

SURVEILLANCE

REPORT 2022

The functioning of the
wholesale electricity
and natural gas
markets

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MESSAGE FROM THE BOARD OF THE CRE

2022: AN EXCEPTIONAL YEAR FOR WHOLESALE ELECTRICITY AND GAS MARKETS

This 16th edition of the CRE's annual report on the monitoring of the wholesale electricity and natural gas markets covers the year 2022. The energy crisis began in the second half of 2021, with the first signs of tension over gas supplies in Europe just before the winter of 2021-2022. It intensified in 2022, not only in the gas markets, but also on the electricity markets, where prices reached unprecedented levels.

The war started by Russia on 24 February 2022 in Ukraine, followed by a gradual decline of Russian gas deliveries by pipeline to almost shutdown in the summer of 2022. The destruction of the Nord Stream 1 and 2 gas pipelines and the massive use of LNG delivered by sea, leading to a reversal of flows from west to east, are all events that have shaken up the functioning of gas markets in Europe, and France has not been spared. Such a situation had never arisen since Russian gas supplies to Europe began more than 50 years ago.

This major gas supply crisis on a European scale was reflected throughout 2022 by a surge in wholesale gas and electricity prices in the region's markets. France, which relies relatively little on gas for its electricity generation, has found itself in a difficult situation as a result of the crisis in its nuclear fleet, which has had its worst year ever, with a 30% drop in generation compared with 2021.

The reaction of the European Union, in particular that of the European Commission and the Member States, but also that of the energy market players, provided a swift response to the major challenges posed by this crisis. In just a few months, the European Union has sharply reduced its gas consumption, filled its gas stocks for the winter of 2022-2023, and completed the connection of several floating LNG terminals, adding to existing port capacity. Faced with soaring electricity prices, the EU has planned and authorised massive aid to consumers from Member States, financed by taxing the infra-marginal profits of electricity producers. The recent fall in prices means that Europe can look forward to emerging from the crisis, even if the situation remains fragile and calls for continued efforts to reduce consumption.

In this context, it is important to note that the well-developed French gas network, with its four LNG terminals and large, flexible storage facilities, has played a major role in ensuring security of supply in Europe, with significant gas exports to Belgium, Germany and Italy. The mobilisation of France's nuclear generating capacity, even though it was reduced throughout 2022, has made it possible to avoid rotating load shedding during the winter, which was otherwise fairly mild.

In these times of high prices and high volatility, which weigh on consumers' bills and force the State into costly interventions, the CRE's task of monitoring the wholesale markets is of particular importance. In 2022, the CRE closely monitored the behaviour of wholesale market players, focusing in particular on detecting and then sanctioning insider trading. Based on the information available, within the scope of its investigation power and at this stage of its analyses, the CRE has not identified, for the year 2022, any behaviour likely to be qualified as market abuse under Regulation (EU) 1227/2011 (REMIT), regarding either gas or electricity.

By generating strong price signals in the short and medium term, the wholesale gas and electricity markets played their part in 2022, affecting sharply and substantially the supply and demand for natural gas, which, by adapting to these new conditions, made it possible to avoid any disruption in supply.

However, these very high prices have had serious consequences, not only economically, but also politically and socially, showing the need to adapt the internal electricity market and strengthen its ability to cope with shocks. The reform proposed by the European Commission in March 2023 should be adopted before the end of the year. It should preserve the functioning of the European internal market while protecting consumers from high prices in the event of a crisis. The corollary of maintaining a market design based on an efficient and liquid short-term market is confidence in the integrity and functioning of this market: thus, the development of REMIT's provisions to strengthen the transparency of wholesale markets is intended to increase public confidence in their proper functioning.

The CRE is committed to implementing the reform of European market design, providing its expertise and support to the French government, and working with all European regulators.

These reforms must also, and above all, support and encourage a major transformation of Europe's energy system, which is already underway and is set to accelerate sharply over the next few years. The climate targets require a rapid increase in the generation of carbon-free electricity, particularly in France from renewable sources. The

significant need for flexibility that this will entail calls for greater integration of the internal electricity market and full use of the price signals it generates.

SUMMARY

The historic rise in prices on the wholesale gas and electricity markets, which began in 2021, peaked in the summer of 2022 and then began to fall at the end of the year.

It was from the second half of 2021 that fears of a shortage of European gas supplies, with low levels of storage, caused wholesale prices to start rising to unprecedented levels. This rise accelerated with Russia's invasion of Ukraine on 24 February 2022 and a gradual, then almost complete, drop in Russian gas deliveries via pipelines throughout the year. By 2022, LNG will have almost completely replaced onshore supplies of Russian gas.

Low supply, fears about security of gas supply, and regulatory measures taken in most European countries to force storage facilities to be filled for the winter of 2022-2023, led to a very sharp rise in gas prices in the first half of the year, peaking at the end of August at historic levels, before easing off at the end of 2022, although remaining at high levels.

Wholesale electricity prices in Europe have been driven up by gas prices, due to the need to generate electricity from gas to cover consumption. French prices have also been affected by the lack of availability of nuclear power plants in 2022 and the uncertainties surrounding them, in particular the detection of stress corrosion, which could affect many of them. Spot and forward electricity prices in France were well above those in other European countries, despite lower gas prices than in Germany or the Netherlands.

At the end of the year, mild temperatures and the reaction of consumers to high prices reduced demand for gas and electricity in Europe, contributing to a sharp fall in prices, against a backdrop of very high levels of gas storage. In France, the authorities' call for energy consumption restraint has also raised public awareness and reduced consumption of different types of consumers, including those consumers not exposed to market prices. For electricity in France, the sharp fall in prices at the end of the year was also due to the rapid return to service of some French nuclear power plants for the winter of 2022-2023.

Against this exceptional backdrop, the wholesale gas and electricity markets played their part by reflecting, through very high prices, the strong tension between energy supply and demand and the high risk of supply disruptions.

Against this backdrop, gas and electricity prices have been particularly volatile and have shown a heightened sensitivity to every event linked to the energy sector, and in particular to announcements concerning gas supplies from Russia or the availability of French nuclear power plants. Such a situation is, by its nature, conducive to market manipulation and insider trading. Against this backdrop, ACER (the European Union Agency for the Cooperation of Energy Regulators), and the financial authorities, have joined forces to improve and strengthen the supervision of the wholesale energy markets. These include enhanced cooperation at European level between ACER and ESMA (the European Securities and Markets Authority) and the launch of a cross-border investigation by a group of three national energy regulators coordinated by ACER. From the second half of 2021, the CRE had stepped up its monitoring of the French gas and electricity markets.

During the crisis, the CRE monitored the wholesale markets close to real time, in collaboration with ACER and the other European energy regulators.

In this highly turbulent context, the CRE's monitoring of the wholesale markets is particularly important.

On the gas market, the CRE carried out systematic analyses of transactions during periods of sharp price fluctuations, in connection with announcements concerning European supplies. On the electricity market, the CRE published on 13 December 2022, based on a survey of French market players, its in-depth analysis of the very high prices and risk premiums observed in the summer and autumn of 2022 on forward contracts delivered in France for the winter of 2022-2023. The CRE also paid particular attention to the quality of REMIT publications on the status of the nuclear power plants, given their major impact on prices.

The scope monitored by the CRE, as part of REMIT, represented more than 5.5 million transactions carried out in 2022 on the wholesale energy markets, for more than 2100 TWh exchanged or €383 billion in value (up sharply from previous years due to the spectacular rise in prices).

At the end of 2022, seven investigations were ongoing by CRE and one case was being looked into by CoRDIS (Committee to Settle Disputes and Apply Sanctions). In the first half of 2023, the CRE's Chairman decided to open two investigations and referred three cases to CoRDIS following investigations into wholesale markets.

To identify possible cases of market abuse, the CRE relies on automated detection tools, as well as on reports of suspicions received from various sources, in particular from PPATs (persons professionally arranging transactions) who, as organisers of trading operations on their platforms, represent a valuable source of information. Pursuant to Article 15 of the REMIT, PPATs are required to notify the national regulatory authority without delay if they have reasons to suspect a breach of Articles 3 or 5 of the REMIT. Despite a very turbulent 2022, the CRE has not observed

any particular increase in the number of alerts from PPATs: seven notifications of suspicious behaviour were received by the CRE in 2022. While this finding may be interpreted as reassuring, the low number of notifications has nevertheless led the CRE to remind certain PPATs of their duty to monitor their market. The CRE works closely with PPATs and ensures that they carry out their monitoring role effectively.

The CRE attaches great importance to European work and projects aimed at establishing common rules and practices for monitoring energy markets within the European Union. Several subjects are of common interest and require close cooperation between regulators and ACER. The CRE actively participates in European working groups and forums relating to REMIT, in close collaboration with ACER, as well as with energy regulators from other EU Member States and financial and competition authorities.

In 2022, the CRE made an active contribution to ACER's work on improving the quality and use of the data declared by market participants to ACER under Article 8 of REMIT. In this context, ACER has updated its guidelines for the reporting of transactional and fundamental data in 2022 and early 2023. As part of its reinforced monitoring of the wholesale markets, the CRE held discussions with a number of market players in 2022 on the quality and interpretation of the data reported to ACER.

In 2022, the European gas market was shaken by the almost complete drop of pipeline deliveries of Russian gas and the massive use of LNG, leading to a reversal of flows in Europe. It has proved resilient despite prices reaching unprecedented levels.

In 2021, the low filling level of European storage facilities, due in particular to the lack of gas injections by Gazprom into the storage capacity it held in several European Union countries, led to fears of supply disruptions for the winter of 2021-2022, against a backdrop of successive political announcements concerning the supply of Russian gas to Europe via pipelines. From the summer of 2021, this context has triggered an unprecedented rise in gas prices.

After the invasion of Ukraine on 24 February 2022, Russia gradually reduced its pipeline gas deliveries, stopping them almost completely at the end of the summer, with no prospect their resumption following the destruction of the Nord Stream 1 and 2 pipelines on 26 September 2022.

Reduced supply and fears about security of supply in Europe led to a historic rise in gas prices until the summer, after an initial peak following the outbreak of war, when the day-ahead price at the PEG (Gas Exchange Point) reached €213.40/MWh on 7 March 2022. Gas demand was also boosted during the summer by deliveries to European storage facilities, encouraged by regulatory measures designed to force storage facilities to fill up before the winter of 2022-2023. The rise in prices affected all maturities. The day-ahead price at the PEG peaked at €227.50/MWh on 29 August 2022, while the forward price for the fourth quarter of 2022 peaked on 26 August 2022 at €302.60/MWh.

Very high wholesale gas prices have attracted all the world's available LNG to Europe, largely offsetting the decline in Russian pipeline gas flows. French LNG terminals have played a central role, receiving 22% of the LNG delivered in Europe and operating on average at 90% of their capacity in 2022.

The replacement of onshore supplies from Eastern Europe by LNG arriving mainly from Southern and Western Europe has led to an unprecedented reconfiguration of flows and generated congestion on the European network, resulting in high price differences between national markets, which until now had been highly correlated. The day-ahead price on the PEG was on average €22.3/MWh lower than on the Dutch TTF, the benchmark market in Europe, with spreads of over €100/MWh in August and September 2022. The TRF (Trading Region France) market zone, with four LNG terminals, full underground storage facilities at the beginning of winter and a well-sized, flexible gas transmission network, has played a major role in this reconfiguration of flows. For the first time, France has become a net importer of gas from Spain and an exporter to Belgium and Germany, while exporting to Italy (via Switzerland) at an exceptionally high level.

Throughout the period, the French gas system was operating to the limits of its capacity. At the end of the year, the redirection of Norwegian gas flows from France to the UK led to major congestion on the French gas transmission network, with a deficit in the north of the country and a surplus in the south. The French grid operators had to activate the localized spreads mechanism and mutualized restrictions, and the CRE was forced to take an emergency decision in December 2022 to respond to this new situation. The CRE is monitoring the nominations of market players in connection with the localized spreads mechanism on the gas transmission network and has questioned several of them in this context. In-depth analyses are ongoing. Lastly, on 15 June 2023, the CRE launched a public consultation on regulatory fixes for managing congestion on the gas transmission networks from south to north, in order to learn lessons from these episodes.

While fears about security of supply were high before the winter, exceptionally mild temperatures, the reaction of industrial consumers to high prices and energy-saving measures have finally enabled France and Europe to get through the winter of 2022-2023 without difficulty.

The sharp increase in the volume of LNG arriving in France led to a significant rise in the volumes traded on the PEG, with most of the LNG traded on the French market. This increase in trading volumes, which averaged 93%, affected all maturities, but was particularly important for medium-term contracts.

In this disrupted environment, wholesale gas prices were highly sensitive to announcements about supplies to Europe, creating an environment conducive to insider trading and market manipulation. The CRE has stepped up its monitoring of the French gas market in 2022 and has carried out an exhaustive search for possible insider trading on the PEG. At this point, no convincing suspicion of market abuse, within the meaning of REMIT, has been identified in the French wholesale gas market.

European electricity prices have been driven by gas prices, while French prices have been particularly affected by the crisis in its nuclear power plants.

Because electricity is priced at the marginal cost of the last unit called, electricity prices are very sensitive to the price of gas - a flexible source of energy that can easily be mobilised when needed at peak times - which then becomes essential to ensure the supply-demand balance, particularly in winter. As a result, gas prices have pushed up European electricity prices significantly in 2022. Although natural gas accounts for only a minor part of France's electricity generation, French prices have also been particularly affected by the low availability of the French nuclear power fleet, following the discovery of the phenomenon of "stress corrosion" in pipes that are critical to the safety of nuclear power plants. This is the most serious generic incident encountered by French nuclear power plants in recent decades.

In 2022, French nuclear generation reached an all-time low of 279 TWh, 82 TWh less than in 2021 and 56 TWh less than in 2020, a year of exceptional disruptions and low production due to the Covid crisis. As a result of this generation deficit, France was, exceptionally, a net importer over the whole of 2022, by a total of 16 TWh. In addition to imports, the fall in production was mainly offset by a rise in gas-fired generation, as droughts and low water levels had a negative impact on hydroelectric power.

French forward electricity prices have been exceptionally high for the winter of 2022-2023, much higher than in neighbouring countries. This has led market participants, particularly suppliers, to buy power at high prices for fear of scarcity, against a backdrop of great uncertainty about the availability of nuclear power plants during the winter. So, despite the ARENH (Regulated Access to Historic Nuclear Energy), these high prices have impacted the prices paid by the consumers.

Futures prices have revealed high risk premiums linked to the extremely high cost that would have been borne by the market players concerned (and more broadly by French society) if expectations of a failure in the supply-demand balance had come true. Futures prices were driven upwards by hedging pressure, as market players were very reluctant to short selling, given the very high risks in that type of position. This pressure on forward prices led market players with generation resources that have limited energy reserves, such as hydroelectric generation and certain nuclear reactors, to manage them prudently over the summer and autumn, which has enabled them to have the capacity they needed over the winter.

Thanks to the improved availability of nuclear power plants from November 2022 and the fall in consumption due to a mild winter, high prices and efforts to reduce energy consumption, the French electricity system did not suffer any actual shortage, despite risks identified during the year.

Spot prices averaged €276/MWh in 2022, well above the forward price for 2022 averaged over 2021 (€95.50/MWh) and averaged over 2020 and 2021 (€70.80/MWh). They were driven up throughout the year by the combined effect of high gas prices, low nuclear output and the constraints anticipated for the winter of 2022-2023, leading to limits on hydroelectric power generation. The peak was reached, at the same time as wholesale gas prices, in the summer of 2022 (€611.6/MWh on average over the week of 22 August 2022), although the summer period is normally characterised by lower prices due to lower consumption. Finally, spot electricity prices in France were higher than in Germany, while gas prices were lower overall.

Following the peak in gas and electricity prices at the end of August, forward electricity prices in France remained very high until the end of the year, with the price of the annual 2023 product and the 1st quarter 2023 product remaining at respectively, €465.70/MWh and €740/MWh on 1 November 2022. Nuclear power availability remained low for most of the autumn, being below around 32 GW until 15 November 2022, fuelling expectations of shortage in France over the winter.

The end of 2022 saw a rapid rise in the availability of the nuclear power plants, from 29 GW on 1 November 2022 to 42 GW on 15 December 2022. Wholesale prices then fell rapidly, due to the reduction in risk premiums for the winter of 2022-2023 and following the drop in wholesale gas prices in the context of moderate consumption and mild temperatures.

The CRE has been particularly vigilant about changes in wholesale electricity prices in France. The CRE has stepped up its monitoring of insider trading during periods of sharp price fluctuations and the publication of insider information on the availability of generation resources.

The CRE also questioned market players on the French wholesale electricity market about their trading strategies, in an attempt to explain the record levels of forward prices achieved during the summer for the winter of 2022-2023. The report published by the CRE on 13 December 2022 concluded that hedging the risks associated with physical activities (generation, supply, consumption, boundaries exchanges) has led, on the one hand, to buy in excess of average anticipated consumption and, on the other hand, to a reduction in sales on the forward markets. This automatically contributed to a tension on the futures markets greater than the anticipated supply-demand balance, which explains, at least in part, the very high level of the risk premium on the French market for the winter of 2022-2023.

An additional explanatory factor mentioned by many market players, although difficult to quantify, was the late auctioning of interconnection capacity, which at most borders takes place only in November and December of year N-1 for the annual product of year N. The CRE, in conjunction with RTE (Réseau de Transport d'Électricité/Electricity Transmission Network) and the regulators and system operators of neighbouring countries, has begun work to bring forward the auctioning of cross-border exchange capacity in order to give market participants greater visibility.

The CRE continues to analyse the individual behaviour of certain market players. Based on the information available, within the scope of REMIT, and at this stage of its analyses, the CRE has not identified any market abuse under REMIT in the electricity futures markets for the winter of 2022-2023 and the year 2023.

For the first time since the capacity mechanism was set up, the ceiling of €60,000/MWh was reached at the December 2022 auction for the 2023 delivery year, reflecting the exceptional stress anticipated on the electricity system.

As regards balancing markets, implementation of the TERRE (Trans European Replacement Reserves Exchange) platform was completed in March 2022 with the start of RTE's ongoing participation. The other existing market mechanisms continued to play their role satisfactorily, with no major impact on price levels. Because of their rapid development and complexity, these markets require close monitoring by the CRE.

Finally, it is worth mentioning that the French daily market experienced the exceptional prices on 4 April 2022, with prices very close to the ceiling of €3000/MWh. This price development led to an increase in the price cap across Europe to €4000/MWh. The report published by the CRE on 26 July 2022 shows that this was an isolated episode resulting from an exceptional combination of several factors, each with a very low probability of occurrence. Following this report, the CRE requested and obtained the suspension of the automatic mechanism for raising the price cap, which would otherwise have had to be raised to €5000/MWh after a similar price peak on 17 August 2022 in the Baltic zone (Lithuania, Estonia, Latvia), and the revision of the mechanism for changing this cap, which was adopted by ACER in January 2023.

Finally, the large installed capacity of French nuclear power means that EDF must reduce generation (to implement modulations), particularly when demand is too low or to optimise schedules for refuelling. The CRE has analysed the implementation of modulations by EDF, ensuring in particular that there is no "capacity withholding" type of behaviour. These CRE's analyses did not reveal any under-optimisation. The modulations presented by EDF are designed to maximise the availability of the nuclear power plants at times of highest consumption, in the interests of the French electricity system and in particular for the winter of 2022-2023.

At the time of publication of this report, the wholesale gas and electricity markets have eased relative to 2022, but their absolute level remains high and their volatility high. The CRE accordingly remains fully committed to strengthening its monitoring of wholesale markets.

This report covers data for the 2022 calendar year. Where appropriate, highlights of monitoring activity during the first few months of 2023 are also mentioned.

The CRE and REMIT: the supervision of wholesale markets, a European affair

Since 2006, the Commission de régulation de l'énergie (the CRE) has been responsible for overseeing the French wholesale electricity and natural gas markets. Each year, it publishes its monitoring report on the operation of the French wholesale electricity and natural gas markets.

Since 28 December 2011, the CRE's task of overseeing the wholesale energy markets has been governed by European Regulation 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency (REMIT).

Pursuant to the provisions of Article L. 131-2 of the French Energy Code, the CRE monitors the wholesale electricity and natural gas markets and ensures compliance with Articles 3, 4, 5, 8, 9 and 15 of REMIT.

In this regard, the CRE pays particular attention to the provisions aimed at ensuring the integrity and transparency of the wholesale energy markets by:

- prohibiting market manipulation and insider trading (Articles 3 and 5);
- obliging market participants to publish inside information they hold (Article 4).

The CRE is also committed to ensuring that PPATs¹ comply with their duties to detect and report suspected insider trading or market manipulation under Article 15 of REMIT.

Finally, the application of certain articles of REMIT has been extended to the French capacity guarantee market. In application of Article L. 131-2 of the French Energy Code, the CRE guarantees compliance with the ban on insider trading (Article 3), the obligation to publish inside information (Article 4) and the ban on market manipulation (Article 5) in the context of the capacity obligation mechanism.

REMIT has been implemented at European level under the provisions of Article 16 of REMIT, which provides in particular for cooperation between ACER, the European Securities and Markets Authority (ESMA), the energy regulators of the Member States of the European Union and the financial and competition authorities.

¹Persons Professionally Arranging Transactions (PPATs), mainly stock exchanges, brokers and certain network operators.

The CRE's monitoring activities in 2022



5.5 million transactions monitored

2,100 TWh traded

More than **€383** billion traded in value



870 alerts received from ACER since October 2017

Some forty cases currently being analysed at monitoring stage

1,767 market participants registered with the CRE



7 investigations in progress

1 investigation currently being examined by CoRDIS

Wholesale market in France in 2022

Electricity prices



€275.90/MWh average spot price:
+153% compared to 2021

€367.20/MWh average annual
forward price: **+286%** compared to
2021

Natural gas prices



€98.10/MWh average spot price:
+111% compared to 2021

€107.30/MWh average annual
forward price: **+218%** compared to
2021

SECTION 1 WHOLESALE MARKETS MONITORING BY THE CRE

1. MONITORING OF WHOLESALE MARKETS BY THE CRE UNDER REMIT IN 2022

1.1 Statistics by source of detection of potentially suspicious behaviour

The CRE's monitoring activities are based on the *ex-post* detection of potentially suspicious behaviour, either using internal detection tools or following reports from external parties.

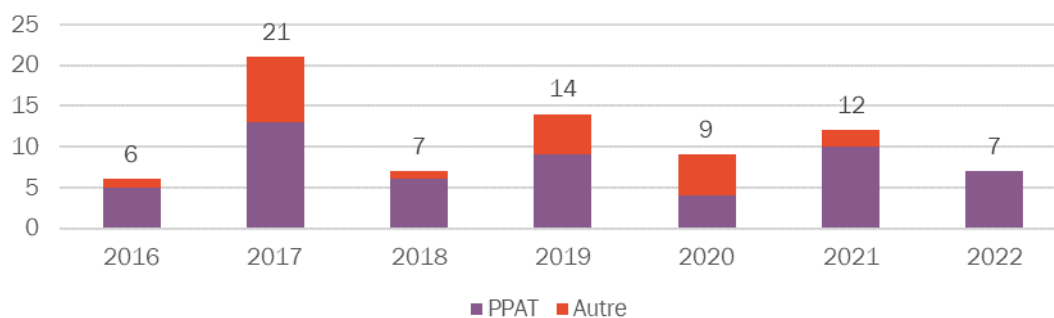
Internal detection is based on monitoring market conditions and fundamentals, but above all on automated tools designed to monitor market segments to detect specific scenarios and behaviours of market participants. The CRE's tools are designed primarily to detect and analyse insider trading and market manipulation practices prohibited by REMIT. The CRE also monitors the effectiveness of the publication of insider information and has tools for analysing and detecting such information.

External detection is based on suspicious transaction reports received from various sources, including first and foremost Persons Professionally Arranging Transactions (PPATs²) who, as organisers of trading operations on their platforms³, represent a valuable source of information for the CRE. Under Article 15 of REMIT, PPATs are required to promptly notify the national regulatory authority if they have reason to suspect a breach of Articles 3 or 5 of REMIT. Breaches of this obligation may be sanctioned by CoRDs (Committee to Settle Disputes and Apply Sanctions) under Article L. 134-25 of the French Energy Code.

Figure 1 shows the number of reports of suspected breaches of REMIT notified to the CRE by PPATs, other regulators or market participants in recent years.

The wholesale markets underwent a profound upheaval in 2022, with sudden movements and record price levels. Only 7 notifications of suspicious behaviour were received by the CRE in 2022, all from PPATs, and in decrease compared to figure on 2021: the fact that there was no particular increase in the number of alerts from PPATs may be interpreted as a sign of a properly functioning market. However, the low number of notifications led the CRE to remind certain PPATs of their duty to monitor. The CRE considers the monitoring activities of the PPATs to be essential, and maintains active collaboration with them, to ensure that they carry out their monitoring role effectively.

Figure 1 : Number of external reports of suspected breaches of REMIT



Source: the CRE

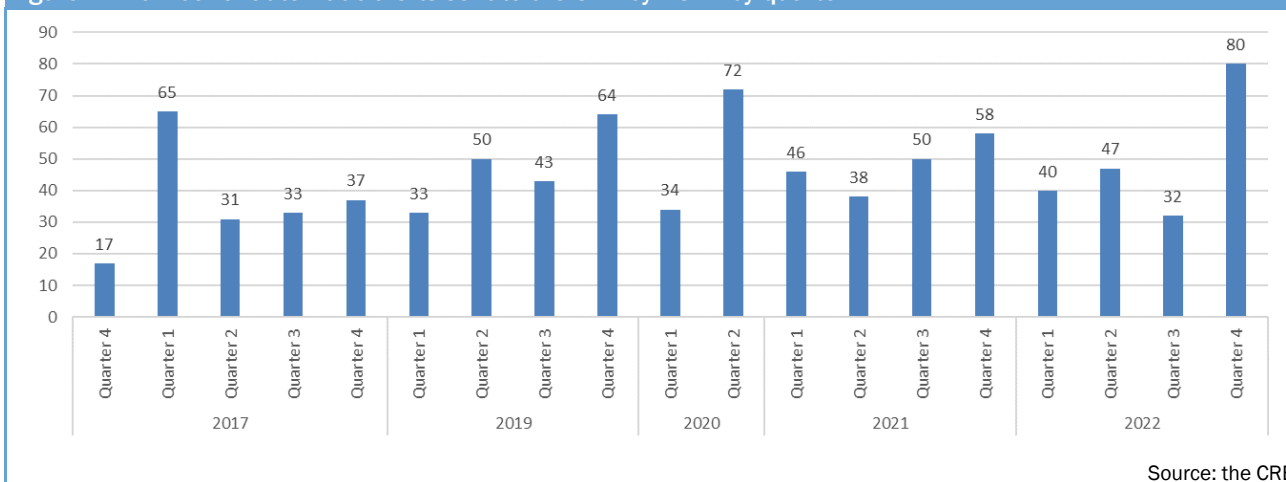
ACER also transmits cases of suspicion that it detects by accompanying them with its preliminary analyses, as well as alerts from its automatic detection systems, without any associated qualitative analysis. On this last point, since the end of 2017 it has been forwarding alerts to national regulators pointing to transactions that it deems suspicious. These alerts make it possible to identify unusual transactions, and an analysis of those by the CRE may lead to an in-depth analysis and possibly an investigation.

From October 2017 to December 2022, 870 alerts for potentially suspicious transactions or groups of transactions were transmitted to the CRE by ACER (Figure 2). Some of these alerts related exclusively to the French market, under the responsibility of the CRE, while others involved cross-border exchanges and accordingly also concern other regulators. Among the alerts received, there is a preponderance of alerts concerning purchases and sales of the same product and at the same price by a market participant, which may result from the market player's own transactions. In 2022, ACER introduced new alerts, in particular concerning the detection of potential insider trading based on the unavailability of generating facilities published by electricity producers. As with the other external sources of detection, the CRE has not noted any significant upward trend in ACER alerts, with the exception of the last quarter of 2022, for which an increase can be explained in part by the new types of alerts introduced by ACER.

²Persons Professionally Arranging Transactions (PPATs), mainly stock exchanges, brokers and certain network operators.

³Among the PPATs identified as being concerned with the French markets, the main ones are currently: EPEX SPOT, EEX, Nord Pool, TP ICAP group (various entities), Griffin, Aurel BGC, GFI Brokers, HPC, Marex Spectron Europe, Tradition Financial Services, RTE, JAO, Prisma.

Figure 2 : Number of automatic alerts sent to the CRE by ACER by quarter



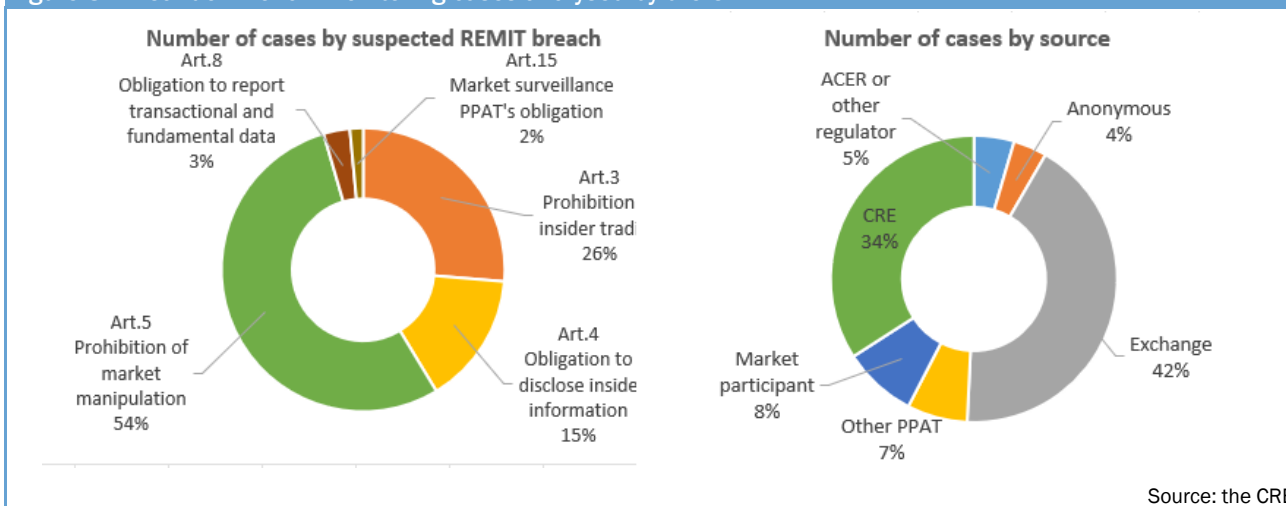
Similarly, other regulatory authorities, both in France and abroad, pass on information about potentially suspicious behaviour to the CRE.

The CRE also receives information about suspicious behaviour from market participants. The CRE encourages this vigilance and reminds that anyone who suspects a breach of REMIT can report it, anonymously or not, to surveillance@cre.fr or on the European notification platform set up for this purpose⁴.

Any suspicious behaviour detected, either internally by the CRE or through an external report, is first checked to ensure that the suspicion is reasonable. To date, around forty cases have been opened by the CRE and are currently being analysed. Four formal investigations were opened by the CRE in 2022 and in the first half of 2023⁵, and one analysis was closed without opening an investigation. The CoRDs, which may be called on by the CRE’s Chairman following such investigations, may sanction breaches of the REMIT in accordance with Article L134-25 of the French Energy Code.

Figure 3 shows a retrospective view of analysed cases. It appears that suspected breaches most often concern Articles 3 and 5 of REMIT (prohibition of insider trading and market manipulation), in 26% and 54% of cases respectively.

Figure 3 : Breakdown of all monitoring cases analysed by the CRE



In addition to suspicious cases, the CRE also analyses unusual market events or the specific behaviour of certain market players. These specific topic-oriented analyses are not generally made public, with some exceptions (see Section 1, §1.2). These topic-oriented studies, because of their generic scope, are not counted among the suspect cases mentioned above, but may lead, depending on the results, to a case analysis or an investigation.

⁴<https://www.acer-remit.eu/np/home>.

⁵The data and the behaviour that gave rise to the opening of investigations in 2022 and 2023 date back to earlier years, as the monitoring and detection of potentially suspicious behaviour is by nature *ex-post*, in addition to which a verification of the reasonableness of the suspicion requires time.



1.2 Strengthening market monitoring in the context of a major gas and electricity supply crisis in 2022

Since the second half of 2021, Europe's energy markets have been experiencing unprecedented price levels, high price volatility and heightened sensitivity to every event linked to the energy sector. This exceptional environment may be conducive to market manipulation and insider trading, due to the increased volatility and responsiveness of the market to published information. In these circumstances, it is particularly important to ensure effective publication of inside information, particularly those concerning the availability of electricity generation capacity.

The CRE has stepped up its controls on the wholesale markets under Articles 3, 4 and 5 of REMIT (prohibition of insider trading, obligation to publish inside information and prohibition of market manipulation), devoting a significant proportion of its resources to analysing transactions and publications in real time or close to real time, so as to be able to open investigations quickly in the case of suspicion.

The CRE also reacted to major events affecting the French wholesale electricity market.

On 8 July 2022, the CRE published a report⁶ on the exceptional prices reached on the French daily market for two hours between 7.00 a.m. and 9.00 a.m. on 4 April 2022, which had the effect of raising the European spot price ceiling from €3000/MWh to €4000/MWh. The analyses carried out by the CRE showed that this price spike was the result of a highly unlikely combination of various uncorrelated, one-off events.

Based on the conclusions of this report, the CRE called for a review of the automaticity of the increase in the harmonised price cap on the single European daily coupling. It should be noted that a similar price spike occurred on 17 August 2022 in the Baltic Zone (Lithuania, Estonia, Latvia). Thanks to the CRE's action, and following an intervention by the Council of European Energy Ministers, the NEMOs (Nominated Electricity Market Operators) and TSOs (Transmission System Operators) suspended the automatic increase in the spot price cap on 13 September 2022 (without this suspension, the cap would have risen to €5000/MWh). Subsequently, a revised methodology, defining more rigorously the conditions for increasing the price cap, was approved and published on 10 January 2023 by ACER.

Starting in summer 2022, the CRE has also carried out an in-depth analysis of the French electricity futures market. On 26 July 2022⁷, it published its preliminary analysis of the very high forward prices for the winter of 2022-2023 and the year 2023. The CRE then launched a survey of all French market participants regarding their trading strategies. The report published on 13 December 2022⁸ explains the futures prices formation in the 2022 environment and highlights that they reflect expectations of extreme tension and high risk-premiums. Based on the information available at this stage, the CRE is not aware of any behaviour likely to be qualified as market abuse under REMIT and is continuing its reinforced monitoring.

As regards the gas market, the CRE carried out special monitoring of the French market in 2022, and in particular conducted an exhaustive search for all possible instances of insider trading on the PEG.

Lastly, the CRE has stepped up its collaboration with ACER and the European national regulators in 2022, to strengthen its ability to detect potential market abuse with a multi-national or European dimension.

1.3 Supporting PPATs (exchanges, brokers, etc.) in their monitoring mission

Pursuant to Article 15 of REMIT, Persons Professionally Arranging Transactions (PPAT) in wholesale energy products must establish and maintain effective arrangements and procedures to detect breaches of Articles 3 or 5 of REMIT and promptly notify the national regulatory authority if they have reason to suspect that a transaction may breach Articles 3 or 5 of REMIT.

CRE considers the monitoring activities carried out by the PPATs to be fundamental and maintains an active collaboration with them. This enables the CRE not only to strengthen the monitoring of the wholesale energy markets in France, but also to benefit from the expertise of each of these PPATs on the market segments they operate. To this end, the CRE has maintained its collaboration with exchanges, brokers active in France and RTE (the only network operator qualified as a PPAT in France) in 2022. These exchanges make it possible to monitor the development and evolution of the monitoring tools and procedures implemented by the PPATs and to share the analyses of suspicious cases detected within their scope. The monitoring of brokers based in France is organised jointly with the AMF (Financial Markets Authority).

The CRE recalls the obligation for PPATs to notify the national regulatory authority if they have reason to suspect that a transaction may infringe Articles 3 or 5 of REMIT. According to ACER's general guidelines on the application

⁶ <https://www.cre.fr/Documents/Publications/Rapports-thematiques/analyse-et-enseignements-sur-le-pic-de-prix-sur-l-enchere-journaliere-pour-le-4-avril-2022>

⁷ <https://www.cre.fr/Actualites/hausse-des-prix-pour-l-hiver-prochain-la-cre-interroge-les-acteurs-de-marche-sur-leurs-strategies-et-leurs-anticipations>

⁸ <https://www.cre.fr/Documents/Publications/Rapports-thematiques/prix-a-terme-de-l-electricite-pour-l-hiver-2022-2023-et-l-annee-2023>

of REMIT⁹, PPATs must at least notify the NRA (National Regulatory Authority) of the Member State(s) of delivery of the wholesale energy product(s) involved and the NRA of the Member State in which the market participant involved in the potential breach has registered¹⁰.

An STR (*Suspicious Transaction Report*) must be clear and precise to enable the NRA being notified to understand the essential facts of the case and must contain as much information as possible to enable the case to be assessed. As a minimum, the notification must contain the following information:

- the identity of the market participant(s) involved;
- the time of the potential breach;
- the market(s) involved;
- details of the transaction(s)/order(s)/behaviour(s) involved.

In addition, Section 8.3 of ACER's Guidance⁹ on REMIT provides recommendations on the relevant information to be included in the STR, when available.

The CRE reiterates the importance of good cooperation between the NRAs and the PPATs, while it has noted a drop in the STRs sent by certain PPATs in 2022 (Section 1, §1.1). Even if, at this stage, the CRE does not suspect any breach of Article 15 of REMIT, the CRE will not hesitate, within the framework provided by law, to open investigations against PPATs that are not properly carrying out their mission of monitoring wholesale markets and, depending on their findings, to refer the matter to CoRDIS, which may impose sanctions.

2. INVESTIGATIONS AND SANCTIONS FOR BREACHES OF REMIT

Pursuant to Article L.135-3 of the French Energy Code, the CRE agents authorised for this purpose by the CRE's Chairman to carry out the investigations necessary for the accomplishment of the CRE's tasks. Accordingly, if there is a suspicion of REMIT breach, the CRE's Chairman can appoint an investigating officer to carry out an investigation.

Pursuant to Article L.135-12 of the French Energy Code, breaches of REMIT are stated first by the investigating officers mentioned in Article L. 135-3. These breaches are listed, described and qualified in an investigating report, which must be sent to the person(s) concerned.

After the end of investigation and pursuant to Article L.134-25, the CRE's Chairman may, if necessary, refer the matter to CoRDIS.

2.1 Investigations conducted by the CRE

Between 2014 and 2022, the CRE opened fifteen investigations under REMIT: two investigations in 2014, three in 2016, two in 2017, one in 2018, one in 2019, four in 2021 and two in 2022.

All of these investigations relate to the prohibition of insider trading and market manipulation (Articles 3 and 5 of REMIT) and the obligation to publish insider information (Article 4 of REMIT).

By the end of 2022, among these investigations:

- one was closed because the practices examined during the investigation occurred before the entry into force of Law 2013-312 of 15 April 2013, which gave CoRDIS the power to sanction this type of breach;
- one was closed in 2020 for reasons related to the prescription;
- one was closed in 2020 with a finding of non-compliance;
- four were closed by a CoRDIS sanction decision, including two in 2022 (Table 1);
- one is currently being examined by CoRDIS;
- for the seven investigations remaining at the end of 2022, the investigating officer's analyses were still in progress.

As part of these investigations, the power to request information (accounting records, invoices and any useful document, including telephone records and existing data exchanges) was put into effect, pursuant to Article L.135-4 of the French Energy Code and Article 13(2) of REMIT.

⁹6th edition of ACER Guidance published on 22 July 2021: https://www.acer.europa.eu/sites/default/files/REMIT/Guidance%20on%20REMIT%20Application/ACER%20Guidance%20on%20REMIT/ACER_Guidance_on_REMIT_application_6th_Edition_Final.pdf

¹⁰In the CEREMP (Central European Registry of Energy Market Participants).

2.2 Summary of the main decisions handed down by regulators in the European Union penalising breaches of REMIT

ACER keeps an up-to-date summary on its website of European decisions¹¹ sanctioning REMIT breaches.

Table 1 : Sanction European decisions in 2022 in connection with Articles 3, 4 and 5 of REMIT breaches

Date of decision	Authority, Member State	Market participant	Type of REMIT breach	Amount of fine	Decision status
25 November 2022	DKER (Bulgaria)	National Electric Company Ead - Nek Ead	Article 5	BGN 625,097 (Bulgarian leva) (approx. €319,607.02)	Appeal possible
25 November 2022	DKER (Bulgaria)	Interprom Eood	Article 5	BGN 336,237 (approx. €171,915.25)	Appeal possible
25 November 2022	DKER (Bulgaria)	Energy Mt Ead	Article 5	BGN 144,984 (approx. €74,129.14)	Appeal possible
25 November 2022	DKER (Bulgaria)	Most Energy Ad	Article 5	BGN 34,289 (approx. €17,531.68)	Appeal possible
25 November 2022	DKER (Bulgaria)	Grand Energy Distribution Eood	Article 5	BGN 27,337 (approx. €13,977.18)	Appeal possible
25 November 2022	DKER (Bulgaria)	Interelektrik Eood	Article 5	BGN 90,475 (approx. €46,259.13)	Appeal possible
25 April 2022	the CRE (France)	Electricité De France SA	Articles 3 and 4	€500,000	Final
25 April 2022	the CRE (France)	Edf Trading Limited	Article 5	€50,000	Final
23 June 2022	CNMC (Spain)	Gasela Gmbh, Solstar Limited	Article 5	€12,000,000	Under appeal
19 May 2022	the CRE (France)	Engie SA	Article 3	€80,000	Final
15 March 2022	E-Control (Austria)	Wien Energie Gmbh	Article 4	€1100	Final
15 March 2022	E-Control (Austria)	Verbund Energy4Business Gmbh	Article 4	€1100	Final
14 June 2022	ACM (Netherlands)	Pzem Energy B.V.	Article 4	€150,000	Appeal possible
12 July 2022	ARERA (Italy)	Enegan Gas Trading S.r.l.	Article 5	€27,000	Final
12 July 2022	ARERA (Italy)	Joytrade S.r.l.	Article 5	€20,000	Final
2022	ANRE (Romania)	Premier Energy Srl	Article 5	RON 500,000 (Romanian lei) (approx. €101,073)*	Under appeal

¹¹Publication ACER Enforcement decisions - Overview of sanctions: <https://www.acer.europa.eu/remit/coordination-on-cases/enforcement-decisions>

2022	ANRE (Romania)	Tinmar Energy S.A.	Article 5	RON 500,000 (approx. €101,073)*	Under appeal
2022	ANRE (Romania)	Eft Furnizare S.R.L.	Article 5	RON 400,000 (approx. €80,954)*	Final
2022	ANRE (Romania)	We Power Team S.R.L.	Article 5	RON 451,022 (approx. €91,272)*	Under appeal
2022	ANRE (Romania)	Nova Power & Gas S.R.L.	Article 5	RON 400,000 (approx. €80,977)*	Final
2022	ANRE (Romania)	Qmb Energ S.R.L.	Article 5	RON 400,000 (approx. €80,977)*	Final
2022	ANRE (Romania)	Transformer Energy Supply S.R.L.	Article 5	RON 400,000 (approx. €80,918)*	Final
2022	ANRE (Romania)	A Energy Ind S.R.L.	Article 5	RON 340,294 (approx. €68,893)*	On appeal
2022	ANRE (Romania)	Next Energy Partners S.R.L.	Article 5	RON 20,000 (approx. €40,443)*	Final
2022	ANRE (Romania)	Entrex Services S.R.L.	Article 5	RON 400,000 (approx. €80,842)*	Final
2022	ANRE (Romania)	Energijataverde.Ro Furnizare S.R.L. (Fostă Apuron Energy S.R.L.)	Article 5	RON 400,000 (approx. €80,893)*	Final
2022	ANRE (Romania)	Alive Capital S.R.L.	Article 5	RON 400,000 (approx. €80,955)*	Final
2022	ANRE (Romania)	Alive Capital S.R.L.	Article 5	RON 800,000 (approx. €161,911)*	Final
2022	ANRE (Romania)	Xpv S.A.	Article 5	RON 800,000 (approx. €161,770)*	Final

* This amount includes both (i) the fine and (ii) compensation to the injured parties.

Among these decisions, CoRDIS imposed two sanctions in 2022 against three companies following two investigations carried out by the CRE. In its sanction decision of 25 April 2022¹², CoRDIS fined on the one hand, Electricité de France S.A. (EDF) €500,000 for failure to comply with Articles 3 and 4 of REMIT, and on the other hand, EDF Trading Limited (EDFT) €50,000 for failure to comply with Article 5 of REMIT. In a decision of 19 May 2022¹³, Engie S.A. was fined €80,000 for failure to comply with Article 3 of REMIT.

In its annual report¹⁴ on the wholesale markets monitoring 2021, the CRE briefly described the sanction decisions handed down by CoRDIS against EDF S.A. and EDF Trading Limited.

