increasing energy imports from these countries to the EU, in particular, to ship Israeli gas via Egypt's LNG export infrastructure. These agreements underline the significance of two players in the region concerning gas exports: Egypt and Israel.



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GROWTH IN EGYPTIAN EXPORTS

Egypt has positioned itself as a cornerstone of East Med gas exports, housing the area's only existing infrastructure facilities for export, namely the Idku LNG terminal with a capacity of 10 bcm and the Damietta terminal with a capacity of 7 bcm. Over the past two years, spurred by record-high gas prices, Egypt has ramped up its exports to Europe. In 2021, Egypt exported 9 bcm, with 80 percent being imported by the EU. This increased to 11.2 bcm by 2022, with 90 percent directed to Europe. Given the elevated gas prices, the country prioritized LNG exports, which in turn led to a rise in oil consumption in the domestic power sector.

In contrast, Israel, despite its significant gas reserves, lacks the infrastructure needed for exporting gas outside the region. However, it has become a crucial component of Egypt's export strategy. Since 2020, Israel has been exporting its gas to Egypt, bolstering the latter's role as a regional gas exporter, as reflected in the trilateral MoU between the Commission, Egypt, and Israel. Israel is dedicated to monetizing its gas reserves and maintaining its position in the regional energy architecture, hence it has plans underway to boost production capacity and explore new export routes.

Despite the region's potential and contributions, the role of East Med gas within the European gas markets is relatively modest in terms of volume when compared to its potential and other suppliers. East Med countries must strategize to enhance old export routes and create new ones. However, the region has been marked by geopolitical tensions, low interconnectivity, and economic challenges that have tempered its ambitions. Despite this, the region witnessed several significant developments in the political and energy realms in 2022, notably the resolution of border disputes (Israel-Lebanon) and new gas discoveries offshore Cyprus. These could have positive implications for the future role of East Med energy resources and export routes.

THE EASTMED PIPELINE CHALLENGE

Potentially, the region could further enhance EU energy security through the proposed EastMed pipeline, despite its complexity in terms of high investment costs, engineering challenges, and geopolitical tensions. Nonetheless, the project would ensure 10 bcm of gas delivered to Europe, securing the diversification of both routes and supplies while also helping to overcome competition with other countries in the LNG

market. To be in compliance with European climate targets and anticipated gas demand, the project could also accommodate the long-term transportation of hydrogen.

The Mediterranean area has played a crucial role in Italy's diversification strategy. It could further aid in securing the European gas market in the future. To achieve this, each producing country needs to address similar domestic challenges, such as rising domestic demand, production constraints, and environmental issues. These challenges are compounded by the uncertainty related to European gas demand in light of its climate targets.

we

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The Mediterranean area is one of the most promising areas for Europe's energy security architecture, as it offers many positive elements, such as existing export infrastructure, long-standing political ties, geographical proximity and abundant gas reserves. Top, Alexandria (Egypt), on the previous page Tripoli (Libya), top Arzew (Algeria) and on the following pages the industrial port of Haifa (Israel).



THE INVASION OF UKRAINE by Russia, one of the largest gas producers in the world and the main gas supplier to Europe, has profoundly disrupted the gas market. European countries, weaned from Russian gas, have begun to actively seek alternative sources. Given its major gas potential, the African continent has been explicitly considered as one of the alternatives. Africa holds about 16,000 billion cubic meters (bcm) of proven reserves, just 8% of global gas reserves. They are mostly concentrated in two regions: North Africa, with Algeria (4,500 bcm), Egypt (2,210 bcm) and Libya (1,500 bcm) leading the pack, and the Gulf of Guinea, mainly Nigeria (5,760 bcm). These four countries are also the main current natural gas producers of the

continent: Algeria produces about 100 bcm annually, followed by Egypt (70 bcm), Nigeria (42 bcm) and Libya (15 bcm). Other African gas producers include Equatorial Guinea (6.7 bcm), Angola (5.6 bcm) and Mozambique (4.6 bcm). Altogether African countries produce about 260 bcm per year, some 6.5% of world gas production. Given these figures the African continent doesn't appear to be strategic for the global gas market. But numbers can be misleading. First, because they do not take into account all the large-scale discoveries made over the last dozen of years in Mozambique, Tanzania, Senegal, Mauritania, and Egypt, most still under development. Second, because natural gas has long

AN AFRICAN ELDORADO

by Philippe Copinschi

WITH SUBSTANTIAL DISCOVERIES AND IMMENSE ESTIMATED GAS RESERVES, AFRICA HAS THE POTENTIAL TO BECOME A MAJOR GLOBAL PLAYER. HOWEVER, REALIZING ITS FULL POTENTIAL WILL REQUIRE OVERCOMING SEVERAL KEY HURDLES

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been considered a useless by-product of oil in Sub-Saharan Africa, as oil companies felt that there were no local market likely to provide demand that would justify the necessary investments (despite the size of the local populations and their intrinsic energy needs), and that the consumer markets (Europe, United States, East Asia) were too far away. Therefore, only very limited investments were made in order either to search for natural gas or to develop the gas fields that had been identified in sub-Saharan African, until the very end of the 1990s. On the contrary, North African countries started their gas production as early as the 1960s, taking advantage of their proximity to the European market.

NORTH AFRICA

Algeria, the main producer in the region, exports its gas via a pipeline to Italy and two others to Spain. One of the two pipelines to Spain, however, has been shut down since October

2021. The country also has four LNG export terminals. However, the infrastructure remains largely underused. Though Algerian gas production hasn't evolved much in recent years, domestic consumption is continuously growing, reducing the quantities available for export. Algeria exported some 55 bcm in 2021, down from 64 bcm in 2010. Despite its large gas reserves, Libya produces relatively little natural gas (14.5 bcm per year) and exports only a small part of this production (4.3 bcm per year). Exports must flow through a single pipeline to Italy via Tunisia since its one LNG terminal remains out of service after damage suffered during Libya's civil war in 2011. Egypt has become a relatively large producer over the past 20 years, producing nearly 70 bcm per year nowadays, triple the level of the 2000s. However, the lion's share of Egypt's production is for local consumption (65 bcm per year), which only leaves some 4 bcm per year for export. The figure is only a third

per year), Equatorial Guinea (3.5 bcm per year) and Cameroon (1.5 bcm per year). Although significant efforts have been made in recent years to reduce flaring (especially in Nigeria) some 30 bcm of gas are still being flared in Africa each year, especially in Algeria, where 8.6 bcm of gas being is flared annually, Libya (5.4 bcm), Nigeria (5.3 bcm) and Egypt (2 bcm). This represents more than 20% of world flaring, even though Africa only accounts for 8.2% of global oil production.

