Commentary

The European Energy Collapse – A Chain of Contingencies or a Recurring Nightmare?

February 2022
Zlata Sergeeva and Nikolay Fedorov
Summary

Choosing to rely exclusively on renewable energy sources (RES) and eliminating hydrocarbons can lead to significant difficulties for an energy system. Challenges may arise when energy storage is insufficient to guarantee a stable power supply. The lack of suitable technologies to apply RES in certain sectors, such as maritime and aviation, can also create problems. These challenges were explicitly demonstrated in the United Kingdom and European Union energy markets in September and October 2021. An unexpected decline in production from RES and high demand for natural gas in Asia both occurred at that time. Moreover, an incident disrupted production at a key Gazprom gas condensate processing plant. This confluence of events resulted in a sharp increase in natural gas prices. In the context of an ongoing transition away from coal-fired power generation toward cleaner energy sources, electricity wholesale prices for customers experienced unprecedented increases. Energy suppliers collapsed, governments spent billions of euros to help consumers, and dependence on coal ironically increased. In this commentary, we discuss whether this series of events was an aberration or a sign of fundamental risk based on a clear internal logic. If the latter is true, then these events may occur regularly unless lessons are learned and challenges are addressed. We also touch upon the role of carbon neutral versions of conventional hydrocarbon products in reconciling market needs with climate goals. These products are elements of the circular carbon economy concept.


In September and October 2021, European energy markets faced a situation that can be described as a perfect storm. Benchmark title transfer facility (TTF) natural gas prices surged to unprecedented levels, reaching $40 per million British thermal units (MMBtu) on October 5 (Figure 1). Power prices followed the same trajectory. They increased by an average of 4.8 times in France and 5.3 times in the United Kingdom (U.K.) over 2016 to 2020 levels (Figure 2). Coal prices also climbed to record levels, reaching $11.5 per MMBtu on October 5, 3.8 times above the 2016 to 2020 average price (Figure 3).
Figure 1. Month-ahead TTF futures.

Source: KAPSARC, based on data from Bloomberg.

Figure 2. Month-ahead power prices in France and the U.K., 2021 and 2016 to 2020 average.

Source: KAPSARC, based on data from Bloomberg.
These market responses raise questions about the European Union’s (EU’s) ability to reach carbon neutrality by 2050. For comparison, after net carbon neutrality commitments from developed countries, China announced its intent to achieve carbon neutrality by 2060, a decade after the EU. In March 2021, China published its 14th Five-Year Plan, which included carbon intensity reduction targets. Soon after, President Xi Jinping announced that China would strictly control coal generation until 2025 and start phasing it out after that (Climate Action Tracker 2021). This emissions reduction campaign greatly reduced China’s coal output, resulting in soaring coal prices (Xuewan et al. 2021). However, unpredictable factors, such as an unexpectedly rapid rebound from pandemic shutdowns and a boom in China’s exports of manufactured products, led to surging energy demand. China was not prepared to meet this demand with other energy sources. The EU may continue to face similar difficulties.
A Perfect Storm of Contingencies

Several coincidental factors on both the demand and supply sides significantly affected energy markets throughout 2021. The first such factor is weather conditions. The winter of 2020 and 2021 was long and cold, lasting about 1.5 months longer than the previous winter (Degree Days 2021). Consequently, unusually large withdrawals were made from natural gas storage facilities to satisfy the demand for winter heating. Natural gas demand in the first quarter of 2021 was 6.3 billion standard cubic meters greater than normal (National Association of Oil and Gas Service 2021).

Natural gas storage was therefore more depleted than usual at the beginning of the traditional summer filling season (BBC News Russia 2021). However, European gas storage facilities were not replenished as quickly as usual because of high summer gas prices. By early August, they were at less than 60% capacity, a 10-year low (Figure 4). Moreover, some countries had gradually reduced their total storage capacities to avoid additional investments in costly infrastructure. For instance, in 2017, the U.K. shut down the Rough storage facility, which had provided 70% of its gas storage capacity for over three decades (Ambrose 2021c).

Figure 4. Natural gas levels at European storage facilities.