¹²<https://www.cre.fr/Documents/Reglements-de-differends/cordis-25-avril-2022-sanction-a-l-encontre-de-la-societe-edf-et-de-la-societe-edf-trading-limited>

¹³<https://www.cre.fr/Documents/Reglements-de-differends/cordis-19-mai-2022-sanction-a-l-encontre-de-la-societe-engie>

¹⁴<https://www.cre.fr/Documents/Publications/Rapports-thematiques/rapport-de-surveillance-des-marches-de-gros-de-l-electricite-et-du-gaz-naturel-en-2021>

2.3 Projects undertaken to increase the investigations efficiency and the introduction of a negotiated sanction procedure

Cooperation with the French AAls (independent administrative authorities), launched in 2019, is a key means of exchanging information with the other French independent administrative authorities (ACPR, ADLC, AMF, ART, ARCEP, CNIL, HATVP)¹⁵. The CRE has a long history of cooperation with the AMF in this regard, based in particular on the memorandum of understanding signed in 2010 to enable the two authorities to benefit from each other's information and expertise and to ensure that their respective missions are carried out fully and effectively, in accordance with the provisions of Article L. 621-21 of the French Monetary and Financial Code and Article L. 134-17 of the French Energy Code¹⁶.

The Inter-AAI Working Group is a driver for innovation and the exchange of expertise and experience, and enables the CRE to examine its own monitoring and investigation methods. By way of illustration, the CRE has exchanged views with the various AAls on putting into effect the power to conduct hearings during investigations.

In addition, the Chairman and the Board of the CRE, as well as the Chairman and the Board of CoRDIS, have jointly decided to propose a reform of the procedures for investigations, enquiries and sanctions, with the aim of speeding up these procedures and improving the proportionality of the means used, in particular by introducing a negotiated sanction procedure. This move to reform has been identified as one of the objectives of the CRE's 2023-2024 roadmap¹⁷.

3. WHOLESALE MARKETS MONITORING AT EUROPEAN LEVEL

3.1 Activities carried out or coordinated by ACER to monitor wholesale markets

Several working groups dedicated to market monitoring exist within ACER and the CEER (Council of European Energy Regulators). In particular, they contribute to the coordinated and consistent operational implementation of REMIT by the national authorities, notably through regular exchanges of experience on the handling of monitoring cases and market abuse scenarios. They are also involved in drawing up the non-binding *Guidance* on the application of REMIT published by ACER.

The CRE attaches great importance to rigorous progress in REMIT's work as part of a constructive European collaboration. It holds several mandates, including chairing the *REMIT Policy Task Force* since the end of 2018, and vice-chairing the *ACER REMIT Committee* since the beginning of 2021.

High prices and volatility on wholesale energy markets have led ACER and European energy regulators to step up their monitoring. In 2022, ACER and the energy regulators actively analysed the behaviour of wholesale market participants, including non-European companies, in order to:

- detect any manipulative behaviour that may have arisen since the beginning of the energy crisis and which may have contributed to the situation seen in the wholesale markets in 2022;
- identify situations where inaccurate or misleading information has been provided to the market;
- detect possible insider trading.

In this context, ACER and the energy regulators of Austria, Germany and the Netherlands have set up a cross-border investigation group under REMIT monitoring of gas markets¹⁸. The creation of this group is intended to coordinate and strengthen efforts to analyse and gather evidence in order to conclude whether or not there have been breaches of REMIT.

¹⁵ACPR - Autorité de contrôle prudentiel et de résolution (Prudential Supervision and Resolution Authority), ADLC - Autorité de la concurrence (Competition Authority), AMF (Financial Markets Authority), ART - Autorité de régulation des transports (Transport Regulation Authority) (formerly ARAFER), ARCEP - Autorité de régulation des communications électroniques et des Postes (Electronic Communications, Postal and Print Media Distribution Regulatory Authority), CNIL - Commission nationale de l'informatique et des libertés (French Data Protection Authority), HATVP - Haute autorité pour la transparence de la vie publique (High Authority for Transparency in Public Life)

¹⁶Previously, Articles 28 and 29 of Law 2000-108 of 10 February 2000

¹⁷<https://www.cre.fr/Documents/Publications/Rapports-thematiques/feuille-de-route-2023-2024-de-la-cre>

¹⁸<https://www.acer.europa.eu/news-and-events/news/acer-and-3-regulatory-authorities-reinforce-coordination-energy-market-abuse>

In addition, cooperation with the financial authorities has been strengthened¹⁹. In particular, ACER and ESMA²⁰ have set up a new *task force* to strengthen their cooperation on the supervision of wholesale energy and energy derivatives markets and their coordination on the exchange of data and knowledge²¹.

In its October 2021 communication setting out a series of support measures to combat rising energy prices, the European Commission gave a mandate to ACER²² to assess the advantages and disadvantages of the current design of the European Union's wholesale electricity market and to make recommendations for its improvement. As part of this mandate, and following the publication of the preliminary report in November 2021²³, ACER published its final analysis report in April 2022²⁴. In the report, ACER did not elaborate on the aspects of the supervision of wholesale markets affected by the crisis (which had been covered in its preliminary report) but concentrated on in-depth analyses relating in particular to:

- energy price levels and their determining factors;
- the current design of the wholesale electricity market;
- extreme price shocks and thoughts on temporary and targeted measures, etc.

3.2 ACER, CEER and the national energy regulators have been particularly vigilant with regard to the development of European policy on the financial stability of the energy markets.

Measures to ensure the financial stability of energy markets affect the behaviour of market participants and may lead to changes in trading strategies, movements between different marketplaces or arbitrage between organised markets and bilateral exchanges. As a result, market liquidity and volatility may be affected, which may have repercussions on wholesale prices.

Understanding the constraints on the trading activities of market participants is a key element in monitoring and interpretation of the behaviour of market participants. As a result, ACER, CEER and the national energy regulators have been particularly vigilant with regard to the development in 2023 of the various mechanisms governing the operation of the wholesale markets. Among the existing mechanisms, as well as those being studied, developed or implemented in 2022, margin calls were monitored in particular.

The purpose of margin calls is to provide financial security for transactions on futures markets (particularly stock exchanges) by eliminating counterparty risk, i.e. the risk that one of the two contracting parties will not deliver the expected product at the agreed price. Margin calls are thus very important for the stability and security of markets in general and energy markets in particular. Margin calls are mainly guaranteed by financial collateral²⁵.

Since 2021, the extreme rise in wholesale market prices and their volatility have led to an exceptional increase in the margins required by clearing houses to take or maintain positions on the electricity and gas futures markets, having a major impact on the cash requirements of market participants²⁶. Faced with this situation, some market players in Europe have received financial support from governments to fund the margins required to trade on organised marketplaces. Other market players, integrated into groups, have relied on the support of their parent company. Lastly, some market players have reduced the volumes of physical production sold forward because of excessive margin calls.

This situation, which contributed to the reduction in activity on the wholesale markets, led the European Commission, after discussions with ESMA and the European Central Bank, to draw up a delegated²⁷ act temporarily

¹⁹Some wholesale energy products are financial instruments. Article 16 of REMIT accordingly provides for cooperation between ACER, ESMA, the energy regulators of other Member States, the financial authorities and the competition authorities. In this respect, financial regulations are linked to the provisions prohibiting market abuse set out in REMIT. The relationship between REMIT and financial regulation was presented by the CRE in Section 1, §1.2 of its 2017 Report on the supervision of the wholesale electricity and natural gas markets: <https://www.cre.fr/Documents/Publications/Rapports-thematiques/Rapport-de-surveillance-des-marches-de-gros-de-l-electricite-et-du-gaz-2017>

²⁰ESMA - Autorité Européenne des Marchés Financiers (*European Securities and Markets Authority*)

²¹<https://acer.europa.eu/news-and-events/news/acer-and-esma-enhance-cooperation-strengthen-oversight-energy-and-energy-derivative-markets>

²²Communication from the European Commission dated 13 October 2021: "*Tackling rising energy prices: a toolbox for action and support*": <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A660%3AFIN&qid=1634215984101>

²³<https://acer.europa.eu/sites/default/files/2022-05/ACER's%20Preliminary%20Assessment%20of%20Europe's%20high%20energy%20prices%20and%20the%20current%20wholesale%20electricity%20market%20design.pdf>

²⁴https://www.acer.europa.eu/Publications/Final_Assessment_EU_Wholesale_Electricity_Market_Design.pdf

²⁵The framework defining what is authorised to be offered as collateral for margin calls is set out in Regulation (EU) 648/2012 of the European Parliament and of the Council of 4 July 2012 on over-the-counter derivatives, central counterparties and trade repositories, known as EMIR (*European Market Infrastructure Regulation*), which falls within the remit of the financial authorities.

²⁶For example, almost all the market players questioned by the CRE during its analysis of forward electricity prices for the winter of 2022-2023 and the year 2023 mentioned their desire to reduce cash flow risks. Having fewer positions on the futures markets allowed them to avoid significant margin calls. Market players have had to adapt their collateral or change their trading strategies.

²⁷<https://www.cre.fr/Documents/Publications/Rapports-thematiques/les-prix-a-terme-de-l-electricite-pour-l-hiver-2022-2023-et-l-annee-2023>

²⁷https://ec.europa.eu/finance/docs/level-2-measures/emir-rts-2022-7536_en.pdf

extending the list of collateral that companies can use. In particular, the European Commission has authorised the use of bank guarantees "not secured by assets" as well as public guarantees.

3.3 Changes in ACER's non-binding guidance

The non-binding guidance published by ACER currently comprise four main documents:

- general guidance on the application of REMIT, the 6th edition of which was published in July 2021²⁸, and
- three specific guidelines on practices likely to constitute market manipulation under Article 5 of REMIT:
 - guidance on "wash trade" practices, defined as the entering into of agreements for the sale or purchase of a wholesale energy product, not involving any change in the ownership of the security concerned or in the market risk or involving the transfer of ownership or market risk between participants acting in concert or collusion, published in June 2017²⁹;
 - guidance on "capacity hoarding" on the intraday electricity market, defined as the acquisition of all or part of the available transmission capacity without using it or without using it efficiently, published in March 2018³⁰;
 - guidance on "layering" and "spoofing" on continuous wholesale markets, defined as the issue by a market participant of a large order or multiple orders on one side of the order book in order to execute one or more trades on the other side of the order book, published in March 2019³¹.

ACER also publishes a list of questions and answers ("Q&A") concerning the implementation of REMIT, and published the latest update of this document on 16 December 2022. This update concerns in particular the duties applicable to storage facilities and recharging infrastructures, gas nominations and insider information relating to infrastructures located outside the European Union.

The CRE is helping to draw up common positions on the definition and supervision of abusive practices on wholesale markets under REMIT.

3.4 Progress in REMIT data sharing by ACER

The centralised data collection by ACER pursuant to REMIT began in 2015. The CRE has been receiving data on the French market since 2016. As the quality of transactional and fundamental data is essential to the performance of its duties, the CRE is actively involved in ACER's work on this matter.

ACER publishes documents to clarify the procedures for reporting transactional and fundamental data. Discussions between ACER, reporting parties, regulators and other stakeholders focus in particular on updates to these documents. The main documents are the manual of procedures for data³² reporting and the TRUM (*Transaction Reporting User Manual*), the latest versions of which were published on 17 April 2023. They are supplemented by FAQ (*Frequently Asked Questions*) document on the declaration of transactional data, updated on 17 April 2023, and another FAQ document on the declaration of insider information and fundamental data, the latest version of which dates from 30 April 2021. The latest updates relate in particular to the introduction of new data formats for describing transactions based on standard contracts and contracts for gas transmission capacity.

The work carried out by ACER, but also by the other regulators, on improving data collection under Article 8 of REMIT and its exploitation for monitoring purposes, continued in 2022. In its quarterly newsletter for the second quarter of 2022³³, ACER reported on the results of its work with regulators to analyse and improve the quality of data regarding transactions arranged by brokers. ACER notes that the number of market players in the data declaration chain and the variety in different market players' agreements and practices make it more difficult to improve data quality.

²⁸For further information: https://www.acer.europa.eu/sites/default/files/REMIT/Guidance%20on%20REMIT%20Application/ACER%20Guidance%20on%20REMIT/ACER_Guidance_on_REMIT_application_6th_Edition_Final.pdf

²⁹For further information: <https://www.acer-remit.eu/portal/document-download?documentId=u518na123yg>

³⁰For further information: <https://acer.europa.eu/Media/News/Pages/ACER-publishes-guidance-on-capacity-hoarding-in-intraday-electricity-markets-that-could-constitute-market-manipulation.aspx>

³¹For further information: <https://www.acer.europa.eu/Media/News/Pages/ACER-publishes-guidance-on-layering-and-spoofing-in-continuous-wholesale-energy-markets.aspx>

³²*Manual of Procedures on transaction data, fundamental data and inside information reporting*: https://documents.acer-remit.eu/wp-content/uploads/ACER_REMIT_MoP-on-data-reporting_V7.pdf

³³REMIT Quarterly 29, 2nd Quarter

2022: https://www.acer.europa.eu/sites/default/files/REMIT/REMIT%20Reports%20and%20Recommendations/REMIT%20Quarterly/REMITQuarterly_Q2_2022_1.0.pdf

In 2022, the CRE continued to improve the processing of data from the REMIT data collection system, and was asking the reporting parties to clarify or correct the transactions data reported to ACER where necessary. The CRE is maintaining the system of national data collection from organised marketplaces (exchanges and brokers) in order to have a basis for comparison that will enable CRE to continue to improve the quality of the data reported, and thus avoid any discontinuity or interruption in market monitoring.

In particular, the CRE calls for vigilance on the part of market participants with regard to the correct declaration of the beneficiaries of transactions, which is all too often provided incorrectly, as well as the correct identification of bilateral transactions, by ensuring that the unique transaction identifier declared by the two counterparties is identical. In particular, these problems with reporting transactional data made it more difficult for the CRE to carry out an analysis in summer 2022 of forward electricity prices for the winter of 2022-2023 (see Section 1, § 1.2), which required discussions with the market participants concerned. The CRE encourages market participants to ensure the quality of data declarations made under Article 8 of REMIT.

At last, in January 2022³⁴, ACER published a decision on the declaration of additional data concerning intraday market coupling for electricity. This data sharing has been operational since 1 November 2022. In this context, the responsibility for making the data available lies with the intraday coupling operators, and not with the market participants themselves.

³⁴Decision 01/2022 of the European Agency for the Cooperation of Energy Regulators of 31 January 2022 requesting additional information concerning the data relating to intraday single coupling:
https://extranet.acer.europa.eu/Official_documents/Acts_of_the_Agency/Individual%20decisions/ACER%20Decision%2001-2022%20on%20SIDC%20data.pdf

Useful references

Suspected market abuse

To ensure the most rigorous possible market monitoring, anyone who suspects market abuse is asked to alert:

- the CRE departments responsible for market monitoring at the following address: surveillance@cre.fr;
- or ACER departments by visiting the Agency's *ad hoc* notification platform: <https://www.acer-remit.eu/np/home>.

Registration of market participants

For any questions relating to registration, market participants can contact the CRE's wholesale market monitoring department at enregistrement.remit@cre.fr.

With regard to REMIT

All the public documentation relating to the implementation of REMIT can be found on the REMIT portal provided by ACER: <https://documents.acer-remit.eu/>.

SECTION 2 CONTEXT OF THE ENERGY MARKETS IN 2022

1. GAS PRICES HAVE REACHED AN ALL-TIME HIGH IN 2022; OTHER COMMODITY PRICES ARE ALSO ON THE RISE, ALBEIT AT LOWER LEVELS

The gas market was particularly tight throughout Europe in 2022, mainly as a result of the 83% drop in Russian gas supplies via pipelines between the beginning and end of the year.

The year 2022 started with relatively low wholesale gas prices, mainly due to strong LNG supplies in Europe (the PEG Y+1 calendar contract averaged €50.20/MWh from 1 January to 23 February 2022). The successive cuts in Russian pipeline exports to Europe following Russia's invasion of Ukraine increased the growth in wholesale gas prices in the spring and summer of 2022 (the PEG Y+1 contract averaged €104.5/MWh between 23 February and 31 August 2022).

Against this backdrop, the European Union decided to fill storage facilities to at least 80% before the start of the 2022-2023 winter and to 90% before each subsequent winter. This measure, decided at the end of June 2022, resulted in strong demand for gas for the 2022 injection campaign: the aggregate level of European storage was 94.9% on 1 November 2022.

The market balance was also significantly affected by the that took place in June at the Freeport LNG terminal, which accounts for almost 20% of US liquefaction capacity. As a result, wholesale gas prices have risen almost continuously since the beginning of the year, and more sharply from June until 26 August 2022, when they reached an all-time high (€310.60/MWh, TTF Y+1). After this price peak, prices gradually eased from the end of August until the end of the year, as fundamentals improved with a successful storage injection campaign, a strong inflow of LNG in Europe and a mild autumn. PEG Y+1 prices fell by more than four times their value between the peak on 26 August 2022 (€297.40/MWh) and the last quotation of the year (€68.80/MWh on 30 December 2022).

Wholesale electricity prices have also seen unprecedented growth, particularly in France. Automatically impacted by the rise in wholesale gas prices, European electricity prices experienced a price surge comparable to that of gas (Section 2, §2). The base calendar contract France Y+1 reached its maximum for the year on 26 August 2022 at €1130/MWh.

This sharp rise, which affected the whole of Europe, was even stronger in France. Due to the discovery of corrosion on safety-critical pipes in nuclear power plants at the end of 2021, the French nuclear power plants experienced a major industrial disruption in 2022. A vast inspection and repair campaign started at the beginning of 2022 has been added to an already busy maintenance programme as a result of the pandemic, and has rendered many nuclear reactors unavailable. Fears about the availability of nuclear power fuelled the rise in electricity prices in France for the winter of 2022-2023, which reflected a significant risk premium reflecting market players' concerns about how the situation would evolve. The drought also kept prices high over the year, by reducing hydroelectric production.

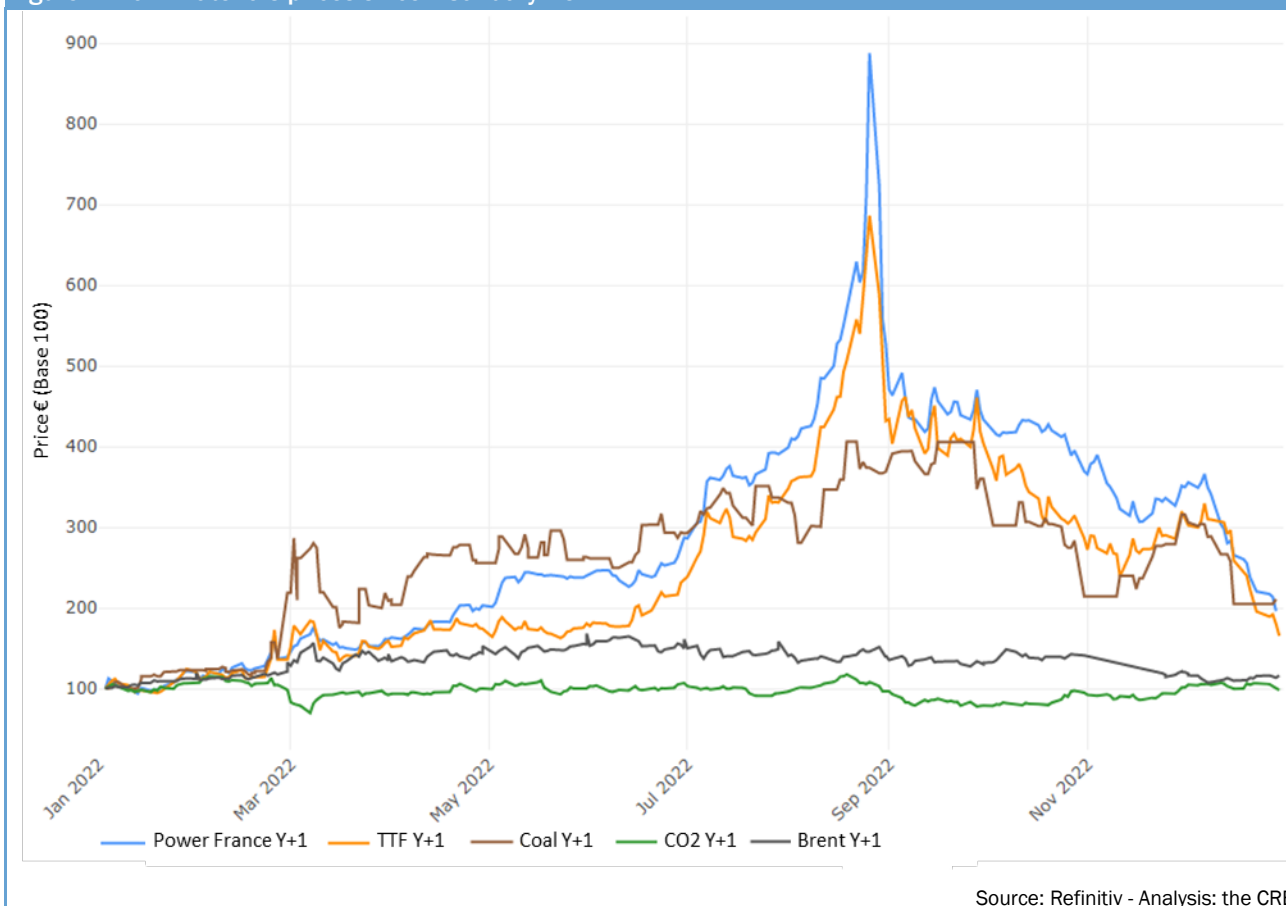
In order to maintain a balance between electricity production and demand against a backdrop of soaring gas prices, Europe has had to make greater use of coal in 2022. Despite a higher CO₂ emission factor, it has regularly been a more economically viable alternative to gas for thermal electricity generation. Coal prices followed the general upward trend in 2022, although the relative rise was smaller than that seen for electricity and gas prices. On 8 April 2022, European regulations banned member countries from importing Russian coal from 10 August 2022³⁵. Given that 45% of European coal imports came from Russia the previous year, Europe has had to secure alternative sources of supply to meet this increase in demand.

After rising sharply in 2021, prices for EUA CO₂ allowances under EU ETS (the European Union Emissions Trading Scheme) stabilised in 2022 at high levels (around €80/tonne on average), albeit with considerable volatility.

Oil prices have also shown considerable volatility over 2022. The year began with OPEC reluctant to increase its production, despite the continuing fall in aggregate world stocks. The beginning of the war in Ukraine has fuelled tensions over supply, with Russian exports falling as a result of the embargoes. However, demand was subsequently kept in check by China's harsh measures against Covid-19, which imposed numerous restrictions that limited its oil consumption and demand. This helped to halt the rise in prices in the middle of the year (a maximum of €99 a barrel for Brent Y+1 was reached on 14 June 2022, compared with €68 a barrel on 1 January 2022), and to start a gradual recovery in world oil stock levels.

³⁵ <https://eur-lex.europa.eu/legal-content/FR/TXT/HTML/?uri=OJ%3AL%3A2022%3A111%3AFULL>

Figure 4: Raw materials prices since 1 January 2021



2. THE YEAR 2022 ONCE AGAIN HIGHLIGHTED THE INTERDEPENDENCIES BETWEEN THE VARIOUS COMMODITY PRICES AND THE PRINCIPLES OF WHOLESALE PRICE FORMATION.

The markets for fuels, electricity and CO₂ allowances are closely linked, and several factors explain this interaction. In particular, electricity prices are directly affected by the price of fuels, especially gas, and CO₂ quotas, because of the crucial role played by thermal power in balancing supply and demand, particularly in winter.

Construction of electricity prices: marginal price settlement

The balance between electricity supply and demand must be ensured at all times. This strong technical constraint is reinforced by the fact that electricity storage is expensive on a large scale. In addition, although there are emergency levers to modulate consumption (interruptibility, voltage reduction, rotating load shedding, etc.), it is difficult to ration electricity consumption because anyone connected to the grid can consume electricity at any time and demand generally shows significant variations. Electricity markets are organised to ensure that the electricity system functions properly at the lowest cost to society.

For this purpose, production is called according to "merit order", which consists of stacking the "controllable" means of production in order of increasing variable³⁶ costs to adjust production to residual demand, calculated after deducting so-called "fatal" production from renewable energies (wind, solar, water flow, etc.). This optimisation enables variable production costs to be minimised at all times.

The European electricity market makes it possible to minimise variable production costs across all European generators, so that market players with generating facilities that have lower variable costs can thus operate them in place of more expensive ones.

In an open market, in which participation is free, producers do not sell their output at a price below its variable cost. Each output is therefore offered on the market at least at its variable cost, which depends essentially on the production chain and fuel prices. The price is then set at the daily auction for all producers and consumers at the variable cost of the last production means called. This principle, known as marginal price settlement, encourages

³⁶The variable cost corresponds to the cost of producing the last kWh generated. It represents the share of costs incurred by the actual operation of the means of production (operating costs, fuel costs, start-up costs, CO₂ certificates, waste management costs, etc.).

producers to offer each means of production on the market at a price equal to its variable cost (and not higher), thereby ensuring that production costs are minimised.

In periods when thermal generation is often needed to cover the net demand for renewable energy, the price of electricity is often set by the variable cost of thermal generation, irrespective of the average share of thermal generation in total generation. This explains the strong correlation between the price of electricity and the price of fuels, as soon as the lower variable cost means are no longer sufficient to cover the demand.

Low variable cost production ("base" means of production such as nuclear or renewable energy) therefore generally receives an "inframarginal rent" equal to the difference between the wholesale price and its variable cost. This profit is intended to cover the fixed costs (which are higher than those of thermal power plants with higher variable costs).

Over long periods, the wholesale price is on average close to the full cost (variable and fixed costs) of electricity generation. For example, in France, the average electricity spot price between 2011 and 2020 was €41.60/MWh.

Price formation in the energy system: strong interdependencies and market-specific factors

Commodity prices may evolve according to specific supply and demand factors on the corresponding markets, but there are strong interactions between the prices of gas, coal, CO₂ allowances and electricity.

Coal is a global market, with several world indices traded in dollars. Its price is often strongly influenced by demand from China and, to a lesser extent, India, as well as by changes in the euro-dollar exchange rate.

Gas prices in Europe are formed in different marketplaces and depend on consumption, physical flows, volumes of LNG delivered, world LNG prices (strongly influenced by Asian demand), storage levels, etc. Before the crisis, a recognised European gas price index, based on the Dutch TTF market, had been building up for several years. Price indices in other European markets, including the PEG in France, moved with very little spread from the TTF. The crisis has led to significant price spreads between European markets, as a result of congestion on the network (Section 3, §2.2) and varying degrees of dependence on Russian gas.

The CO₂ allowance market is a regulated market in which supply is administered, since the total quantity of CO₂ allowances in circulation in Europe is set by public authorities (and decreases each year). Allowances are purchased to cover emissions from electricity generation, industry and aviation. Their price is highly dependent on economic activity and electricity consumption forecasts, but other factors also play a very important role, such as political objectives and regulatory developments in the market. Expectations about the future European energy mix (faster or slower rate of decarbonisation) have a direct influence on the price of CO₂.

Finally, as explained above, wholesale electricity prices vary according to the variable operating costs of the most expensive power stations needed to meet demand, which are often thermal power stations. So, a rise in fuel prices and CO₂ quotas has a direct impact on electricity prices.

These interactions between commodity prices are taken well into account by the market and can be observed through relatively stable and explainable relationships.

Finally, the availability of French nuclear power plants has a very direct impact on electricity prices in France, but also to a lesser extent in Europe, due to the important role of interconnections. Less nuclear generation means greater reliance on thermal generation over a greater number of hours. It can even lead to fears of shortages, when prices can reach very high levels, no longer reflecting production costs but rather significant costs to the economy in the event of rotating load shedding.

3. THE PRICE OF CO₂ ALLOWANCES REMAINS HIGH IN 2022 (€81.30/Tco₂ ON AVERAGE), WITH HIGH VOLATILITY.

The EU ETS (*Emissions Trading System*) aims to facilitate the achievement politically determined GHG (greenhouse gas) emission reduction targets. The annual volume of allowances is defined by the European Commission and is made available free of charge (for some industry and aviation) or sold at auction. During the course of the year, allowances can be traded freely by the market participants to adjust the coverage of their CO₂ emissions forecast for the year within their scope (actual emissions are then verified and emitters must surrender an equivalent volume of permits to avoid being penalised). The European Union introduced this system in 2005 to measure, monitor and reduce emissions from its industry and electricity producers. Its implementation has been planned in several phases of increasing duration.

The year 2022 marks the start of Phase 4 of the EU ETS, which began in 2021. The start of Phase 4 has been marked by major negotiations to reform the mechanism for achieving the European Union's climate objectives.

Since summer 2021, EU institutions have been working on overhauling the EU ETS as part of the "Fit for 55" package. This package of proposals aims to achieve an interim target of a net reduction of at least 55% in greenhouse

gas emissions by 2030, with a view to making the EU climate neutral by 2050. The key points of the reform are as follows³⁷:

1. The reduction in GHG emissions from the EU ETS sector raised to -61% in 2030 compared with 2005, i.e., a linear reduction in the number of allowances in circulation in the EU ETS raised to -4.2%/year (instead of -2.2%, as initially planned for Phase 4);
2. the mechanism for allocating free allowances will be gradually reduced by -10%/year from 2026, until it is completely abolished by 2034;
3. the Stability Reserve Mechanism (SRM) will be strengthened;
4. Most shipping companies will be included in the EU ETS from 2024;
5. A new separate carbon market (EU-ETS II) for the building and road transport sectors will be introduced from 2026;
6. A new CBAM (Carbon Border Adjustment Mechanism)³⁸ will be introduced from October 2023 to tax emissions from certain products imported into the European Union.

In addition to the reform of the EU ETS, the year 2022 was above all marked by the unprecedented energy crisis, which had a major impact on the price and volatility of CO₂ allowances.

After 2021, a year marked by a record rise in the price of CO₂ (up 147% with a peak of €88.90/t_{CO2} reached on 8 December 2021), 2022 began with a new rise in prices. The price of CO₂ thus reached €96.90/t_{CO2} on 8 February 2022, against a backdrop of a strong energy complex and persistent concerns about tight supply. Indeed, rising gas and electricity prices have gradually increased the relative attractiveness of coal as a substitute for gas-fired power generation. However, with a higher CO₂ emissions factor than gas, coal also requires the purchase of additional emission allowances, which increases demand and carbon prices.

Following Russia's invasion of Ukraine on 24 February 2022, EUA prices plummeted by 30% in a matter of days, dropping below €60/t_{CO2}, while gas prices reached historic highs in Europe. The price of carbon finally recovered in March and, although volatile, prices remained relatively stable until August 2022, at around €82/t_{CO2}.

Prices started to rise again in August, supported by higher gas prices and the prospect of high coal consumption over the winter. The price rose by almost 30% in just a few days, peaking at €98/t_{CO2} on 19 August 2022. Carbon prices then fell rapidly at the end of August and beginning of September, as stock markets plummeted due to fears of recession. On 9 September 2022, the price came down to €66/t_{CO2}. Uncertainty persisted until the end of 2022, contributing to price volatility. Prices strengthened overall in November and December 2022, in connection with European discussions on the reform of the EU ETS and the prospect of volume reductions. The price was finally set at €84/t_{CO2} on 30 December 2022.

As CO₂ allowances are financial instruments, on 28 March 2022 ESMA³⁹ published its final report on the operation of the European CO₂⁴⁰ allowance market, which was commissioned by the European Commission in its communication of 13 October 2021 on rising energy prices⁴¹. ESMA concluded that the breakdown of positions on the CO₂ allowance market showed little change since 2018 and was broadly in line with the expected functioning of this market, in which non-financial market players take long positions to hedge their exposure to the price of CO₂ allowances and financial market players act as intermediaries to facilitate trading and provide liquidity to the market. ESMA noted the relatively small role played by investment funds in the CO₂ allowance market. ESMA also makes targeted recommendations to improve the transparency and supervision of the European carbon market. Among its recommendations, it recommends that ESMA be given additional powers to monitor the market, giving it access in particular to data on primary market transactions. It submitted more structuring measures to the Commission for consideration, weighing up their advantages and disadvantages: the introduction of a system of position limits for derivatives on CO₂ allowances, and the introduction of carbon market monitoring, centralised at EU level, similar to the task assigned to ACER in the electricity and gas markets.

³⁷[https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI\(2022\)698890](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2022)698890)

³⁸English: *Carbon Border Adjustment Mechanism* (CBAM)

³⁹European Securities and Markets Authority (ESMA), Autorité Européenne des Marchés Financiers (ESMA)

⁴⁰<https://www.esma.europa.eu/press-news/esma-news/esma-publishes-its-final-report-eu-carbon-market>

⁴¹Communication from the Commission dated 13 October 2021: "Tackling rising energy prices: a toolbox for action and support" (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A660%3AFIN&qid=1634215984101>)

Figure 5: Change in the price of CO₂ allowances

4. 2022, THE HOTTEST YEAR IN FRANCE SINCE THE BEGINNING OF THE 20TH CENTURY

According to Météo France's⁴² climate report, 2022 was the hottest year on record in France since 1900, surpassing the record set in 2020. The average annual temperature in France was 14.5 °C, 1.6 °C above normal⁴³ and 0.4 °C above the previous record set in 2020.

In particular, May and October were the hottest months on record, and the summer of 2022 was the second hottest behind the summer of 2003. Only January was below normal.

Winter was mild overall at the beginning and the end of the year. However, France experienced very rare and exceptionally intense cold spells at the beginning of April and the beginning of December, with record-breaking cold and snowfalls on the plains. These exceptional circumstances particularly affected the French electricity system, which experienced extreme tension on 4 April 2022⁴⁴.

Overall, the very high temperatures in 2022 have had a significant downward effect on French electricity consumption, particularly during the autumn and winter months. Conversely, during the summer of 2022, successive heat waves increased electricity consumption for air conditioning.

On a European scale, France's 2022 record is no exception. Many other countries had their hottest year on record.

The year 2022 was also marked by an exceptional drought (the 2nd driest year since 1959, with a record rainfall deficit of 25% below normal). May and July were particularly dry, with a record rainfall deficit (July 2022, with a deficit of almost 85%). Only in June, September and November was there a surplus of rainfall. This drought significantly reduced the availability of hydroelectric power in France (to its lowest level since 1976) and the rest of Europe. In particular, hydraulic stocks reached historically low levels in July 2022, reinforcing market concerns for the winter of 2022-2023.

The average amount of sunshine over the country was also exceptionally high for most regions in 2022 (on average 15% higher). 2022 has been the sunniest year since measurements began, and many sunshine records were broken. This high level of sunshine has made a significant contribution to the increase in renewable solar energy production in 2022.

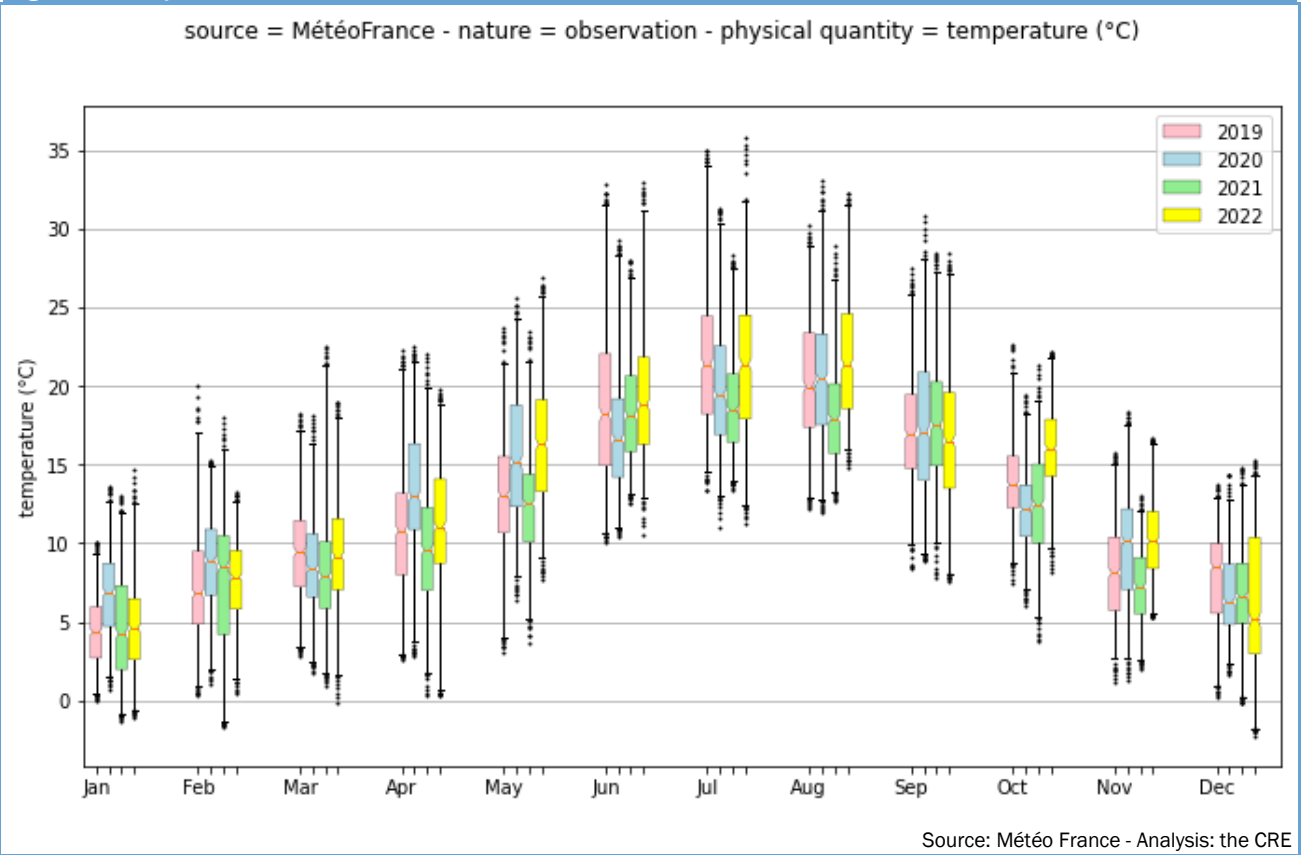
⁴²<https://meteofrance.fr/actualite/publications/2022-les-bilans-climatiques>

⁴³Reference average 1991-2020

⁴⁴See the CRE report on this subject published online 8 July 2022: <https://www.cre.fr/Documents/Publications/Rapports-thematiques/analyse-et-enseignements-sur-le-pic-de-prix-sur-l-enchere-journaliere-pour-le-4-avril-2022>

On the other hand, the average wind speed in 2022 was significantly lower than in a normal year, which had a negative impact on the load factor of the wind energy industry in France, which is at its lowest level for ten years.

Figure 6: Temperatures in France



SECTION 3 WHOLESALE NATURAL GAS MARKETS

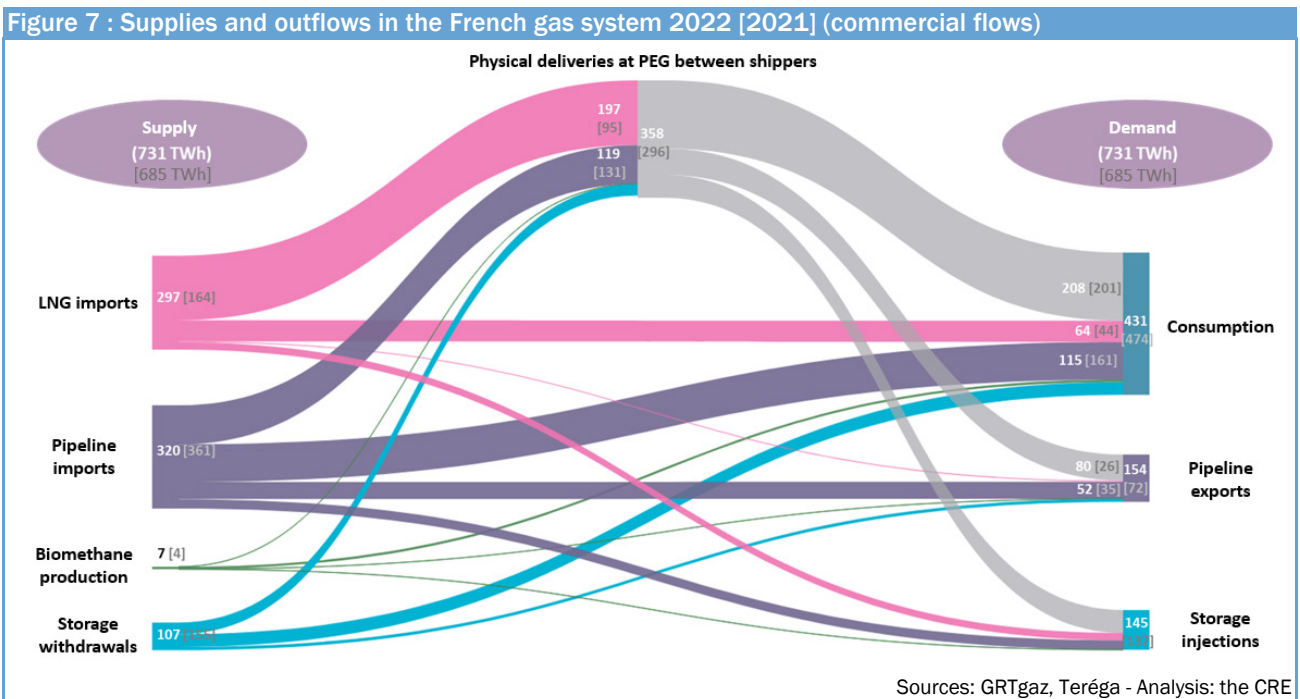
1. GAS SUPPLY AND DEMAND IN FRANCE IN 2022

1.1 Balance of the French gas system

The balance of the French gas system has shown a significant change in structure compared with 2021, particularly marked by the fall in Russian gas supplies via pipelines, which has led to a fall in pipeline imports and an increase in exports (mainly to countries to the north and east). The country has avoided a shortage thanks to a steady supply of LNG and falling consumption, resulting in less need to draw on storage facilities.

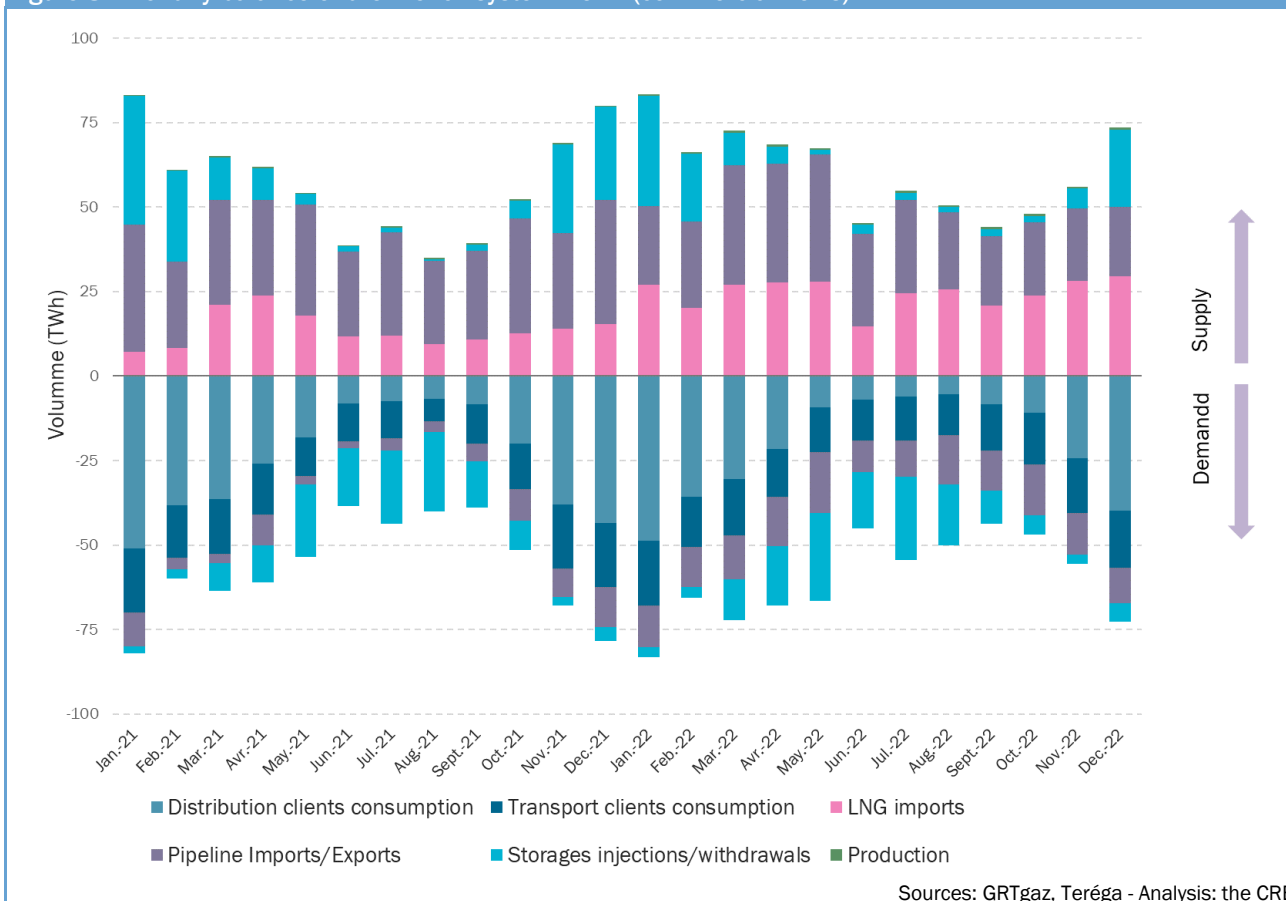
This Figure 7 presents a simplified view of the main trade flows for the year 2022 on the TRF. For the first time, the CRE is publishing the flows on the TRF in this format. The diagram assumes a number of hypotheses that need to be clarified for it to be fully understood:

- the balance sheet represents the sum over the year of the daily net commercial flows between the various TRF shippers;
- the link between each entry in the balance sheet is made in proportion to each shipper's supply for each day.



The Figure 8 represents the monthly evolution of the balance of flows on the TRF. In particular, there has been a sharp rise in LNG supplies, combined with an increase in exchanges at the PEG.