Since beginning operations, several of these African liquefaction plants have faced erratic production, particularly in Angola where multiple technical issues disrupted plant operations in the early years. In Nigeria, political instability in the Niger Delta region, where oil and gas production is located, frequently disrupts operations. These repeated setbacks have largely hampered investments to increase capacity, despite significant potential. Several projects to build new liquefaction plants and expand production capacity at existing ones have been abandoned or frozen. Nevertheless, construction of a 7th liquefaction train at Nigeria's Bonny Island plant is underway, which should allow the country to reach 33.4 billion cubic meters of LNG production per year by 2024. Similarly, Congo-Brazzaville could soon modestly join the ranks of African LNG producers. Commissioning of its first liquefaction plant (Tango FLNG, 0.67 bcm annual capacity) is expected in December 2023, followed by a second (Marine XII FLNG, 2.7 bcm annual capacity) in 2025.

NEW POTENTIAL PRODUCTION POLES

However, the most promising future for African LNG lies outside the two historic production areas. Very significant gas discoveries were made off Mozambique and Tanzania in the early 2010s, and to a lesser extent off Senegal and Mauritania since 2016.

With exploitable resources comparable to Nigeria's at nearly 5,000 bcm in Mozambique and around 1,500 bcm in Tanzania, East Africa has the potential to become a major player in the global LNG market by the end of the decade. After several years of delay, the projects are finally beginning to advance. ENI launched its first Mozambique project in 2022 - the floating Coral South LNG plant with a capacity of 3.85 bcm per year. TotalEnergies also initiated its Mozambique LNG project in 2019, which will ultimately enable 19 bcm of LNG production annually. However, the project was halted in 2021 due to insecurity in northern Mozambique where production facilities are located. It could resume in the second half of 2023 and be completed by 2026. ENI and ExxonMobil should also soon launch their Rovuma LNG project, comprising two liquefaction trains for eventual production of 22 bcm per year.

The total of projects already approved or in approval stages thus amounts to 46 bcm/year, which will become available in the coming years. Production could be even higher long-term since, given the resource base, operators aim for 75 or even 90 bcm/year

of what it was at the turn of the century. Egypt could potentially export much more through the gas pipeline linking Egypt to Israel and to its two LNG terminals. Thanks to recent discoveries, both production and exports have substantially increased in 2022 and should further increase in 2023.

GULF OF GUINEA

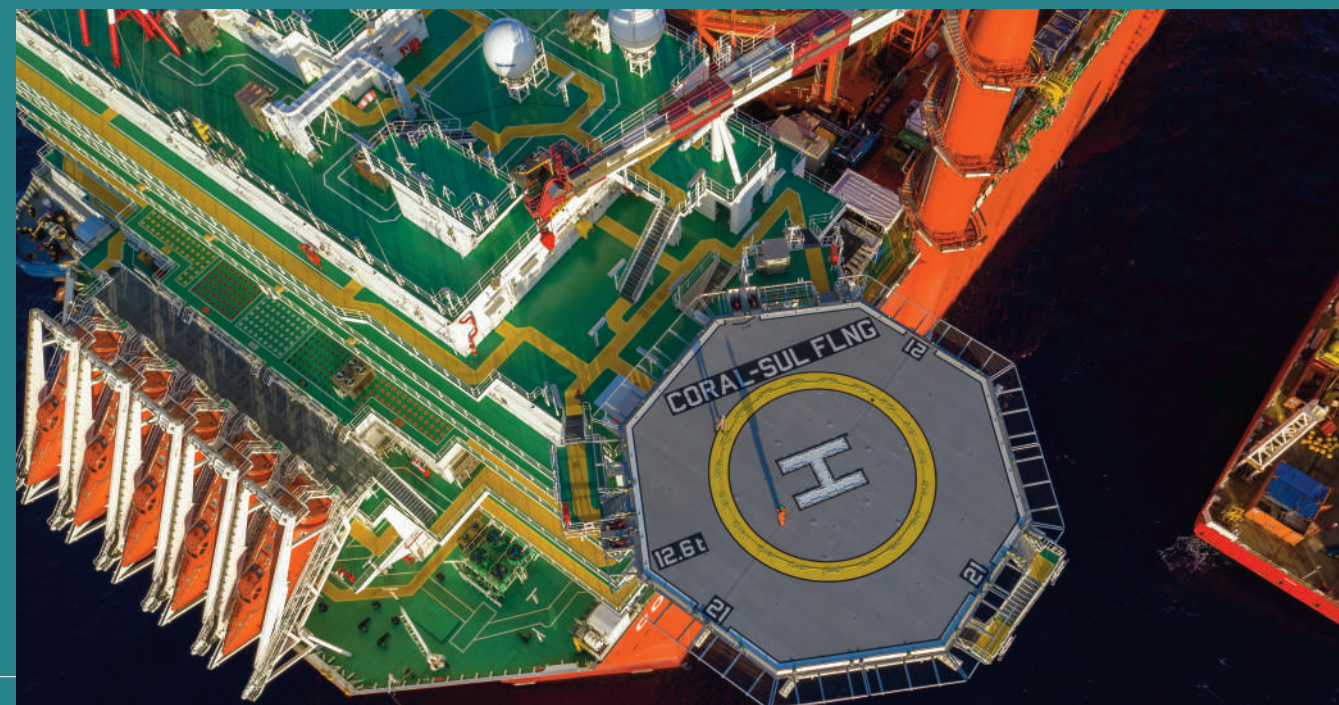
For decades, most of the associated gas produced in sub-Saharan Africa was simply flared, despite the disastrous environmental and health consequences. It was not until 1999 that the first sub-saharan liquefaction plant was commissioned in Nigeria, followed by those in Equatorial Guinea (2007), Angola (2013) and Cameroon (2018), allowing the region to start monetising its gas resources. Cumulative LNG production in sub-Saharan Africa amounts to 36.3 bcm per year (7.3% of world production), mostly from Nigeria (26 bcm per year, making Nigeria the 6th LNG exporter in the world) followed by Angola (5.5 bcm



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A TECHNOLOGICAL GEM

Coral South is the first project by Eni and partners to develop gas resources from the Rovuma Basin offshore Mozambique. It involves producing and selling gas from the southern Coral field via the Coral Sul FLNG (Floating Liquefied Natural Gas) facility - a floating liquefaction plant with 3.4 million ton annual LNG capacity, fed by 6 subsea wells. Coral Sul began introducing hydrocarbons in June 2022 and produced its first LNG cargo in November, making Mozambique an LNG producer and contributing to economic and social development. Energy efficiency techniques adopted from the design stage minimize CO2 emissions. Coral Sul FLNG's energy use per ton of LNG is significantly below industry averages - 256 kWh versus 275-400 kWh for other operational units.



by 2030 from Mozambique and Tanzania combined. This volume would make the region the world's fourth largest LNG exporting capacity behind the United States, Qatar and Australia. In Senegal and Mauritania, smaller yet substantial discovered quantities also suggest the region could become an export hub in coming years. Estimated gas resources spanning the maritime border between the two countries range from 1,400 to 2,850 bcm, with additional discoveries ongoing. Development phase 1 of the Grand Tortue/Ahmeyim (GTA) complex was approved in 2018 by BP and should yield 3.65 bcm/year of LNG starting in 2022 via a floating plant. Another phase planned to add 3.65 bcm of annual LNG production by 2026 is underway.