Source: KAPSARC, based on data from Bloomberg.
Thus, European gas storage facilities were already lagging dangerously behind schedule in preparing for the upcoming winter in early August. Then, an accident occurred at a Gazprom plant near Novy Urengoy. On the night of August 5, a large fire broke out at a gas condensate processing plant and was not extinguished for a full day. The resulting damage forced Gazprom to stop producing both natural gas and condensate at its key fields in Urengoy and Yamburg. The gas and condensate production processes are interrelated. Gazprom therefore argued that it was technologically impossible to export ‘fat’ gas (with condensate) through the Yamal-Europe pipeline, which accepts only ‘dry’ gas (without condensate). Consequently, the accident halved the volume of natural gas supplied to Europe via the Yamal-Europe pipeline. Even before the consequences of the accident were fully realized, the market reacted. TTF prices immediately increased by another 6% following the announcement of the accident (Podobedova 2021). Pipeline deliveries were below pre-accident levels as of September 14 (Schukin 2021). On September 29, volumes delivered via the Yamal-Europe gas pipeline were still at half of their normal levels. However, Gazprom officials stated that this volume reduction was temporary and related to one client’s orders (Interfax 2021).

The third coincidental factor, increased demand for gas in Asia, was the culmination of political processes in the Asian market that had begun several years earlier. China was the central driver of these processes. In 2018, relations between Australia and China began deteriorating when Australia banned the Chinese company Huawei from competing for contracts to build its 5G network (Reuters 2020). Political tensions remained high, and coal shipments from Australia were temporarily disrupted in 2019. China also began allowing fewer Australian cargo ships to unload at its ports (Biswas 2021). Then, in mid-2020, Australia called for an investigation into the origins of COVID-19. China responded by imposing an unofficial ban on coal imports from Australia (Russell 2021). Concurrently, China began to introduce restrictions on its own domestic coal production and usage.

China needed to compensate for this reduction in coal imports and production amid its rapid recovery from COVID-19. Thus, China’s natural gas imports, including liquefied natural gas (LNG), soared (Liang 2021). This increase in natural gas will also help China achieve its stated climate goals. Thus, this trend is unlikely to weaken in the coming years. China is increasingly committed to reducing its dependence on coal, and only gas can help it reduce this dependency. China’s LNG imports in the first half of 2021 were 28% higher than in 2020. Analysts expect 12% to 13% year-on-year growth in Chinese LNG imports in the second half of the year, despite already high prices (Aizhu and Jaganathan 2021).

Natural gas in the Asian market is traditionally traded at a premium to the European market. However, more than half of the LNG currently exported to Asia is fixed and supplied under oil-indexed contracts. The volumes available for the spot market to react to the Japan Korea Marker (JKM)-TTF differential are therefore in limited supply. Thus, the market is likely to respond to even small differences in supply. In the summer of 2021, the price gap between the two markets remained very small (Figure 5). Suppliers were therefore encouraged to ship LNG to Asia instead of Europe.

China is increasingly committed to reducing its dependence on coal, and only gas can help it reduce this dependency.
The European Energy Collapse – A Chain of Contingencies or a Recurring Nightmare?

The trend toward greater volatility, however, is based on a set of events and actions that may occur in different forms somewhat regularly.

The Potential for a Recurrence

This confluence of events may initially appear to be isolated. However, it highlights an emerging fragility in energy markets that may make them more susceptible to various disruptions on the supply and demand sides. In the future, 2021 may be regarded not as an aberration but as the first in a series of increasingly volatile years for energy. Individual market swings may be impossible to predict. The trend toward greater volatility, however, is based on a set of events and actions that may occur in different forms somewhat regularly.

New national energy policies aim to phase out hydrocarbons to decrease greenhouse gas emissions and achieve various recently announced net-zero emissions targets. These policies have resulted in some progress. However, the effects of these policies on current markets and energy systems can be very costly. Using the U.K. as an example, we can show that existing technical capabilities in renewable energy are not sufficient to provide stable electricity output. In particular, utilities are unable to manage the intermittency of renewable energy sources on a large scale. Thus, the energy supply to consumers and industries may be disrupted. Ironically, the easiest solution to this volatility and the lack of a stable energy supply from renewable sources may lead to even more carbon dioxide emissions.
In the U.K., the late summer of 2021 was unexpectedly warm but not particularly windy. Thus, the demand for electricity for space cooling was higher than normal. At the same time, electricity generation from wind farms was lower than expected (Figure 6). In the first half of September 2021, wind farm output accounted for between 0% and 20% of the U.K.’s domestic generation. In the same period in 2020, wind’s share of total output sometimes exceeded 50%.