Figure 8 : Monthly balance of the French system 2022 (commercial flows)



1.2 Lower consumption due to record temperatures, high gas prices and efforts to reduce consumption

Total gas consumption in France will reach 431 TWh in 2022, down 9% from 2021. Consumption by customers connected to the distribution network fell by 17%, as a result of mild temperatures at the beginning and end of the year and efforts to reduce consumption, which specifically reduced consumption of gas for heating.

The year 2022 was also marked by a significant reduction in gas consumption by industrial customers connected to the transmission network compared with 2021 (-11%). Very high gas prices have prompted many of them to reduce their consumption, and in some cases to scale down or even suspend their operations. This phenomenon, which began in the second half of 2021, continued throughout 2022.

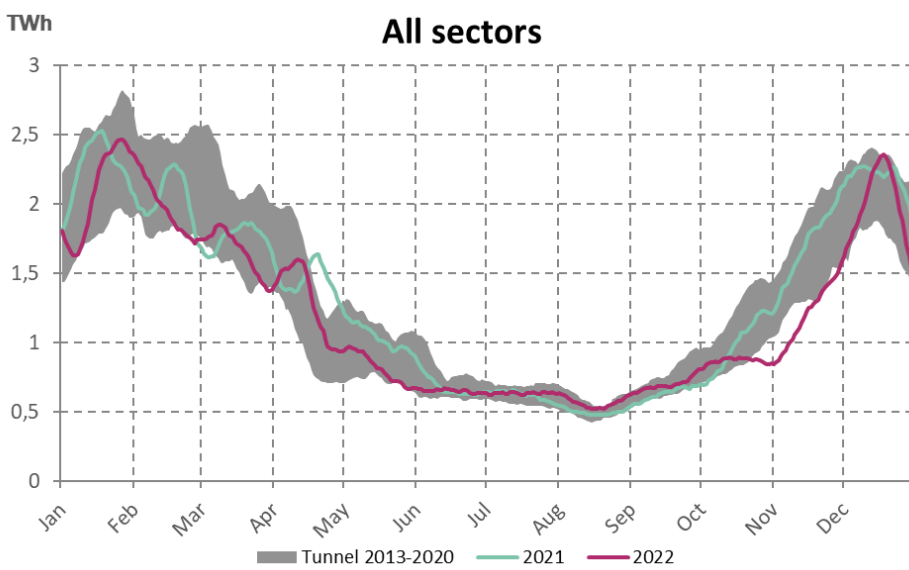
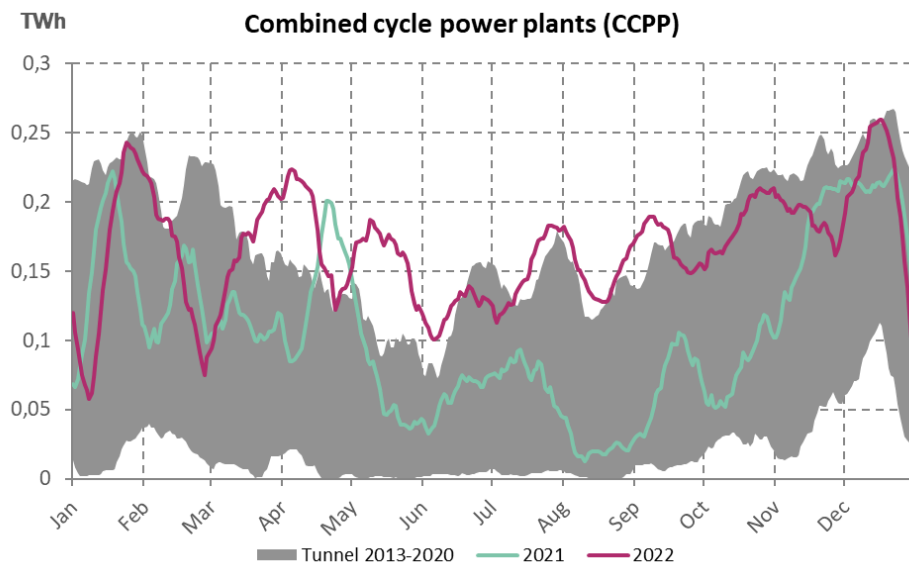
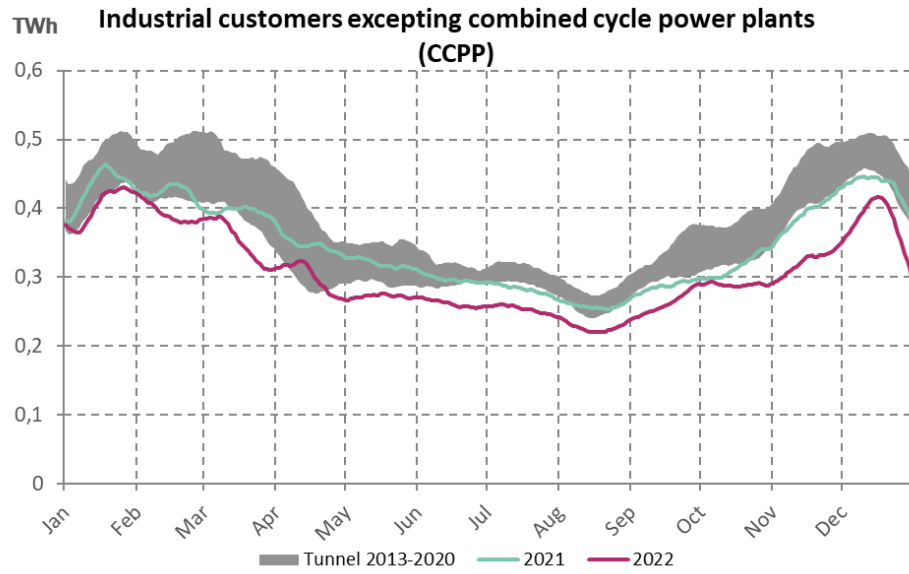
Gas consumption for power generation, meanwhile, has risen by 55% in 2022 compared with the previous year. The low availability of France's nuclear power plants and low hydroelectric production have led to an increase in the production of thermal electricity.

Table 2 : Growth in French gas consumption between 2021 and 2022 [TWh].

	2021	2022
Distribution network	303	253
Customers directly connected to the transmission network (excluding gas-fired thermal power stations)	132	117
Gas-fired thermal power stations	39	61
Total consumption	474	431

Source: GRTgaz

Figure 9 : Consumption by CCGT (combined-cycle gas turbine) power plants, grid customers excluding CCGTs and all sectors combined



Sources: GRTgaz, Teréga - Analysis: the CRE



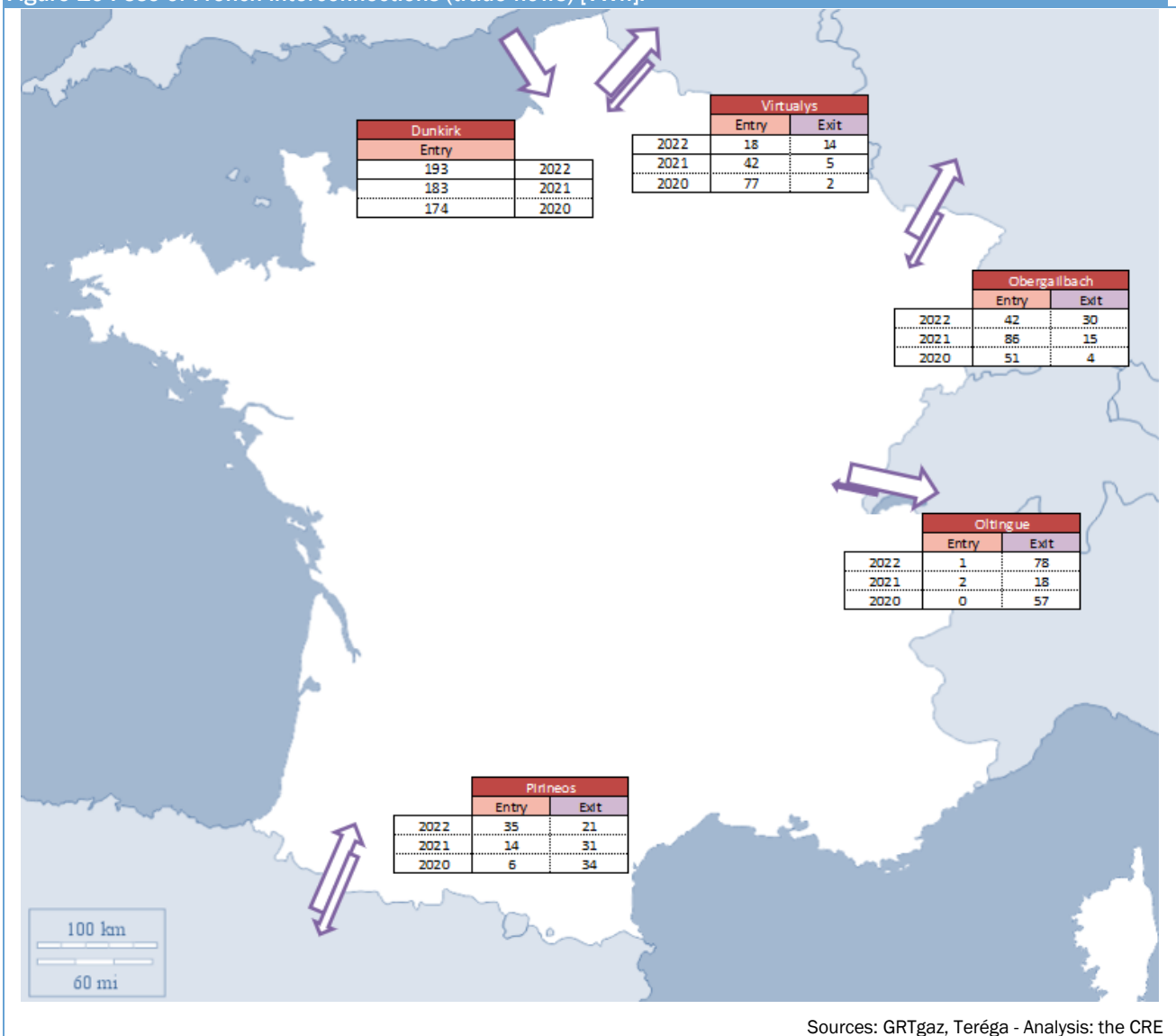
1.3 The fall in Russian gas pipeline exports to Europe has led to flows revers from west to east, with France as a transit zone contributing to the continent's security of supply.

The year 2022 was marked by a gradual decline in Russian gas flows through pipelines to Europe in response to European sanctions following the invasion of Ukraine on 24 February 2022. Overall, Russia's exports to Europe have fallen by an average of 56.9% compared with 2021. This fall could not be offset by the increase in Norwegian gas flows to the continent, which rose by just 8.3%.

This decline has had a greater impact on the countries of Eastern Europe, which are more dependent on Russian gas and some of which have been completely cut off. The increase in LNG imports from the continent has led to a reversal in the majority of flows, so most LNG has begun to flow to the west of the continent, where there are more LNG regasification facilities, and then exported to countries in the north and east.

Within the scope of the TRF, gas pipeline imports will be 11% lower in 2022 than in 2021. The utilisation rate for supply from Germany (PIR Obergaillbach) has fallen by 17% compared with 2021, with the sharp reduction in Russian gas exports. The reversal in the direction of European flows has led to a drop in the utilisation rate at the entry to the Belgian interconnection at Virtualys (-10% compared with 2021).

Figure 10 : Use of French interconnections (trade flows) [TWh].



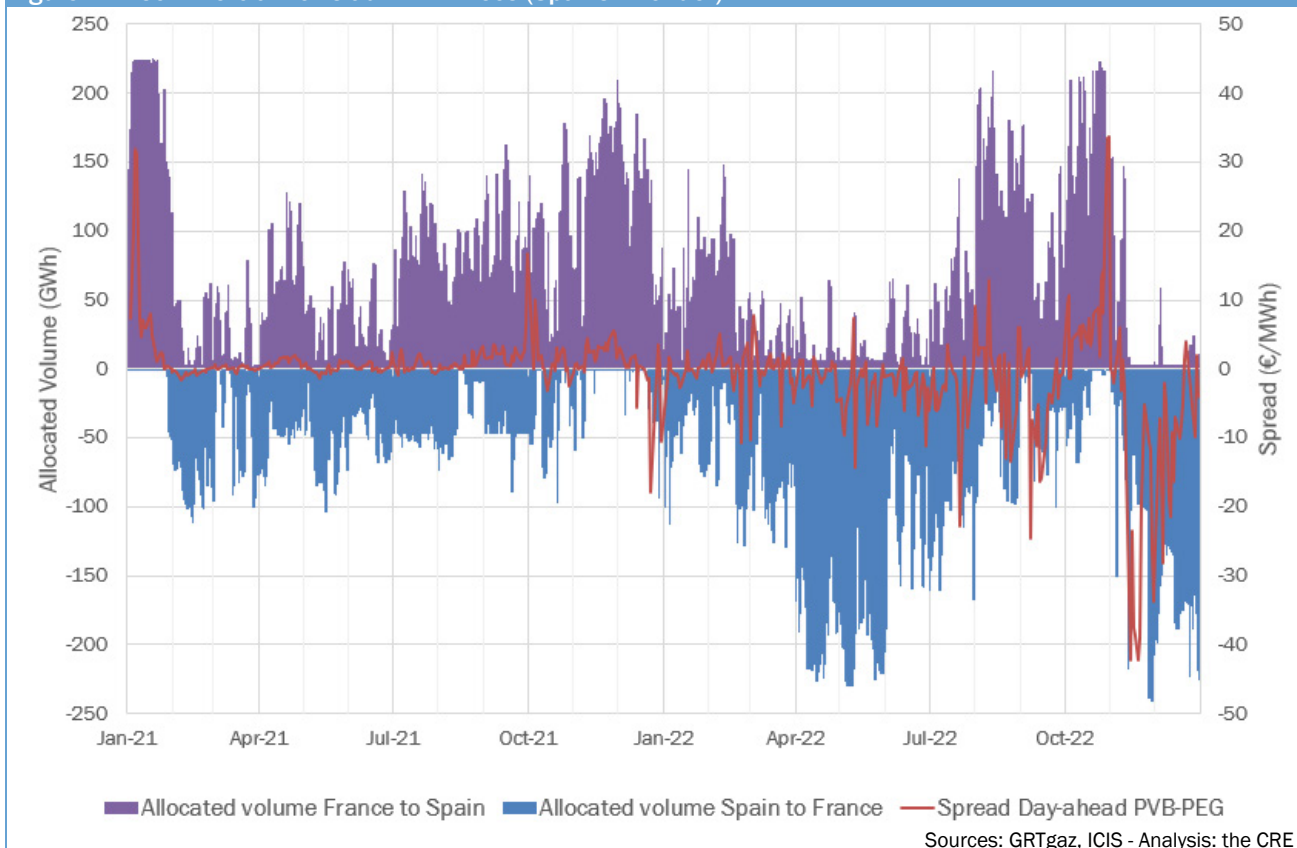
Sources: GRTgaz, Teréga - Analysis: the CRE

The influx of LNG into France has led to an increase in pipeline exports from France, up 114% in 2022 compared with 2021. As a result of the fall in Russian gas supplies to neighbouring countries to the east, utilisation rates at the exit points of the interconnections with Italy (PIR Oltingue), Germany and Belgium have increased by 62%, 43% and 60% respectively compared with the average over the last three years.

The Iberian Peninsula's dependence on Russian gas was already one of the lowest in Europe before the gas crisis, thanks in particular to its seven LNG terminals and its pipeline supplies of gas from North Africa. Historically, France exported more gas to the Spanish interconnector (PIR Pirineos) than it imported, but this trend got reversed in 2022, enabling the TRF to play a transit role in supplying gas to countries further east. Utilisation rates were up 25% on entry and down 11% on exit compared with 2021.

The redirection of flows from south to north at the Spanish interconnector began in the first quarter of 2022. This trend continued until the end of the year, with the exception of the months of August to October, when Spanish gas demand was driven up by air conditioning needs, followed by maintenance at several Spanish LNG terminals, and then low Spanish wind production in October, a month in which gas demand in France was contained by mild temperatures.

Figure 11 : Commercial flows at PIR Pirineos (Spanish frontier)



1.4 Sharp rise in LNG supplies offsets fall in Russian gas pipeline flows

LNG imports on the TRF reached 297 TWh in 2022, 81% more than in 2021 and 58% more than the average for the last three years (bearing in mind that some of the LNG unloaded at the Dunkirk terminal goes directly to Belgium). These historic import volumes have helped to maintain France's security of gas supply.

With four LNG terminals, France was better prepared for the crisis than some of its neighbouring countries, which had few or none. Many countries have accordingly decided to make temporary use of floating storage and regasification units (floating LNG terminals). In France, the authorities have accepted the proposal submitted by TotalEnergies to install one at Le Havre in 2023, which would enable the equivalent of 60% of the Russian gas imported by pipeline through France in 2021 to be injected into the GRTgaz network, representing around 10% of France's annual consumption⁴⁵.

Very high gas prices in Europe have attracted the world's LNG cargoes to the European hub.

American LNG has made a particularly strong contribution to the increase in LNG deliveries to Europe, with volumes imported into France increasing fourfold between 2021 and 2022, a significantly greater variation than for other producing countries (Figure 12 : Number of deliveries to France in 2022 by country of origin). France was even the top destination in Europe for American LNG in the first half of 2022 (Figure 14).

⁴⁵<https://www.grtgaz.com/medias/actualites/projet-terminal-methanier-flottant-FSRU-havre>

LNG from Russia continued to be a significant source of supply, increasing in 2022 compared with previous years. With its LNG imports almost doubled compared with 2021, France was the European country that imported the most LNG in 2022. Imports to French LNG terminals accounted for 22% of Europe's LNG imports in 2022. Next came Spain (19%), which was the leading importer in 2021, followed by the UK (16%).

Figure 12 : Number of deliveries to France in 2022 by country of origin

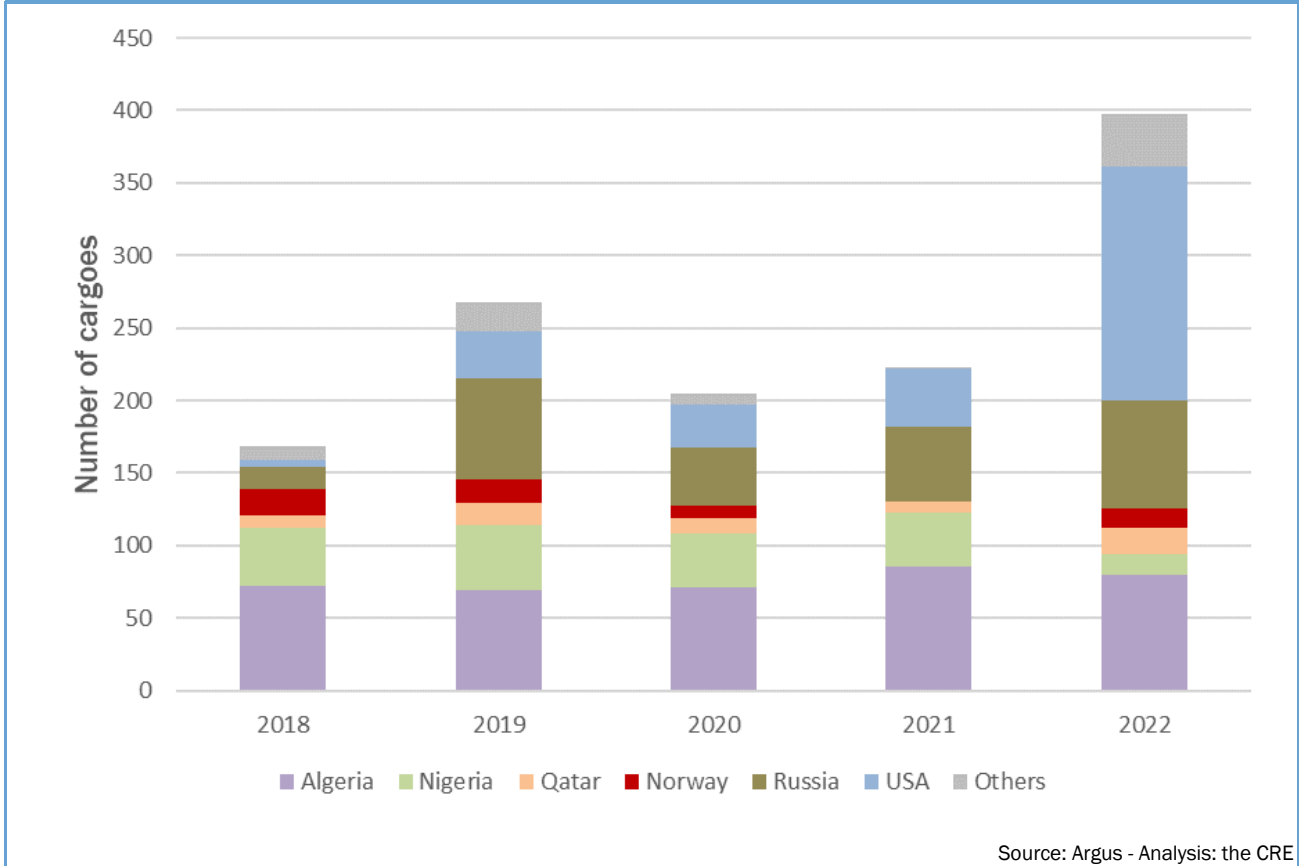
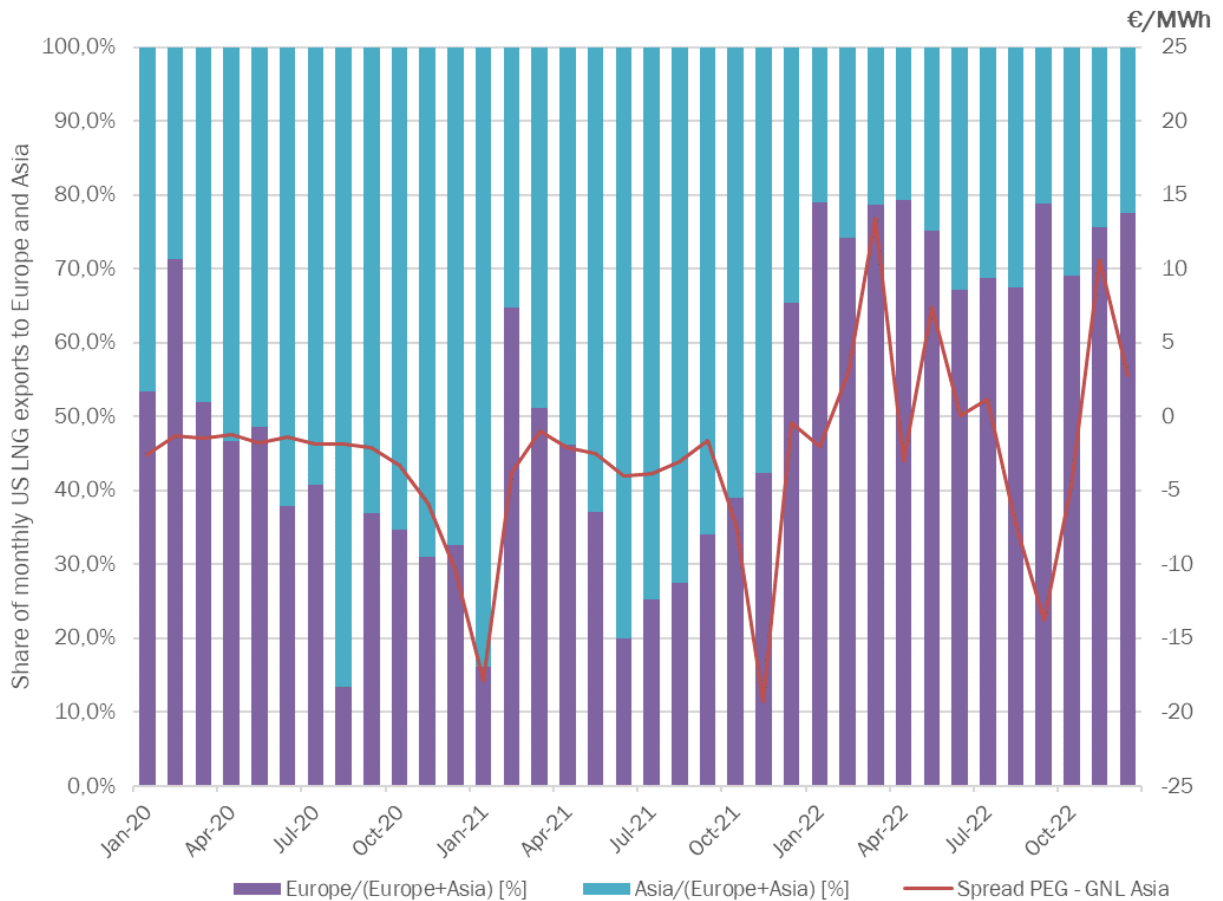


Figure 13 : LNG imports by country (European Union and United Kingdom)



Source: Refinitiv - Analysis: the CRE

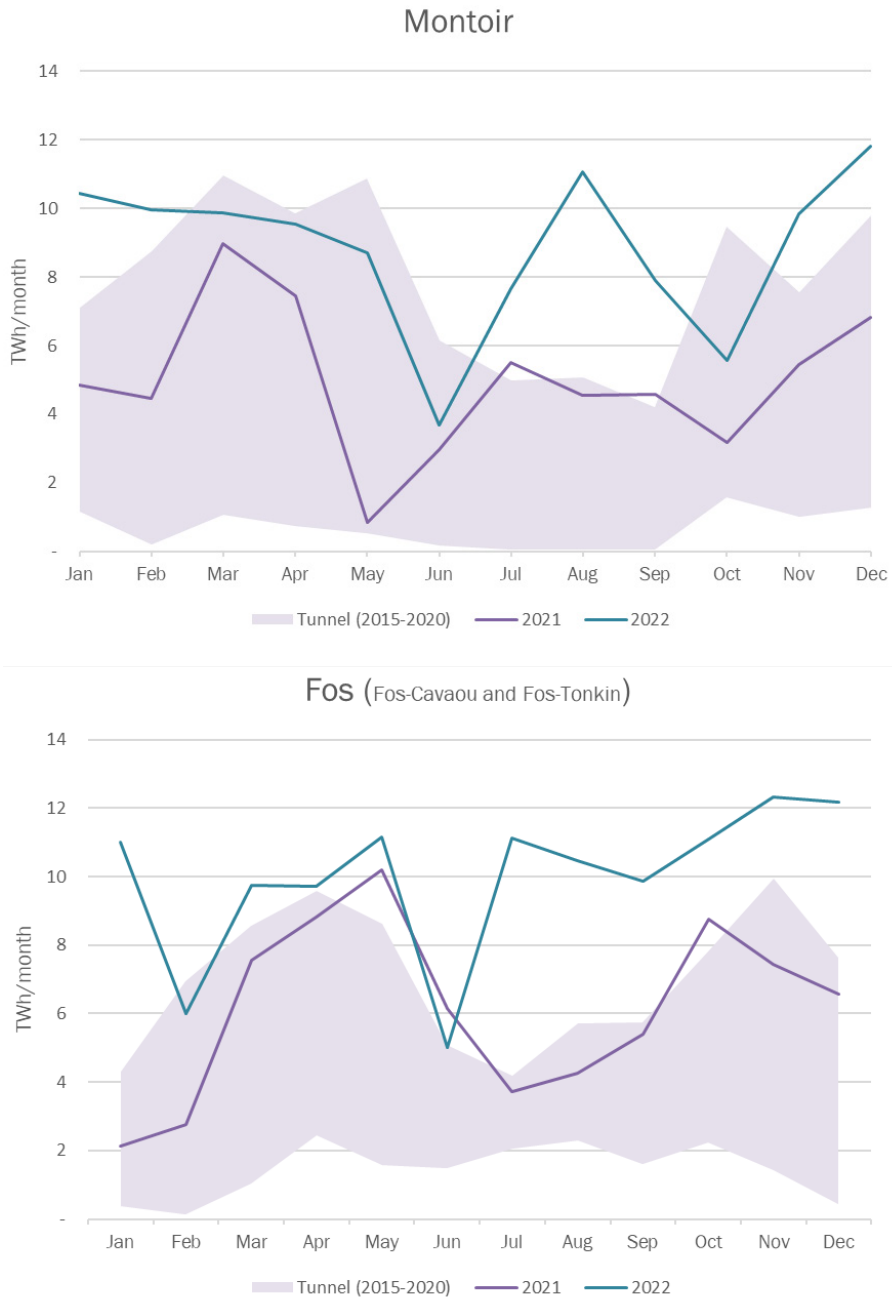
Figure 14 : Share of monthly US LNG exports to Europe and Asia

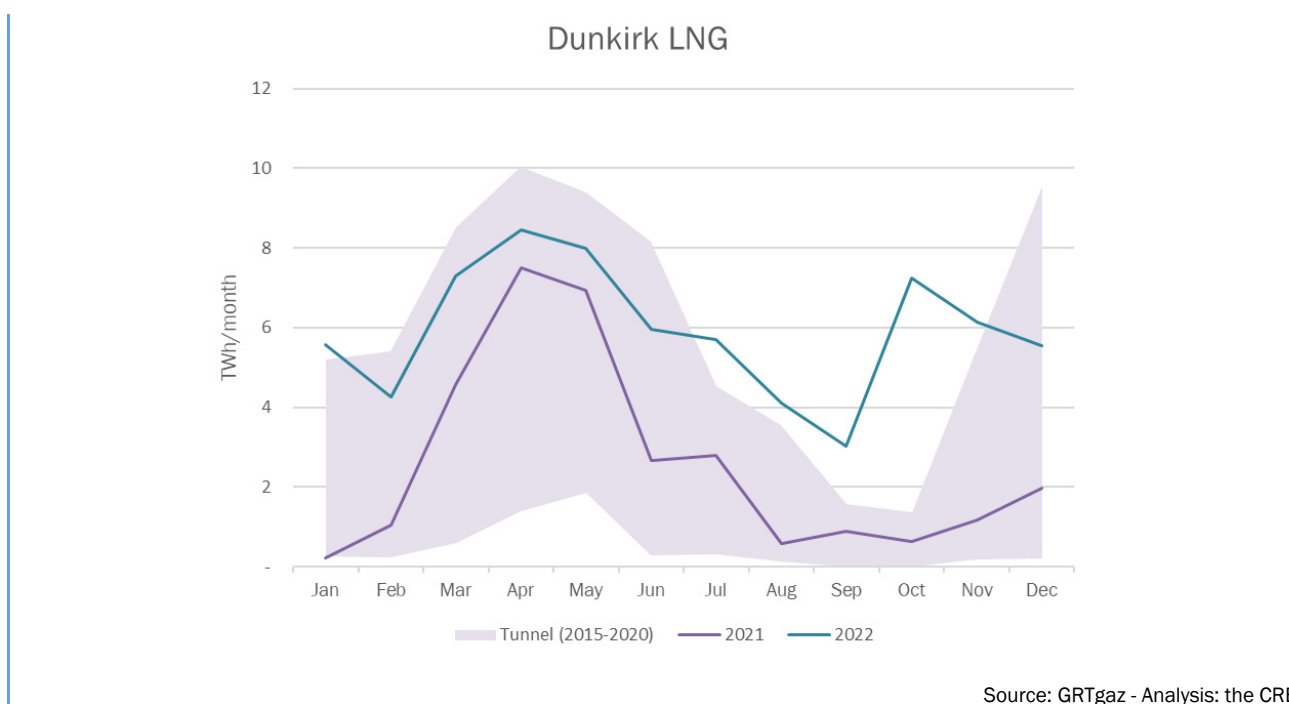


Source: Refinitiv - Analysis: the CRE

The sharp year-on-year increase in LNG output to the French grid in 2022 affected all LNG terminals: 78% for Montoir, 62% for Fos and 130% for Dunkirk. French terminals operated on average at 90% of their nominal capacity in 2022, with a drop in activity in June due to planned maintenance operations.

Figure 15 : Outputs from LNG terminals (commercial flows)





1.5 Limited withdrawals from storage at the beginning of the year due to mild temperatures and a successful injection campaign in Europe, boosted by the new storage obligations of EU member countries

The low level of European storage capacity at the beginning of the winter of 2021-2022 (77% on average at 1 November 2021, compared with 94.5% for France) had contributed to a tightening of the European gas market. The huge increase in LNG supply and the fall in demand due to very high gas prices and efforts to reduce consumption, coupled with mild winter temperatures (an average of 1.2 °C above the norm for the winter of 2021-2022 in France, according to Météo France), have ensured the continent's security of supply.

At the end of winter, most of the storage facilities in France have to be emptied of a certain volume to ensure that the aquifers can breathe and maintain their performance over the coming winters. At 1 April 2022, the aggregate level of storage in France was 23.7% (30.4 TWh), close to the average for the last three years at that date (23.3%).

As the low level of storage in Europe contributed significantly to the crisis in the winter of 2021-2022, on 27 June 2022⁴⁶ the European Union adopted a regulation requiring a minimum level of storage of 80% by 1 November for each member country, with intermediate thresholds to be reached in the preceding months. The target fill level will be increased to 90% in subsequent years. In France, existing regulations already required suppliers to fill their subscribed storage capacity to 85% by 1 November^{47,48}.

As a result, the injection campaign was very strong throughout the summer of 2022, boosted by a massive influx of LNG into Europe. At 1 November 2022, French storage facilities were 100% full, compared with an average of 97.7% over the previous three years. At the same date, the fill rate for European storage facilities was 94.9%, 17.8% higher than on 1 November 2021, a year which had been affected by the low fill rate for Gazprom's storage facilities, particularly in Germany.

By the end of the initial sales campaign ending in February 2022, 95.4% of storage capacity in France had been subscribed. Additional sales in April and May also enabled 100% of H-gas capacity to be subscribed⁴⁹. This confirmed that the 2018 domestic legislation on third-party access to gas storage is working well.

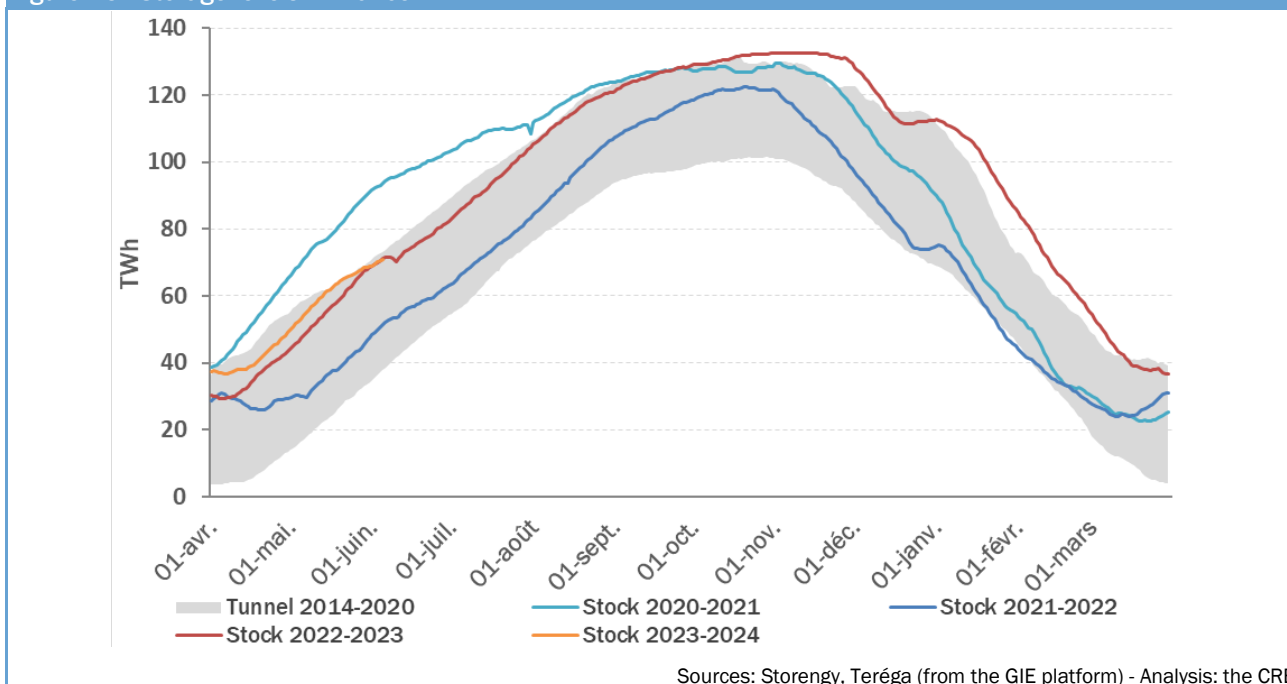
⁴⁶ <https://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:32022R1032>

⁴⁷ French Energy Code, Article L421-7: https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000036436013/

⁴⁸ Order of 9 May 2018 specifying certain provisions relating to the underground storage of natural gas, Article 2: <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000036936721>

⁴⁹ B-gas and H-gas are the two types of mains gas supplied to French households connected to the network. B-gas is a low calorific value gas. On the other hand, H-gas has a high calorific value. B-gas is imported from the Netherlands, while H-gas comes from Russia, Algeria and Norway. Their origins explain why B-gas is found mainly in the north of France and around Rouen, while H-gas is supplied to other regions.

Figure 16 : Storage levels in France



1.6 The localised spread mechanism was regularly triggered at the end of the year, resulting in a significant cost for TSOs

The localised spread is a mechanism that has been in place in France since the winter of 2017-2018 to manage congestion on the French gas network, originally mainly in the majority north-south flow direction. The principle is to allow the TSO to call on market participants to buy gas upstream of congestion and sell it downstream.

Historically, the tightest period for the network was the gas summer (April-October), when shippers injected gas into storage facilities in preparation for the following winter. Since summer is a period of low national consumption, the main outflows of gas from the French network were injections to the Atlantique and Lussagnet storage facilities and transit flows to Spain, all three of which are located to the south of the network and thus cause congestion in a north-south configuration.

In 2022, the French gas system was able to cope without too much difficulty with the end of gas flows at the inter-connections with Germany (Obergaibach) and Belgium in H-gas (Virtualys). However, at the end of the year, the redirection of large volumes of Norwegian gas from France to the UK led to a deficit of gas north of the TRF and a surplus south of the TRF, creating congestion from south to north on the gas transmission network. The localised spread mechanism was triggered by GRTgaz and Teréga fifty-seven times in 2022, most of them in December, which is the highest number of annual activations since the mechanism began.

The use of this market mechanism reflects a tighter situation than in previous years. The total volume allocated in 2022 (2614 GWh) and the number of activations of the mechanism (57) are three times higher than the average for the previous three years. The average transaction price (€13.30/MWh) is six times higher than the average for the last three years. In total, the mechanism will have generated costs for TSOs estimated at €34,700,000 over 2022.

The CRE points out that the behaviour and offerings of market participants in response to the localised spread mechanism are regularly monitored. The CRE is accordingly particularly attentive to nominations made at the beginning of the day by market participants active in the localised spread mechanism, which has the effect of exacerbating congestion. Taking into account the conditions for activating the local spread at the end of 2022 and the associated cost, the CRE has questioned a number of market players.

Table 3 : Assessment of the activation of the localised spread in 2022

	Total 2019	Total 2020	Total 2021	Total 2022
Number of activations	44	16	1	57
Total volume allocated (GWh)	1807	659	17	2614
Average transaction price (€/per MWh)	3.99	1.4	1.0	13.3

Source: GRTgaz

2. 2022 WAS A YEAR OF HISTORIC NATURAL GAS PRICES

2.1 The very sharp fall in Russian gas pipeline supplies pushed up gas prices in Europe in 2022.

In 2022, gas supplies to Europe by pipeline will be marked by a halving of Russian flows compared with the previous year, totalling just 18%, whereas they were the continent's leading source of supply in 2021. In response, LNG imports have doubled and will be Europe's leading source of gas supply in 2022 (36%). The shares of other countries supplying Europe via pipelines in total European supply have changed little compared with last year, with Norway accounting for 33%, North Africa for 10% and Azerbaijan for 3%.

Wholesale gas prices in Europe rose sharply at the end of February following Russia's invasion of Ukraine. Prices subsequently fell in response to the massive influx of LNG to the continent, which reduced fears of a shortage. The market became tense again after the Russian President signed a decree at the end of March requiring foreign buyers to pay for Russian gas in roubles, in response to European sanctions. Failure to comply with the decree led Gazprom to announce at the end of April that it was halting gas deliveries to Bulgaria and Poland, a situation that subsequently spread to a number of major European suppliers who had contracts with Gazprom.

After a period of relative stability, prices began to rise sharply from mid-June, triggered by the fire at the Freeport LNG liquefaction plant, which accounts for 20% of US liquefaction capacity. This rise was fuelled throughout the summer by the gradual reductions in capacity on the Nord Stream gas pipeline (which accounted for half of Russian exports to Europe in 2021), described by Gazprom as being due to technical problems with the compressors upstream of the pipeline. This upward trend was also supported by the unavailability of Norwegian gas facilities and the drought that affected hydroelectric production. Prices continued to soar following Gazprom's announcement in mid-August that Nord Stream would be completely shut down at the end of the month for maintenance. After reaching an all-time high on 26 August 2022 (PEG *front-month* contract at €244/MWh), prices fell from the end of August onwards against a backdrop of good storage capacity levels and discussions at European level on the implementation of gas price caps. The failure of Nord Stream to resume flows at the beginning of September following maintenance operations and the destruction of the pipeline at the end of the month were unable to halt the downward trend. This trend continued until the end of the year, with a slight rebound in December as temperatures dropped.

After a period of relative stability, prices began to rise sharply from mid-June, triggered by the fire at the Freeport LNG liquefaction plant, which accounts for 20% of US liquefaction capacity. This rise was fuelled throughout the summer by the gradual reductions in capacity on the Nord Stream gas pipeline (which accounted for half of Russian exports to Europe in 2021), described by Gazprom as being due to technical problems with the compressors upstream of the pipeline. This upward trend was also supported by the unavailability of Norwegian gas facilities and the drought that affected hydroelectric production. Prices continued to soar following Gazprom's announcement in mid-August that Nord Stream would be completely shut down at the end of the month for maintenance. After reaching an all-time high on 26 August 2022 (PEG *front-month* contract at €244/MWh), prices fell from the end of August onwards against a backdrop of good storage capacity levels and discussions at European level on the implementation of gas price caps. The failure of Nord Stream to resume flows at the beginning of September following maintenance operations and the destruction of the Nord Stream 1 and 2 pipelines in September were unable to halt the downward trend, which continued up to the end of the year.

European storage capacity was filled steadily throughout the year. In particular, Germany mandated the German market area operator Trading Hub Europe to purchase gas to fill the country's storage facilities. The sustained injection campaign in Europe will have enabled us to achieve the targets set at the beginning of the winter.

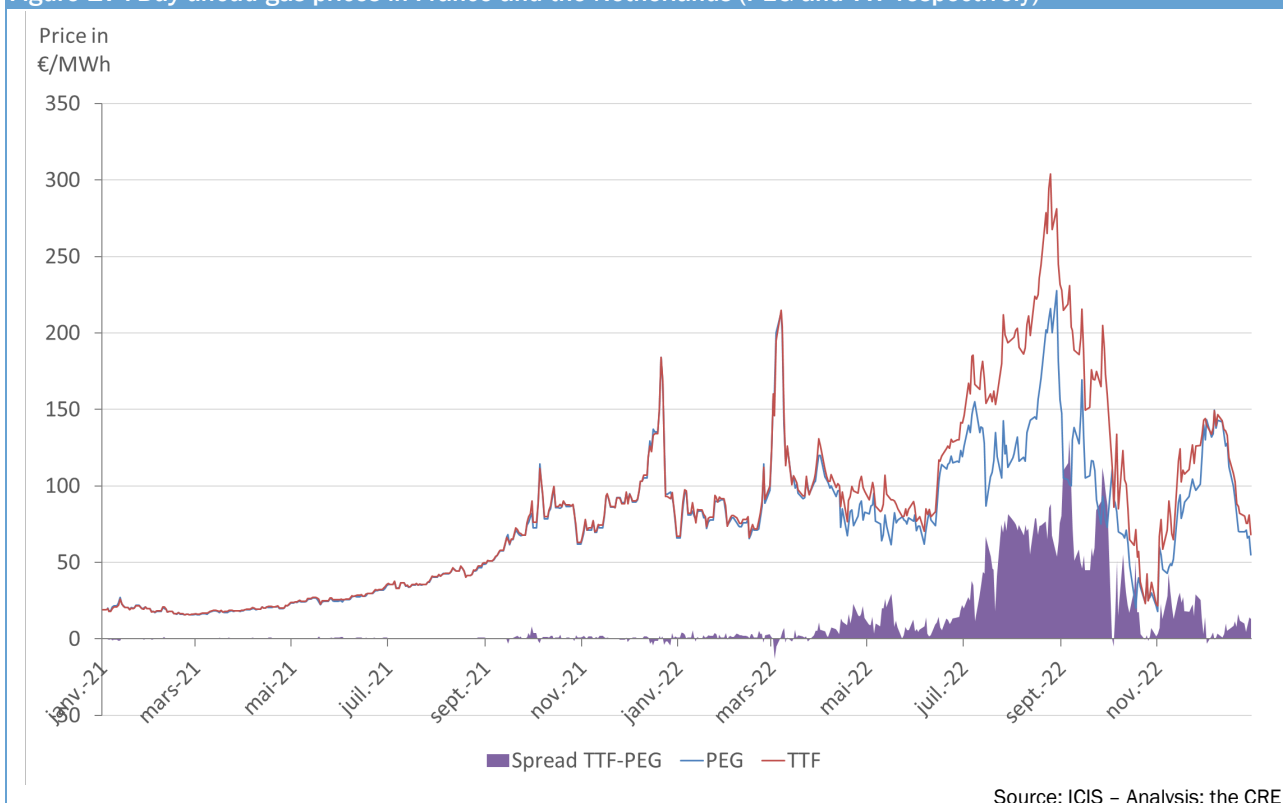
The drop in Russian gas supplies has forced Europe to make massive use of LNG. Most geographical arbitrages favoured Europe because of its higher prices compared with Asia. This historic influx of LNG, made possible by the many LNG infrastructures in the west of the continent, contributed to Europe's resilience in the face of the Russian supply shock, but it came at a high price.