MULTIPLE CHALLENGES AHEAD

With these multiple discoveries and immense estimated reserves, Africa is often portrayed as the new gas El Dorado. However, realizing the full potential of the region faces several hurdles.

The first issue is financial: developing East Africa's resources alone is estimated to cost tens of billions of dollars over coming decades. Securing customers is thus a priority for operators and a precondition for final investment decisions. Logically, future East African production should target Asia (Thailand, China, Japan, India, etc.). However, it may compete with other producers also seeking to supply Asia, like Australia, Qatar or even Iran and the United States. While all plan to substantially increase LNG output, it is uncertain whether Asian demand can absorb such ample supply.

The second question is allocating production between the global and local markets. As African demographics keep rising and energy access has become a major development issue, oil companies must balance exporting LNG (the most lucrative option) with government demands to supply domestic or regional markets to boost development. Pressure from Tanzania to divert gas to the local market is a key reason development stalled over 10 years. Similar uncertainty affects Nigeria, where only 1 in 4 people have electricity access currently.

Finally, political instability poses the third barrier. Between chronic volatility in the Niger Delta, piracy in the Gulf of Guinea and deadly attacks by Islamist militants in northern Mozambique, the entire region presents major risks for international oil companies.

We

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THE STRATEGIC AND GEOPOLITICAL PARTNERSHIP BETWEEN RUSSIA AND CHINA IS UNBALANCED: XI JINPING IS IN CONTROL, MOVING ACCORDING TO NATIONAL INTERESTS, VERY MUCH INCLUDING ENERGY

AN ASYMMETRICAL ALLIANCE
by Giulia Pompili

ALLIANCE

ENERGY IS ALWAYS a key strategic point for discussion during when Chinese leader Xi Jinping and Russian President Vladimir Putin meet. According to public data from Chinese customs, in 2022, 17 percent of China's crude oil imports—totaling 1.7 million barrels per day—came from Russia. Crude oil to China, which accounted for 31 percent of Moscow's exports in 2021, rose to 35 percent one year later. At a press conference in January 2023, Russian Deputy Prime Minister Alexander Novak said that “despite the actions of hostile countries and sanction restrictions, 535 million tons of oil were produced in 2022, which is 10 million tons more than in 2021. Exports also grew by 7 percent.”

中华人民共和国万岁



世界人民大团结万岁

The People's Republic of China last year also helped its strategic Russian partner from the standpoint of coal exports, which rose from 25 percent to 32 percent. But on closer inspection of the data, the increase is doesn't amount to much: it's useful mostly for Russian propaganda more than for securing China's supplies. Because, over the years, an energy-intensive giant like China has figured out how to diversify its sources. And, in fact, Russia comes second to Saudi Arabia in terms of oil imports and second to Indonesia in terms of coal.

CHINA'S WEAKENING ECONOMY

In the fall of 2021, the People's Republic of China faced serious energy shortages. Blackouts in major cities were commonplace for months. Factories rationed power distribution. Office lights went out, elevators stopped working, aqueducts stopped pumping water to homes.

According to analysts, several factors were responsible for the sudden increase in energy demand, including post-pandemic reopenings in countries dependent on imports from China. To meet the growing demand, industrial zones in the People's Republic of China doubled production: for example, energy-intensive aluminum, cement and steel production sites.

Officials in Beijing believed that after lifting the pandemic restrictions, the Chinese economy would enjoy an acceleration; it didn't. Quite the opposite. In the first four months of 2023, China's industrial production grew year-on-year by 5.6 percent compared to the expected 10.9 percent. China's economy is so severely weakened that even leader Xi Jinping has called for people to "grit their teeth."

That's why it is now importing much less energy than expected: nearly two million barrels of oil per day less than forecast in August and one-sixth less natural gas than the previous year, according to reporting in The New York Times. This slowdown has helped keep oil and gas prices low and, more importantly, helped the West geopolitically: although China did not join Western sanctions against Russia after the invasion of Ukraine, the volume of Chinese energy imports from Russia are not enough to replace the lost European market.

Russian pipeline routes to China

Inaugurated in 2019 by Russian President Vladimir Putin and Chinese President Xi Jinping, the 4,000-kilometer Power of Siberia pipeline transports Russian gas from the huge Siberian fields of Kovyktinskoye and Chayandinskoye to Blagoveshchensk, the Russian city on the Amur River on the border between the Russian Federation and the People's Republic of China. By 2025, Russian gas exports to China are expected to rise to 38 billion cubic meters per year. Also in the planning stages is a sister pipeline, the Power of Siberia 2, which will supply China with an additional 10 bcm. The first flows are expected to travel along the pipeline in 2026.



Source: Gazprom



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In practice, the strategic and geopolitical partnership between Russia and China is unbalanced: the facts show that it is Xi Jinping who is in control, moving according to national interests, including on energy, which is the lifeline of Russian diplomacy.

POWER OF SIBERIA

For decades, Siberia has been a strategic energy supplier underpinning China's transformation into the world's second-largest economy. When the West imposed sanctions on Russia and the Kremlin decided to shift the focus of its energy exports eastward, it looked precisely to the country that had sworn its "boundless friendship" just before the start of the war in Ukraine.

Gazprom's biggest success story is the Power of Siberia, the pipeline inaugurated in 2019 that, when fully operational, would have resulted in Russia selling 38 billion cubic meters (bcm) of gas per year to China, for a total of 1,000 bcm on a 30-year contract, with an estimated sale price of USD 350-400 per 1,000 cubic meters. During Xi Jinping's last visit to Moscow in late March, Putin said it is "pretty much all agreed" with the Chinese side on the construction of the Power of Siberia 2, a new pipeline that would run from the Yamal Peninsula in western Siberia to China.