Figure 6. Wind generation in the U.K. as a percent of total generation, September 2020 and September 2021.

The U.K.’s National Grid Energy System Operator (ESO) was forced to offset the loss of generation from wind with hydrocarbons. The National Grid ESO has no long-term contracts for securing natural gas at a stable price. Moreover, natural gas spot prices were extremely high at that time. Thus, the ESO was forced to balance the U.K.’s electricity supply using coal, which is cheaper. For instance, Électricité de France’s (EDF’s) coal plant West Burton A, which had been on standby, was fired up on September 6 (BBC News 2021b). As a result, the share of coal in the U.K.’s total electricity generation jumped to 7.2% that evening (Figure 7). In the late evening and early morning hours of September 14 to 16, coal’s share decreased slightly to 5%-6% of total electricity generation.

On September 15, a fire started on a sub-sea cable of the Interconnexion France-Angleterre (IFA) 1 interconnector between the U.K. and France (Britton 2021). Half of the IFA 1 interconnector’s capacity for electricity imports from France, or 1 gigawatt (GW), was shut down (Reuters 2021). Repairs are expected to be completed by the end of March 2022 (Sheppard, Wilson, and Thomas 2021). Importing electric power from IFA 1 typically provides 3% of the U.K.’s electricity consumption during peak periods.
hours (2 GW out of 33 GW consumed). Thus, this loss is not objectively critical. However, the perception of the impact had more significant effects, as electricity prices in the U.K. wholesale market spiked on the news. On September 15, these prices reached a 10-year record high, peaking at $73.3 per MMBtu (Figure 7). This record was beaten on September 28, when prices climbed to $80.8 per MMBtu.

In 2017, the Rough storage facility, which provided 70% of the U.K.’s gas storage capacity, was shut down (Ambrose 2021c). Without enough storage facilities, the intermittency of renewables could not be balanced properly. This imbalance led to the sharp increase in energy prices. As a result, several U.K. energy providers, which together supplied more than 1.5 million customers, collapsed (BBC News 2021c). We provide more detail on this collapse in the “Consequences of the Crisis and Possible Solutions” section.

**Figure 7.** Power generation by fuel type in the U.K., September 2021.

Without enough storage facilities, the intermittency of renewables could not be balanced properly.
Russia’s Role in the Market

Several groups have made allegations that Russia, and Gazprom in particular, is trying to cash in on the problems of European consumers. The International Energy Agency publicly called for Russia to increase its supply of natural gas to the European market (Ambrose 2021a). A group of European lawmakers called for the European Commission to investigate Gazprom’s role in the recent gas price surge. They allege that the Russian gas monopolist may use the market crisis as a pretext to circumvent regulatory approval for the Nord Stream 2 pipeline. Gazprom may start supplying gas via this pipeline without approval (Krukowska, Tanas, and Khrennikova 2021).

However, European countries stopped buying new natural gas on spot, preferring to withdraw some gas from the storage facilities which were filled during the period of lower summer prices (TASS 2021a). As a result, Gazprom booked only one-third of the offered Yamal-Europe pipeline capacity (31.4 million cubic meters per day) for October and refused to book additional transit capacity via Ukraine (Marrow and Golubkova 2021) due to the lack of demand. Chairman of the Gazprom Board of Directors Viktor Zubkov stated on October 28 that the company fully complies with its contractual obligations (Rossiyskaya Gazeta 2021).

Moreover, in 2021, the supply of pipeline gas from Russia to Europe reached historically high levels. In the first half of 2021, European imports of Russian gas were 17.2 billion cubic meters greater than during the same period in 2020, an increase of 22%. The main buyers of this gas were Germany, Turkey and Italy. Russian gas exports to Germany increased by 44% and to Italy by 14% year-on-year. Turkey’s pipeline imports from Russia increased threefold relative to those in the first half of 2020 (TASS 2021b). Even compared with the first quarter of 2019, the supply of gas to Europe from Russia was almost 5% higher (Gazprom 2019, 2021).