2.2 Short-term prices hit record highs, with unprecedented spreads between European trading points

In 2022, the average price of the PEG *day-ahead* contract, at €98.10/MWh, was more than twice that of 2021 (€46.50/MWh), i.e. five times the historical average of around €20/MWh. Prices at the PEG reached a first peak of €213.40/MWh on 7 March 2022 following Russia's invasion of Ukraine, exceeding the December 2021 peak of €183.5/MWh. The August price peak was even higher, at €227.50/MWh on 29 August 2022.

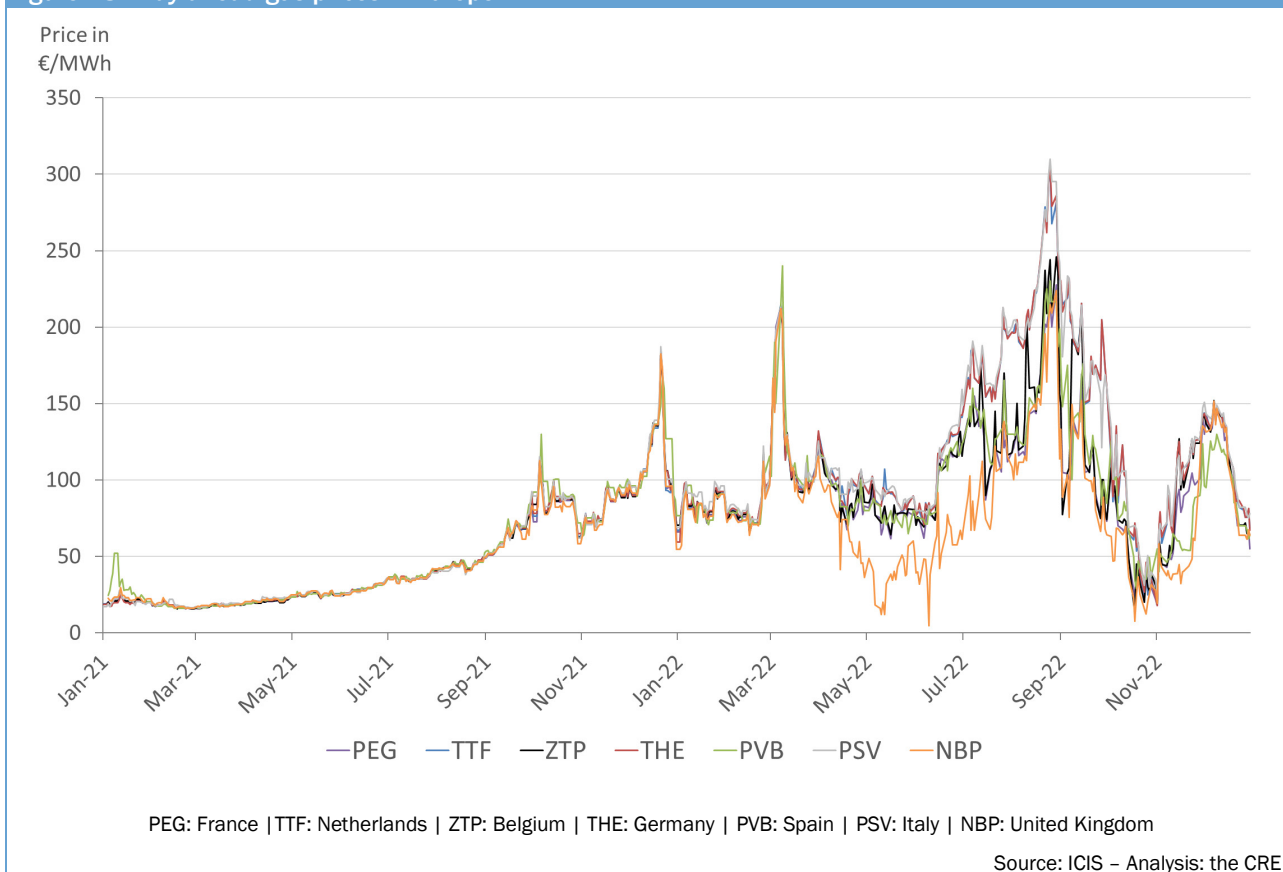
The PEG *day-ahead* contract recorded an average discount of €22.30/MWh over the year compared with the TTF. Price spreads between the various exchange points in Europe, which have historically been highly correlated, have increased considerably in 2022 as a result of the drop in Russian gas supplies via pipelines, leading to a reversal of flows from west to east and major congestion. The countries most dependent on gas, located to the east of France, have seen higher prices than countries less dependent on it, such as France, the Iberian Peninsula and the United Kingdom. By way of comparison, the price spreads observed in previous years between the PEG and the TTF was only €0.16/MWh in 2021 and €0.10/MWh in 2020. Prices between market zones narrowed their gaps at the end of 2022, in line with the easing of tension on the gas market.

Figure 17 : *Day-ahead* gas prices in France and the Netherlands (PEG and TTF respectively)



The increase in the price spreads between the exchange points in the more eastern countries compared with those in western Europe is reflected in the average annual spreads between the PEG and the *day-ahead* contracts delivered in Germany, the Netherlands and Italy, which are worth €22.80/MWh, €22.30/MWh and €24.60/MWh, respectively. These were far greater than the price spread between the Spanish exchange point (PVB) and the PEG, which averaged just €2.60/MWh. The UK, with its LNG terminals and supplies of gas from the North Sea, stepped up its pipeline exports to the continent until it reached maximum capacity at the beginning of April, causing the NBP price to fall sharply compared with other trading points. Over 2022, the NBP *day-ahead* contract recorded an average discount of €15.40/MWh compared with the PEG.

Figure 18 : Day-ahead gas prices in Europe



2.3 Forward prices rise in response to fears of supply shortages

Forward gas prices, which are widely used to index supply contracts, have risen more sharply than in 2021. The average price of the calendar contract delivered over the following year (2023) has risen from €33.700/MWh to €107.30/MWh, an increase of 218%. Contracts with longer maturities have also seen significant increases, standing at €76.90/MWh for 2024 and €56.40/MWh for 2025.

Following on from 2021, futures prices were in *backwardation* for almost all of 2022, meaning that shorter-term contracts were more expensive than those with longer maturities, anticipating an end to the crisis in the medium term. Compared with 2021, prices and spreads between different maturities have increased in 2022. These spreads narrowed at the end of 2022 as prices eased.

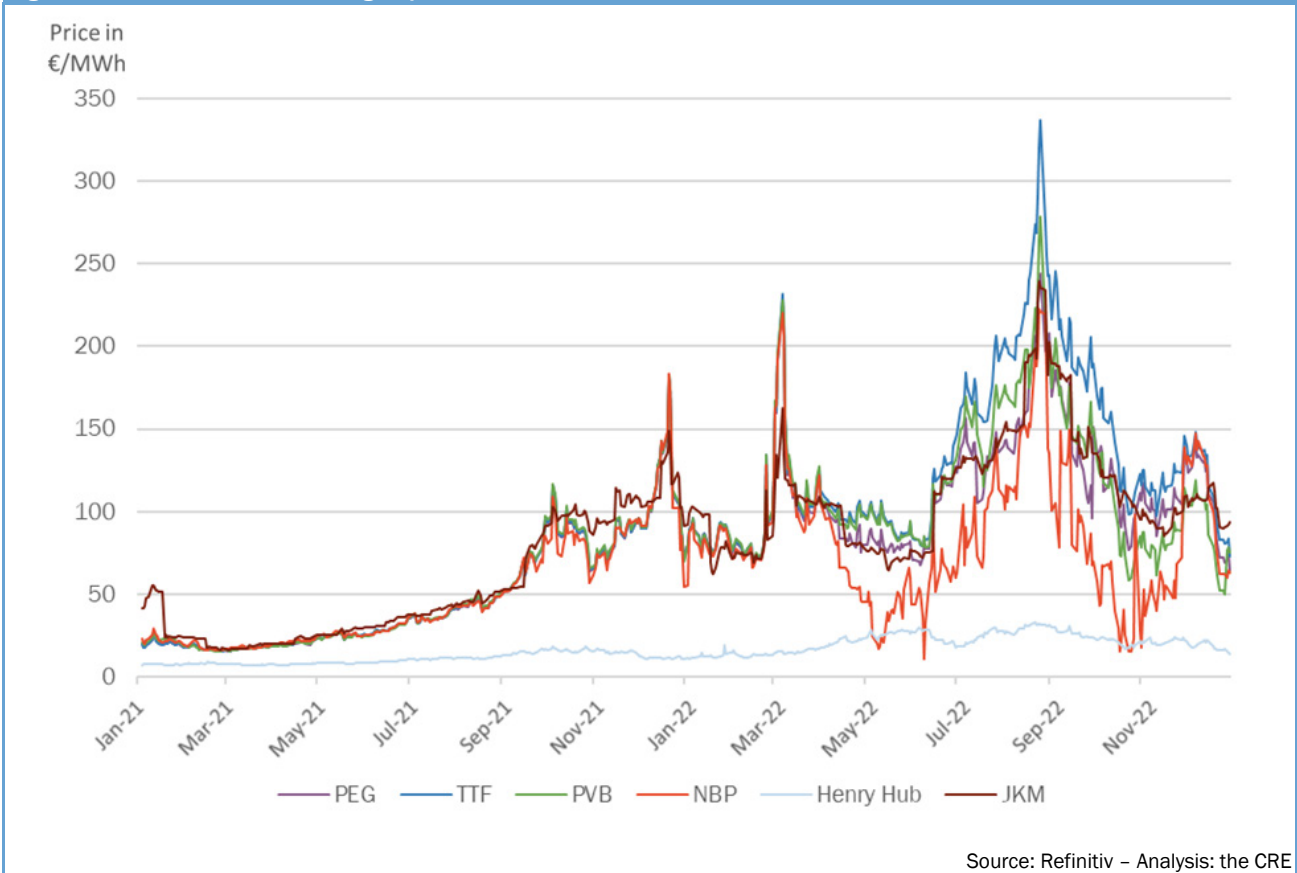
With regard to monthly contracts, the *front-month* contract delivered to the PEG recorded an average price of €112.80/MWh in 2022 compared with €47.40/MWh in 2021, i.e., an amount more than twice as high. On a global level, the price spread between Europe and Asia fluctuated over the year, with a total of more than four times as many days on which the PEG *front-month* contract price was higher than the Asian LNG price (JKM). For example, the maximum annual spread of €77.60/MWh reached on 8 March 2022, coinciding with the price peak in Europe following Russia's invasion of Ukraine.

Asian demand has been held back by China's zero-covid policy, which has slowed the economic recovery of the world's largest LNG consumer. The impact of strong European demand for LNG was observed globally in 2022, with a fall in imports from Asia and South America despite the increase in the number of liquefaction facilities. The price of Henry Hub, the benchmark gas contract in the United States, rose less than in Asia and Europe. Demand outstripped production, then fell in June with the shutdown of Freeport LNG, before rising again with record gas consumption for power generation in the summer.

Figure 19 : PEG forward price



Figure 20 : Month-ahead world gas prices



2.4 Price spreads between winter and summer were unfavourable but did not prevent the allocation of almost all storage capacity in France.

Forward gas prices generally show a seasonal pattern, with prices for winter delivery higher than those for summer delivery. This seasonality in forward prices is in addition to the difference between shorter-term and longer-term prices described above.

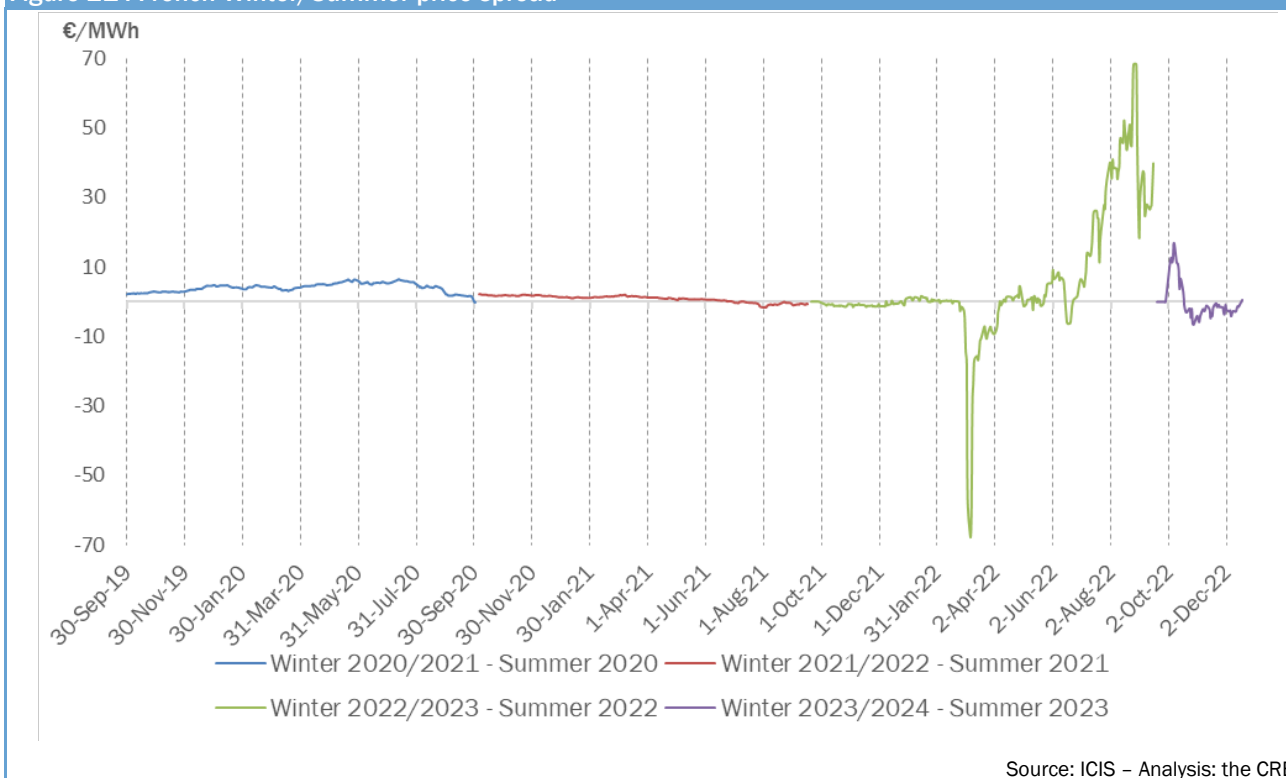
The year 2022 was marked by high volatility in price spreads between contracts delivered in the winter and summer of the same year (Figure 21)⁵⁰. Tight short-term supply conditions, resulting in strong *backwardation*, have reduced or even reversed the price differences between the Winter/Summer 2022 and Winter/Summer 2023 contracts.

This Summer-Winter price spread was significantly lower in the 2022-2023 marketing year than in previous years, making it more difficult to sell storage capacity in France. Over the 2021-2022 gas year, the price of the Winter 2022 contract was lower than the Summer 2022 contract on 43% of days.

The first auctions for the 2022-2023 campaign, which began in mid-February 2022, did not lead to a subscription of the entire offered capacity. Despite this unfavourable context, the zero reserve price auction system introduced by the CRE when French storage came under regulation enabled the vast majority of storage capacity to be sold between November 2021 and February 2022. In addition, a significant proportion of storage capacity for the period 2022 – 2023 had already been sold by operators at multiannual auctions held between June 2019 and June 2021.

Finally, 100% of storage capacity in France for the winter of 2022-2023 has been sold⁵¹.

Figure 21 : French Winter/Summer price spread



3. TRADING VOLUMES ON THE PEG WERE UP SHARPLY, IN PARTICULAR AS A RESULT OF LARGE QUANTITIES OF LNG.

In 2022, trading volumes in *spot* contracts rose sharply, up 59% on the previous year. This increase is reflected in the growing number of transactions for these contracts, which stood at 55%.

The volume of futures contracts traded rose even more sharply: +108% year-on-year. Trading in seasonal contracts saw the biggest increase in terms of volume (+129%), followed by quarterly contracts (+124%) and monthly

⁵⁰The price spread between the winter and summer of year Y corresponds to the difference between the price for delivery during the gas winter (from 1 October of year Y to 31st March of year Y+1) and the price for delivery during the gas summer (from 1 April to 31st September of year Y).

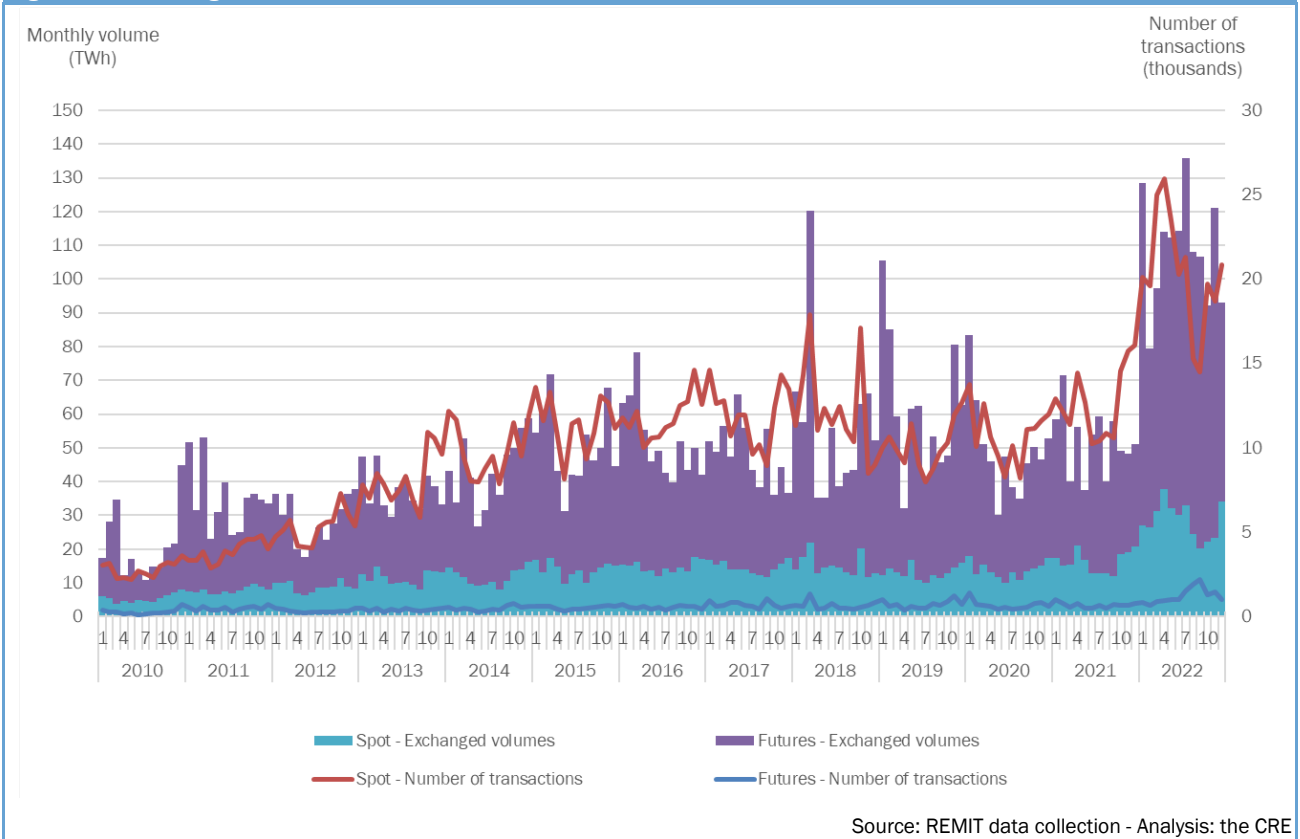
⁵¹51 With regard to the storage capacity of H-gas.

contracts (+100%). The volume of calendar contracts traded fell by 7%. The number of futures contracts traded rose by 171%.

The exceptionally high prices of 2022 have fuelled market fears about counterparty risk, leading market players to make much greater use of exchange *clearing* services for their OTC transactions: In 2022, 21% of futures contracts traded by brokers were cleared by exchanges, compared with just 4% the previous year.

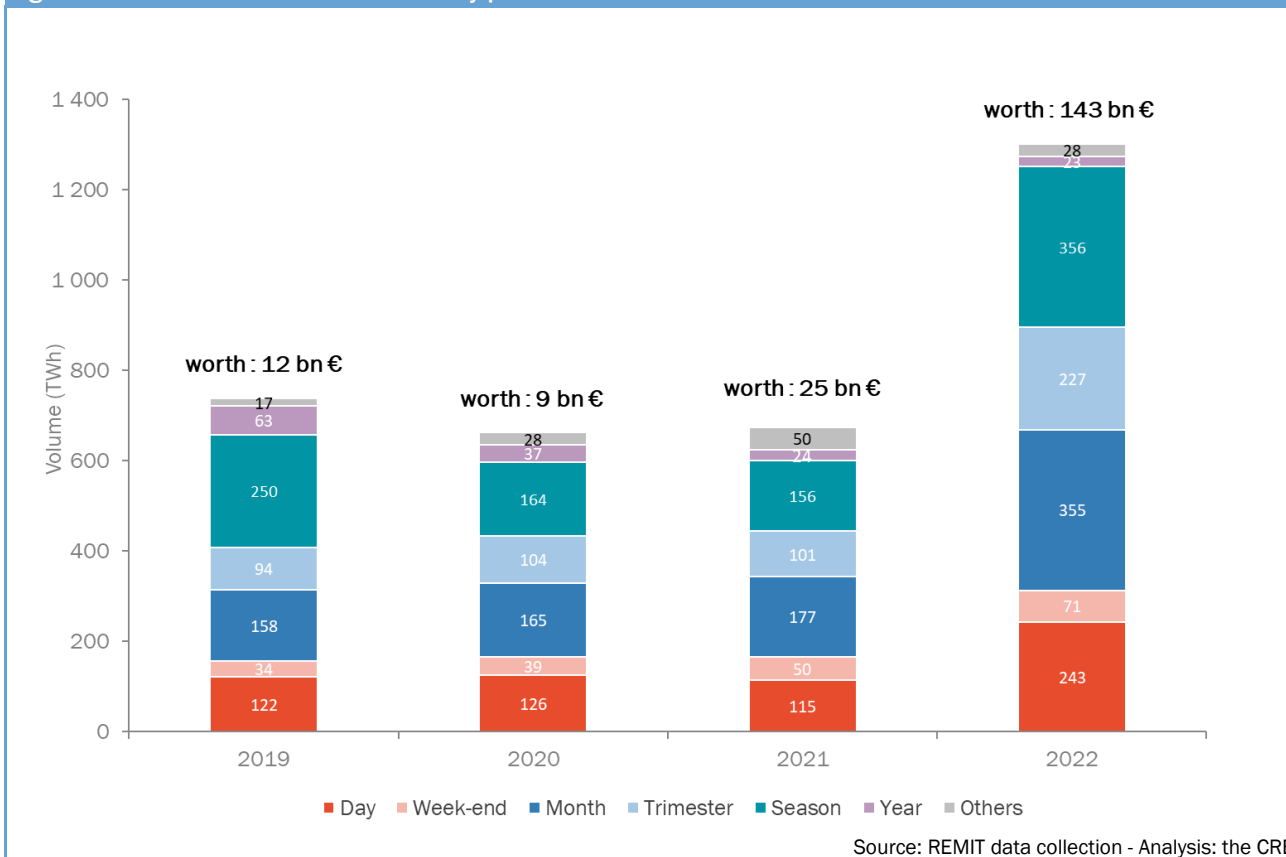
In contrast to the PEG, liquidity on European trading points has mostly fallen as a result of high prices and volatility. This increase in the attractiveness of TRF is due in particular to the sharp rise in LNG volumes imported into France in 2022.

Figure 22 : Trading volumes and number of transactions on the French intermediated market



The exceptional scale of the price rise in 2022 was reflected in the increase in the total value in euros of transactions carried out over the year, which was more than eight times higher than the average for the previous three years. This amount is almost five times higher than in 2021, when the price rise began, with major peaks at the end of the year.

Figure 23 : Volumes and values traded by product on the intermediated market



The total volume of trade has increased significantly compared with the average for the last three years (+59%). Monthly and quarterly contracts show the biggest increases in volumes, with +112% and +107%, particularly for contracts delivered in the fourth quarter of 2022. Calendar contracts are the only contracts whose volume has fallen, by 69% compared with the three-year average. The year 2022 will thus have seen market players increase their forward hedging activity, but with a preference for the shortest maturities in view of market uncertainty and very high margin calls on long-dated products.

Figure 24 shows the quarterly sum of net physical positions per market player on the French wholesale gas markets, by delivery period and product maturity. Since the trades under consideration do not involve imports or exports, the sum of net buying positions is equal to the sum of net selling positions.

It can be seen that the sum of net positions is significantly lower than transaction volumes (Figure 22 and Figure 23), which can be explained by successive purchases and sales of the same product by the same market player, which offset each other when calculating the net position. This difference may reflect the level of market liquidity.

The total volume of positions held by market players has increased significantly compared with the average for the last three years (+59%). Monthly and quarterly contracts show the biggest increases in volume, with +112% and +107%, particularly for contracts delivered in the fourth quarter of 2022. Calendar contracts are the only contracts with decreased volumes, at 69% compared with the three-year average. The price crisis will have led market players to increase their forward hedging, but in favour of the shortest maturities in view of market uncertainty and very high margin calls on long-dated products.

Figure 24 : Sum of long positions per market player, delivery period and product maturity

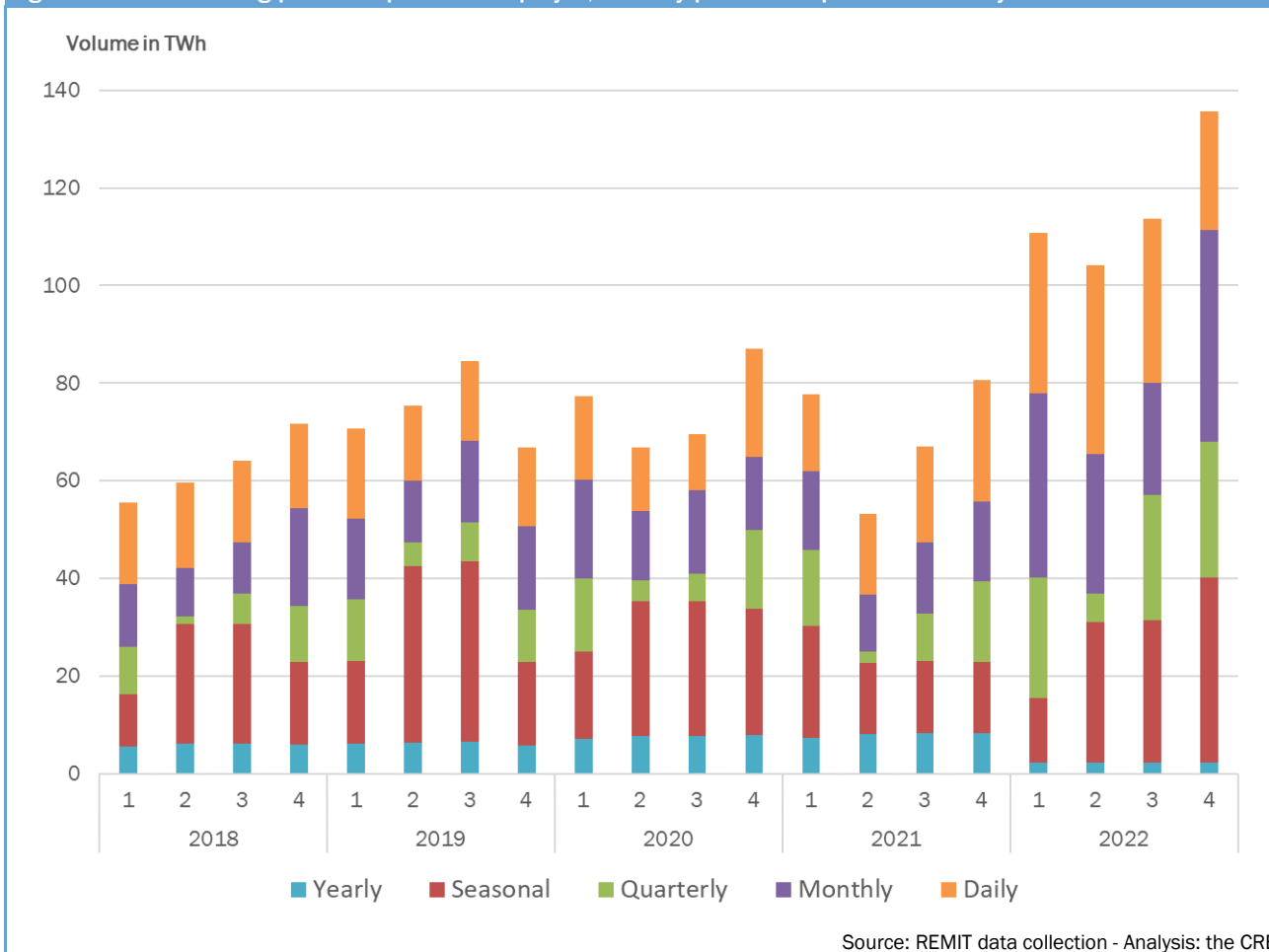


Figure 25 shows the evolution of the sum of the total open positions ("open interest") of market players between 2021 and 2022 on all the futures contracts with delivery periods equal to or greater than M+1. Open positions are increased by the conclusion of new contracts between market players and decreased by opposite transactions or the delivery of expired contracts. The market players have been grouped into different classes to distinguish them according to their main activity. The central energy market players are accordingly the gas and electricity producers or suppliers, and the TSOs/storage operators. Banks/funds/trading houses are considered as financial market players. Intermediate energy market players include consumers and intermediaries ("market access"). Foreign market intermediaries include brokers and exchanges.

After a period of relative stability in total open interest at around 150 TWh, it increased by around half in the second quarter of 2022. Most of these positions were taken by central energy market players, for whom hedging was more intense between the first and third quarters, when prices peaked sharply. The third quarter saw a further increase in open interest buying by central French energy market players and an increase in open interest selling by foreign financial market players, against a backdrop of historically high prices.

Figure 26 also shows changes in total open positions in futures contracts by distinguishing between positions taken on different maturities, rather than by type of market player. It shows that the increase in positions taken by market players from April 2022 onwards is mainly due to contracts delivered on medium and even long-term maturities. Between April and August 2022, the open interest in contracts with maturities of three to twelve months rose by around 70%, from around 70 TWh to 120 TWh. This variation is greater than that of the open interest for contracts with a maturity of thirteen months or more, which is around 20%, rising from around 100 to 120 TWh. Figure 25 shows that most of this increase in positions taken in the second quarter of 2022 corresponds to the central market players in energy, who are primarily physical market players. Furthermore, open interest on maturities of one to two months remains relatively constant. In the second quarter of 2022, market players took significant positions on contracts for the coming summer and winter.

Figure 25 : Total open positions in futures contracts over 2021 and 2022 (by market player class and nationality)

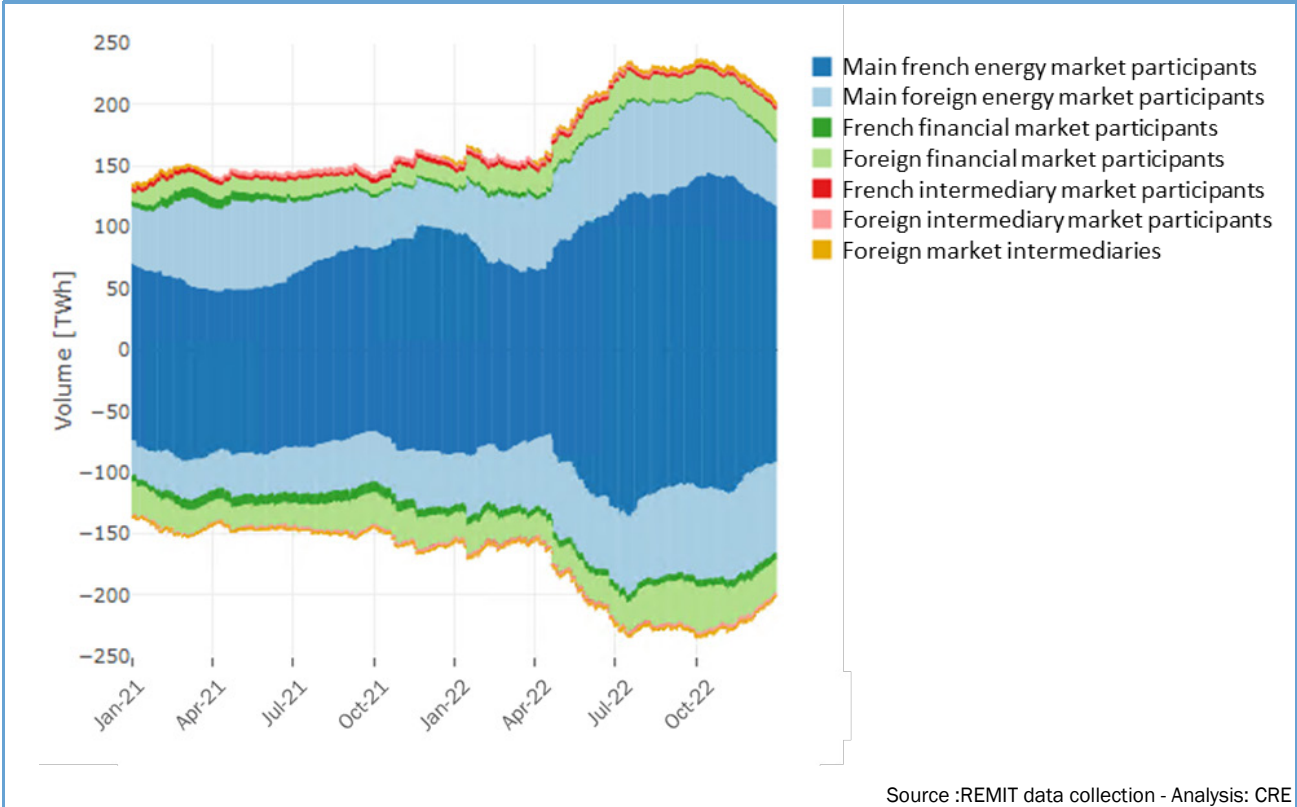
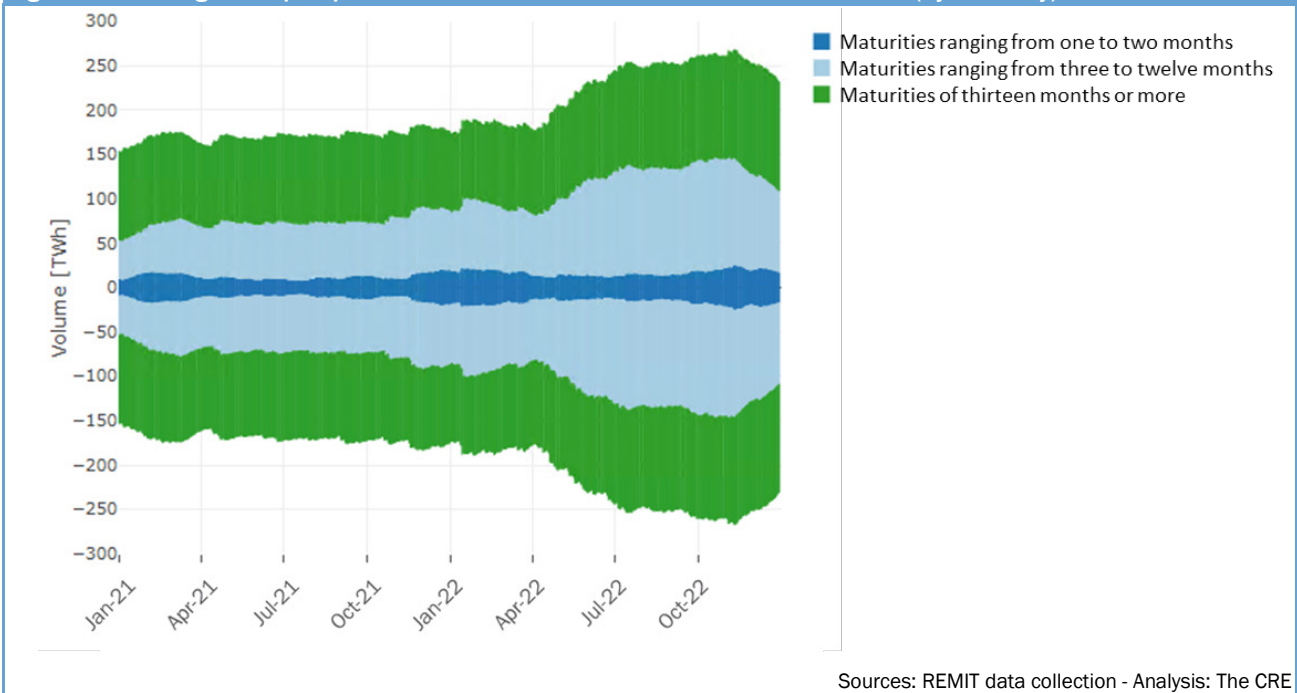


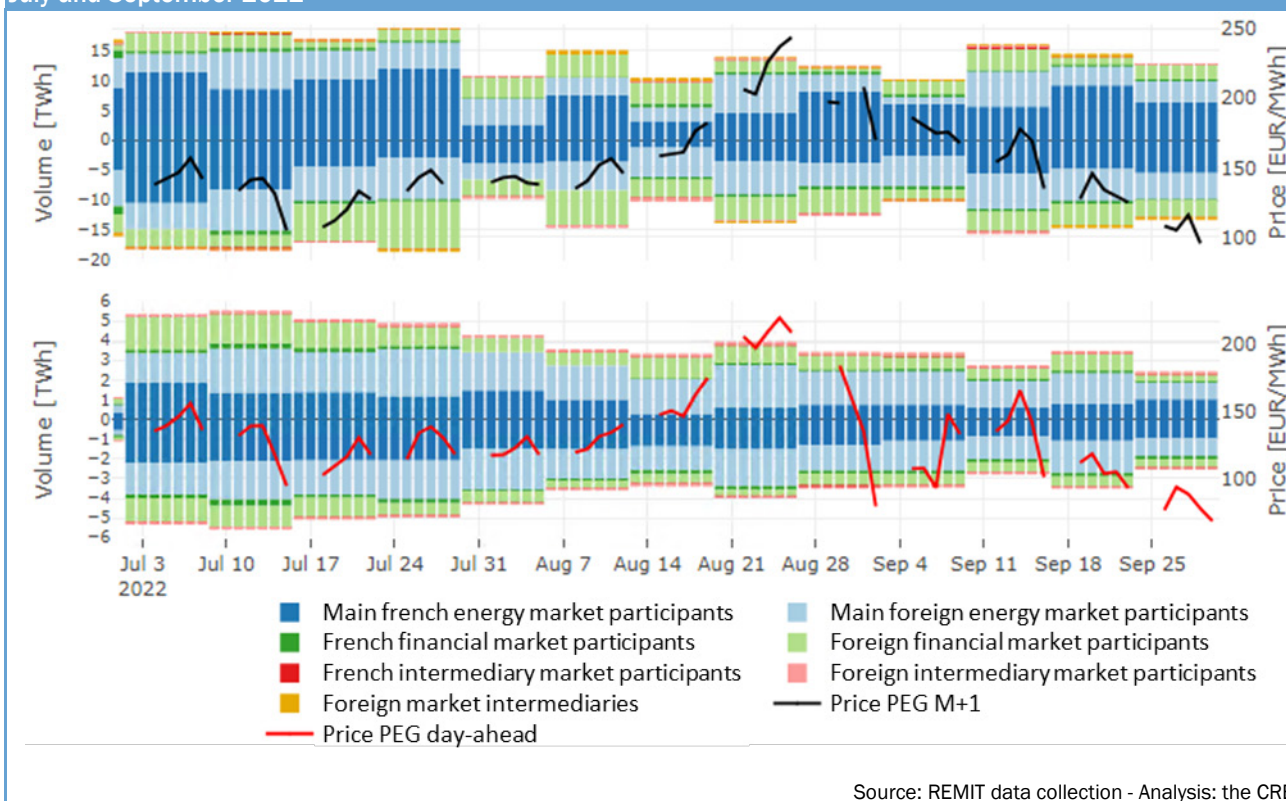
Figure 26 : Changes in open positions in futures contracts over 2021 and 2022 (by maturity)



Prices for the PEG *front-month* and PEG *day-ahead* contracts reached their highest values on 26 and 29 August 2022 respectively, at €244 and €227.50/MWh. Transactions by market players were analysed around these historical price peaks, with no particular break in the distribution of trades by type of market player.

Figure 27 shows the evolution of open futures positions and *spot* volumes (*day-ahead and within-day*) traded from July to September 2022. A degree of stability in the *open interest* for each class of market player was observed throughout the period. As regards short-term contracts, the breakdown of market players remains in line with that of previous weeks, except for a fall in purchasing volumes by central French energy market players offset by an increase by their foreign counterparts.

Figure 27 : Changes in open positions and weekly spot volumes traded by category of market player between July and September 2022



4. SUM UP OF THE WHOLESALE NATURAL GAS MARKETS FUNCTIONING IN FRANCE IN 2022

The year 2022 was marked by a gas supply crisis of historic proportions in Europe and France. The rise in prices that began in 2021 has continued and accelerated sharply in 2022, boosted in particular by the gradual reduction and almost complete drop of Russian gas supplies via pipelines following Russia's outbreak of war in Ukraine.

The sharp rise in wholesale gas prices led to an exceptional influx of LNG into Europe, particularly in France, which was the continent's leading importer. This reconfiguration has led to a historic reversal of flows in Europe, which are now oriented from west to east. Against this backdrop, the European internal market has been an asset in this crisis, enabling flows to be optimised.

The French TRF market zone, with its four LNG terminals, underground storage facilities that are full at the beginning of winter and a well-sized, flexible gas transmission network, has played a major role in the reconfiguration of European gas flows. French infrastructures, stretched to the limits of their capacity, have thus been able to guarantee France's security of supply, while contributing to that of Europe.

The wholesale gas market functioned without interruption and generated the price signals needed to restore the balance between supply and demand. This has made it possible to continuously encourage the supply of gas where it is most needed, and to achieve the European goal of reducing gas consumption by 15%.

The CRE has stepped up its monitoring of the French gas market in 2022. In particular, all instances of insider trading on the PEG were analysed and several market players were interviewed. In addition, the nominations of market players in connection with the spread mechanism located on the gas transmission network have been the subject of specific analyses. At this stage, no convincing suspicion of market abuse in the French wholesale gas market within the REMIT, has been identified in connection with the crisis. However, the CRE is continuing its analysis.

Finally, this major crisis has highlighted the critical importance of filling gas storage facilities, the need to diversify sources of gas supply and the major role of infrastructure. In these respects, France appears to have been better prepared than some of its neighbours.

SECTION 4 WHOLESALE ELECTRICITY MARKETS

1. SUPPLY AND DEMAND IN FRANCE IN 2022

1.1 Balance of the French electricity system: France was a net importer of electricity in 2022

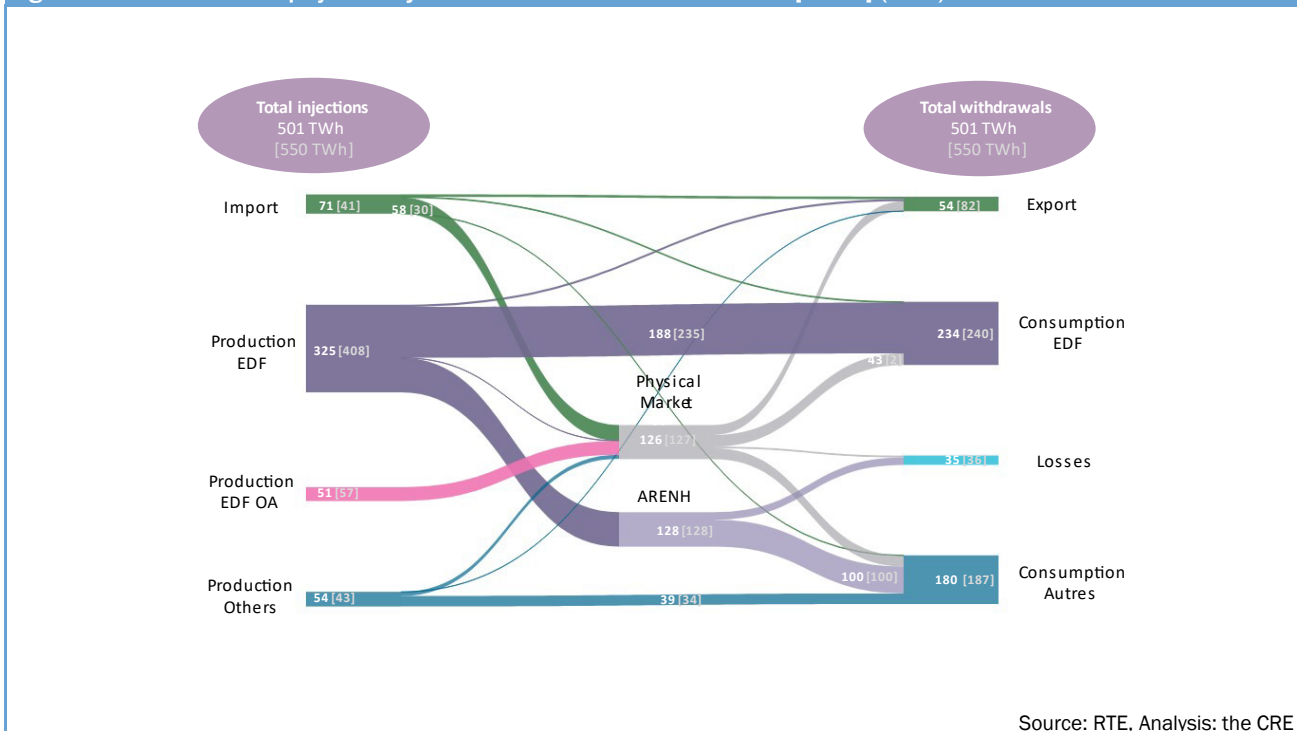
The balance on the French wholesale electricity markets in 2022 was heavily affected by three independent events: the rise in commodity prices linked to the fall in European gas supplies from Russian pipelines, the fall in the availability of nuclear power plants due to the discovery at the end of 2021 of corrosion on pipes critical to the safety of nuclear power plants, and an exceptional drought due to a record shortfall in rainfall, which has sharply reduced hydroelectric production in France.