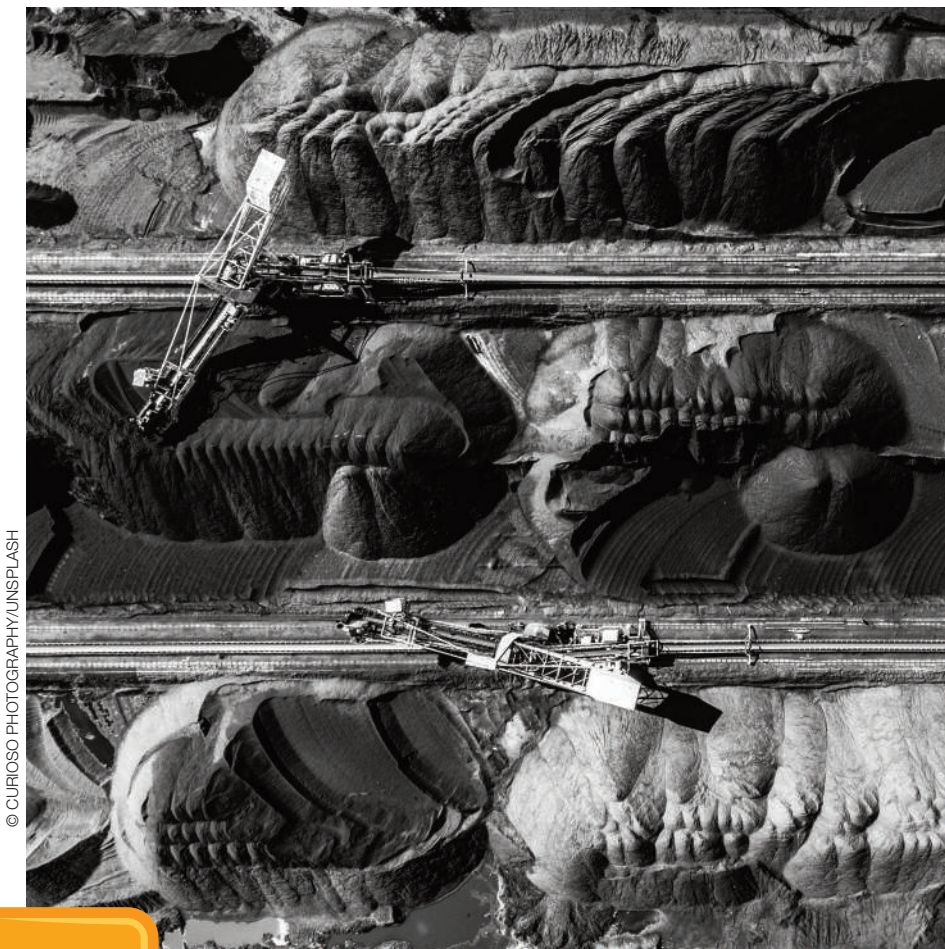
Alas, China does not seem to be in a hurry to commit to getting the project up and running. According to several analysts, China is either trying to prolong negotiations to get a better contract, or it simply does not want to increase its dependence on Russian gas, which for now accounts for just 5 percent of its imports, a figure that would rise to about 20 percent when Power of Siberia 2 came online. China supports Russia in its ideological battle against the West, but it also knows that depending on one supplier for energy is a political risk: a lesson it learned from Europe.

We

GIULIA POMPILI

She has been a journalist for *Il Foglio* since 2010, where she covers mainly news from East Asia. In 2017, she started Katane, the first newsletter in Italian on Asian events. She is the author of the book *Sotto lo stesso cielo* (Mondadori edition).

THE RETURN



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HUGE QUANTITIES OF LIQUEFIED NATURAL GAS, DIVERTED FROM THE ASIAN MARKET TO EUROPE FOLLOWING THE RUSSIAN CRISIS, HAVE BEEN LARGELY REPLACED BY THE DIRTIEST FUEL: COAL



OF COAL

by Moisés Naím

TO GET THE TRUE MEASURE of the impact the war on Ukraine has had on natural gas flows worldwide, it pays to take a good hard look at the fuel natural gas was meant to displace forever: coal.

Though climate scientists have long stressed the urgent need to phase out coal—the world's most polluting fuel—this decade has seen an unexpected and profoundly damaging boom in coal production. Energy consumers faced with the need to supplant phased-out nuclear power and disrupted natural gas supplies with coal, the mineral that fueled the 19th century.



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India's coal demand will grow from 955 million tons per year in 2019-2020 to 1.27 billion tons per year from 2023-2024 and as far as 1.5 billion tons by the end of the decade. Pictured is the New Delhi railway station.

DISAPPOINTED EXPECTATIONS

It wasn't supposed to be this way. At the outset of the COVID pandemic, in 2020, the International Energy Agency announced categorically that global coal demand had peaked in 2014 and that coal use in power generation was likely to peak before 2030. The rosy view then was that the slow-down in energy demand brought on by the pandemic would provide the

world the badly needed breathing room to step away from coal decisively, pivoting to gas as a bridge fuel in the transition to renewable alternatives.

It hasn't worked out that way. Global coal demand stood at 5.7 billion tons (BT) in 2014. By 2022, production rose above 8 billion tons, its highest level ever. This came even as coal prices spiked in 2021 and 2022, making coal production more prof-

continent went on a frenzied buying spree for its liquefied alternative: building infrastructure at record speed and outbidding traditional buyers on gas spot markets. As gas prices spiked and traditional buyers from Pakistan and India to Indonesia and Bangladesh found themselves priced out of the market, they found themselves badly in need of the kinds of fuels that can serve as the backbone of a robust grid: power sources that can be brought online quickly to balance the grid, and that can run at any time of the day or night, rain or shine. They turned, in other words, to coal: the one source that could keep the lights on in people's homes, offices and shops and the machines turning over in their factories.

THE BOOM IN DEMAND FROM CHINA AND INDIA

According to India's Ministry of Coal, the country's demand will grow from 955 million tons per year in 2019-2020 to 1.27 BT per year in 2023-2024 and as much as 1.5 billion tons by the end of the decade. China, for its part, uses three times as much coal as India, and continued to approve new coal fired power-plants at a record pace through the first quarter of 2023, according to Greenpeace.

Remarkably, this Asian coal boom has taken place even as both countries bring record renewable generation capacity online at the same time. As Europe hoards more and more of the world's available natural gas to keep its power grid stable, the rest of the world is forking around natural gas, racing at once to produce more of the cleanest and more of the dirtiest electricity in response to the crisis.

In Pakistan and Bangladesh, the summer of 2022 was marked by damaging blackouts as utilities found it impossible to secure enough gas to run their existing gas-fired power plants. This happened even though, on paper, their governments had signed long-term supply contracts to guarantee supply.