The volume of natural gas that Russia sells to European customers is limited by its availability. According to Oxford Institute for Energy Studies estimates, Gazprom has no spare volumes available (Fulwood and Sharples 2021). Additionally, Gazprom has domestic priorities and is currently preparing for the Russian winter by filling domestic storage. Guaranteeing export volumes in excess of its contractual agreements to European customers is a way for the company to demonstrate goodwill. However, it is not an obligation. Gazprom must consider the impacts this could have on its balance sheet (Sobko 2021).
Implications for the EU

Given the current energy crisis, the positions of some EU members on climate action seem to have become less unified. For instance, the Czech Republic has asked for changes to the EU’s carbon dioxide emissions reduction plan. It claims that the current version of the plan will damage the Czech economy, especially its automotive industry (Ponikelska 2021). The Czech Republic is heavily dependent on coal, and the automotive industry employs more than 700,000 people. These jobs are threatened by the EU’s proposal to ban combustion engines from 2035.

Additionally, Poland refuses to shut down operations at the Turow lignite mine, even after an EU court order requiring it to do so. In accordance with the order, Poland is subject to a penalty of 5 million euros (€) per day starting in June 2021 unless it ceases its extraction activities (Bodoni and Onoszko 2021). However, the country claims that switching off the mine will threaten its energy security, as 70% of Polish power is generated from coal.

The events of September 2021 have called into question the EU’s and U.K.’s plans to phase out coal entirely. The U.K. announced its plan to phase out coal in summer 2021, with a deadline of October 2024 (Vetter 2021). However, the CEO of Drax, a U.K. power company, has stated that the plan to close its two coal plants by September 2022 may be delayed. The government may ask the company to keep them operational (Kennedy 2021).

France is pushing for the significant development of nuclear power, which not all EU member states welcome. In October 2021, ministers from 10 countries, including France, addressed the EU leadership in Brussels regarding this issue. They provided a letter stating that nuclear energy “must be part of the solution” (Stickings 2021). Furthermore, President Emmanuel Macron of France announced that by 2030, the country will invest €1 billion (1.16 billion U.S. dollars) in the development of nuclear technologies. These technologies are to include small modular reactors and atomic waste recycling (De Beaupuy and Nussbaum 2021). This example illustrates the challenges that European countries face in reaching consensus on the appropriate energy mix given the pressure from many directions.

Altogether, the EU must overcome several types of challenges to achieve its target of net-zero emissions by 2050. Even interim targets, such as reducing greenhouse gas emissions to 55% of 1990 levels by 2030, will be difficult to achieve. The situation is further complicated by the COVID-19 pandemic and the disruption of global supply chains.

Consequences of the Crisis and Possible Solutions: Carbon Neutral Hydrocarbons

The EU faces a complex set of policy challenges and market dynamics in trying to achieve carbon neutrality. As this study illustrates using the 2021 European gas market, efforts to replace hydrocarbons with renewables can paradoxically increase reliance on hydrocarbons. Clearly, an energy system that relies entirely on renewable energy is not practical in the
The European Energy Collapse – A Chain of Contingencies or a Recurring Nightmare?

A more sophisticated approach that sensibly incorporates the use of hydrocarbons as an energy source is likely to be the best option.

The events in September and October 2021 and the resulting high energy prices triggered a chain reaction of events. Large purchasers of energy, such as heavy industries and public utilities, have faced severe hardships, as the following list of consequences shows:

- In August 2021, Achema, a Lithuanian company, was forced to delay plans to restart its ammonia facility.

- OCI N.V., a Dutch company, had to partially shut down production at its ammonia plant in Geelen.

- CF Industries, a major fertilizer company, was forced to shut down operations at two manufacturing complexes in the U.K. on September 15. The shutdown was “due to high natural gas prices” (Business Wire 2021).

- On the same day, two utility companies in the U.K. ceased trading. These companies were Utility Point (with 220,000 domestic customers) and People’s Energy (with 350,000 domestic customers and 1,000 non-domestic customers) (Lewis 2021).

- On September 17, Yara International announced that it would cut about 40% of its European ammonia output. This cut was because of the high price of natural gas feedstock. This Norwegian company is the world’s second largest ammonia producer. The decision will impact Yara’s facilities, which have a production capacity of about 2 million tonnes per year (Solsvik et al. 2021).