The year 2022 was accordingly marked by an unprecedented fall in nuclear and hydro generation, partially offset by a fall in consumption due to high prices, efforts to reduce energy consumption and mild weather, resulting in a significant drop in the amount of energy injected into and consumed by the French grid.

Figure 28 shows a simplified view of the main physical flows on the French electricity system in 2022. The CRE is publishing the physical flows in this format for the first time. This diagram incorporates several assumptions that need to be clarified for it to be fully understood:

- The balance sheet only includes physical flows through the balancing items and not financial flows;
- the physical market includes the daily and intraday markets operated by EPEX SPOT and Nord Pool, as well as the block exchange programmes between Balance Responsible Entities, reflecting OTC forward exchanges with physical delivery;
- only the main ARENH delivery is represented (100 TWh), the additional ARENH (20 TWh), which involves a resale by the suppliers of the energy to EDF, does not lead to a physical exchange between EDF and the suppliers, but only a financial transfer;
- the link between each balance allocation is made in proportion to the supply of each Balance Responsible Entity.

Figure 28 : Balance⁵² of physical injections and withdrawals in 2022 [2021] (TWh)



Injections into the grid will accordingly fall by 9% between 2021 and 2022, from 560 TWh to 510 TWh. This fall is largely explained by the drop in nuclear generation (-82 TWh) and the fall in end consumption (-19 TWh excluding losses and pumping).

⁵²The graphic illustration is slightly different from the total physical balance between injections and withdrawals (501 TWh compared with 510 TWh). The difference is mainly explained by the chart's compensation for pump and turbine flows from the STEPs.

ARENH subscriptions for delivery in 2022 remain stable at 128 TWh (including 28 TWh to cover losses on the networks)⁵³ because the 100 TWh ceiling for end-customer suppliers has been reached.

Against a backdrop of soaring wholesale electricity prices, the government announced in January 2022 that an additional 20 TWh of ARENH would be made available to electricity suppliers for 2022, applicable from 1 April 2022. Under the mechanism, suppliers benefiting from additional ARENH undertake to resell to EDF a quantity of energy equivalent to that of their additional ARENH, at a price to be fixed by decree.

Total electricity generation in France, from all sources, is well below historical levels, at 445 TWh (-10% compared with 2020 and -15% compared with 2021)⁵⁴. The fall in generation compared with 2021 is significant for nuclear power (-81 TWh), but also for hydroelectric power (-12 TWh).

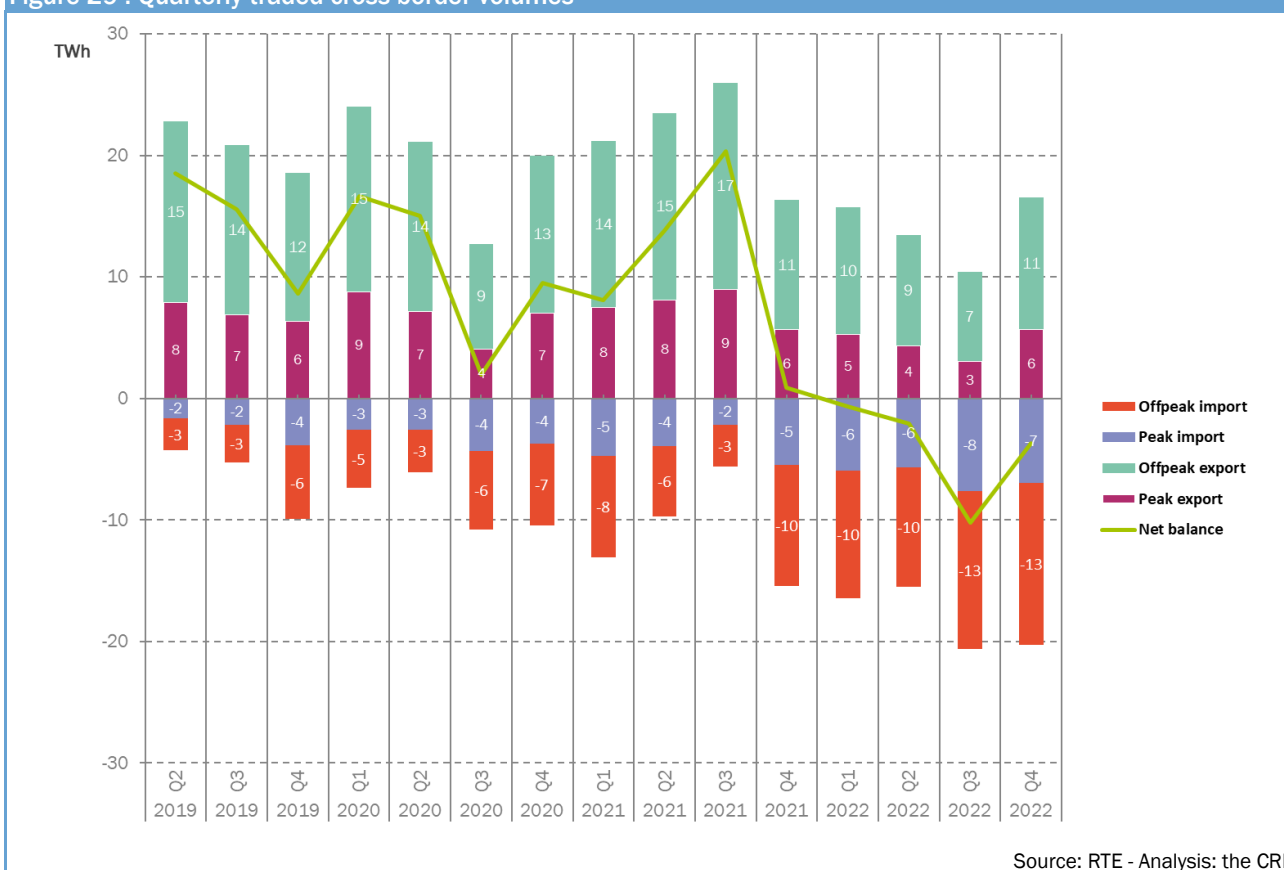
Table 4 Trend in France's export trade balance

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Export trade balance France (TWh)	47	25	30	56	44	47	65	62	39	38	60	56	43	43	- 16

Source: RTE

Exceptionally, France will have an import balance of 16 TWh in 2022, compared with an export balance in 2020 (43.2 TWh) and 2021 (43.1 TWh).

Figure 29 : Quarterly traded cross-border volumes



Source: RTE - Analysis: the CRE

1.2 Electricity consumption to fall sharply by 2022

In 2022, French electricity consumption declined sharply compared with 2021. Consumption in 2022 stood at 453 TWh, down 4% on 2021 (472 TWh) (Figure 30). This drop in consumption is clearly visible from October 2022 until the end of the winter.

⁵³ARENH came into force on 1 July 2010, obliging EDF to sell part of its nuclear electricity to alternative suppliers at a regulated price of €42/MWh in 2021.

⁵⁴Electricity balance 2022, RTE



This fall is the result of a combination of two effects: on the one hand, the very mild weather observed in 2022 (see Section 2, §4), and on the other, the reaction of demand to the very high forward prices observed for the winter of winter 2022-2023 (4th Quarter 2022 and 1st Quarter 2023).

Climate-adjusted consumption in France in 2022 is lower than in 2021⁵⁵, at around 459 TWh (467 TWh in 2021)⁵⁶, a fall of 1.7%. Adjusted consumption in 2022 is even lower than in 2020, a year that was severely affected by health measures and the economic downturn.

This fall in adjusted consumption in 2022 can be explained by the effect of very high prices on businesses and local authorities, as well as the public authorities' efforts to raise awareness among consumers who have not been exposed to price rises, encouraging them to be more frugal with their energy consumption.

In particular, RTE has published weekly electricity consumption from October 2022⁵⁷, with a comparison with previous years based on climate-adjusted data. The data published by RTE show that all categories of consumers have reduced their demand, from the mass market to industry. The fall in electricity consumption compared with previous years was between 5% and 9%, depending on the month and on a constant climate basis, helping to ease the market during cold spells.

Table 5 Evolution of weekly electricity consumption by the end of 2022

Period	September 2022	October 2022	November 2022	December 2022
Average corrected consumption	44 GW	45 GW	53 GW	63 GW
Deviation from pre-COVID historical average (2014-2019)	-5%	-8%	-8.5%	-9%

Source: RTE

⁵⁵To facilitate structural comparison from one year to the next, RTE corrects consumption to take account of climatic contingencies and calendar effects. In France, electricity consumption is highly dependent on temperature. Electricity is used both for heating in winter (France has a large number of electric heaters) and for air conditioning in summer (which has a more marginal effect). In addition, as years do not have the same number of days from one year to the next (e.g. leap years), a correction is applied to compare years on the basis of 365 days.

⁵⁶See RTE 2022 electricity balance: <https://analysesetdonnees.rte-france.com/bilan-electrique-synthese>

⁵⁷See the RTE website: <https://www.rte-france.com/synthese-hebdomadaire-consommation-electrique-francaise>

Figure 30 : Consumption in France (weekly average)



Source: RTE - Analysis: the CRE

1.3 The discovery of stress corrosion at a time when the maintenance programme was already under strain led nuclear production to an all-time low in 2022

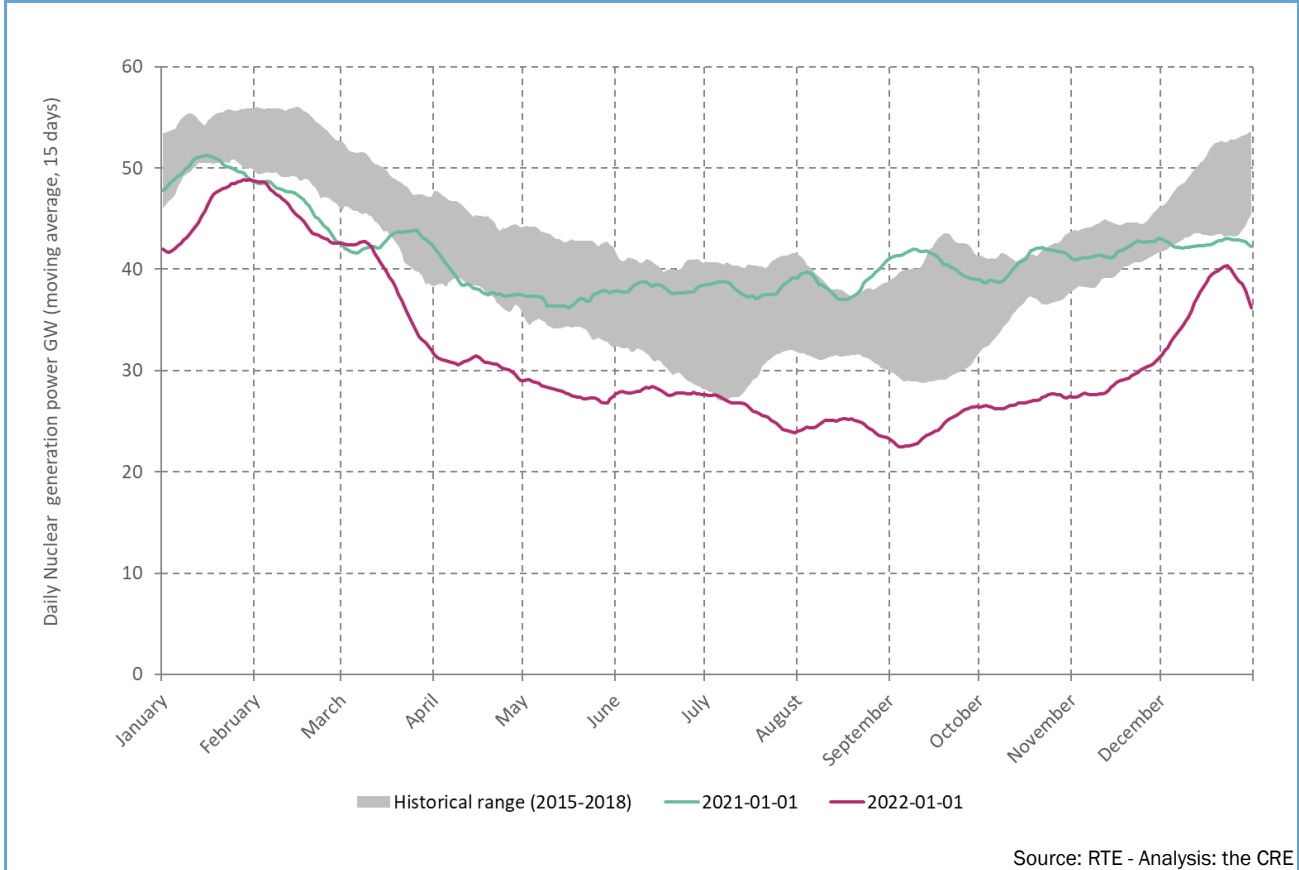
1.3.1 The actual production of electricity by the nuclear power plants is the lowest since the end of construction of the existing reactors

The discovery of the phenomenon of stress corrosion and its generic nature has had an exceptional and unpredictable impact on the availability of French nuclear power plants in 2022. All the checks and repairs needed to deal with this problem have been added to a maintenance programme that was already under strain because of the repercussions of the health crisis in 2020, the scheduled shutdowns for refuelling purposes (Section 4, §1.4), and the maintenance and improvement work that generally takes place during the ten-yearly outage programmes (RTE predicted a complicated situation in 2022 in the 2019 electricity supply-demand balance forecast⁵⁸).

This combination of factors has reduced the availability of France's nuclear power plants to a level not seen since the late 1990s. EDF has scheduled a large number of shutdowns for the summer in order to maximise the availability of the plants during the winter period. As a result, availability reached a low point during the summer and autumn, with a minimum of around 22 GW at the end of August. From September onwards, nuclear plant availability will increase, but remain at a very low level until mid-November (32 GW on 15 November 2022), before rising rapidly to reach 42 GW in December. The actual return to operation of the units meant that the winter months could be partly bridged.

⁵⁸ <https://assets.rte-france.com/prod/public/2021-12/Bilan-previsionnel-2019-rapport.pdf>

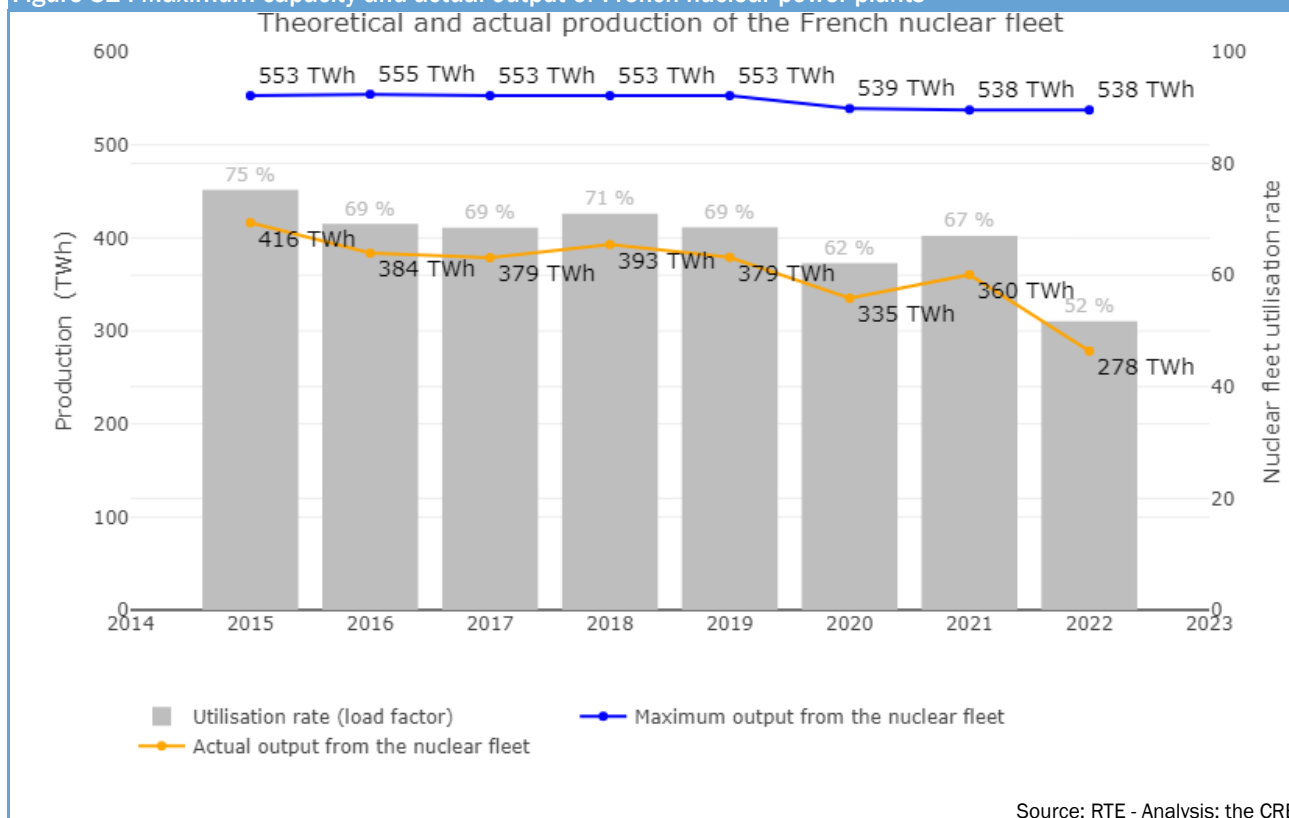
Figure 31 : Smoothed average daily output of French nuclear power plants



As a result of this low availability, output from the French nuclear power plants will fall sharply in 2022 compared with previous years, with an actual volume of 279 TWh, compared with 360 TWh in 2021 and 379 TWh in 2019. The year 2022 was also worse in terms of production than 2020 (335 TWh), which was particularly affected by the health crisis.

The nuclear capacity utilisation rate is 52%, well below the level seen in recent years (~70%).

Figure 32 : Maximum capacity and actual output of French nuclear power plants



1.3.2 EDF has issued specific information on the treatment of stress corrosion

The phenomenon of corrosion discovered on safety-critical piping in nuclear power plants, known as "stress corrosion", has been the subject of specific communications from EDF, as well as from the ASN (French Nuclear Safety Authority) and the IRSN (French Institute for Radiological Protection and Nuclear Safety). The CRE has paid close attention to the correct publication of information by EDF in application of its duties under REMIT. Insofar as this phenomenon has profoundly disrupted the operation of the wholesale electricity market in 2022 and will have long-term consequences on the shutdown schedules for France's nuclear power plants, the CRE would like to highlight a few key stages in the evolution of the situation.

During the ten-year shutdown of Reactor No. 1 at the Civaux nuclear power plant, which began on 21 August 2021, EDF carried out ultrasonic testing of several welds in the safety injection circuit⁵⁹. The safety injection circuit is a backup system that injects boron water into the reactor's main primary circuit to cool the core in the event of a breach in the primary circuit. The aim is to maintain a sufficient level of water in the core to cool the fuel.

Checks on Civaux's Reactor No. 1 revealed defects near the welds on some pipe elbows, which initial analyses qualified as stress corrosion cracking. Inspections carried out on the same equipment at the Civaux's No. 2 Reactor revealed similar faults.

As a generic anomaly relating to reactors belonging to the same 1450 MW family cannot be ruled out, EDF decided on 15 December 2021 to extend the shutdowns of the two Civaux reactors and to preventively shut down the two reactors of the Chooz B nuclear power plant, which are of the same type as those at Civaux, on 16 and 18 December 2021, in order to carry out checks.

On 14 January 2022, EDF published a briefing note⁶⁰, which has been updated several times, setting out developments in relation to stress corrosion.

The main EDF communications on stress corrosion are summarised below:

- On 14 January 2022, during the third ten-yearly inspection of Reactor No. 1 at the 1300 MW Penly power plant, an anomaly was identified near a weld on a section of pipework in one of the four lines of the safety injection system.
- On 8 February 2022, analysis of the results of the non-destructive examinations carried out during the last ten-yearly outage programmes for the 56 reactors in the nuclear power plants and the results of the latest

⁵⁹https://www.irsn.fr/FR/Actualites_presse/Actualites/Pages/20211216_NI-Detection-fissures-tuyauteries-RIS-reacteurs-1-2-Civaux.aspx#.YhynUejMJPY

⁶⁰https://www.edf.fr/sites/groupe/files/2022-11/EDF_CSC_Mise%20a%20jour%20Note%20Info%20du%203novembre2022_0.pdf

laboratory assessments led EDF to draw up a prioritised list of reactors where inspections will be repeated, using optimised resources and taking into account feedback from Civaux and Penly:

- within 3 months of their scheduled shutdowns: Bugey 3, Flamanville 1 and Flamanville 2 - within 3 months, during a specific shutdown: Chinon 3, Cattenom 3 and Bugey 4.
- On 14 April 2022, EDF indicated that it was continuing with its inspection and expert valuation plan for the prioritised reactors. Indications of stress corrosion were detected during ultrasonic non-destructive testing of sections of pipework in the Chinon B3, Cattenom 3 and Flamanville 2 reactors.
- On 19 May 2022, EDF indicated that twelve shutdown reactors were concerned by stress corrosion testing.
 - The analysis, based on circuit assessments and calculations, digital simulations and tests carried out in EDF's metallurgical expertise laboratory (LIDEC), highlighted several elements: the location of the phenomenon in the zone thermally affected by the welds, the a priori predominant influence of the geometry of the circuits, the influence of the welding processes, the existence of a compression zone in the metal, which limits the development of the stress corrosion phenomenon to a few millimetres.
 - At the same time, **EDF carried out an initial safety analysis and submitted it to ASN, complete with calculations, on its ability to shut down its reactors completely safely**, including in the event of the loss of 2 of the 4 lines of the safety injection circuits.
 - The method used to schedule inspections on the other reactors in France, based on an analysis of the results of ultrasound examinations carried out as part of the ten-yearly inspections, **has enabled EDF to define a multi-year inspection and repair schedule**.
- On 27 July 2022, the inspections, expert assessments, and analyses carried out since May 2022 enabled **EDF to define a perimeter of the reactors most susceptible to the occurrence of stress corrosion, to identify the specific area to be monitored as part of the maintenance programmes** and to continue the inspection programme at every nuclear plant:
 - pipes with little or very little sensitivity to the appearance of corrosion in 900 MW reactors (32 reactors) and 1300 MW "P4" type reactors (8 reactors)
 - RIS circuit lines (safety injection circuit) for 1300 MW "P4" type reactors (12 reactors) and RIS and RRA circuits (shutdown reactor cooling circuit) for N4 reactors (4 reactors) that are sensitive or highly sensitive to stress corrosion.

The programme of checks to be carried out on the reactors in the nuclear power plants is accordingly based on a priority search for stress corrosion on the N4 and P4 levels.

- On 26 July 2022, the ASN judged EDF's strategy to be "appropriate".
- The timetable for carrying out these checks takes into account the sensitivity of the auxiliary circuit pipes to the appearance of stress corrosion and is in line with the shutdowns already scheduled for 2022 to 2025.
- On 21 September 2022, EDF is continuing its programme of controls and treatment of stress corrosion in accordance with the strategy presented to ASN in July 2022. To date, repairs have been carried out on 10 reactors shut down for maintenance, in connection with expert assessments that have required the removal of sections of piping, and 5 reactors are being inspected.
- On 3 November 2022, EDF indicated that of the 10 projects launched in the summer of 2022, stress corrosion-related repair work had been completed on 6 reactors. At the Chooz 1 Reactor, the duration of repair operations has been extended because the scope of the work has been extended and additional inspections have been carried out.

At the same time, as part of the treatment of the stress corrosion phenomenon and in accordance with the strategy it proposed, EDF carried out checks on the pipes of the safety injection system of Reactor 1 at the Cattenom nuclear power plant. With the support of IRSN, ASN examined the information provided by EDF to justify maintaining these indications and restarting the reactor for a period of eight months. ASN considers that, given the uncertainties surrounding the fault characterisation measurements and the assumptions and methods used in the mechanical calculations, the strength of the pipes affected by these two indications is not certain. The welds concerned will accordingly have to be repaired before the reactor can be restarted.

- On 16 December 2022, **EDF submitted a report on the overall situation after a year of analysis**. The most recent reactors are those most affected by the phenomenon: the four N4 reactors and the twelve 1300-P4

reactors. **Of these 16 reactors, 10 had been treated in 2022** or were in the process of being treated by that date.

The heavy industrial programme involving the shutdown of numerous reactors for maintenance and inspection, as well as the ongoing programme of inspections and repairs to pipes potentially affected by stress corrosion and the various events that occurred during 2022 affecting them, led EDF to revise its production target for 2022 four times in 2022, and its production target for⁶¹ 2023 once

- 13 January 2022⁶²: The 2022 target is between 300 and 330 TWh, compared with the 330-360 TWh previously announced;
- 7 February 2022⁶³: the 2022 target is between 295 and 315 TWh; the 2023 target of 340 - 370 TWh currently announced will be adjusted as soon as possible;
- 11 February 2022⁶⁴: the 2023 target is between 300 and 330 TWh ;
- 19 May 2022⁶⁵: the 2022 target is between 280 and 300 TWh ;
- 3 November 2022⁶⁶: the 2022 target is between 275 and 285 TWh.

1.4 The characteristics of the nuclear power plants within the French electricity system mean that EDF has to modulate its production.

The size of the French nuclear power plants means that EDF has to plan for modulation of the reactors when demand is too low.

Depending on the timeframe, EDF carries out two types of modulation on its nuclear power plants:

- Long-term modulation, decided in advance to optimise the schedule for refuelling;
- short-term modulation, decided close to real time, when wholesale prices are lower than the variable cost or use value of the power plant (low consumption, high renewable production, or particularly high use value).

1.4.1 Long-term modulation

EDF has to shut down units for modulation over several days, or even weeks for certain units. Indeed, some reactors have a limited stock of fuel until the next refuelling or maintenance outage. More often than not, this constraint means that fuel has to be saved in order to be available, for example, during the winter, but the opposite situation is also possible, and the reactor then has to produce energy in order to burn up its fuel to an acceptable level for the next maintenance. These constraints arise because of the limited flexibility of the overall maintenance schedule, which also depends on the availability of teams from EDF and its industrial partners. In this way, EDF shuts down its power plants for modulation for a certain period of time in advance, so that they are not called on.

These long-term modulation outages are announced by EDF to the market via time series of unavailabilities published on REMIT platforms. The Figure 33 illustrates the number of outages for long-term modulation announced by EDF as a function of the month and the Figure 34 shows the capacity involved. The Table 6 table shows the number of nuclear units affected by modulation each year and illustrates the record number reached in 2020 in recent years.

⁶¹ EDF publishes press releases setting out its annual nuclear generation targets. EDF's nuclear production targets are based on a vision of the future, taking into account the various operational risks that could affect the availability of the nuclear power plants. These objectives contain different information to that which can be deduced from the outage schedules published by EDF under REMIT. In fact, these schedules represent an "up to date" view of the progress of internal work at EDF and do not take into account, for example, possible delays in maintenance shutdowns, unforeseen events or the effects of industrial action. In addition, these schedules give a vision of available power which may naturally differ from actual production, the latter being dependent on market conditions and the need to optimise generating plants fleet management (Section 4, §1.4).

⁶² <https://www.edf.fr/groupe-edf/espaces-dedies/journalistes/tous-les-communiqués-de-presse/edf-actualise-son-estimation-de-production-nucleaire-en-france-pour-2022>

⁶³ <https://www.edf.fr/groupe-edf/espaces-dedies/journalistes/tous-les-communiqués-de-presse/edf-ajuste-son-estimation-de-production-nucleaire-en-france-pour-2022>

⁶⁴ <https://www.edf.fr/groupe-edf/espaces-dedies/journalistes/tous-les-communiqués-de-presse/edf-ajuste-son-estimation-de-production-nucleaire-en-france-pour-2023>

⁶⁵ <https://www.edf.fr/groupe-edf/espaces-dedies/journalistes/tous-les-communiqués-de-presse/point-actualite-nucleaire-du-18-mai-2022>

⁶⁶ <https://www.edf.fr/groupe-edf/espaces-dedies/journalistes/tous-les-communiqués-de-presse/edf-ajuste-son-estimation-de-production-nucleaire-en-france-pour-2022-0>

Figure 33 : Number of nuclear unit outages for long-term modulation, by month of start of outage

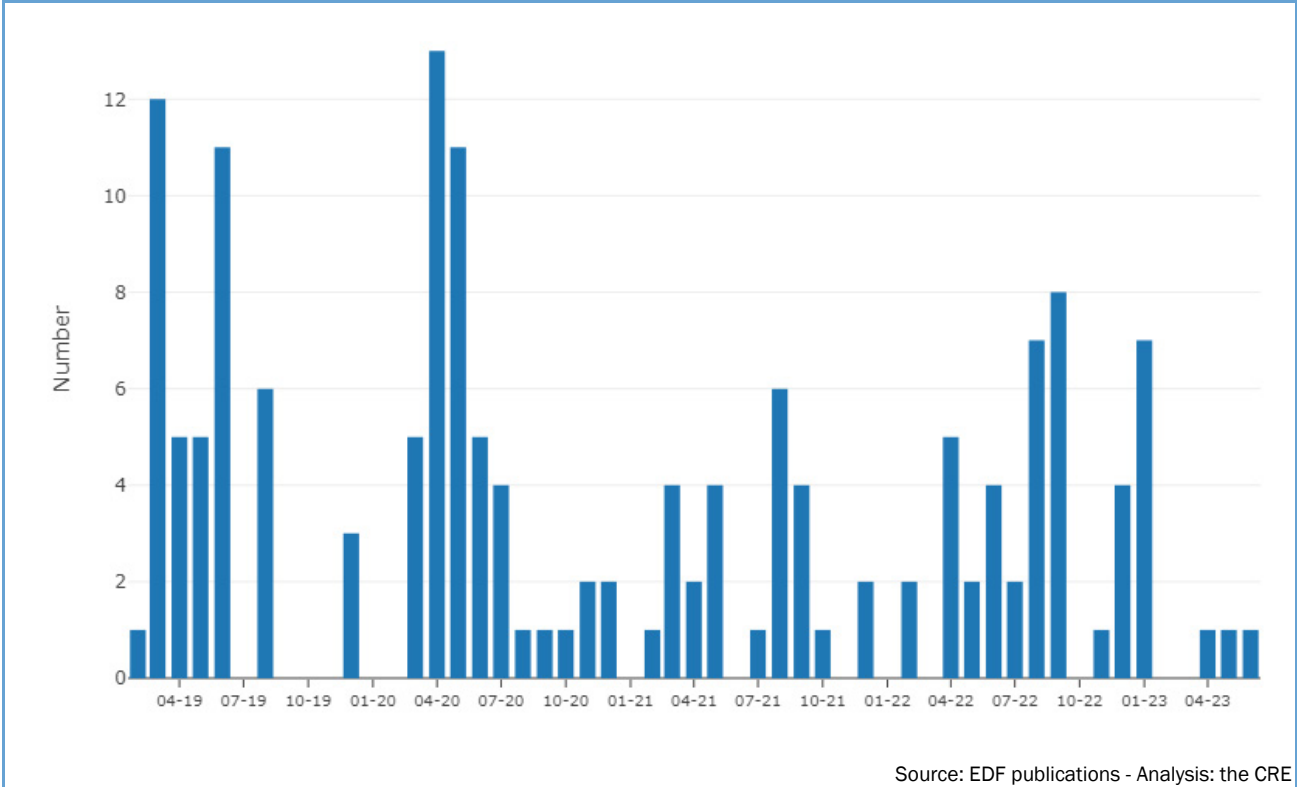


Figure 34 : Power affected by long-term modulation of nuclear units by month of start of shutdown

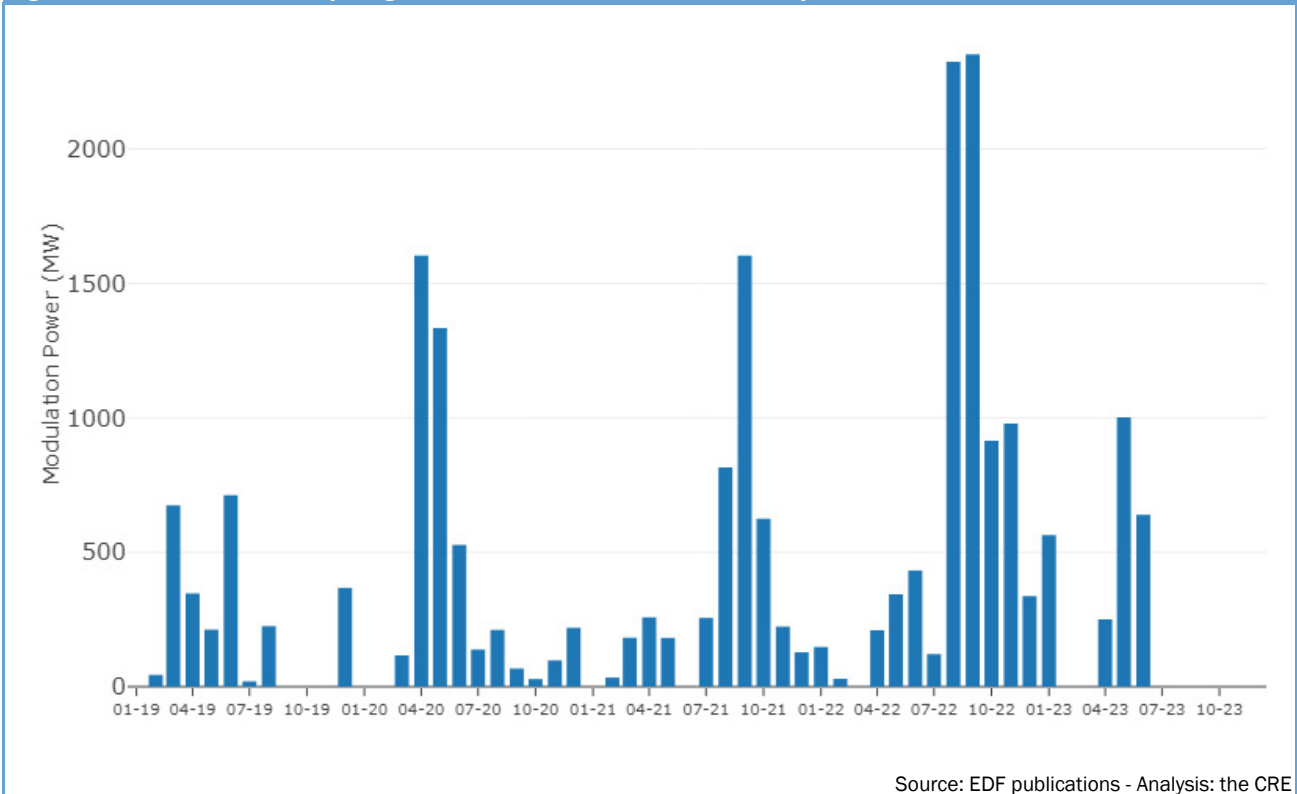


Table 6 Number of different units affected by at least one shutdown for long-term modulation

	2019	2020	2021	2022
Number of units concerned	14	22	13	13

Source: EDF publications

As the CRE described in its 2020 wholesale market monitoring report, the health crisis has had a particularly strong effect on power plant shutdown schedules, prompting EDF to make a large number of long-term modulations. The



Figure 33 clearly shows that 2020 is the year with the highest number of long-term modulations. The year 2021 saw a reduction in the number of long-term shutdown, which logically remained limited to the summer months. In 2022, as a result of changes to the schedule linked to stress corrosion, the number of shutdowns due to modulation increased again. EDF has also placed most of these shutdowns in the summer.

The month of August 2022 stands out very clearly with the very long outages that have begun for the Saint Laurent 2 and Dampierre 1 units, resulting in a peak in modulated power.

Alongside the unavailability logs, EDF publishes additional messages on the duration of unavailability and counts down the number of weeks remaining under modulation and announces the end of these special management arrangements where applicable. An example of this type of additional message is shown below.

Acteur de marché : EDF	Date de publication 2022-08-23T18:07:51+02:00
Statut : Active	
Date et heure de début 2022-08-23T18:07:00+02:00	
Identifiant du message 6349-EDF-PROD-RTE-0000000_001	
Code EIC de l'acteur de marché 17X100A100R00182	
Message	
Blayais 4 aura besoin d'économiser l'équivalent de 3 semaines de combustible par arrêts ou baisses de puissance imposées d'ici son prochain arrêt pour rechargement.	

1.4.2 Short-term modulation

EDF may have to reduce production at its power plants for a few hours or even a few days if economic conditions justify it. This may be the case when wholesale prices are particularly low and below the variable costs of nuclear power (high production of renewables or low demand, as for example in April 2020), but also when usage values are particularly high, in the case of a unit constrained by its fuel stock or when periods of high voltage are anticipated in the future, resulting in very high forward prices, which justify preserving the fuel stock. For this type of modulation, the decision to shut down a unit is taken at very short notice, and the decision period before the start of outages for modulation is accordingly in most cases less than 24 hours.

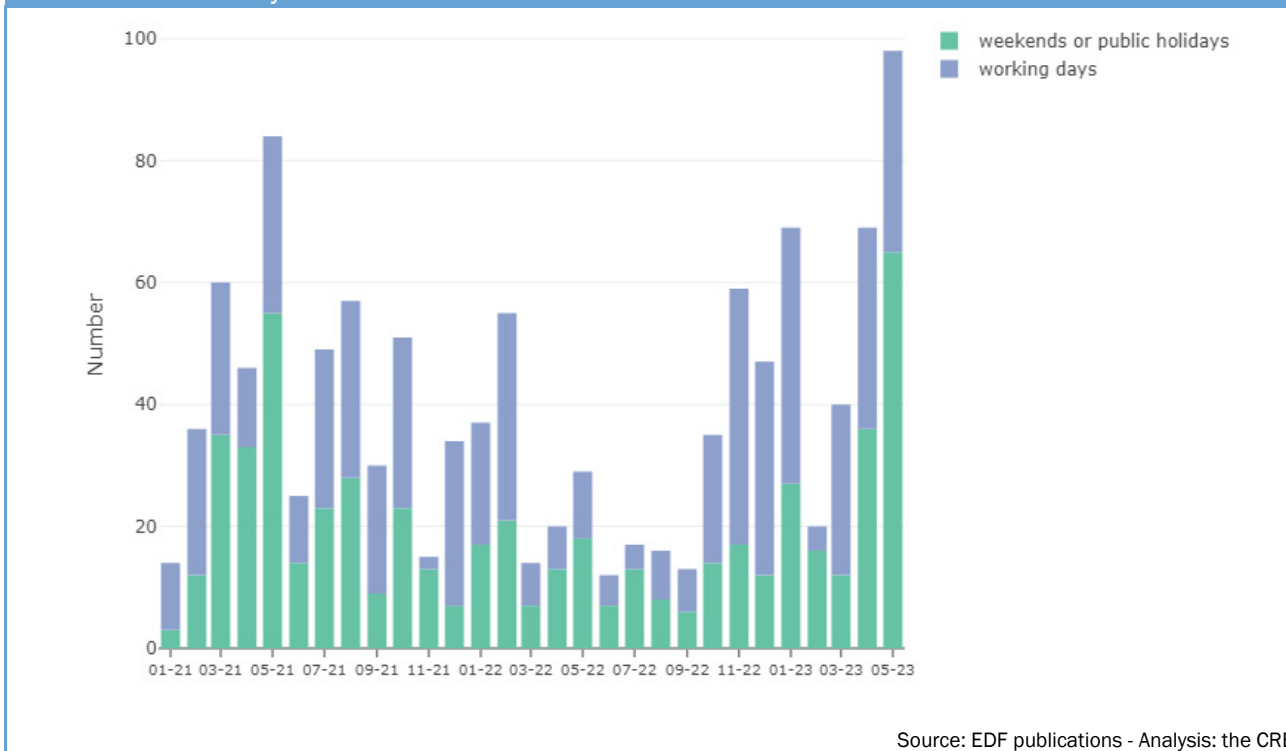
In fact, nuclear power stations, particularly when they are operating with limited stock before their next refuelling, can be managed in terms of "usage value" in the same way as hydroelectric dams. The usage values reflect the need to save fuel until the next refuelling, in order to have fuel available for the times when the supply/demand balance is at its tightest.

For most nuclear units, the marginal cost offered on the market mainly reflects the cost of nuclear fuel, which is low. However, for the part of the nuclear power plants managed on a usage value basis, the marginal costs used to optimise EDF's plants and to draw up offers on the market are not linked to fuel costs but depend on price expectations for the most tense periods to come. In the same way as for hydroelectric dams, this management has the effect, all other things being equal, of modifying the economic precedence and driving up short-term *spot* prices, reflecting the value of short-term electricity savings that make it possible to save deliverable energy for tighter periods in the future. As a result, some nuclear power stations can be more expensive than gas power stations at times, in order to save fuel for times that will be even more expensive in the future, or even present a risk of failure.

When modulation is decided on, following the daily auction ("out-of-the-money" unit), the cessation or reduction of power due to modulation is not necessarily published specifically, but may be published in a general notice indicating the management of constrained stocks over a given period.

The Figure 35 shows the number of short-term modulations carried out/month, based on REMIT publications and on the assumption that EDF carries out a modulation when the unit is 100% operational, but produces less than 50% of its rated capacity. This criterion is prescriptive and would require further study for a case-by-case analysis.

Figure 35 : Number of short-term modulations carried out/month. A reactor modulating for at least one hour over the course of a day counts as a modulation.



Source: EDF publications - Analysis: the CRE

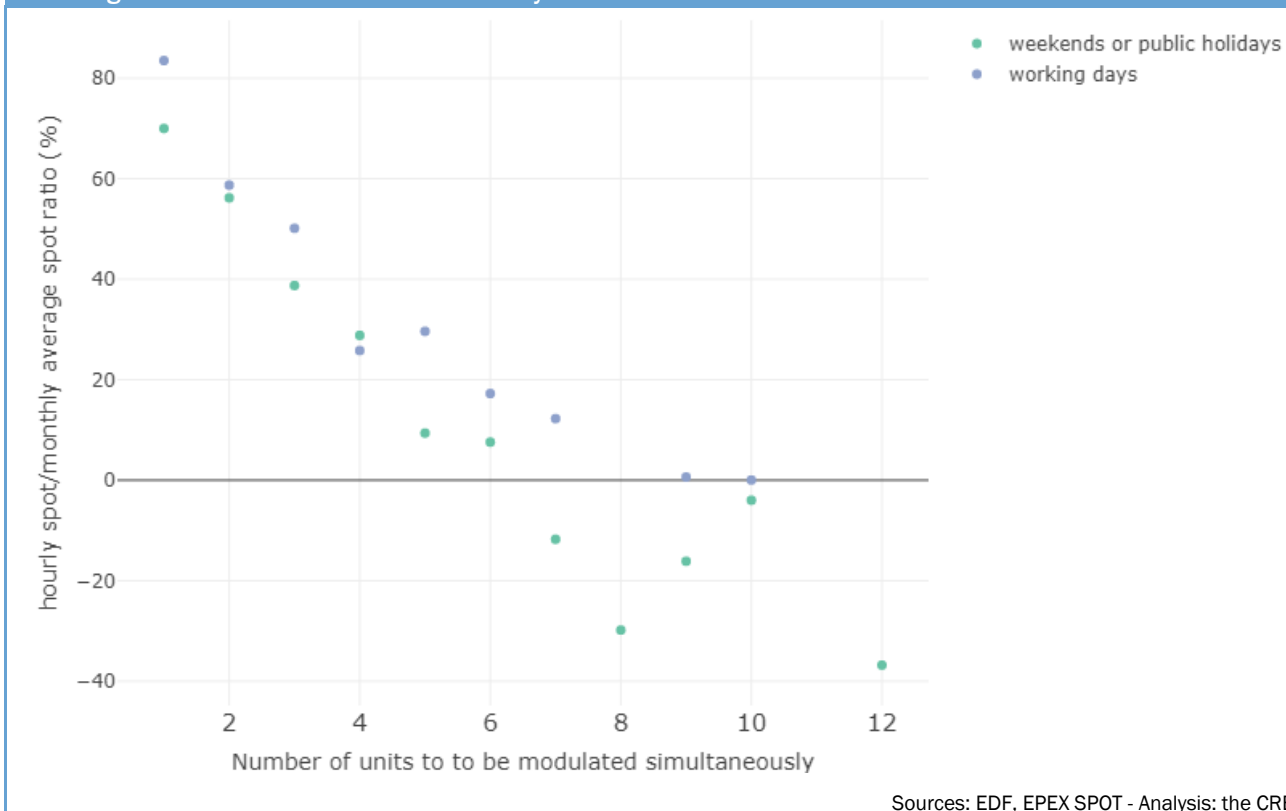
Despite very high spot market prices, in 2022 there were many instances of downward modulation of nuclear power plants, which means that their opportunity cost (usage value) was even higher than spot market prices. This is directly linked to the very high forward prices for the winter of 2022-2023.