In today's hyper-connected world, a supply shock in one part of the energy system ripples out worldwide. Decisions made somewhere on the globe play out very differently in other parts of the planet. The disruption to global gas flows shows up directly in our decade's lamentable spike in coal production, which must be counted among the most damaging, and under-reported impacts of the invasion of Ukraine.

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itable than ever. The 2020s presented us with a golden chance to turbo-charge the clean energy transition. Instead, the world has doubled down on its dirtiest fuel.

WHAT HAPPENED?

The war in Ukraine accounts for much of the shift. As Russia's invasion of Ukraine disrupted Europe's access to piped gas, the

MOISÉS NAIM

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LNG

Strategy

by Marc-Antoine Eyl-Mazzega

FOR EUROPE, LNG IS THE PRIMARY SOURCE OF GAS, SUPPLIED LARGELY BY THE UNITED STATES. AND IT IS A GOOD SOLUTION FOR REDUCING THE DEMAND FOR COAL IN EMERGING ASIAN COUNTRIES. THERE REMAINS THE UNKNOWN ELEMENT OF RUSSIA

PRIOR TO RUSSIA'S UNANTICIPATED incursion into Ukraine in February 2022, the liquefied natural gas (LNG) markets presented a fairly predictable narrative. On the production end, the United States was poised to join Qatar and Australia as leading global exporters, until Qatar was set to surge ahead by ramping up its production capacity. Russia was progressing steadily towards becoming the fourth largest exporter, with its projects strategically positioned to cater to both the Atlantic and Pacific markets.

Elsewhere, promising ventures were being undertaken in East Africa, West Africa, Canada, and East Asia. In terms of consumption, China's meteoric ascent to becoming one of the biggest demand centers seemed inexorable. There were even instances where China outstripped Japan, momentarily claiming the title of the world's largest importer.

Aside from the established importers such as Japan, South Korea, and Taiwan, the markets experienced a swell in off-takers from emerging economies. These countries were leveraging competitive prices and the advantages of Floating Storage and Regasification Units (FSRUs).

Conversely, Europe remained a relatively stagnant market, saturated with Russian and Norwegian pipeline gas and with LNG import facilities operating significantly below their capacities. Collectively, since 2015, the LNG markets had been primarily driven by buyers, and numerous technical disruptions affecting supply largely went unnoticed.

THE USE OF LIQUEFIED NATURAL GAS VERSUS PIPELINE TRADE

Internationally, the growth rate of LNG trade was outpacing that of pipeline gas trade, though it was not expected to significantly surpass it. Contracts were becoming shorter and more flexible, and the US "Henry Hub+" pricing model was challenging the traditional oil indexation system. Small scale LNG was also experiencing increased uptake, particularly in remote industrial zones or coastal urban areas, as well as in bunkering operations.

Demand for spot LNG was not confined to winter periods, but

was steadily growing during the summer months in Asia and Latin America. Moreover, LNG was emerging as a method of curtailing coal demand in the industrial and power generation sectors of emerging Asian economies. It also presented a viable solution for supporting inconsistent renewable energy sources and unreliable hydroelectric power.

The use of LNG in shipping was also on the rise, spurred by the 2020 regulations established by the International Maritime Organization (IMO).

When Russia began to uncharacteristically limit its pipeline exports to Europe in May-June 2021 – while still adhering to contractual obligations – LNG imports into Europe began to rise, leading to a tightening of the global LNG markets. By the autumn of 2021, the emergence of a new transatlantic LNG stream was visible. This proved beneficial for US exporters and European buyers, as this route was considerably shorter compared to supplies from the Gulf of Mexico to Asia.

This situation was abruptly and drastically intensified by Russia's subsequent decision to further reduce, and eventually sever, most of its pipeline gas supplies to Europe between March and August 2022. In conjunction with Norway's pipeline gas, LNG supplies swiftly became the cornerstone of Europe's gas supply security.

Although the industry's flexibility facilitated swift adjustments in trade flows, the subsequent surge in prices completely eliminated the availability of spot cargoes for emerging economies. In certain cases, these economies also lost their import infrastructure as Floating Storage and Regasification Units (FSRUs) were rented out by Europeans who were willing to pay a premium to relocate these facilities.