- On September 20, one of the largest Ukrainian fertilizer producers, Odessa Port Plant (OPP), announced that it would suspend production for five weeks. The suspension was due to a sharp rise in gas prices. Another Ukrainian fertilizer company, Ostchem, reduced its ammonia and urea production for the same reason (Davydova 2021).

- On September 21, British Steel stated that “these colossal, unprecedented [price] rises make it impossible to profitably make steel” (Kinch and Varriale 2021).

- By September 23, five more U.K. energy providers collapsed. These companies were Hub, MoneyPlus, PFP, Green and Avro Energy. In total, seven companies failed, accounting for more than 5% of the market. As a result, the British government regulator Ofgem moved 1.5 million U.K. customers to new suppliers, such as EDF and British Gas (BBC News 2021c).

- The U.K.’s sixth largest energy provider, Bulb (1.7 million customers), is seeking financing to avoid collapse. Another energy company, Igloo, is working with restructuring consultants (BBC News 2021a). More collapses may follow if prices continue to rise and the U.K.’s government does not provide subsidies.

- The large Spanish fertilizer company Fertiberia decided to curtail its operations at several production sites. It stopped production at its Palos de la Frontera site as of October 1 (Cockerill 2021).
EU households are now facing a sharp increase in energy bills. For example, retail electricity prices are expected to rise by an average of 10% next year for households in France. German gas providers are expected to raise prices by 12.6% this fall (Paull 2021). Spain, Italy and France have announced several government aid measures to support their citizens. For instance, France plans to spend about €600 million to provide €100 subsidies for low-income households. Italy spent €1 billion on direct interventions in the energy market to cut consumer prices. It is also expected to announce a €4.5 billion support package for households (Khan et al. 2021). Spain plans to regain about €650 million from energy companies and €2.5 billion from utilities that benefited from “excess profits” (Ishwarkimmins 2021). The Spanish government claimed that “this situation can provoke a backlash against carbon-cutting initiatives.” It argued that carbon-cutting policies “may not stand a sustained period of abusive electricity prices” (Krukowska and Lombrana 2021). The U.K. is considering a similar windfall tax on energy providers (Ambrose 2021b).

Given these events, a resulting question is how climate goals can be achieved without threatening the stability and affordability of the energy supply. Several approaches can address this broad challenge. However, given the scale of the challenge, a holistic approach is needed that is not limited to the energy sector. Climate goals can only be achieved sustainably and successfully through a combination of solutions. A complete discussion of these solutions warrants a separate study via multiple lines of research. However, possible solutions include nature-based solutions; enhanced energy efficiency in the consumer and industrial sectors; carbon capture, utilization and storage technologies; and direct air capture.

One holistic, economy-wide approach, namely, the circular carbon economy (CCE) concept, is currently in development. Combining the pillars of reducing, reusing, recycling and removing, the CCE concept is flexible. It considers the unique aspects of countries’ pathways to achieving climate goals (KAPSARC 2020). The idea of circularity emphasizes the closed loop nature of an economic system in producing energy and resolving any externalities.

Among the variety of solutions that may be incorporated in the CCE approach, **carbon neutral versions of traditional hydrocarbons** can play a critical role. These technologies include carbon neutral LNG and carbon neutral oil. Carbon neutrality has no universally established definition. Usually, carbon neutral cargo includes a carbon offset that covers up to 100% of the emissions in different stages of its value chain. These offsets can stem from a variety of activities, such as sequestering or avoiding emissions (Fattouh, Heidug, and Zakkour 2021). Emissions can be sequestered through carbon capture, utilization and storage technologies, which capture and reuse carbon dioxide emissions or store them in geological formations (Aramco 2021; U.S. Department of Energy 2021). Emissions can be avoided by reducing or replacing activities that generate carbon emissions. For example, avoiding emissions may involve introducing more energy efficient practices (Helmholtz Climate Initiative 2021).
Carbon neutral hydrocarbon products offer some of the advantages of conventional fossil fuels, such as high reliability, similar physical properties and compatibility with existing infrastructure. They may not require additional investments on the consumer side. They also provide environmental benefits, such as smaller or even net-zero carbon footprints. Moreover, they can be traded at relatively low prices. According to our estimates, the cost of carbon neutral LNG may range from $8 to $12 per MMBtu. The price premium over other LNG is relatively small compared with the price volatility that current gas markets are experiencing. Thus, carbon neutral LNG can be competitive on the energy markets.