However, there were fewer short-term modulations in 2022 (354, or 1.6 TWh) than in 2021 (501, or 2.1 TWh). This observation can be explained by the fact that in 2022 EDF favoured long-term shutdowns over short-term modulation, and above all by the fact that the availability of plants was already very low in absolute terms. This is because it is only possible to downgrade a reactor that is actually available.

Subject to the assumptions made, Figure 35 shows that almost half of the short-term modulations over the period 2021-2022 (47%) were concentrated by EDF on weekends and public holidays, which is consistent with consumption and spot prices that are generally lower during these periods. November and December 2022 also saw a high number of short-term modulations. In November, this was due to a significant fall in spot prices, despite continued tension in the 1st Quarter of 2023, and in December to the end-of-year holidays, which were accompanied by a significant fall in consumption in France.

The Figure 36 y-axis shows the ratio between spot prices during the hours when EDF modulated its nuclear plants downwards in 2021 and 2022 compared with the average hourly spot prices for the month in question, and the x-axis shows the number of modulation episodes during the month. There is a very clear correlation between episodes of low prices and an increase in the number of modulations, which means that the majority of modulations occurred during periods of low prices.

Figure 36 : Average of ratios (hourly spot price for hours with modulation) / (average monthly spot price), according to the number of units modulated by EDF



1.4.3 Monitoring of nuclear power plants optimisation

Monitoring of nuclear power plants optimisation for the French electricity system requires a critical analysis of a number of interdependent parameters, in particular:

- the usage values calculated by EDF;
- maintenance scheduling;
- the fuel management method chosen by EDF.

The CRE control of usage values

Every month, the CRE receives the variable costs of every generator in France, as used by producers for their optimisation, including the usage values of the nuclear power plants.

On the basis of the usage values declared by the generators, the CRE's monitoring services are able to detect "capacity withholding" type behaviour by checking that only generators that are unavailable or whose usage value is higher than the wholesale price are shut down by the generators.

The checks carried out by the CRE have never revealed any aberrant usage values in view of the forward prices and fuel constraints announced by EDF for the units concerned.

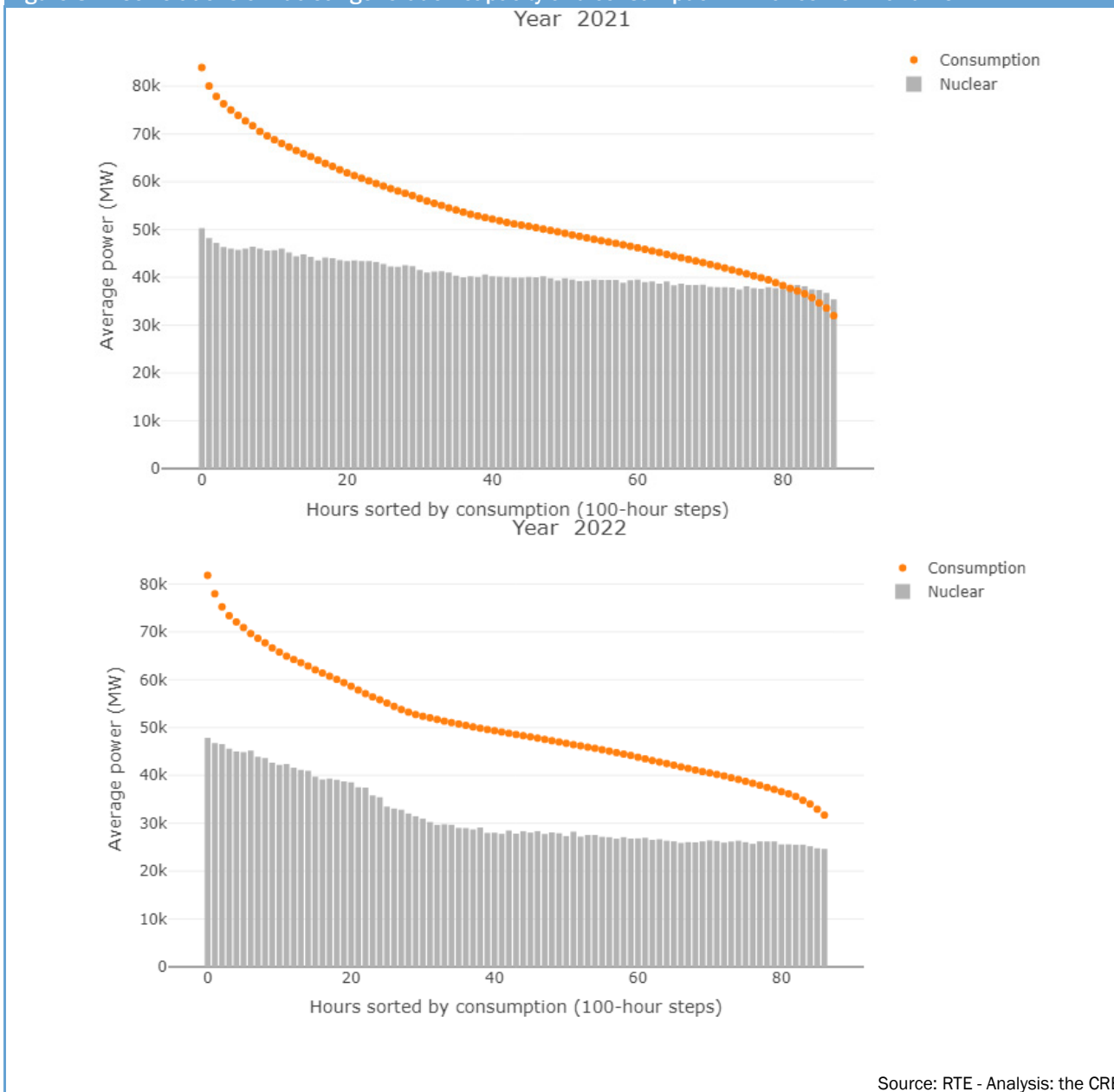
Maintenance scheduling

The scheduling of maintenance is calculated by EDF based on a large number of parameters: fuel management constraints, operational organisation of the teams and contractors in charge of maintenance, environmental and safety constraints, and so on.

General analyses can be carried out to assess consistency. Figure 37 shows the average output of the French nuclear power plants as a function of consumption in France in 2021 and 2022.

Each bar represents the effective generating capacity of the nuclear power plants over a period of 100 hours of similar consumption over the year. The hours with the highest consumption are on the left of the diagram, and consumption decreases from left to right. This graph shows that nuclear power generally produces the most during periods when consumption is highest.

Figure 37 : Correlations of nuclear generation capacity and consumption in France 2021 and 2022



Source: RTE - Analysis: the CRE

The fuel management method chosen by EDF

The scheduling of maintenance, and in particular outages for refuelling, also depends on structuring choices concerning the reactor’s operating mode, the availability of industrial intervention facilities and the fuel cycle as a whole. These issues are beyond the scope of the CRE, which is accordingly not in a position to assess them.

In conclusion, the analyses carried out by the CRE on the subject of modulation of nuclear power plants have not revealed any sub-optimisations. On the contrary, the modulations are intended to help maximise the availability of the nuclear power plants at times of highest consumption, in the interests of the French electricity system and in particular for the winter of 2022-2023.

1.5 Growth in installed capacity: 2022 was a year of strong growth for renewable energies

In 2022, France's solar capacity will have increased by +2.7 GW, an increase of 20%, the same as in 2021. The development rate remained above the historical average for the second year running, at +14.7%/year.

The wind farm will record an additional 2.4 GW in 2022 (+13% compared with 2021), compared with an increase of 2.2 GW between 2020 and 2021. The development wind farms breaks down into 1.9 GW of onshore wind power and 500 MW of offshore wind power, including the Saint-Nazaire wind farm.



The total increase in solar and wind farms is 5.1 GW in 2022, compared with 4.9 GW in 2021. By the end of 2022, solar production will be 15.8 GW and wind production 21.2 GW.

Table 7 Change in installed capacity of wind and solar farms

	2014	2015	2016	2017	2018	2019	2020	2021	2022	TCAM ⁶⁷ 2014/2022
Wind power (GW)	9.3	10.3	11.8	13.5	15.1	16.5	17.6	18.8	21.2	+ 10.8
Solar (GW)	5.3	6.2	6.8	7.7	8.5	9.6	10.4	13.1	15.8	+ 14.7

Source: RTE

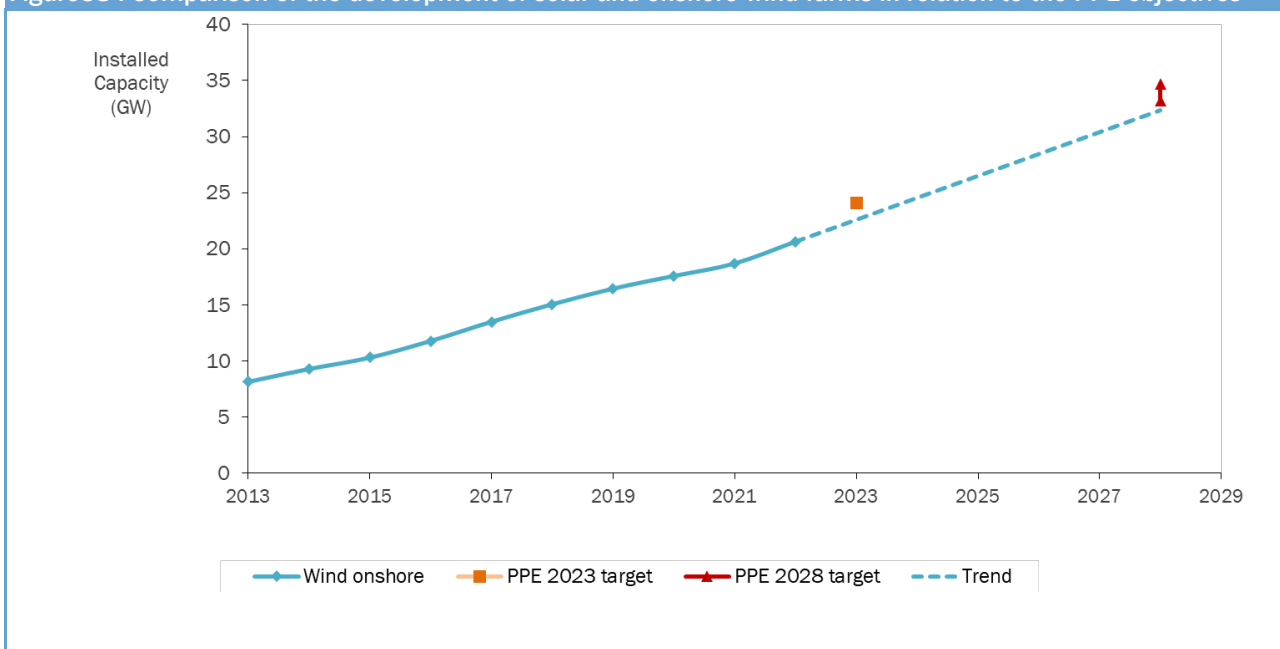
Table 8 Evolution of wind and solar farm production

	2014	2015	2016	2017	2018	2019	2020	2021	2022	TCAM 2014/2022
Wind power (TWh)	17	21.1	20.9	24.1	28.1	33.8	39.7	36	38	+ 11.1
Solar (TWh)	5.8	7.2	8.2	9	10.5	12.1	12.4	13.9	18.4	+15.8

Source: RTE

The rate of growth in solar and wind farms remains insufficient to meet national targets (Figure38). France's multi-annual energy programme⁶⁸ set a target of 24.1 GW of onshore wind power by 2023 and 33.2 to 34.7 GW by 2028. The targets for solar power are 20.1 GW in 2023 and 35.1 to 44.0 GW respectively.

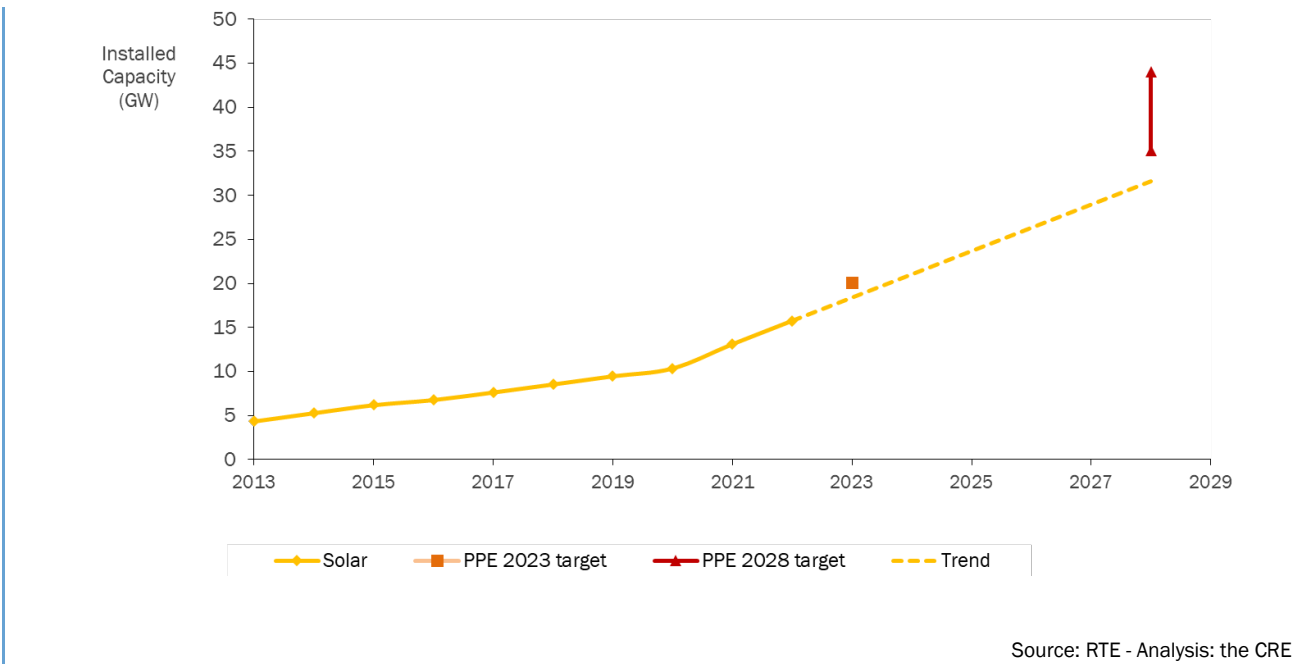
Figure38 : Comparison of the development of solar and onshore wind farms in relation to the PPE objectives



⁶⁷Average annual growth rates.

⁶⁸Multiannual energy programmes: <https://www.ecologie.gouv.fr/programmations-pluriannuelles-lenergie-ppe>





The installed capacity of fossil-fired facilities remains unchanged (19 GW) and includes the Landvisiau power plant, which was connected to the grid in November 2021 but officially came on stream in April 2022.

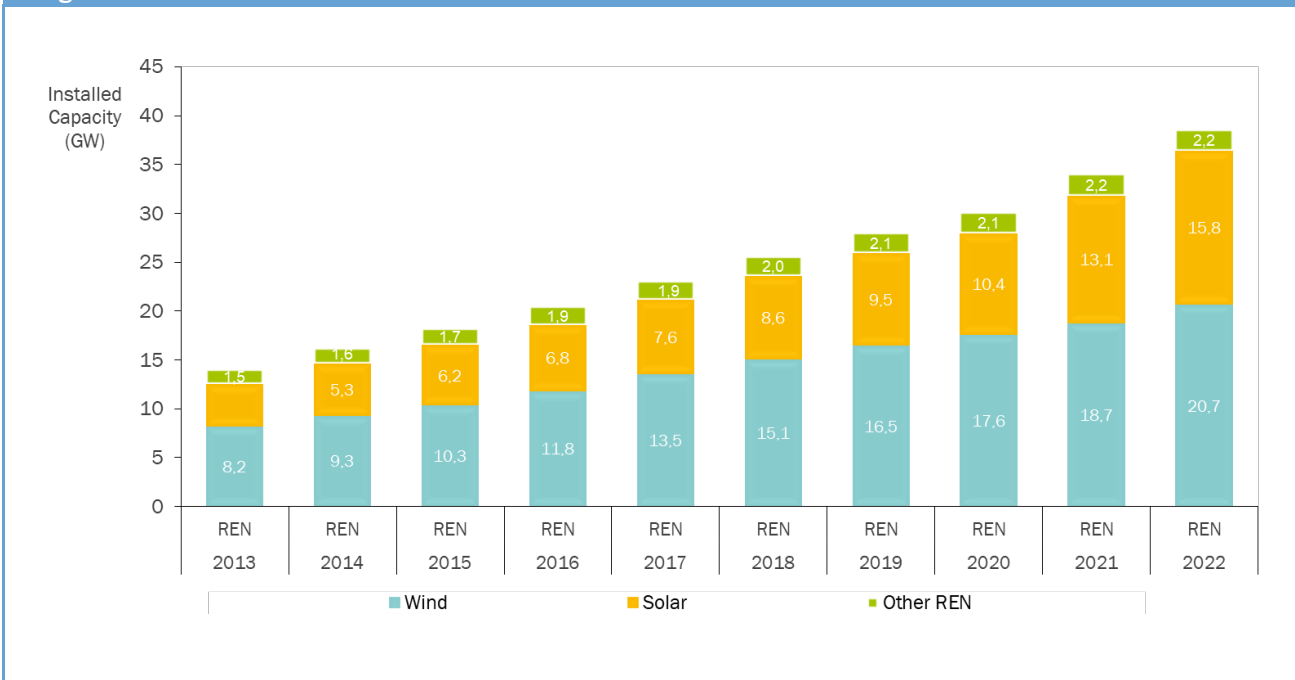
In view of the nuclear crisis, the closure of the Emile-Huchet coal-fired power station in Moselle, scheduled for 2022, has been postponed.

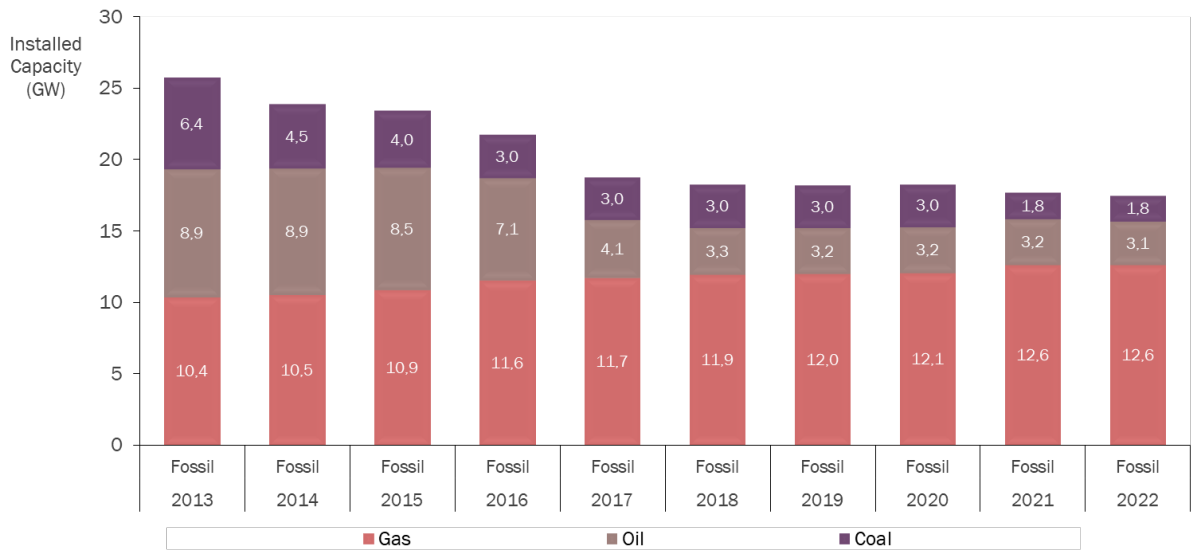
Installed hydroelectric capacity remains stable at 25.7 GW.

With 144.3 GW at the end of 2022, the total installed capacity of the French generators was 5.6 GW higher than at the end of 2021.

Despite the development of wind and solar power, production from renewable sources (excluding hydroelectric) increased only slightly in 2022, to 64.6 TWh, compared with 60 TWh in 2021 (Figure 40). The main reason for this small increase in production is the fall in the load factor for wind power, which stands at 21.6% in 2022 (38 TWh), compared with 23.2% (36 TWh) in 2021 and 26.6% in 2020. As a result, wind power generation is only up by 5%, despite the 13% growth in the installed capacity. In contrast, the load factor for solar power has increased (14.6% compared with 13.9% in 2021). The significant growth in the installed base has led to a 30% increase in generation (18 TWh).

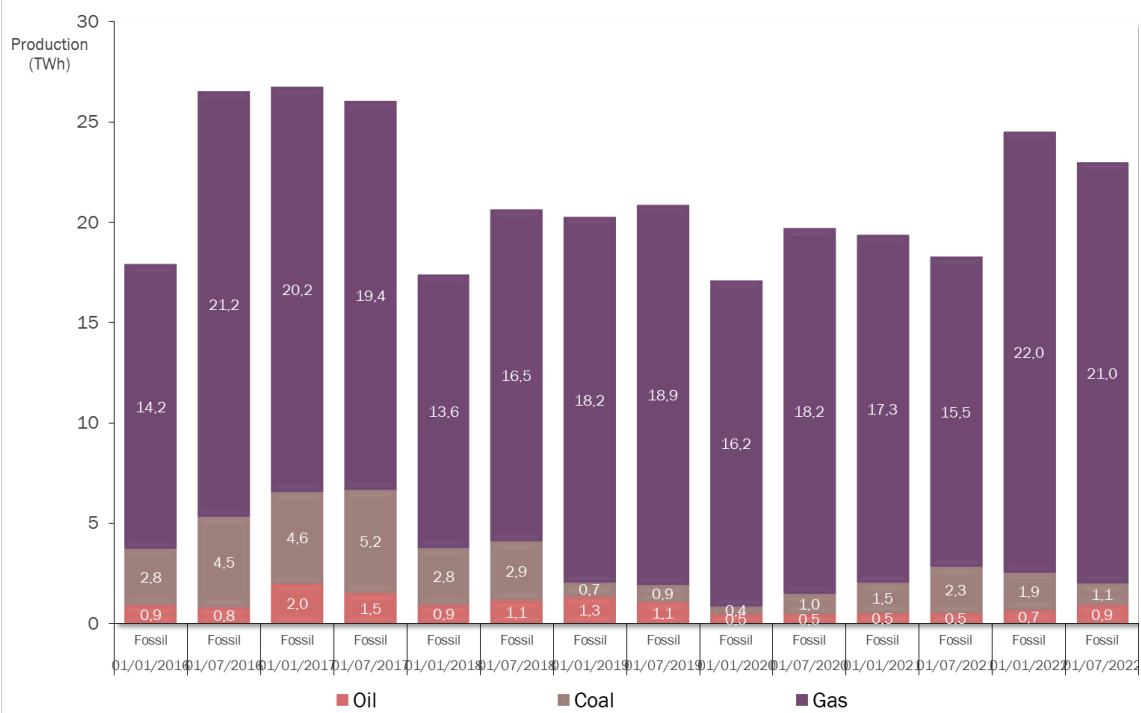
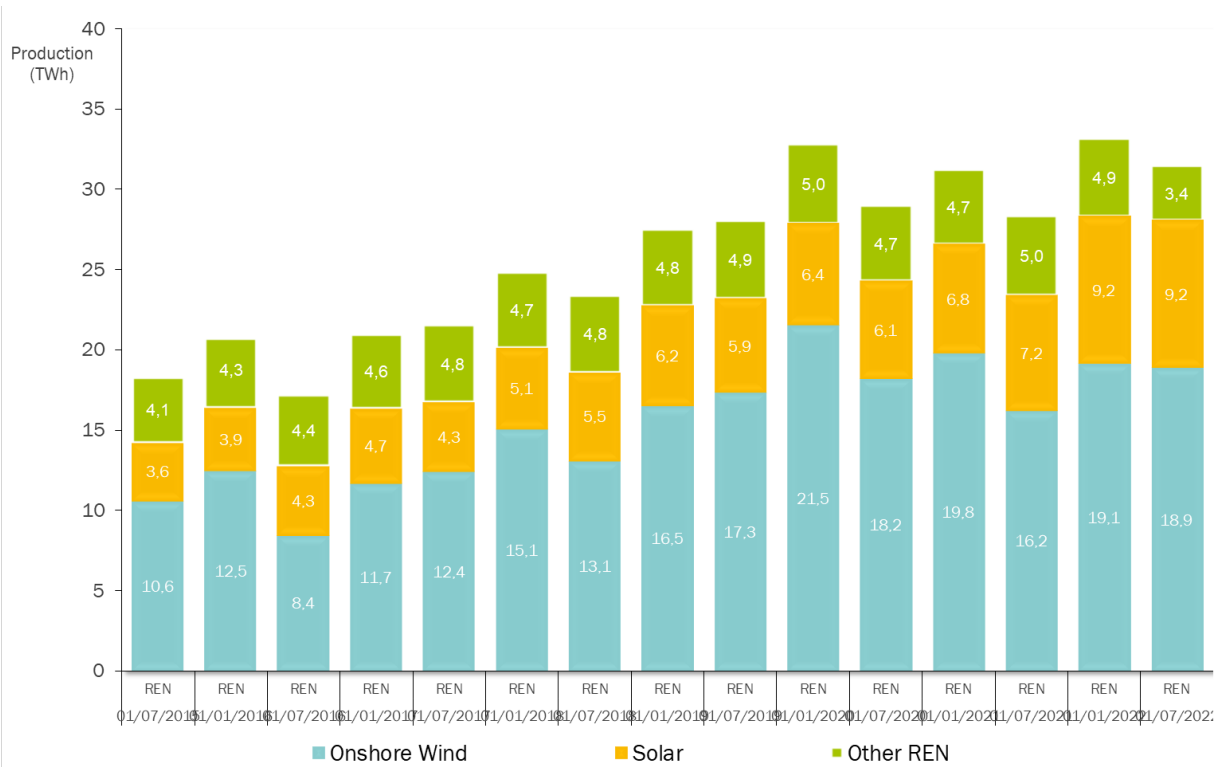
Figure 39 : Comparative growth in installed capacity for renewable energies (excluding hydro) and fossil-fired energies





Source: RTE - Analysis: the CRE

Figure 40 : Comparison of half-yearly production from renewable sources (excluding hydro) and fossil-fired sources



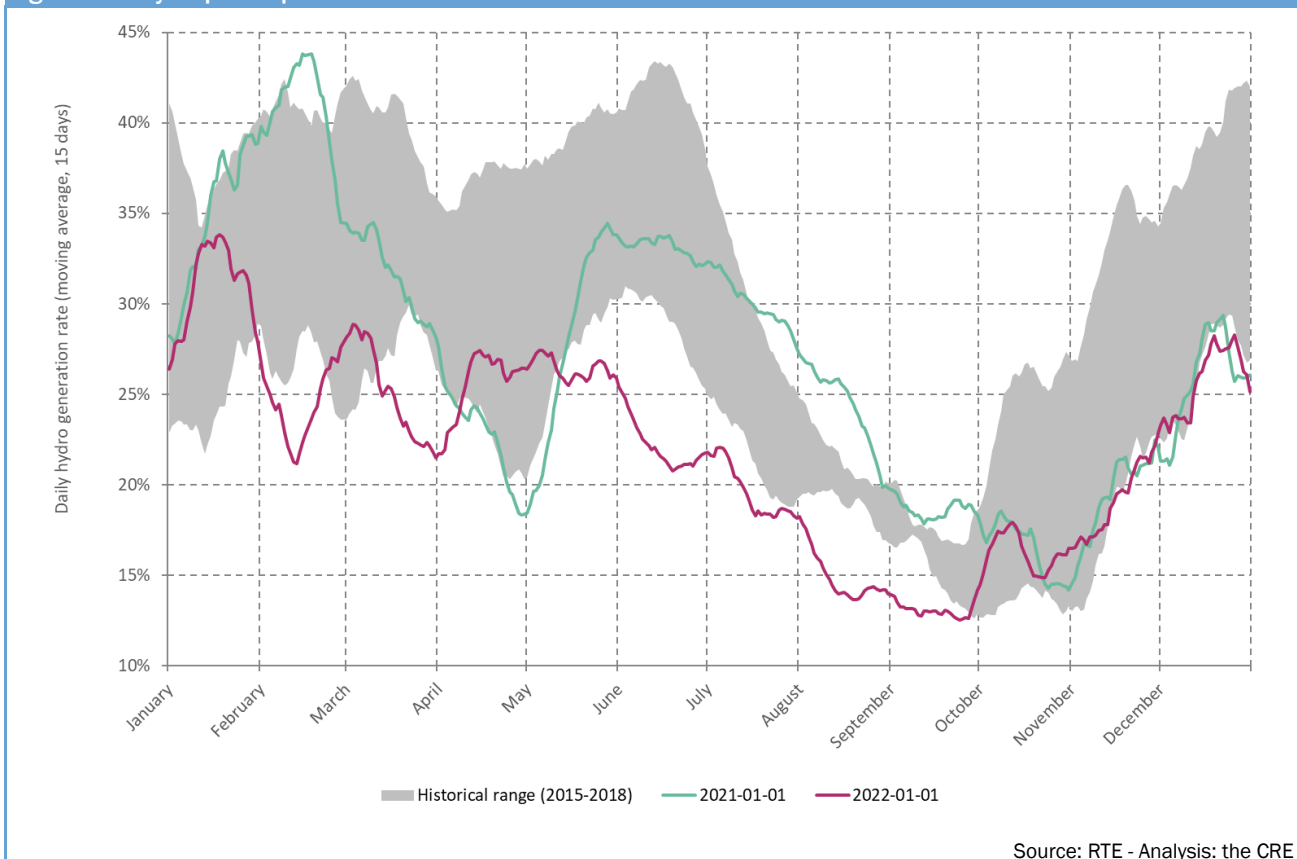
Source: RTE - Analysis: the CRE

1.6 As a result of abnormally hot and dry weather conditions, hydroelectric production was at its lowest level for 50 years.⁶⁹

Although hydraulic reserves were at the historical average at the beginning of 2022, unfavourable hydrological conditions affected hydraulic production throughout the year. When the snow melted from April to July, stocks were not replenished sufficiently, leading to a fall in reserves from mid-July, which reached very low levels in August.

As a result, and in anticipation of a tense situation for the winter of 2022-2023 with very high wholesale prices, operators have managed stocks cautiously over the summer, with limited output from stock plants (see graph below). This management, combined with an increase in rainfall in September and November (when rainfall was higher than normal), enabled stocks to return to normal levels from the end of the year.

Figure 41 : Hydropower production rate

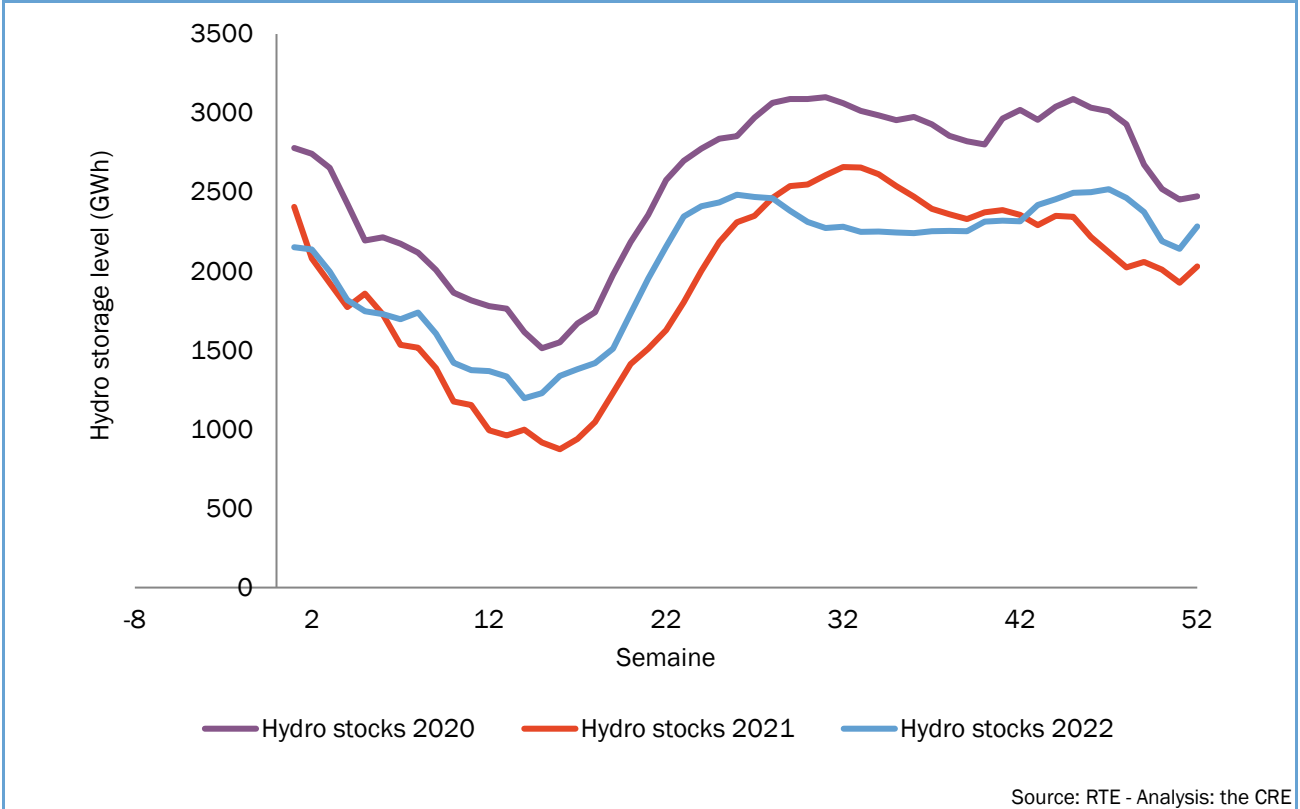


In 2022, hydropower will have produced 49.6 TWh (-12 TWh compared with 2021, i.e. a fall of 20%). The same is true of average generation over the period 2014-2019 (61.6 TWh).

⁶⁹Electricity balance 2022, RTE



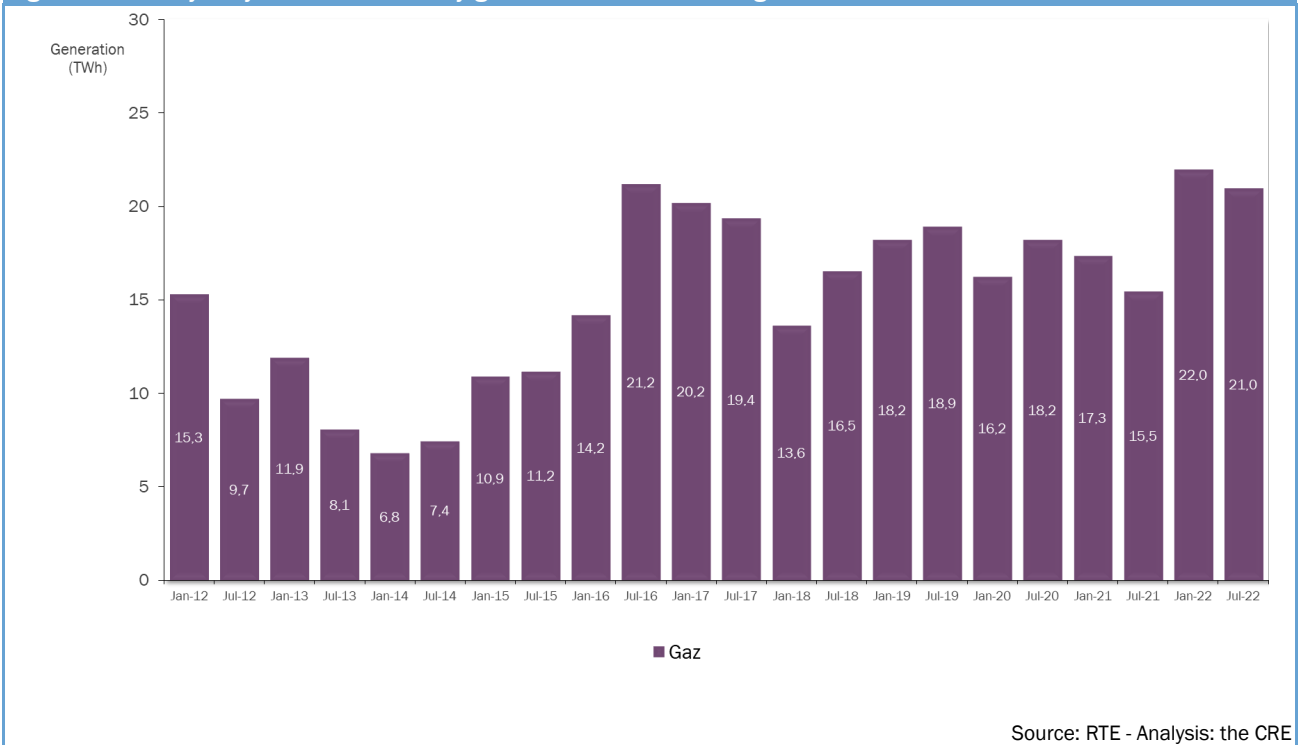
Figure 42 : Changes in the hydropower capacity



1.7 Gas production was boosted by lower nuclear production and favourable economic conditions

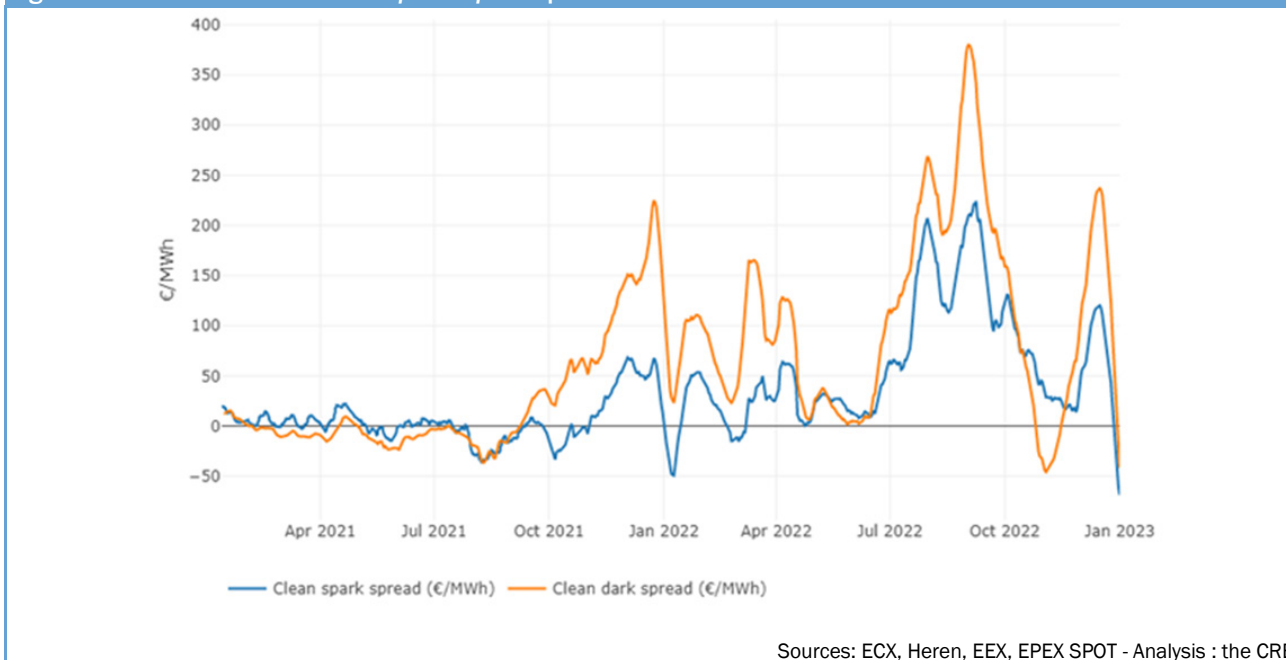
By 2022, fossil-fired generation, mainly gas-fired, has risen sharply (+ 30% compared with 2021 and + 25% compared with 2020), reaching a total of 42 TWh. This increase in production is largely explained by the fall in nuclear production, which was partially offset by increased imports and production from gas-fired power stations.

Figure 43 : Half-yearly trend in electricity generation from natural gas



This growth in gas production is consistent with the increase in the profitability of thermal facilities, as shown by the *clean spark spread*.

Figure 44 : *Clean dark and clean spot⁷⁰ spark spreads smoothed over two weeks*



This profitability was particularly high during the summer, when the availability of nuclear power was low and hydro-electric generation was limited. Contrary to the usual cycle, in which pilot gas power stations slow down after winter periods, gas production remained strong throughout the year.

On the *spot* market, combined cycle power stations make a profit when more expensive resources are called up at the auction, such as less efficient gas-fired power stations (e.g. TACs), load shedding, resources with limited stocks or more expensive foreign resources (Italian gas-fired power stations).

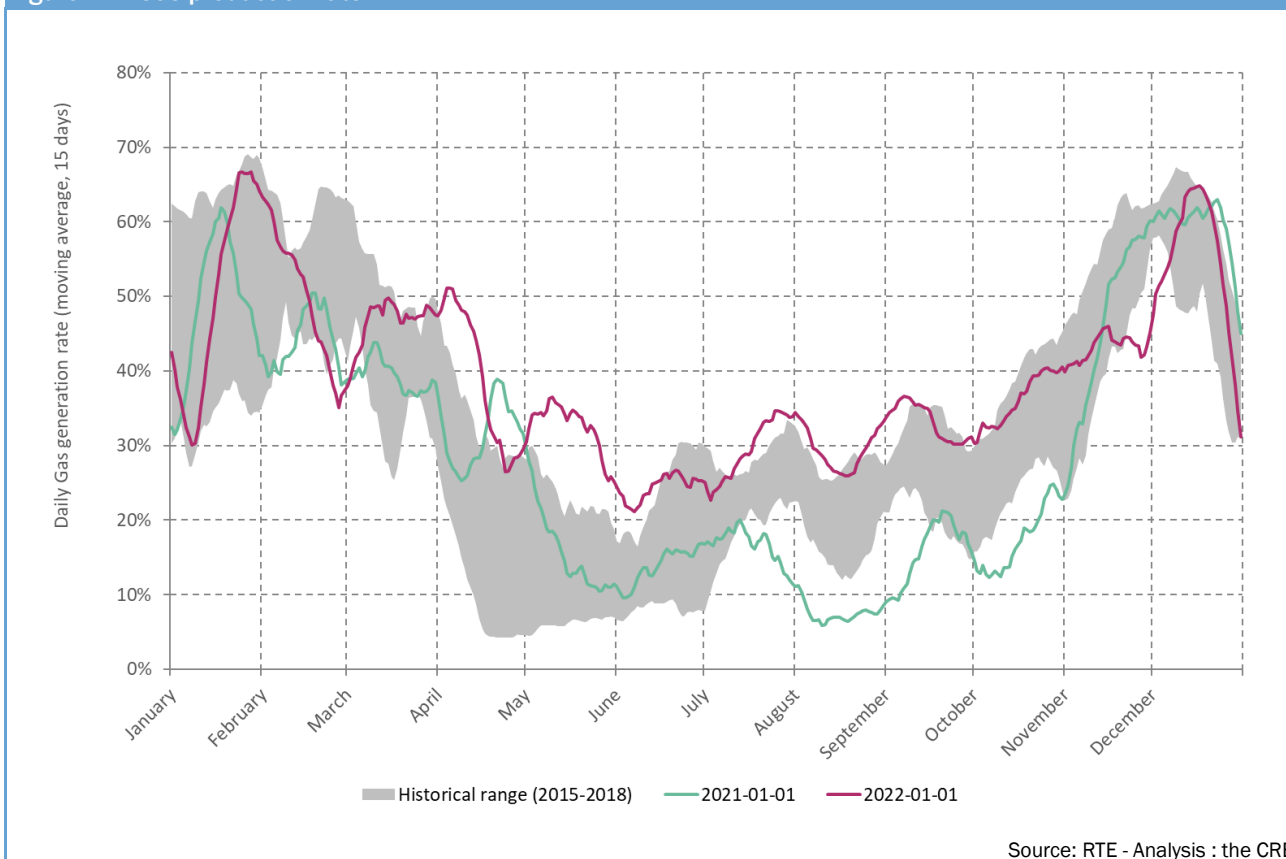
Gas production was boosted at the end of the year by the return of maintenance work on combined-cycle power plants and production from cogeneration plants.

The sector's production also benefited from the commercial commissioning of the Landivisiau power plant in April 2022, which achieved a good level of availability.

⁷⁰The *clean dark spread* and the *clean spark spread* refer to the level of profitability of coal and gas-fired power stations as a function of the variable cost of inputs (fuel costs, with a benchmark rate of return, and including the price of CO₂) and revenues from the sale of electricity. This graph is based on the following assumptions:

- for coal-fired power stations: efficiency of 35% and emission factor of 0.96 tonnes CO₂/MWh . However, it should be noted that this efficiency corresponds to new reference installations and may accordingly be far from the efficiencies of existing installations, and that other costs, particularly transport costs, are not taken into account here.
- for gas-fired power stations: efficiency of 53% and emission factor of 0.35 tonnes CO₂/MWh .