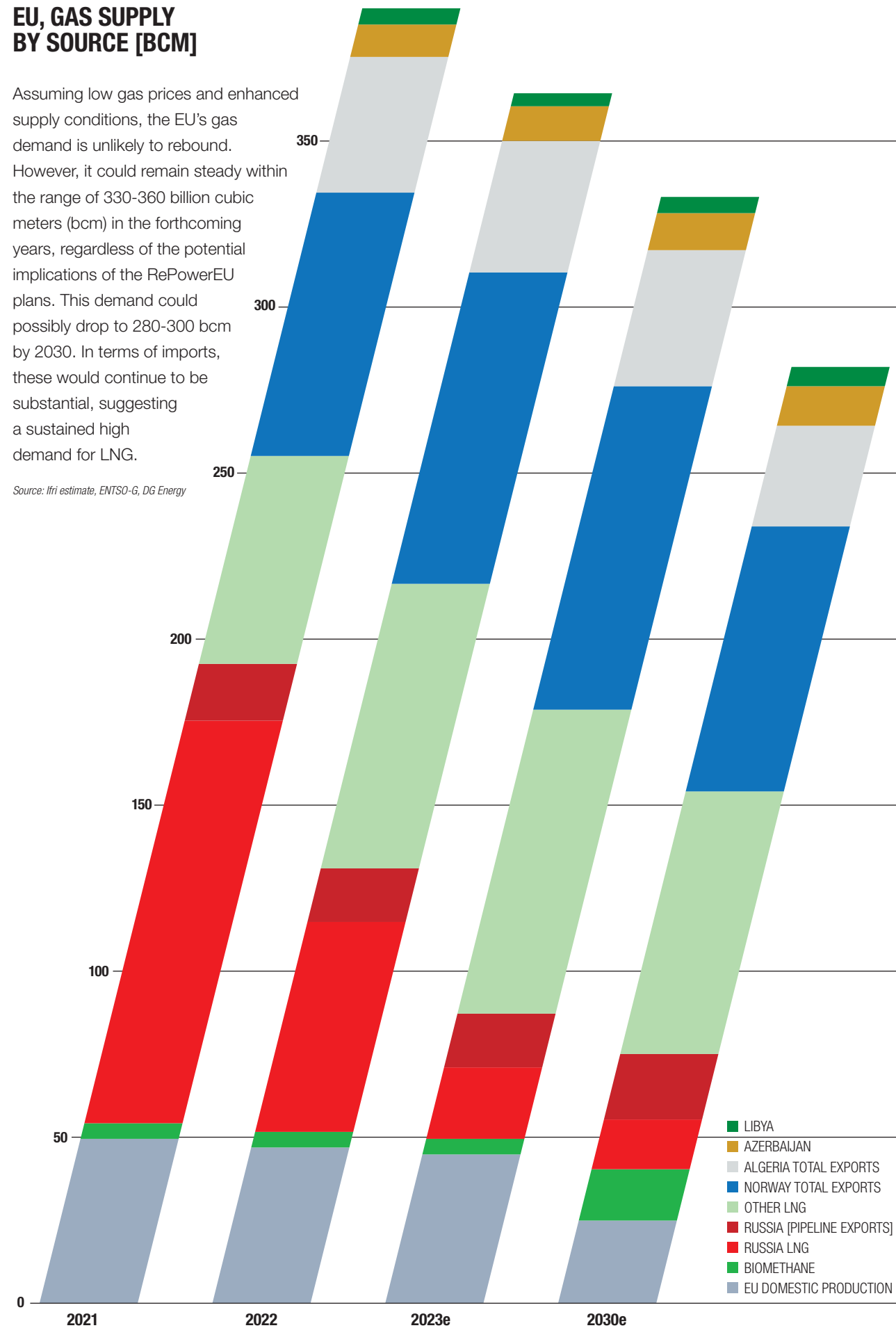
THE NEW GLOBAL LNG EQUATION

If Europe had not developed such a substantial LNG import infrastructure over recent years – a third in the Iberian peninsula – and if Russia had terminated pipeline gas sooner and not maintained its own LNG flows from the Yamal LNG and Sakhalin-2 LNG projects, in addition to some minimal pipeline flows, the situation would have been far more serious.

EU, GAS SUPPLY BY SOURCE [BCM]

Assuming low gas prices and enhanced supply conditions, the EU's gas demand is unlikely to rebound. However, it could remain steady within the range of 330-360 billion cubic meters (bcm) in the forthcoming years, regardless of the potential implications of the RePowerEU plans. This demand could possibly drop to 280-300 bcm by 2030. In terms of imports, these would continue to be substantial, suggesting a sustained high demand for LNG.

Source: Itri estimate, ENTSO-G, DG Energy



Furthermore, had the US industry not established such a large and adaptable export infrastructure, Europe's energy security, along with its economies, would have plunged into severe turbulence by the end of 2022. This would have inevitably led to gas rationing and the implementation of emergency solidarity measures.

Of course, Europeans benefited from a mild weather and also took resolute and key actions: providing large liquidity to traders (although this resulted in increased costs in Germany), taking Gazprom subsidiaries into administrative management and nationalizing Uniper, making high storage refilling mandatory, improving internal logistics, such as between France and Germany, and reducing demand. The ability to credibly and rapidly identify, rent and connect dozens of FSRUs was also essential. In Italy, the government successfully delegated ENI with the responsibility of securing additional volumes from any available source.

While US LNG only played a marginal role in Europe in past years, it became predominant within a few months in the incremental LNG supplies sourced by Europeans as from spring 2022, to the extent that LNG cargo traffic jams appeared off the European import terminals even when Freeport LNG was in maintenance, as Europeans were unable to absorb such volumes. Key short term developments include:

- Germany, Europe's largest gas market which up until recently had no LNG import terminal, will become one of Europe's largest LNG import markets, with several import facilities, either flexible or fixed, already in operation and further reinforced. Due to the structural decline in gas demand, the government has been downsizing the number of units ultimately needed.
- France, Italy, Greece, Finland, and the Netherlands are markets where import capacities have been reinforced by flexible import infrastructure. In South-East Europe, US and EU supported gas infrastructure developments proved key. These included the Croatian LNG terminal, which is now set for expansion, and the establishment of Greece as a gateway for imports into Bulgaria and potentially Romania and beyond. Spain's substantial LNG import capacities also facilitated the redirection of some of the Algerian pipeline supplies to Italy without any complications.
- The US will continue to cover a large part of Europe's LNG demand as other exporters have almost no export capacity to offer Europe in the foreseeable future. The transatlantic LNG trade artery continues to expand in 2023 and is set to remain a primary route, indicating that the majority of US LNG supplies will continue to be directed towards Europe. This could potentially lead to reduced LNG traffic through the Suez and Panama canals. Meanwhile, established markets in Asia will continue to absorb large LNG volumes, with Japan recently committing to new long-term contracts.

It is crucial to note that Asia's LNG demand is still twice as high as the volumes imported by Europeans (respectively 20-25 million tonnes (mt)/month versus 8-12 mt/month).

- While markets have loosened since the fall of 2022, they could potentially tighten again in the winters of 2023-2024 and 2024-2025 due to limited global flexibility, especially if Europe experiences a harsh winter. This could result in storage facilities being largely depleted ahead of the following winter.
- From 2026 onwards, new waves of LNG export projects across the world (primarily the U.S. and Qatar, and at lower scale, Papua New Guinea, Canada, Mozambique, and Tanzania) will boost supplies globally and most probably lead to lower prices for a few years before demand picks up. Qatar's 40 percent capacity expansion will continue to be predominantly orientated towards Asia, while the US is expected to continue serving the European and Latin American markets. Yet beyond this ongoing wave, the expansion of the LNG industry is most probably going to slow down, if not stop: financing projects at times of short and flexible contracting, inflation, supply chain tensions, and most probably, lower prices, is and will be a challenge. Moreover, gas resource-holding countries will want to make maximum use of their gas resources locally.
- Last but not least, an LNG tanker construction boom is in the pipeline, with the French company GTT, the global membrane leader, reporting over 160 new orders. Beyond Korea, they will have to be built in Chinese shipyards too, and on time, as many older vessels will have to be scrapped.

FUTURE MARKET UNCERTAINTIES ARE DOMINATED BY GEOPOLITICS

On the supply side, Russia presents the first wildcard. In the short term, the question revolves around whether Putin will direct or halt LNG exports to Europe or OECD-Asia, or the potential ramifications of some EU governments' plans to prohibit Russian LNG imports. In the medium term, the question isn't about whether Russian pipeline gas will make a comeback to Europe. Any return to pre-war levels is now dismissed. At most, we could anticipate pipeline volumes of 50 billion cubic meters (bcm)/year, down from 140 bcm/year. The fate of long-term contracts will likely be determined in arbitration courts (the Gasum-Gazprom case is intriguing but not fully decisive), which Russia will most likely not recognize.