Carbon neutral LNG markets are new but are much more developed than carbon neutral oil markets. The first carbon neutral LNG cargo was announced by Shell in June 2019, and the carbon neutral LNG market has developed rapidly since then. As of November 2021, 30 deliveries or announcements of planned deliveries of such cargos were made worldwide. By comparison, only four carbon neutral oil cargos have been supplied thus far. Figure 8 shows the costs of carbon neutral LNG relative to current TTF natural gas spot prices. Based on this comparison, industrial companies may be able to use carbon neutral LNG to reduce emissions in their products’ value chains.

Figure 8. Cost of carbon neutral LNG versus TTF natural gas month-ahead prices with plant shutdown points.
Concluding Thoughts

As this commentary demonstrates, several factors disrupted the European energy market in fall 2021. One such factor was the lack of large-scale technological solutions that can balance the intermittency of renewables with the simultaneous phasing out of fossil fuels. Another was the series of unexpected events that led up to the disruption. These events included the long winter of 2020 and 2021, high natural gas demand and the rerouting of LNG to the Asian market. An incident at a Gazprom plant and warm weather in September 2021 compounded these issues. The U.K. and the EU faced major consequences, including:

• Natural gas and coal spot prices rapidly increased threefold to fivefold.
• Retail electricity prices sharply increased for customers by over 10%.
• Several utility companies serving more than 1.5 million customers collapsed.
• Governments spent billions of euros helping utility companies maintain the provision of electricity to customers.
• Coal plants were relaunched, leading to greater greenhouse gas emissions and raising questions about whether these countries would achieve their climate goals.
• Large industrial consumers of natural gas, such as fertilizer and steel plants, reduced or shut down production.

The CCE concept offers a holistic, adaptable solution that both meets climate ambitions and guarantees energy security and a stable supply for consumers. Carbon neutral versions of traditional hydrocarbon products can be included within this. Because the market for carbon neutral hydrocarbons remains immature, the rules and standards for offsets and trade remain unclear. However, this market is developing rapidly, and new practices and regulations are continually being established. Further research from KAPSARC will focus on these issues.
The European Energy Collapse – A Chain of Contingencies or a Recurring Nightmare?

References


The European Energy Collapse – A Chain of Contingencies or a Recurring Nightmare?


About the Project

The project “The Future of Hydrocarbons in a Carbon-Managed World” is aimed at estimating the consequences of international carbon regulation for hydrocarbon markets. Conventional hydrocarbon producers have started responding to this regulation with 'carbon neutral’ versions of their products. Nowadays, the carbon-neutral LNG market is more developed than the carbon-neutral oil market. This project is focused on accumulating existing experience of the delivery of carbon-neutral hydrocarbon products, analyzing the likely transformation of market fundamentals due to the increasing requirements for carbon neutrality and proposing a pathway to help Saudi Arabia to keep its competitiveness in the evolving market.

About KAPSARC

The King Abdullah Petroleum Studies and Research Center (KAPSARC) is a non-profit global institution dedicated to independent research into energy economics, policy, technology and the environment, across all types of energy. KAPSARC’s mandate is to advance the understanding of energy challenges and opportunities facing the world today and tomorrow, through unbiased, independent, and high-caliber research for the benefit of society. KAPSARC is located in Riyadh, Saudi Arabia.

Legal Notice

© Copyright 2022 King Abdullah Petroleum Studies and Research Center (“KAPSARC”). This Document (and any information, data or materials contained therein) (the “Document”) shall not be used without the proper attribution to KAPSARC. The Document shall not be reproduced, in whole or in part, without the written permission of KAPSARC. KAPSARC makes no warranty, representation or undertaking whether expressed or implied, nor does it assume any legal liability, whether direct or indirect, or responsibility for the accuracy, completeness, or usefulness of any information that is contained in the Document. Nothing in the Document constitutes or shall be implied to constitute advice, recommendation or option. The views and opinions expressed in this publication are those of the authors and do not necessarily reflect the official views or position of KAPSARC.