Figure 45 : Gas production rate



1.8 The rise in gas prices helped to boost coal-fired power generation in 2022, which remained a very small part of the French energy mix

The production by coal-fired power plants reached 3 TWh in 2022, i.e. 0.8 TWh less than the amount produced in 2021. This production is still a very small part of the French energy mix, accounting for less than 1% of national consumption. Only the Emile-Huchet and Cordemais power plants produced electricity in 2022.

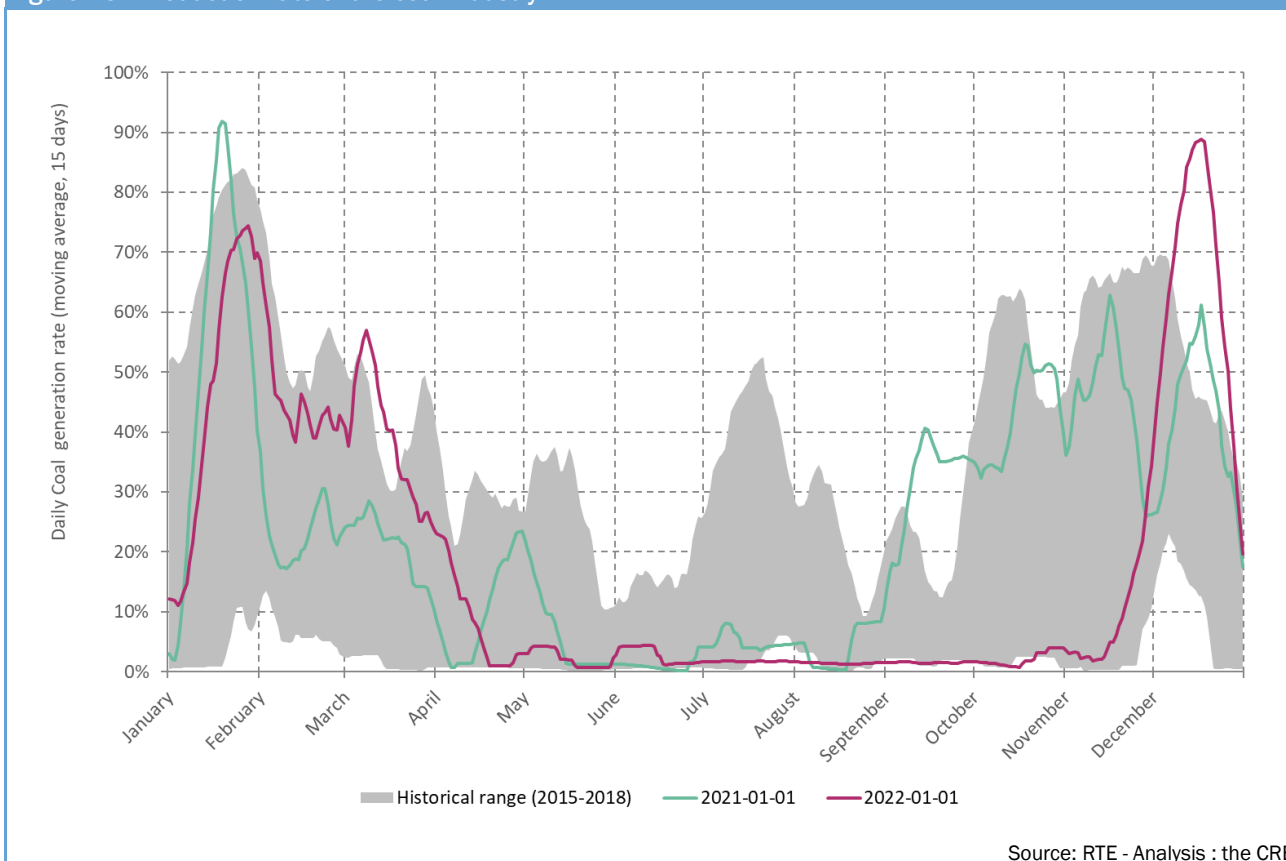
High electricity prices have made the remaining coal-fired power plants very profitable, as shown by the positive level of the "clean dark spread" throughout 2022. As the increase in coal prices was lower than the increase in gas prices, coal-fired power plants were more profitable than gas-fired power plants.

The electricity produced by coal-fired power plants is subject to an emissions cap set by the government, which limits their operating time to around 700 hours at full power for each plant. In February 2022, this ceiling was raised by decree because of concerns about security of electricity supply, to around 1,000 hours of operation at full power between 1 January and 28 February 2022, and around 600 hours for the rest of the year.

In September 2022, a further amendment was made, setting the emissions cap at around 3.1 kilotons of CO₂ equivalent/megawatt of installed electrical capacity, equivalent to around 3,100 hours of operation between 1 March 2022 and 31 March 2023.

The closure of the Emile-Huchet power plant, initially scheduled for March 2022 as part of the decarbonisation of the energy sector, has been postponed to 2023 to help ensure security of supply during the winter of 2022-2023. The plant resumed electricity production on 29 November 2022 following maintenance operations. As a result, coal has been used as a peak resource for the winters of 2021-2022 and 2022-2023.

Figure 46 : Production rate of the coal industry



1.9 Marginality of the various production means in 2022

A production mean is said to be marginal when the last production unit called on to satisfy demand belongs to this mean. Its marginal cost of production then theoretically determines the wholesale price of electricity at that moment. The marginality of a sector may differ from its share in the annual production.

In practice, however, it is difficult to identify the marginal mean. The main problem in identifying the marginal resources is the proximity of the variable costs of the means of production in different technology. In addition, producers are not required to offer a bid at the *day-ahead* auction that is strictly equal to their variable cost: they can include their start-up costs or agree to sell at a loss for one hour to avoid restart costs or to participate in the balancing reserve markets.

The definition of "marginal technology" itself can pose a problem, as it is often the case that several inputs (possibly using different technologies) must adapt their production to cope with even a small variation in demand. This may be the case: (i) because of the European coupling of markets (ii) when the management, even at the margin, of one resource has an impact on others. For example, "block" offers on the market that cover several timeframes and are accepted or rejected simultaneously can create threshold effects.

Finally, it should be noted that "stock" production resources participate in the market not based on their variable production cost, but on the basis of their opportunity cost, calculated by taking into account the value that future production would have. The technologies concerned are hydroelectric power and, to a lesser extent, nuclear power, for power plants that do not have enough fuel to operate at full power until their planned reload date.

Thus, determining the marginal rates for the different means is normative. The stacking of resources of production and marginality over a given hour are accordingly only a "pictorial" way of looking at the optimisation of the system.

In order to better reflect these findings, the CRE has modified its method for determining the marginal channels in 2020. The new method allows several technologies to be considered as marginal at the same time. The CRE's calculations are based on the marginal costs directly transmitted by the producers. The description of the method for each hour of the year is shown below:

1. If France is coupled to at least one country (coupling threshold of €0.01/MWh), and if there is no means of generation whose marginal cost is less than €1/MWh of the *spot* price, then the borders forms part of the marginal resources.
2. The means of production⁷¹ whose marginal cost is close to the *spot* price are also form part of the marginal resources. The contribution of each means to marginality decreases as a function of the difference between the *spot* price and its marginal cost⁷².
3. If France is not coupled to at least one country, and if there is no French means of production with a marginal cost close to the *spot* price, then marginality is defined as "other".

Hydraulics and water use value

The water usage values transmitted by the producers to the CRE, defining the variable costs of hydroelectric production, were particularly high in 2022, when water in dams could appear to be a free resource for producers. This is due to the "opportunity cost" management of hydropower production facilities with limited water reserves: in order to reserve hydropower production for periods when prices are highest, producers define a "usage value" for the water, which reflects the prices anticipated for the most expensive periods. Thus, the prices offered by hydroelectric dam operators can be very close to the anticipated marginal costs of gas-fired power plants.

For nuclear power, part of the nuclear fleet is optimised in usage value, unrelated to fuel costs, when the fuel stock is limited. This means that some power plants can be more expensive than CCGTs. In 2022, many reactors had high usage values, which is a consequence, on the one hand, of the very high forward prices in the winter of 2022-2023, and, on the other hand, of the changes in unit shutdown schedules in connection with containment and the problem of stress corrosion (Section 4, §601.3).

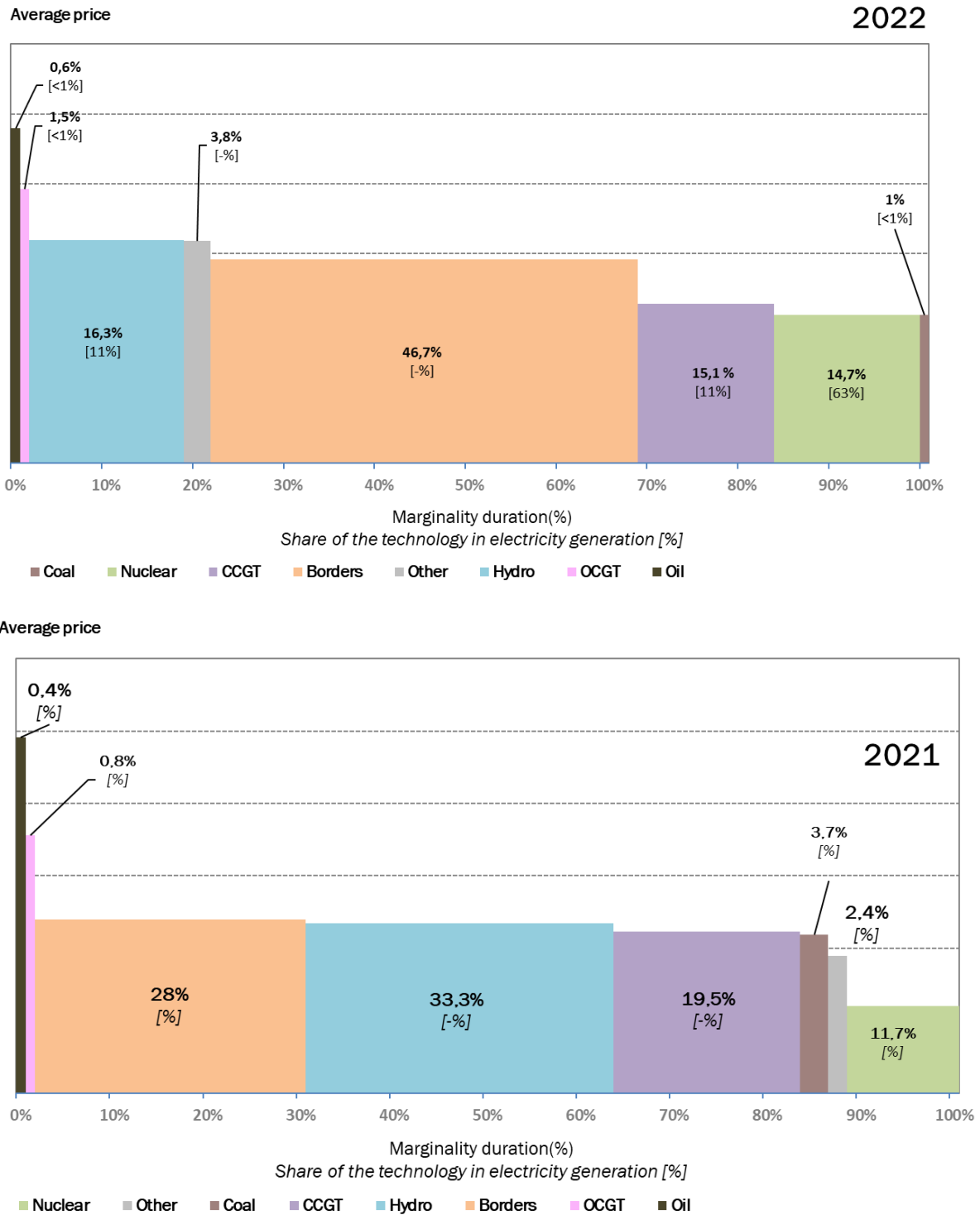
As mentioned above, high usage values reflect the need to save fuel until the next refuelling. Conversely, negative values are possible to reflect the need to operate at maximum power regardless of price when fuel must be consumed before the next scheduled shutdown.

Opportunity cost management is essential to ensure that the flexibility of limited stock resources (hydropower, batteries and nuclear power in some cases) is available at times when the power system at its highest voltage, and that the entire stock of producible energy is not used unnecessarily at the beginning of the year.

⁷¹Provided for in the call programme

⁷²The formula has been adapted to take account of rising prices. The contribution therefore now decreases more slowly as a function of the difference between the *spot* price and its marginal cost.

Figure 47 :Marginality of the various production means in 2021 and 2022



Sources: EPEX SPOT, RTE, Producers - Analysis :the CRE

The drop in hydro power generation, which is usually marginal for a large part of the time, notably because of the heterogeneity of this sector, has had the effect of deeply modifying marginality in France.

Hydropower now accounts for only 16.3% of the marginality, whereas it was marginal 33.3% of the time in France in 2021. This reduction is mainly due to the interconnections, which account for almost 46% of marginality in France, in line with the sharp rise in imports.

During the third quarter of 2022 in particular, France relied heavily on imports from neighbouring countries for its balance, which had the effect of increasing border marginality to over 70% in August. Italy, which is usually an importer because of the higher price, has brought the last MWh missing in France during periods of tension and frequently sets the price, unlike in 2021.



Despite the increase in its production, the marginality of gas is decreasing because the technology has worked more in base load mode due to its high profitability. The marginality of nuclear power is also increasing. In particular, the graph of marginality by month (Figure 48) shows that nuclear power was frequently marginal at the end of 2022 as a result of the return to operation of a large number of units, but also of the optimisation in terms of use value of certain reactors which found themselves operating in "semi-base" load mode.

Figure 48 : Marginality of the various production channels in 2021 and 2022 by month

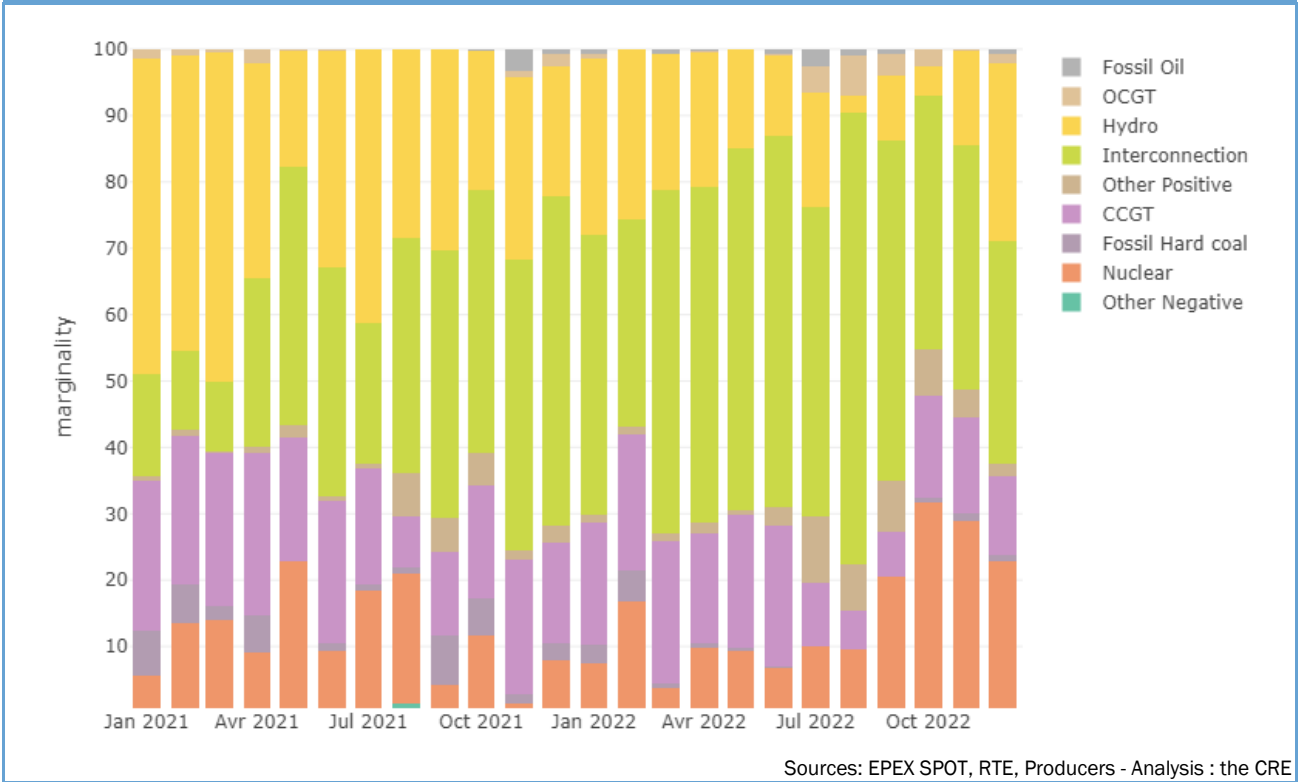
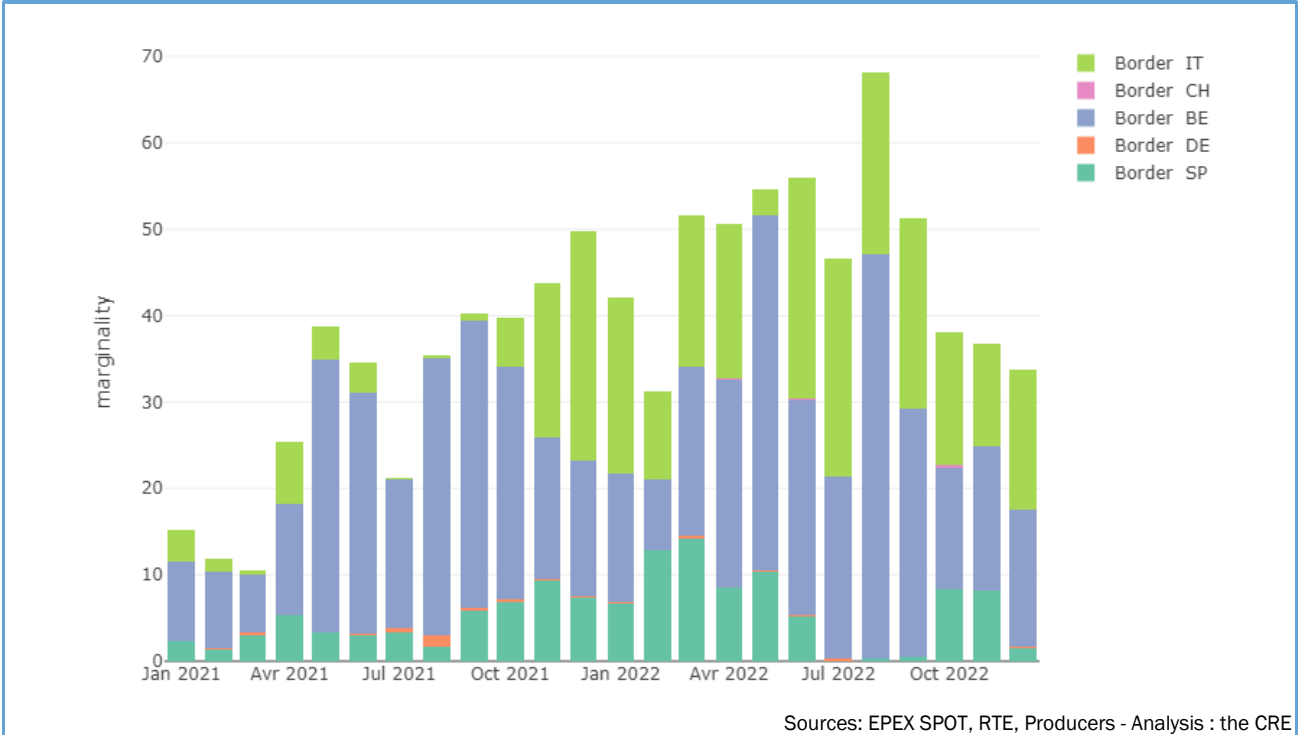


Figure 49 : Marginality of different borders in 2021 and 2022 by month



2. WHOLESALE ELECTRICITY PRICES

2.1 An unprecedented rise in spot prices linked to higher fuel prices and greater reliance on imports

Spot prices play an essential role in the smooth operation of the European electricity system, by determining in a coordinated way at European level the day before for the following day, hour by hour, the generation mix used to meet forecasted consumption. In addition, the prices of forward products are established by reference to expectations of future spot prices over the period in question.

The average baseload spot price for 2022 has risen exceptionally compared to 2021, to an average of €275.9/MWh over the year, an increase of 153% compared to 2021 (109.2€/MWh) and 600% compared to 2019, a more normal year. Such a high level has never been reached before.

The average spot price achieved in 2022 (€275.9/MWh) was well above the average forward price for 2022 recorded during 2021 (€94.7/MWh) and even higher than the average price recorded over 2020 and 2021 (€70.8/MWh).

A relatively stable start to the year for spot prices

After a particularly tense end of 2021 (daily prices peaked at an average of €452.9/MWh on 22 December 2021), linked to the gas crisis in Europe and the discovery of generic incident affecting the French nuclear fleet (see section 4.1.3 §), 2022 began with spot prices in decline (below €200/MWh on average in January and February 2022). Despite the lower availability of nuclear power, the electricity system benefited from mild temperatures, strong wind generation in France and Europe and large supplies of LNG, which moderated gas prices in the short term.

The energy situation worsened considerably from 24 February 2022 with Russia's invasion in Ukraine. Electricity prices have risen sharply in France and Europe in the wake of rising fuel prices. In the space of a few days, the French spot price rose considerably, reaching an average daily peak of €540.7/MWh on 8 March 2022 (an increase of 190% between 24 February and 8 March 2022), well above the previous peak in December 2021 (€452.9/MWh).

In the second half of March and until mid-June 2022, there was a relative fall in prices due to favourable weather conditions (mild temperatures and strong renewable production) and reduced pressure on gas thanks to the influx of LNG deliveries.

However, on 4 April 2022, the French market, hit by an exceptional cold snap for April, suffered⁷³ a period of tension, marked by unprecedented price peaks (up to €2,990/MWh). On 8 July 2022⁷⁴, the CRE published a report showing that this isolated event was the result of an extremely unlikely combination of independent adverse events, in a context of particularly low nuclear availability.

The event of 4 April 2022 has had significant consequences for all European electricity markets, with the automatic and non-reversible increase in the European price cap on the single daily coupling auctions, from €3,000/MWh to €4,000/MWh. Indeed, pursuant to the ACER decision of 14 November 2017⁷⁵, the spot price cap is automatically raised in the 24 countries participating in the coupled market once the price reaches 60% of the cap for one hour in a country.

In its report of 8 July 2022, the CRE noted that this was an entirely random and one-off event, and that it should not have had any structural consequences in Europe. The CRE has called for a review of the automatic increase in spot market price caps. The automatic increase in the spot price cap was finally suspended on 13 September 2022 by the NEMOs⁷⁶ and TSOs^{77,78} when a further increase to €5,000/MWh was about to take place due to another event in the Baltic zone. A revised methodology was approved and published on 10 January 2023⁷⁹ by ACER, which provides for an increase in the cap if the price reaches 70% of the existing cap on at least two different days in a rolling 30-day period. The increase in the ceiling is €500/MWh instead of €1,000/MWh. The transition period is 28 days and adjustments are frozen and cannot be accumulated during this period. Finally, a similar mechanism for the floor price of -€500/MWh has also been introduced in the event of extreme negative prices (reduction of the floor price in increments of €100/MWh).

A sharp rise in spot prices in the summer of 2022

⁷³The night of 4 April 2022 was the coldest for a month of April since 1947, even though the arrangements for managing peak consumption in France come to an end on 31 March.

⁷⁴<https://www.cre.fr/Documents/Publications/Rapports-thematiques/analyse-et-enseignements-sur-le-pic-de-prix-sur-l-enchere-journaliere-pour-le-4-avril-2022>

⁷⁵https://www.acer.europa.eu/sites/default/files/documents/Individual%20Decisions_annex/Annex%2520I_ACER%2520DA%2520MAX-MIN_0.pdf

⁷⁶NEMO: *Nominated Electricity Market Operator*. These are entities within the European Union, which carry out tasks related to single daily or intraday coupling, in addition to their tasks as market operators on the electricity market.

⁷⁷TSO: Transmission System Operators

⁷⁸https://www.entsoe.eu/documents/nc/NC%20CACM//SDAC%202022/SDAC_Coms_note_suspension_of_HMMCP_final.pdf

⁷⁹<https://www.acer.europa.eu/sites/default/files/documents/Individual%20Decisions/ACER%20Decision%2001-2023%20on%20HMMCP%20SDAC.pdf>

From the second half of June 2022, the spot price of electricity in France rose again until the end of the summer. Prices reached record highs on average in the summer of 2022, a period usually characterised by lower prices due to lower consumption. The price was driven mainly by the combined effect of the sharp rise in gas prices and forward prices for the winter of 2022-2023.

Indeed, forward prices influence short-term prices, through the means of production with limited energy stocks (mainly hydropower), offered on the market taking into account the opportunity cost of no longer having this production available for the most expensive future periods. This effect is even bigger when stocks are low, which was the case for hydraulics in 2022.

In the summer of 2022, France was hit by three major heat waves, which led to a significant need for air conditioning and a consequent increase in electricity consumption. In terms of production, the drought has significantly reduced hydro stocks in France and Europe, leading to cautious management of hydropower capacity in anticipation of the winter. Nuclear production continued to deteriorate over the summer due to the high concentration of maintenance shutdowns in the run-up to winter and the ongoing checks on reactors affected by stress corrosion. As a result, fossil-fired generation and, above all, imports (particularly from Italy, despite much higher gas prices than in France) were used to a greater extent, while fuel prices rose sharply (Section 2.1 §), contributing to higher electricity prices. The spot price of electricity in France rose by almost 250%, from a weekly average of €177.5/MWh in the week of 6 June 2022 to €611.6/MWh in the week of 22 August 2022. The price reached a daily peak of €743.8/MWh on 30 August 2022.

Spot prices ease at the end of the year

The autumn of 2022 was marked by more favourable conditions, contributing to a fall in spot prices until November. As a result, the price fell by 80%, reaching a weekly average of €107.7/MWh in the week of 24 October 2022.

Temperatures remained very high compared with normal levels (October was the hottest month on record), helping to reduce gas and electricity consumption. At the same time, the large volume of LNG has enabled gas stocks to be replenished, reducing pressure on gas demand and prices. In terms of production, the electricity system benefited from good wind and solar production, as well as better rainfall, which helped to replenish hydro stocks.

At the end of the year, the drop in temperatures led to an increase in consumption, particularly at the beginning of December, when a major cold snap hit France. Spot prices have risen in line with consumption and the rise in gas prices linked to increased demand for heating and electricity generation.

Intraday prices are logically very close to spot prices, averaging €276.4/MWh in 2022, more than double the average for 2021.

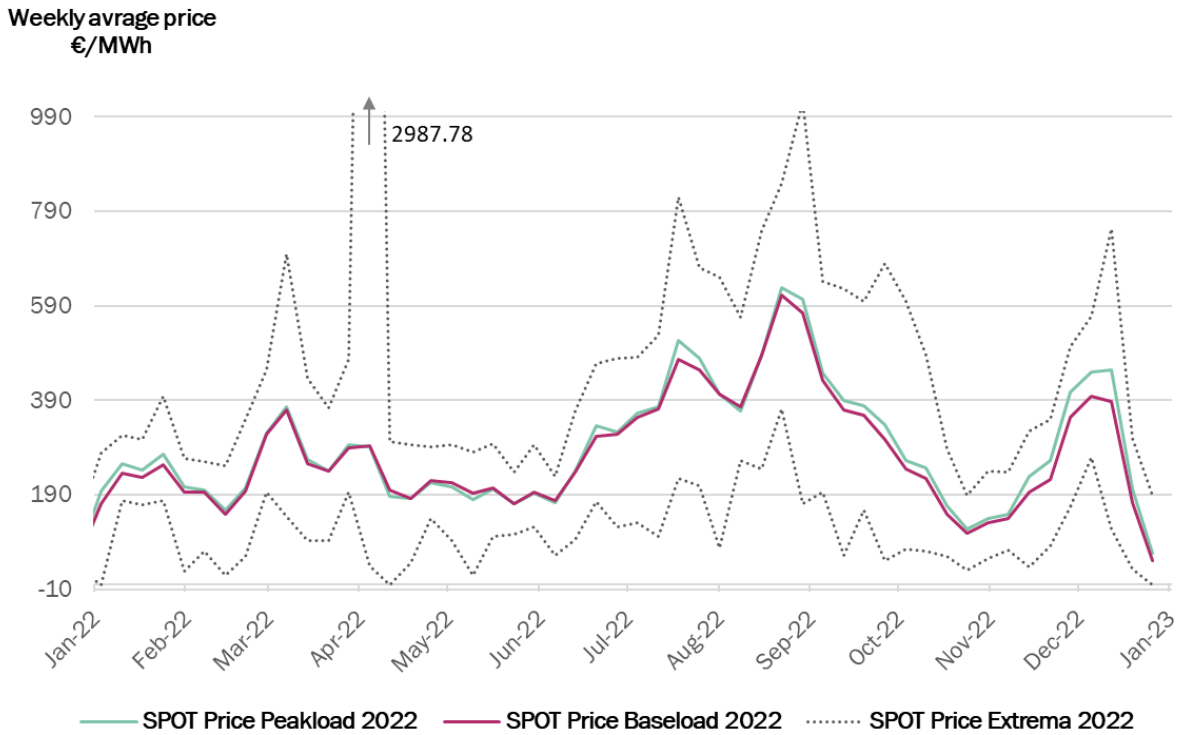
Overall, 2022 was marked by an exceptional increase in spot prices in France and Europe, which were strongly impacted by the rise in gas prices and forward prices for the winter of 2022-2023. Electricity production in France was affected by historically low availability of French nuclear power and a fall in hydroelectric generation. However, mild temperatures during the autumn and winter and high futures prices led to a reduction in consumption, helping to contain the rise in spot prices at the end of the year.

Table 9 : Average day-ahead and intraday prices

Period	Average Day-Ahead price	Average Intraday price
2019	€39.5/MWh	€39.7/MWh
2020	€32.2/MWh	€32.9/MWh
2021	€109.2/MWh	€109.5/MWh
2022	€275.9/MWh	€276.4/MWh

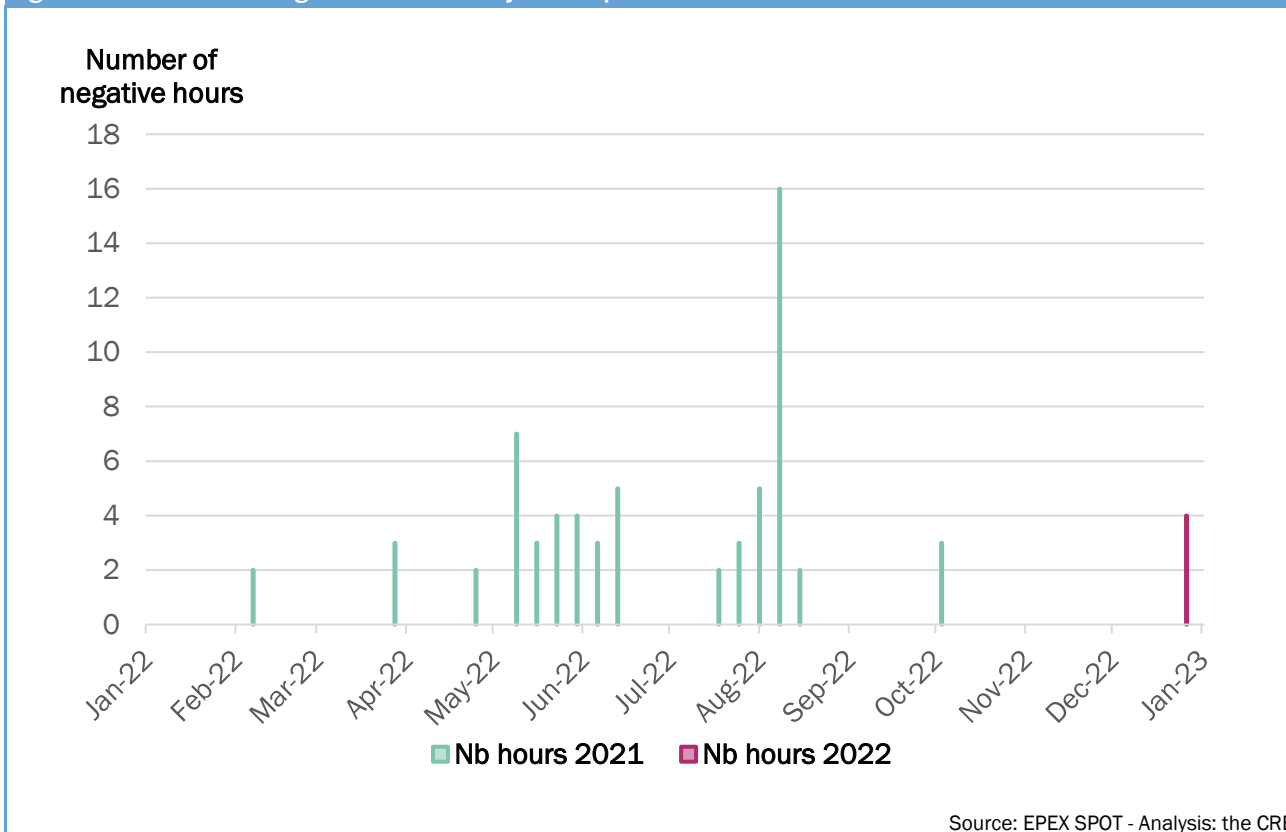
Source: EPEX SPOT

Figure 50 : Evolution of day-ahead prices in France in 2022 (weekly average of baseload and peakload prices and extrema) and their comparison with day-ahead prices in France in 2021 (weekly average of baseload prices).



Source: EPEX SPOT - Analysis: the CRE

Figure 51 : Number of negative hours for *day-ahead* prices in France in 2021 and 2022



2.2 Difference between spot prices and EDF's marginal costs in 2022

Regarding *spot* price formation, the CRE analyses the differences between *spot* market prices and the marginal costs declared by EDF based on the calculations of its daily optimisation models.

Since 2017, the indicator presented by the CRE has been determined as the monthly arithmetic average of the differences between the *spot* price and the marginal⁸⁰ cost of EDF's generating plants fleet, divided by the average *spot* price.

$$Ecart\ moyen = \frac{1}{12} \sum_{m=1}^{12} \frac{\sum_{hem} (prix_{spot,h} - cout_{marginal_{EDF,h}})}{\sum_{hem} (prix_{spot,h})}$$

On average, the price-cost spread in 2022 was 1.2%, which is lower than those observed in 2021 and 2022 (this gap is measured in relative terms).

The various discrepancies published in subsequent⁸¹ monitoring reports are listed in the Table 10.

⁸⁰In other words, the cost to EDF of producing 1 additional MWh from its generating plants fleet. EDF declares this quantity to the CRE for each hour.

⁸¹The method for calculating the average spread changed in 2017.



Table 10 : Evolution of EDF's price-cost spreads

Year	Price-cost spread
2008	6.0%
2009	6.5%
2010	3.2%
2011	5.0%
2012	2.2%
2013	4.5%
2014	5.5%
2015	5.3%
2016	2.9%
2017	1.5%
2018	3.5%
2019	1.5%
2020	1.5%
2021	2.6%
2022	1.2 %

The CRE stresses that this indicator is based on declarative data and does not prejudice the correct level of EDF's marginal costs. Furthermore, the average deviation does not reflect the occurrence of exceptional deviations, for which the CRE is likely to implement additional controls. Finally, the indicator considers all market periods, including those when EDF may not be a marginal market player on the spot market.

Without prejudice to further controls, the CRE considers that the average deviation measured in 2022 does not reflect the exercise of clear market power by EDF.

2.3 Convergence of French spot prices with neighbouring countries

The coupling of the European spot markets makes it possible to jointly optimise the use of interconnections, production resources and flexibility on a European scale, by means of an "implicit" allocation of interconnection capacity, which makes it possible to allocate in a single process the energy requested or offered by market participants and the capacity on the interconnections⁸². Thus, daily market prices are identical on the various European markets as long as the interconnection capacity remains available, and trades are made from a country with a lower price to a country with a higher price.

Market coupling plays an essential role for interconnected European countries, allowing them to benefit from the synergies between the national structures of production and consumption, to promote the integration of renewable energies through the geographical spread of sources and to strengthen the resilience of national electricity systems. France benefits greatly from this European integration, enabling it to export its surplus electricity production in Europe and to benefit from imports that are essential for its electricity supply, as was particularly the case in 2022.

Since 2006, the CRE has been a driving force for the integration of electricity markets and coupling with other European markets. Market coupling has now become a European mechanism, implemented in all electricity-connected countries of the European Union since June 2021.

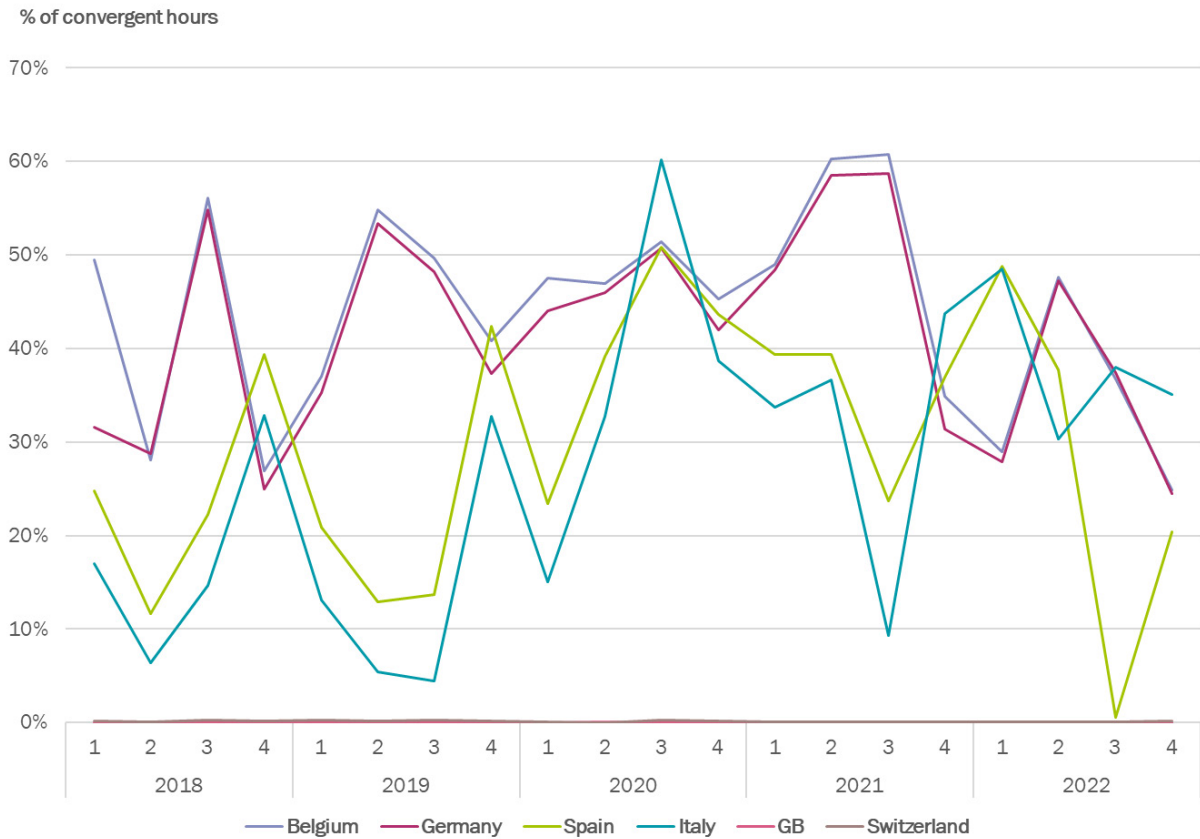
In 2022, convergence was lower overall than in 2021. Convergence rates have fallen between France and Belgium (35% on average in 2022 compared with 51% in 2021), Germany (34% on average in 2022 compared with 49% in 2021) and Spain (27% on average in 2022 compared with 35% in 2021), while they have risen between France and Italy (38% on average in 2022 compared with 31% in 2021).

It should be noted that convergence with Switzerland and the United Kingdom is almost null, as these countries, which are not members of the European Union, are not members of the Single Daily Coupling.

This fall in price convergence between France and its neighbours can be explained by the greater volatility of prices in 2022, linked to the rise in spot prices in Europe. In addition, France's electricity generation system has been more strained than that of its European neighbours, due to its low nuclear production. France has had to rely more heavily on imports from its neighbours and make greater use of high variable-cost production facilities. This situation contributed to France's higher prices compared with its neighbours (see below), as import capacity into France was saturated.

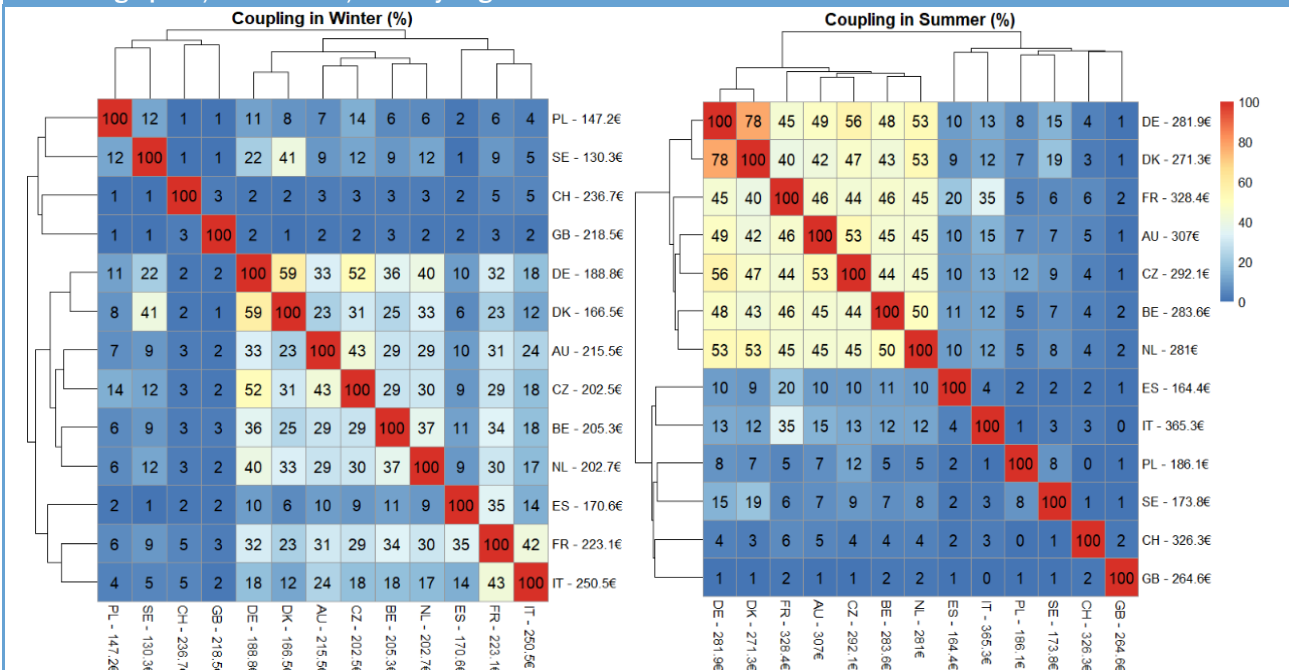
⁸² The transmission capacity needed to exchange energy is allocated "implicitly" in the auction system. Since 2015, the coupling of the CWE is done using a flow-based multi-border optimisation method. There are special cases where capacity can be allocated "explicitly", instead of or in parallel with "implicit" allocation.

Figure 52 : Quarterly convergence rate of French spot prices with European neighbours



Sources: ENTSOE, EPEX SPOT, Nord Pool - Analysis: the CRE

Figure 53 : Matrices of coupling rates between countries on the spot market in winter 2022 and summer 2022; the average price/season and/country is given for information.



AU: Austria, BE: Belgium, CH: Switzerland, CZ: Czech Republic, DE: Germany, DK: Denmark (zone DK1), ES: Spain, FR: France, UK: Great Britain, IT: Italy, NL: The Netherlands, PL: Poland, SE: Sweden (zone SE4)

Sources: ENTSOE, EPEX SPOT, Nord Pool - Analysis: the CRE



The Figure 53 highlights the closest European countries by price level and season in 2022. It visually brings together the countries with the highest coupling rates between them. In winter 2022, France had a higher coupling rate with Italy (coupled 42% of the time) than with its other European neighbours. On the other hand, during the summer of 2022, the French price was more often close to the German, Austrian, Belgian and Dutch price (coupled 46% of the time).

Price convergence between countries varies according to the season. In particular, colder temperatures in winter mean greater demand on interconnections, resulting in more frequent decoupling and greater price spreads between the various European countries with different temperature-sensitive consumption and electricity mixes.

The Figure 54 shows the distribution of the spreads between the spot price in France's neighbouring countries and the French spot price. In 2022, the Italian price was equal to the French price 33% of the time and more than €10/MWh higher for 45% of the time.

The Table 11 below shows the monthly spreads between European *spot* prices and the French *spot* price.