A critical question is whether Russia can develop its own LNG technologies, both for the planned terminals (Arctic 2, Obsky, Baltic LNG) and ships. Alternatively, Russia will aim to expand pipeline exports to China, potentially influencing the country's LNG import requirements, or broaden its footprint in the petrochemicals sector. This matters because Russia aims to expand its export capacity from 33 million tonnes (mt) to 100 mt per



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year. A more realistic goal appears to be in the 45-50 mt range. The second wildcard relates to the security of the Hormuz strait. With Iran toying with the ultimate Israeli red line in becoming a nuclear threshold state, a military conflict that would impact Qatar's exports cannot be ruled out. For the time being, things look in check following China's brokered Iran-Saudi agreement on the resumption of diplomatic ties, China's offtake of future Qatari volumes and the fact Iran needs to export its own oil and other products. In turn, the East Mediterranean export potential is still open, whether via a pipeline, LNG or local utilization. Another uncertainty lies in the tensions in the Taiwan Strait. A full-fledged war wouldn't be necessary to seriously disrupt

trade in the Malacca Strait – a Chinese blockade of Taiwan would inevitably also carry a maritime dimension. China's strategy of over-contracting imported gas, especially LNG, from sources including the US, is undoubtedly designed to provide flexibility and stimulate more export project developments to avoid soaring prices. It could even facilitate supplies to Europe if advantageous. This strategy also ensures China can handle any situation through both pipeline imports and domestic supplies. Unsurprisingly, China is reportedly interested in expanding Line D with Turkmenistan and securing further Russian pipeline supplies, provided it can dictate the terms. Turkmenistan will continue to be largely landlocked, but if new ac-

cess routes to China, Pakistan/India, or Turkey become available, there is a potential for an additional 50 billion cubic meters (bcm)/year of pipeline supply that could also have a significant impact. Another risk stems from terrorism, weak governance and instability in East Africa, which might further prove challenging for the completion of Mozambique's LNG plants. In turn, it remains to be seen if Venezuela manages to enter the LNG market, such as via Trinidad. On the demand side, it looks like China will continue its temporary coal resurrection, and will want to limit its dependence on imported gas, for energy security reasons.

LNG AND THE ENERGY TRANSITIONS

A critical question arises as to whether LNG can reclaim its role in emerging economies as a secure fuel that can drive energy transitions. While Europe equates LNG with energy security, for these countries LNG has become a byword for unaffordability and unpredictability. The current pricing environment of \$10/Mbtu has led to a resurgence in demand, particularly in India. Asian emerging economies that reverted to coal or heavy fuel for power generation in 2022 can be expected to return to LNG in the future as they ramp up solar deployment, prices drop, and industries decarbonize. However, they will need to confront escalating costs on both the supply and demand side, financing infrastructure amid rising interest rates, weakening national currencies against the dollar, and European taxonomy rules limiting activities from EU's banks.

While the EU is projected to rely heavily on substantial LNG imports until at least 2030-2035, OECD importers could potentially reduce gas and LNG imports in the 2030s. This would free up some of the essential molecules to fuel accelerated transitions in emerging markets and ensure competitive prices. This scenario could coincide with a decline in US gas demand, which could also make more volumes available for exports by then. Regardless, the LNG industry must intensify efforts to curb fugitive methane emissions and take the global methane pledge seriously. Gas certification needs to be credible, standardized, and immune to the temptation of greenwashing. Furthermore, the regulations of the International Maritime Organization (IMO) will play a significant role, particularly requiring the optimization and shortening of shipping routes.

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Within a matter of months, starting in the spring of 2022, US LNG, which Europe had relied on only marginally in past years, became critical to European supplies, to the point that veritable bottlenecks were created at European import terminals. Pictured is a loading arm, which transports LNG from the station to the tanker.



China has entered into a large number of contracts to import gas-LNG in particular—not least from the United States, to create flexibility and avoid a price surge. Pictured is Nantong, home to the main LNG terminal in China's Jiangsu province.

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THE ARCTIC WAY

by Vitaly Yermakov

THE PASSAGE ACROSS THE ARCTIC IS NOW A NEW OPPORTUNITY FOR RUSSIA TO UNLOCK AND MONETIZE ITS VAST ARCTIC OIL AND GAS RESERVES AND EXPORT THEM TO WORLD MARKETS

FOR CENTURIES, there have been persistent efforts to discover a sea route linking the Atlantic and Pacific oceans through the northern seas, with the goal of facilitating commercial shipping. Russia holds a crucial advantage in the Arctic transportation shortcut, as the entire Northern Sea Route (NSR) falls within Russia's exclusive economic zone (EEZ) in the northern Arctic seas. This route not only provides access to Europe through the Barents Sea and the North Sea, but also offers connections to the Asia-Pacific region via the Sea of Okhotsk and the East China Sea.

The Soviet Union took active measures to develop the Northern Sea Route (NSR) starting from the 1930s. This initiative was crucial for supplying Russian Arctic cities along the coastline, leading to the establishment of a fleet of nuclear icebreakers during the 1960s and 1970s. The utilization of these icebreakers enabled safe navigation through the entire NSR, even in challenging icy conditions. To this day, Russia remains the sole Arctic nation with the capability of nuclear icebreaker operations.

In contemporary times, the NSR has emerged as a strategic opportunity for Russia, presenting a means to unlock and capitalize on its extensive reserves of oil and gas in the Arctic. These reserves are estimated to be approximately 85 trillion cubic meters (Tcm) of natural gas and 17 billion tons of crude oil. Exploiting the NSR would allow Russia to export these resources to global markets, thereby enabling their monetization.

RUSSIA'S AMBITIOUS GOALS

Russia's Arctic strategy includes a vision to enhance domestic shipbuilding capabilities for constructing Arctic-class tankers and the development of a new generation of nuclear icebreakers. These ambitious programs are expected to have significant economic benefits, serving as vital drivers of economic growth and job creation within Russia.

The country has set forth ambitious goals for augmenting the transportation turnover of the Northern Sea Route (NSR). The target is to increase the turnover from approximately 35 million tons in 2021 and 2022 to 80 million tons by 2024, with a further aim of reaching 150 million tons by 2030. These objectives rely primarily on the successful implementation of a limited number of oil and liquefied natural gas (LNG) projects led by Gazpromneft, Novatek, and Rosneft in regions such as Yamal, Gydan, and Taimyr.

However, a potential concern lies in the risk of infrastructure developments lagging behind the realization of existing and planned oil and gas projects. This could lead to transportation bottlenecks, hindering the efficient movement of goods along the NSR. Recognizing this as a significant challenge, Russia's Arctic Strategy acknowledges the need to address and mitigate such risks in order to achieve the ambitious targets set forth by the nation.

The ongoing conflict in Ukraine, which has escalated into a significant geopolitical standoff between Russia and the West, has had a notable impact on the plans for the Northern Sea Route (NSR). This conflict is considered the most severe since the end of the Cold War.

Technological sanctions imposed against Russia have the potential to hinder Arctic developments, particularly in achieving the NSR transportation turnover targets. Delays may occur in implementing LNG projects, as Russia heavily relies on Western equipment and technology for these ventures. Additionally, the disrupted cooperation with Korean shipyards, which played a crucial role in constructing Arctic-class tankers, is expected to exacerbate logistical challenges.

However, while there may be postponements, it does not signify complete derailment of Russia's plans. In fact, Russia now places even greater importance on the NSR's development due to its geopolitical significance. The country possesses the technical capability to proceed independently, albeit with some delays.

In a world marked by growing global rivalries, having a transportation trade route to China and other Asian markets under Russia's control, beyond the reach of the US Navy and secure from potential sanctions or blockades, represents a valuable strategic asset for Russia.

The Russian government appears to acknowledge the limited prospects for a significant increase in international transit volumes through the Northern Sea Route (NSR) in the coming decade. Consequently, the NSR's emergence as a prominent Arctic maritime shortcut, capable of competing with the Suez route for a substantial share of global shipping volumes, remains a distant possibility at best.

Established international marine trading routes continue to offer technological and logistical efficiencies, providing global shipping companies with viable alternatives. Meanwhile, Russia still has considerable work ahead to develop the necessary logistical infrastructure for the NSR, essentially starting from scratch.

The Arctic region has experienced a more than twofold increase in temperature rise compared to the global average over the past two decades. This warming trend has the potential to reduce ice coverage in the Arctic seas, thereby extending navigation periods. Winter temperatures near the NSR have averaged around -20 degrees Celsius in the past decade, compared to an average of approximately -24 degrees Celsius from 1970 to 2000. In the summer, average temperatures in the area have increased from around +3 degrees Celsius between 1970 and 2000 to approxi-



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mately +4.5 degrees Celsius from 2010 to 2020. Warmer temperatures have contributed to a decline in sea ice coverage within the NSR water area and a general reduction in multiyear ice. However, the extent of ice varies significantly from year to year. For instance, the NSR was entirely ice-free in September 2020, but ice conditions posed greater challenges in 2021 and 2022.

NUCLEAR ICEBREAKERS: THE ONLY FLEET IN THE WORLD

The usage of the Northern Sea Route (NSR) has been on the rise as ice cover diminishes, highlighting the importance of icebreaker support for successful shipping in Arctic waters. Russia holds a unique advantage in this domain, as it possesses capabilities unmatched by any other Arctic nation. It boasts the world's only fleet of nuclear icebreakers, operated by Rosatomflot, a subsidiary of Rosatom, the state-owned nuclear energy operator.

Currently, there are seven nuclear icebreakers in operation, but three of them are nearing the end of their service life. Russia has introduced a new series of nuclear icebreakers, known as the series 22220, including the vessels "Arctica," "Sibir," and "Ural," which commenced operations in 2020, 2021, and 2022, respectively. These new icebreakers are more powerful, with a capacity of 60 MW, and feature improved body designs that enable them to navigate through ice up to three meters thick. With a width of 34 meters, they can clear a path for a 70,000-deadweight-ton (dwt) tanker, whereas the current requirement is two 30-meter width icebreakers for the same task.

However, the ultimate objective is to construct an even more robust generation of nuclear icebreakers, known as the LK-110 series. These icebreakers would utilize a 110 MW power propulsion unit to navigate through ice up to 4.3 meters thick. With a width of 48 meters, they would be capable of creating a 50-meter-wide channel for 100,000 dwt tankers. Significantly, these icebreakers would maintain a speed of ten knots while breaking through two-meter-thick ice, offering a cost-efficient year-round transportation solution via the NSR to Asia.

The construction of the first vessel in the LK-110 series, projected to cost US\$1.5 billion, will be fully financed by the Russian state budget. It is expected to be commissioned by the year 2030 at the Zvezda shipyard in Russia's Far East.

Russian companies operating in the Arctic, such as those involved in the Yamal LNG project, aim to achieve a higher level of self-sufficiency by utilizing Arc7 ice-class vessels for independent passage through the Northern Sea Route (NSR) during most of the navigation season. They aim to limit the need for





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assistance from the expensive Rosatomflot nuclear icebreakers to times when ice conditions are particularly challenging and only for the most difficult sectors of the NSR.

An example of this approach is the Yamal LNG project led by Novatek. The project's LNG tanker fleet consists of fifteen Arc7 vessels and eleven conventional LNG carriers. The Arc7s designed specifically for the project have a capacity of 170,000 cubic meters of natural gas, measuring 299 meters in length and 50 meters in width. They are equipped with 45 MW engines that can be fueled by marine fuel oil, diesel, or LNG. These vessels can travel at a speed of 19.5 knots in open water and at a reduced speed of 5.5 knots through sea ice up to two meters thick. Their Azipod propulsion system enables them to move forward and backward through ice, significantly enhancing their ability to navigate independently in Arctic waters.

To increase the turnover rate of the existing Arc7 fleet, Novatek is constructing LNG transshipment terminals near Murmansk on the Barents Sea and at Kamchatka, located at both ends of the Northern Sea corridor. Transshipment operations involve transferring natural gas from Arc7 LNG carriers to conventional LNG tankers, which are more cost-effective. This strategy reduces overall transportation costs and enhances the efficiency of utilizing the Arc7 fleet by restricting their voyages to Arctic waters, where they are most suitable. Such measures result in reduced travel days compared to alternative routes, enabling Novatek to handle a growing number of shipments. As a result, the disadvantage of higher transportation costs for Russian LNG projects compared to their main competitors is mitigated, while

their key advantage of extremely low production costs enhances their overall competitiveness.

EXPANDING LNG PROJECTS

The expansion of LNG projects on the Yamal and Gydan peninsulas is set to be the primary driver of increased cargo volumes along the Northern Sea Route (NSR) in the near future. However, the anticipated significant growth in transportation turnover will be largely propelled by the launch of the Vostok Oil project, a flagship endeavor led by Rosneft. This is a project of great importance, with confirmed oil reserves of 6 billion tons. It is expected to achieve a combined hydrocarbon production of 50 million tons per annum by the mid-2020s in its first phase, which will be based on the Vankor and Payakha clusters. The project's second phase, planned for the early 2030s, will involve the development of the East-Taymyr fields, potentially increasing hydrocarbon production to up to 100 million tons per annum. If successful, the Vostok Oil project would be a game changer for Russia's overall hydrocarbon development in the Arctic, as well as greatly contributing to the expansion of shipments via the NSR.

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Ice retreat has led to a general increase in shipping through the NSR. However, the support of icebreaker ships (pictured) remains an absolute necessity for successful shipping in Arctic waters, and in this field, Russia has capabilities that no other Arctic nation can match.

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