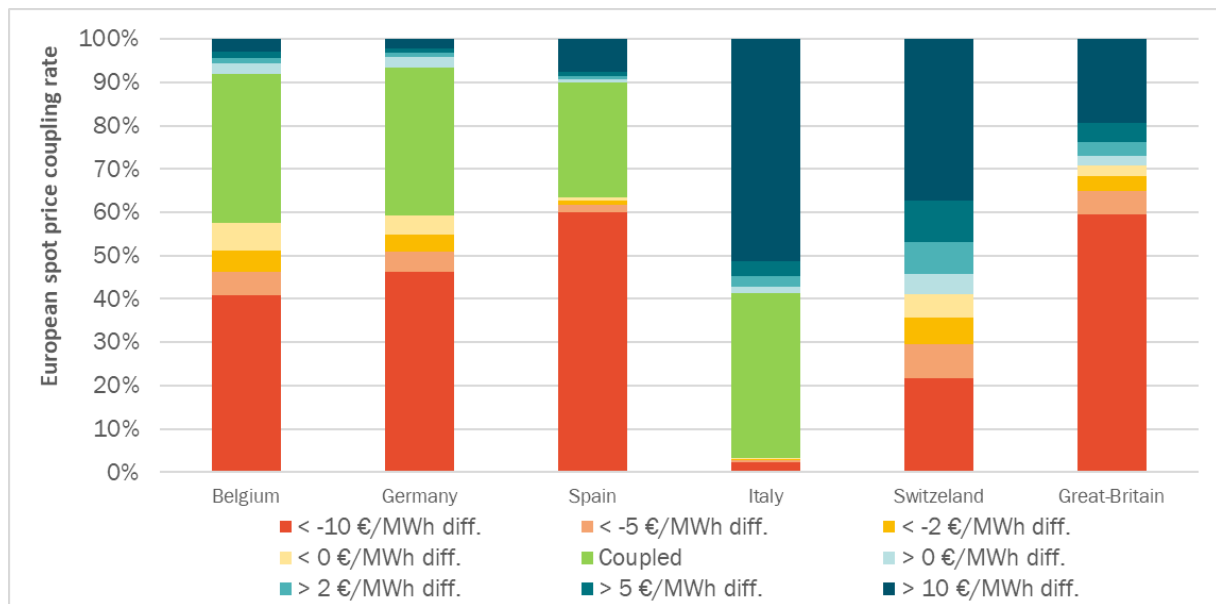
On average, among its neighbours, France was one of the countries with the highest spot price in 2022. Only Italian and Swiss prices were higher than France on average over the year (by + 32% and + 6% respectively). In 2022, Italy suffered from much higher gas prices than France.

Spain stands out from the other European countries, with an average price in 2022 of €167.5/MWh, around 30% lower than in Germany (€235.5/MWh). This unprecedented situation for Spain is explained by the introduction of a subsidy mechanism for gas-fired electricity generation in the Iberian Peninsula⁸³ on 13 May 2022 by a Royal Decree. The effect on Spanish prices can be clearly seen from June 2022 onwards.

Furthermore, while Great Britain is usually one of the countries with the highest prices, due to its electricity mix which is heavily dependent on gas and imports, 2022 is an exception. In fact, in 2022, the average spot price for Great Britain was €241.6/MWh (an increase of 75.5% compared with 2021, lower than the increase seen in most European countries). The spot price for Great Britain in 2022 was accordingly lower than France and even Belgium (€244.5/MWh). Great Britain is in a favourable position, less dependent than continental Europe on Russian energy supplies. As a result, the increase in its LNG imports in 2022 has limited the rise in the gas price in Great Britain, and accordingly the rise in its wholesale electricity prices. Great Britain also benefited from abundant renewable electricity production in 2022. The year 2022 saw Great Britain act as a net exporter to continental Europe (mainly to France), particularly from the second quarter of 2022 until November 2022.

⁸³ On 13 May 2022, the Spanish and Portuguese governments introduced an intervention mechanism on the Spanish and Portuguese electricity markets, capping the price of gas at €40/MWh, with the aim of lowering the wholesale market price and thus reducing the electricity bills of households and businesses in the respective countries.

Figure 54 : Spreads between European spot prices and the French spot price in 2022 (country price - French price)



Sources: ENTSOE, EPEX SPOT, Nord Pool - Analysis: the CRE

Table 11 : Spreads between monthly European spot prices and the French spot price between 2018 and 2022 (country price - French price)

	Germany					Belgium					Switzerland				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
January	-5,5	-11,8	-3,0	-6,7	-43,7	1,8	-0,7	-0,1	-2,0	-20,0	8,8	1,1	4,6	1,0	8,0
February	-8,6	-3,8	-4,3	-0,3	-56,7	-1,3	1,0	2,2	-0,4	-22,9	4,2	2,2	7,9	4,9	23,1
March	-10,9	-3,3	-1,3	-3,0	-43,2	2,4	3,7	0,2	-3,6	-29,5	5,0	1,9	2,3	6,0	10,8
April	-1,5	-1,1	3,6	-9,5	-67,4	4,2	-0,2	1,2	-6,1	-46,5	0,6	0,6	3,7	0,5	-5,6
May	-0,9	0,6	2,7	-2,0	-19,9	10,1	0,8	0,5	0,3	-20,8	-1,3	0,9	2,0	2,5	-0,3
June	0,1	3,2	0,4	0,6	-30,4	7,7	-1,8	-0,2	0,9	-29,3	0,9	2,6	-0,1	0,1	6,4
July	-1,9	2,0	-3,3	3,0	-85,9	1,5	0,0	-3,6	-1,0	-79,6	-0,9	0,2	-0,6	2,6	-17,8
August	-2,2	3,4	-1,9	5,4	-27,3	2,3	0,3	-1,3	2,2	-44,4	-0,3	0,5	-1,3	5,2	-4,8
September	-7,2	0,3	-3,5	-6,9	-48,6	6,8	-1,9	-3,0	0,9	-48,2	-0,5	1,9	-1,3	2,7	10,0
October	-12,5	-1,7	-3,9	-32,9	-26,3	10,4	-1,0	1,5	-7,2	-21,5	7,4	1,4	0,3	25,9	5,2
November	-11,1	-4,9	-1,3	-40,9	-18,3	10,0	-1,5	-0,2	-14,9	-11,5	-2,6	0,0	1,4	9,8	27,2
December	-6,8	-4,5	-4,9	-53,6	-19,3	4,8	-0,1	-1,0	-29,3	-1,6	2,8	4,4	3,0	7,6	9,2
Average price	44,5	37,7	30,5	96,9	235,5	55,3	39,4	31,9	104,1	244,5	52,2	40,9	34,0	114,9	281,7
	Spain					Italy					Great-Britain				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
January	15,0	0,8	3,1	0,7	-9,7	13,3	6,4	7,9	2,0	15,5	21,3	7,4	4,1	29,1	7,8
February	6,2	7,4	9,7	-20,5	14,7	8,1	10,7	12,5	8,5	27,7	9,2	10,8	10,2	12,6	10,5
March	-8,1	14,9	3,9	-4,7	-11,8	9,8	19,7	7,6	9,9	16,3	16,3	17,7	11,7	16,0	6,0
April	9,1	12,3	4,2	1,9	-41,6	14,9	15,2	11,0	6,0	16,7	24,5	12,4	14,1	11,9	-21,2
May	20,5	11,2	6,4	11,8	-10,3	17,3	12,5	6,1	14,2	31,8	26,3	10,3	10,2	30,3	-47,1
June	16,2	17,9	4,8	9,8	-78,8	13,1	15,5	1,2	8,9	24,8	19,1	14,2	3,7	17,2	-59,5
July	10,5	13,8	1,2	14,0	-258,2	9,6	12,9	2,6	22,0	50,5	12,7	8,0	-0,8	30,0	-112,9
August	5,9	11,6	-0,6	28,6	-337,6	7,0	11,8	1,2	28,5	55,1	9,2	8,3	3,5	48,0	-55,6
September	9,3	6,6	-5,2	20,8	-253,6	14,5	15,2	0,5	23,4	41,4	12,5	5,1	0,9	84,2	-85,8
October	-0,5	8,6	-1,3	27,5	-51,7	9,7	13,5	4,1	46,2	34,6	7,3	3,6	9,9	41,4	-40,9
November	-5,8	-3,7	1,8	-23,7	-76,3	-0,9	2,2	7,4	9,3	35,7	2,5	5,9	9,0	4,7	-30,1
December	6,9	-2,7	-6,4	-35,5	-173,9	9,6	5,8	5,3	16,5	33,0	14,9	9,6	12,3	15,2	20,1
Average price	57,3	47,7	34,0	111,9	167,5	60,7	51,3	37,8	124,7	308,4	64,9	48,9	39,6	137,7	241,6

Sources: ENTSOE, EPEX SPOT, Nord Pool - Analysis: the CRE

2.4 Forward prices in France showed very high risk premiums for the winter of 2022-2023 due to uncertainty over nuclear availability

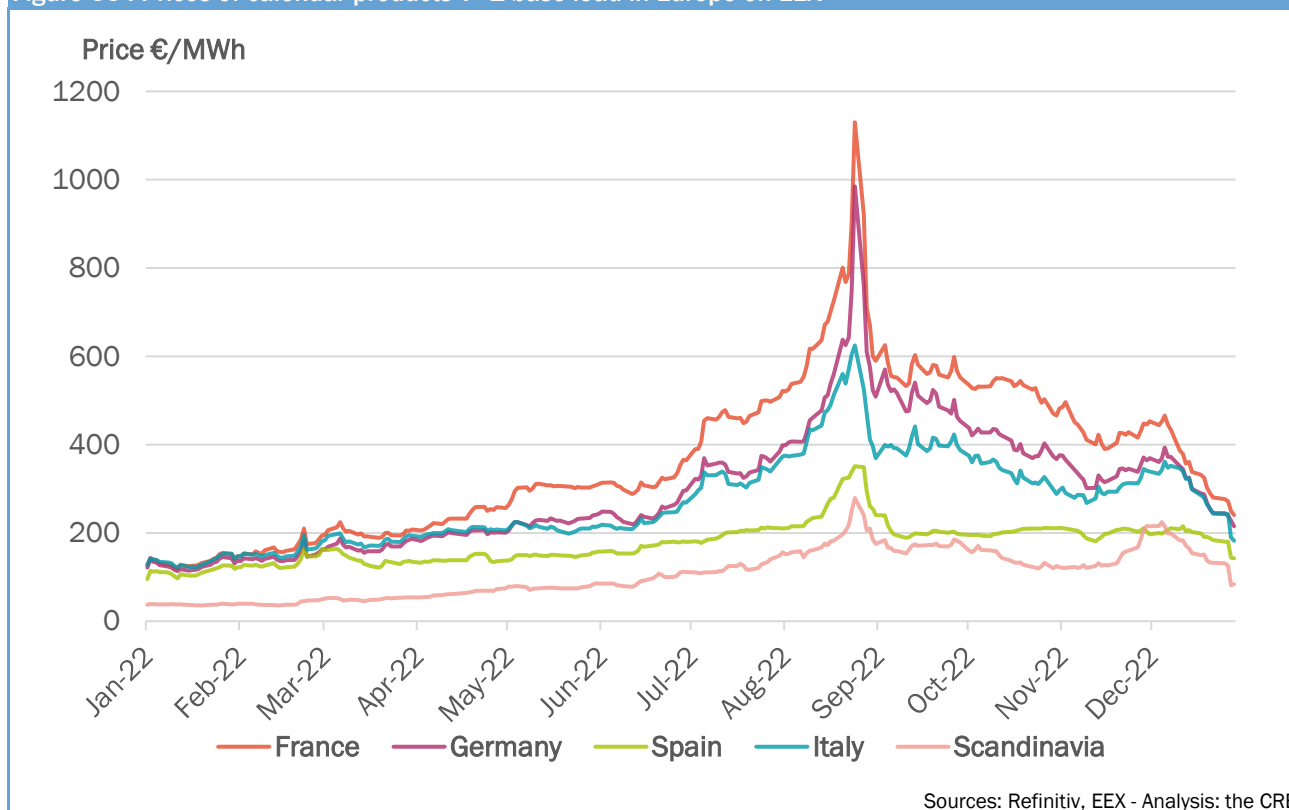
Wholesale forward prices, in particular the annual product, play a major role in the economics of the electricity system: they determine to a large extent the price paid by consumers, and also constitute a large part of producers' income.

Futures markets allow for the exchange of electricity in advance of given delivery periods in the future. They group together products for different time horizons ranging from a few days to several years in advance. A market participant requiring physical⁸⁴ delivery at a given time can adopt one of two approaches: a purchase on the spot market, hedging the price risk with a futures product with financial settlement, or a direct purchase of a physical product on the futures markets.

For financial delivery products, settlement prices are valued daily until the last delivery day of the contract, and ultimately correspond to the average of spot prices achieved over the contract delivery period. These contracts are used by market participants to hedge against the risk of price fluctuations. For example, for a producer, it means "securing" a volume and a price before delivery, or for a supplier, it means determining a supply price to consumers or "securing" a supply margin. In the longer term, forward prices are a signal for investment and can be used as a reference when negotiating long-term contracts.

The futures markets were hit hard by the energy crisis in 2022. Forward prices for delivery in 2023, and particularly those for delivery during the winter of 2022-2023, have risen exceptionally, well above the levels seen in other European countries.

Figure 55 : Prices of calendar products Y+1 base load in Europe on EEX



Prices initially rose sharply in the first half of the year, peaking in the summer of 2022 (with a peak of €1,130/MWh reached on 26 August 2022 on the 2023 annual contract), while fears about security of supply for the winter of 2022-2023 were at their highest.

⁸⁴There are two types of forward delivery:

- Physical delivery: the contract provides for a delivery of electricity that will be "debited" from the seller's Balance responsible party balance perimeter and "credited" to that of the buyer's.
- Financial delivery: the parties agree on a price and a price reference (usually the D-1 spot market). The parties make a financial transfer between them corresponding to the difference between the agreed price and the reference price multiplied by the agreed volume, as soon as the reference price is known.
- From a financial point of view, these two types of delivery are equivalent.

Forward prices gradually eased from autumn onwards, remaining at a very high level until early December, before falling rapidly at the end of the year thanks to the rapid return to service of the nuclear fleet, as well as the easing of the gas market and the fall in consumption (with the first visible results of efforts to reduce consumption).

The rise in forward electricity prices in 2022 reflects the combination of two crises on an unprecedented scale:

- The first concerns Europe's security of gas supply for the winter of 2022-2023, due to the sharp drop in gas pipeline deliveries from one of its main suppliers, Gazprom. Since Russia's invasion in Ukraine, the threat of a complete shutdown of Russian gas imports has directly affected the markets, generating fears of shortages for the winter of 2022-2023;
- the second concerns France more directly, because of the state of its nuclear fleet, affected by the shutdown of several reactors. The discovery of stress corrosion at the end of 2021, on top of an already very busy maintenance schedule, has led to several shutdowns. As EDF has had to carry out additional and unprecedented checks and repairs, this has created greater uncertainty about its ability to bring the plants concerned back into service before the winter.

In these particularly tense conditions, the CRE strengthened its monitoring of the wholesale markets and on 26 July 2022⁸⁵ published its preliminary analysis of forward electricity prices for the winter of 2022-2023. The CRE noted that forward electricity prices, and in particular prices for delivery in France in the first quarter of 2023, reflected market participants' expectations of a particularly tight supply-demand balance. The CRE pointed out that these forward prices included risk premiums that seemed very high compared with a reasonable expectation of future daily prices. Market players wishing to hedge their exposure to wholesale prices were clearly prepared to pay these risk premiums.

In view of the exceptional nature of the situation and the very high level of prices observed compared with historical modelling, the CRE formally questioned market participants about their strategies and expectations for the winter of 2022-2023.

In its final report, published on 13 December 2022⁸⁶, the CRE presents its analysis of the increase in forward prices and summarises the responses of the market participants questioned. The main conclusions are as follows:

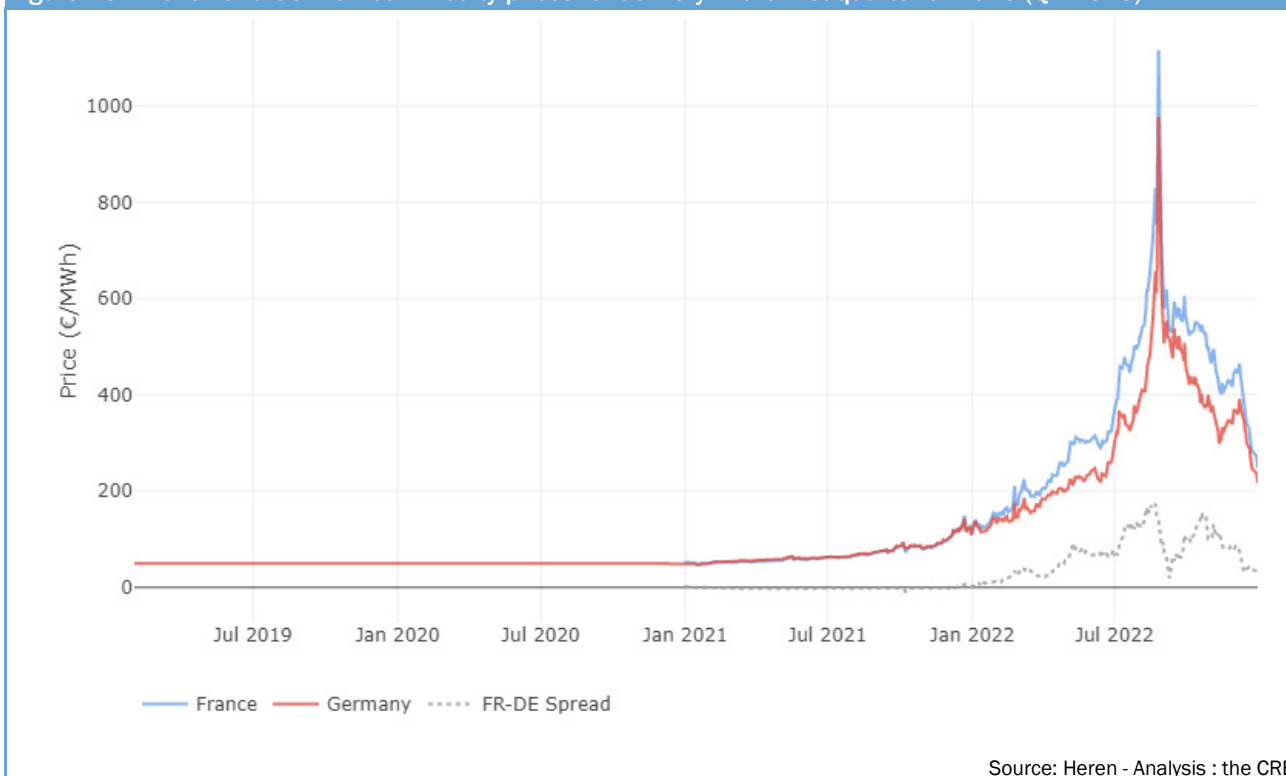
- In the context of 2022, marked by strong uncertainties about the supply-demand balance, the price levels achieved are essentially explained by the hedging of risks linked to the physical activities of the market players (mainly producers, suppliers and large consumers);
- the cautiousness of market players seeking to limit their risks in times of crisis has led, on the one hand, to higher-than-average purchases in terms of anticipated volume requirements and, on the other hand, to a reduction in sales on the futures markets. This automatically contributes to greater tension on the futures markets than in the anticipated physical balance, which explains, at least in part, the high risk-premia observed in France;
- In view of low liquidity and very high and volatile prices, the market players interviewed indicated a general reduction in proprietary trading (including so-called "directional" or "speculative" strategies) on the futures markets. In addition, there was little short-selling activity for contracts delivered in France for the winter of 2022-2023, probably due to the very high levels of risk carried by these positions. According to the CRE's analyses, the high wholesale prices observed in France were not the result of speculative positions taken by one or more market players;
- While the French market was expected to be an importer on average during the winter of 2022-2023, most of the exchange capacity at the borders for 2023 was not marketed until the end of November 2022 (except for the interconnections with the United Kingdom). The corresponding imports, which are necessary to balance supply and demand in France, could not accordingly be taken into account without risk in the sales offers on the futures markets. Some market players have expressed their reluctance to take on the risk of exposure to sales on the French market that would not be hedged by holding interconnection capacity, as the financial risk associated with such unhedged positions has risen sharply in the context of 2022.

The spread between the prices of forward contracts delivered during the winter of 2022-2023 in France and Germany particularly revealed the risk premium phenomenon on the French market in 2022. Indeed, the France-Germany price spread increased throughout the early part of 2022 and widened particularly over the summer. For example, on 15 July 2022, the French price (€867.5/MWh) was more than twice its German equivalent (€398.5/MWh). The France-Germany price spread on the first-quarter 2023 product peaked on 25 August 2022 at €595/MWh, and the French 2023 2023 remained more than €100/MWh higher than the German 2023 *calendar* for most of the year.

⁸⁵<https://www.cre.fr/Actualites/hausse-des-prix-pour-l-hiver-prochain-la-cre-interroge-les-acteurs-de-marche-sur-leurs-strategies-et-leurs-anticipations>

⁸⁶<https://www.cre.fr/Actualites/la-cre-publie-son-analyse-des-prix-de-gros-de-l-electricite-pour-l-hiver-2022-2023-et-l-annee-2023>

Figure 56 : French and German commodity prices for delivery in the first quarter of 2023 (Q1 2023)



Source: Heren - Analysis : the CRE

Forward prices finally eased off sharply, initially from the end of October 2022 and then in December.

This reduction in prices applies to all the products offered, but mainly affects the product for the first quarter of 2023. For example, for the 2023 *calendar* product, the price falls from €526/MWh on 24 October 2022 to €433/MWh on 30 November 2022 and then to €248/MWh on 30 December 2022.

Prices also fell in Germany, but by a smaller proportion. This fall in forward prices has resulted in a reduction in the France-Germany price spread, down to €43/MWh on 30 December 2022, i.e., a relative spread of 18%, well below the 40-60% spreads observed during the summer.

This reduction in risk premiums at the end of the year is the result of a situation that market participants ultimately perceived as less risky, due to several fundamental factors:

- the rapid return to service of EDF's nuclear power plants after a long period of very low availability;
- the general easing of pressure on the wholesale gas market;
- the fact that the cold days of early December were passed without difficulty by the French electricity system.

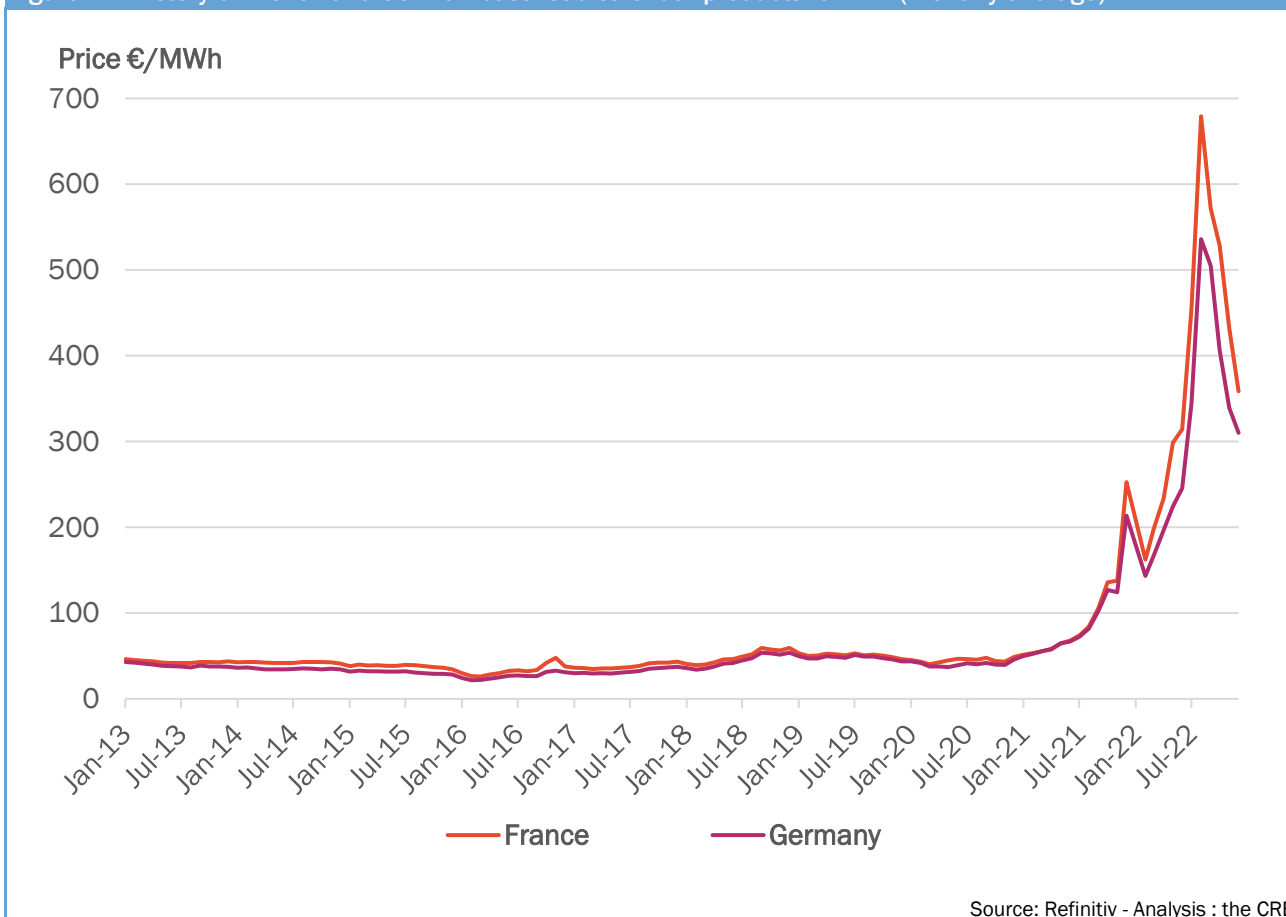
The increase in liquidity due to the contribution of long-term interconnection capacity could also have played a role. There were 6 auctions of long-term transmission rights between 24 October 2022 and 28 December 2022 covering the whole of the first quarter of 2023 in the direction of imports into France, for a total capacity of 2.6 GW, which is very significant compared with all the positions opened over this quarter, which increased by almost 3 GW over the same period, ending up at around 10 GW.

Finally, the 2023 French *calendar* product traded in 2022 at an average of €367.6/MWh, an increase of 288% compared with the average 2021 price for delivery in 2022 (€94.7/MWh) and 624% compared with the average 2019 price for 2020 (€50.8/MWh). The 2023 German base-*calendar* price traded at an average of €298.3/MWh in 2022, an increase of around 237% compared with the 2021 price for 2022 (€88.5/MWh) or an increase of 520% compared with 2019 for 2020 (€48.1/MWh).

In this context, the CRE, in conjunction with RTE and the regulators and system operators of border countries, has begun work on anticipating the marketing of cross-border exchange capacity in order to provide market participants with greater visibility, which should help to reduce risk premiums.

To put the exceptional nature of the crisis in 2022 into perspective, a history of prices for French and German base load calendar products for Y+1 maturity since 1 January 2013 is presented in the Figure 57.

Figure 57 :History of French and German base load calendar products for Y+1 (monthly average)



The prices observed in 2022 are exceptional compared with the historical variations seen since the opening up of the electricity markets in Europe. The average electricity price over the period 2013-2021 is around €48.3/MWh, compared with the average price in 2022 of €367.6/MWh.

Despite these very high price levels, on the basis of the information available and at this stage of its analyses, the CRE is not aware of any behaviour likely to be qualified as market abuse under REMIT for 2022.

3. VOLUMES TRADED ON WHOLESALE MARKETS ARE DOWN

Trading on wholesale markets takes place over-the-counter or on the stock exchange. Most OTC trades are intermediated by brokers. The products traded may be physically or financially settled. On the French market, products with financial settlement can be traded directly on exchanges (mainly EEX) or intermediated by brokers and then registered with an exchange for settlement through the clearing house (transactions mainly registered on EEX). Products with physical settlement are mainly intermediated by brokers.

Auctions organised by EDF on a platform dedicated to the forward sale of energy acquired under state-guaranteed purchase obligation contracts also represent significant volumes of energy.

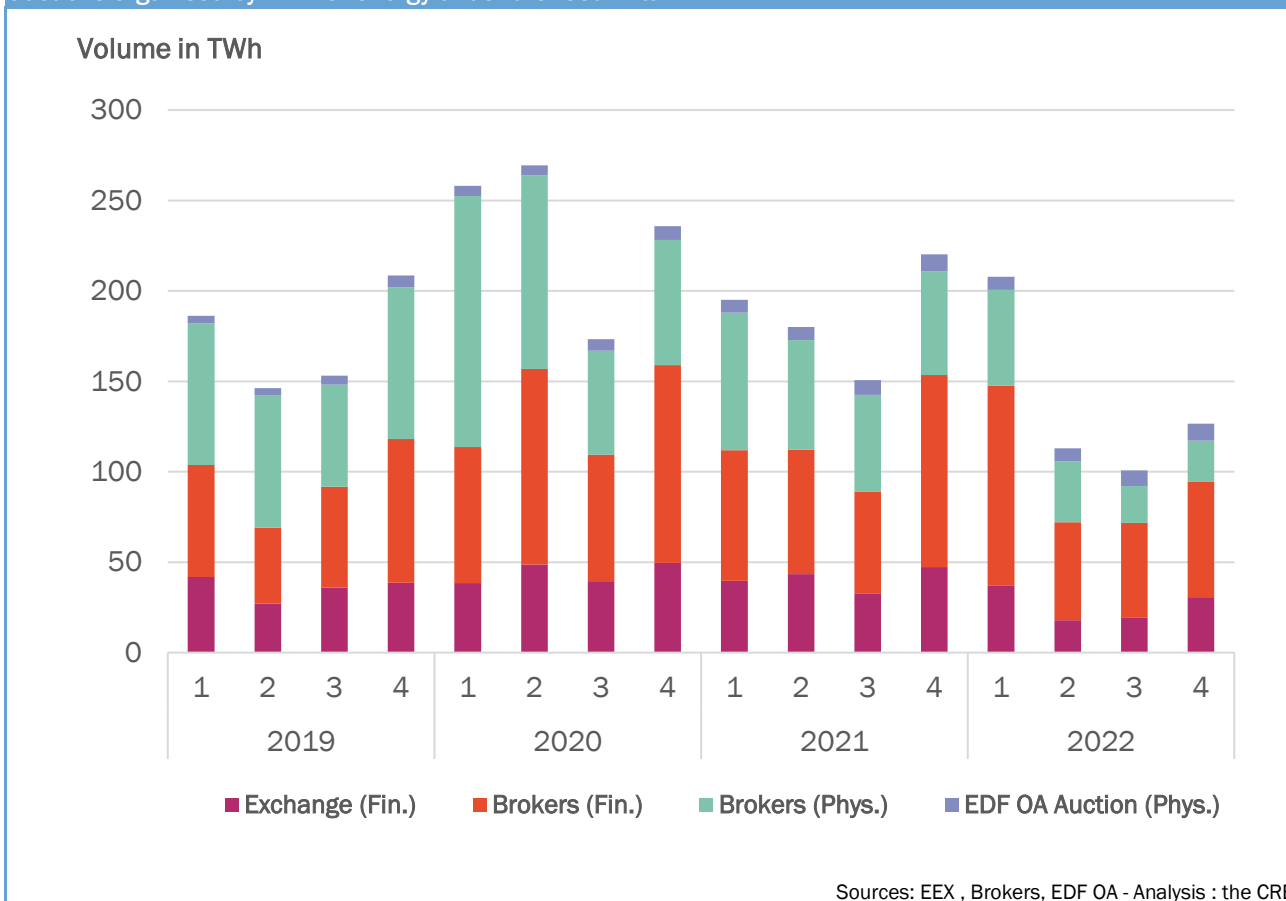
On the futures markets (OTC, EEX), the products traded in France range from a 3-year horizon (*calendar product Y+3*) to one day before delivery (*day-ahead product*). Most *day-ahead* and *intraday* trading is carried out on the EPEX SPOT and Nord Pool exchanges, the designated operators in France of the European coupling of the day-ahead and intraday markets. Exchanges on *day-ahead* products are carried out via daily auctions (*single day-ahead coupling - SDAC*); intraday products are traded on a continuous market (*single intraday coupling - SIDC* - and the national market).

On the futures markets, the volumes traded on the French electricity market are down by 26% in 2022 (548 TWh) compared with 2021 (746 TWh) and by 42% compared with 2020 (937 TWh). This trend, in the opposite direction to that seen on the gas market, is observed for all forms of trading, with a 35% fall in volumes traded on the EEX exchange (105 TWh in 2022 compared with 163 TWh in 2021), an 8% fall in OTC volumes for financial products (280 TWh in 2022 compared with 303 TWh in 2021) and a 4% fall in OTC volumes for physical products (130 TWh in 2022 compared with 248 TWh in 2021). The number of transactions is also down by 7% between 2021 and 2022.

The futures market continued to become more financialised over the period under review. This growth in financial settlement products may reflect a preference for reducing counterparty risk in futures trading. While collateral and margin call procedures vary for physical settlement products, financial settlement products eliminate counterparty risk through the clearing house. The year 2022 is marked by a sharp decline in trading volumes, both financial and physical, from the second quarter onwards, which coincides with a very sharp rise in futures prices. Rising prices and margin requirements seem to be deterring market participants from forward transactions.

It should be noted that the volumes sold at auctions organised by EDF for energy under the feed-in tariff are not directly comparable with the others. This is because they do not give rise to "round trip" exchanges, but only to sales by EDF.

Figure 58 : Volumes traded on the stock exchange or via brokers on the futures markets, volumes sold at auctions organised by EDF for energy under the feed-in tariff.



Sources: EEX , Brokers, EDF OA - Analysis : the CRE

The Figure 59 presents all the volumes traded on the wholesale markets by maturity, on the futures markets as well as the daily and intraday markets. Between 2021 and 2022, most volumes traded for each type of product are decreasing:

- annual products: decrease by 34%, from 296 TWh traded in 2021 to 194 TWh in 2022,
- quarterly products: decrease by 4%, from 242 TWh traded in 2021 to 233 TWh in 2022,
- monthly products: decrease by 38%, from 144 TWh in 2021 to 88 TWh in 2022,
- weekly products: decrease by 51%, from 64 TWh in 2021 to 31 TWh in 2022,
- daily products: decrease by 18%, from 182 TWh in 2021 to 149 TWh in 2022.

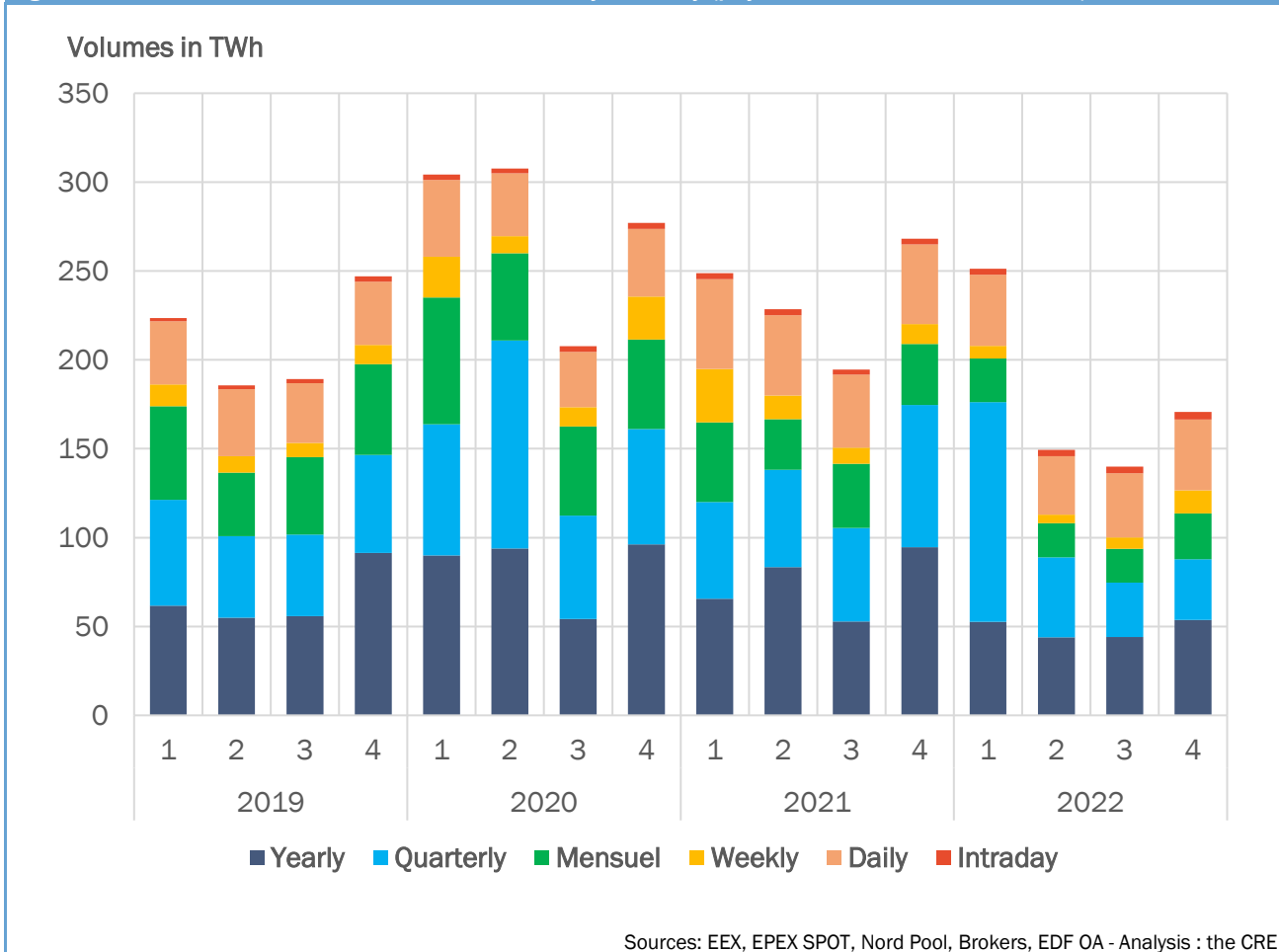
Trading volumes for intraday products are set to rise, from 13 TWh in 2021 to 15 TWh in 2022. Whereas in 2021, the fall in volumes traded was most marked on products with a maturity of more than one month, 2022 saw a sharp decline across all products, except for quarterly contracts, which fell by a moderate 4%, and intraday contracts, which rose by 17%. This decline is particularly noticeable for products with physical delivery.

Forward products represent the largest share of products traded on the wholesale electricity markets, as market participants mainly hedge their exposure over the medium to long term and adjust this hedge over time. Shorter-term, daily, and intraday markets are particularly essential for optimising the production fleet and the use of inter-connections, even if they represent smaller trading volumes. Even so, the daily market has very significant volumes,



especially as it can be used to buy or sell electricity whose price is already covered by a purchase or sale of a forward contract for financial delivery. Intraday products represent around 1% of trading.

Figure 59 : Volumes traded on wholesale markets by maturity (physical and financial combined)



In 2022, the sum of net positions is lower than in 2021, particularly in terms of annual products. This can be explained in particular by the high risk-premium environment, where uncertainty over 2023 nuclear production was high, which could lead EDF to limit forward sales.

The Figure 60 chart shows the evolution of market players' open positions by category, for annual base load, physical and financial products combined. It should be noted that this is the change in open positions over the year preceding delivery.

The stakeholder categories were defined as follows:

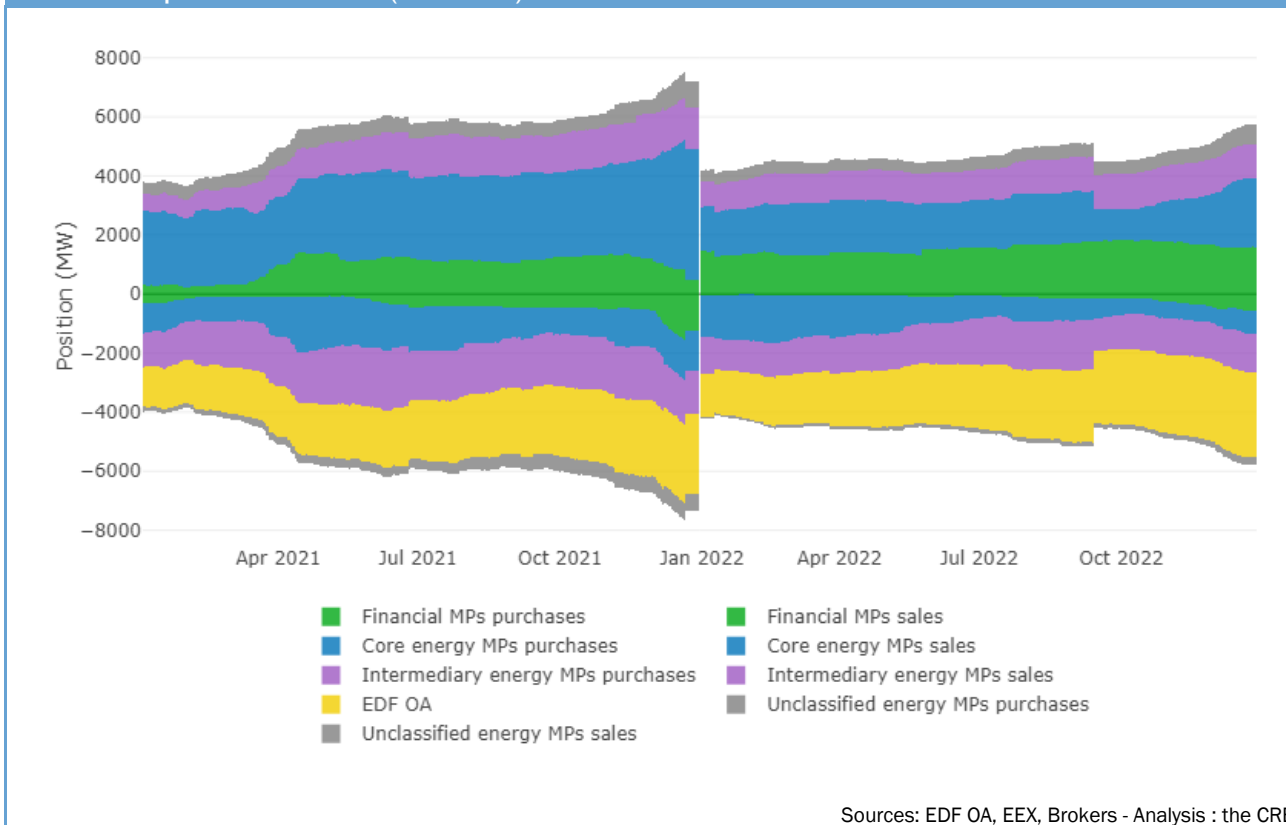
- the main physical energy market players, composed of energy suppliers and producers,
- the intermediary physical market players, composed of consumers, aggregators, etc.,
- the financial market players, including investment funds, *trading houses*, etc. active on the French electricity market,
- EDF OA, which sells volumes from state-guaranteed purchase obligation contracts, sold forward in accordance with the procedure established by the CRE⁸⁷.

Over the entire period, physical market players represent most open positions in the annual base load product. EDF OA remains the main seller in 2021 and 2022. In 2021 and 2022, there is an increase in sales by financial market players at the end of the year, which could correspond to the coverage of interconnection capacity acquired at the end of the year for the following year.

⁸⁷The CRE Deliberation N° 2019-259 of 28 November 2019 deciding on the methodology for calculating the avoided cost of electricity produced under the purchase obligation.



Figure 60 : Evolution in the position of market players by category, for the base load annual product, physical and financial products combined (vision Y+1)



4. BALANCING MARKETS: SYSTEM SERVICES, BALANCING AND RESERVES

The products traded on the balancing markets are considered under the REMIT regulation as wholesale energy products. As such, the CRE is responsible for monitoring these markets. In addition, in application of the European regulation on balancing⁸⁸ (the "Electricity Balancing" regulation, hereafter "EB regulation"), and of Article L. 321 11 of the French Energy Code, the CRE approves the operating rules for these markets.

4.1 Reminder of the general operating principles of the balancing markets and future developments

In order to balance consumption and production at all times, RTE, as the party responsible for the stability of the electricity network, requests services from balancing service providers to regulate electricity production or consumption. To ensure this balance, different types of reserves can be mobilised: on the one hand, the system frequency services composed of the frequency containment reserves (FCR) and the automatic frequency restoration reserves (aFRR), which can be activated automatically, and on the other, the manual ancillary services. In addition, balance responsible entities are financially encouraged to balance their injections and imports on the one hand, and their withdrawals and exports on the other, ahead of real time, in order to limit the imbalance volumes.

The activation and procurement of balancing reserves are evolving towards a generalisation of market-based mechanisms, particularly in the context of the European integration of balancing markets the CRE is strongly involved in these developments, aimed at improving the efficiency of the system for the benefit of consumers, and ensures the proper functioning of these new markets.

4.1.1 The frequency containment reserve

The FCR aims to contain frequency deviations on the continental European interconnected grid, by modulating injections or withdrawals of the participating units, in response to real-time frequency deviations. The FCR is procured

⁸⁸Commission Regulation (EU) 2017/2195 of 23 November 2017 on a guideline for balancing the electricity system: <https://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:32017R2195&from=FR#:~:text=Il%20C3%A9nonce%20des%20r%20C3%A8gles%20pour,aux%20fins%20de%20l%20C3%A9quilibre.>

by RTE from French and foreign balancing service providers, through the "FCR" cooperation, which RTE joined at the beginning of 2017. This cooperation gives rise to daily calls for tender conducted jointly by the TSOs of 8 countries (Germany, Austria, Belgium, Denmark, France, the Netherlands, Slovenia, Switzerland and the Czech Republic)⁸⁹.

Only the procurement of the FCR is subject to a market-based mechanism. Because of the way this reserve is activated (automatic and decentralised, depending on frequency deviations), there is no competition between energy activations. Furthermore, exchanges between countries resulting from the activation of the FCR are never constrained by exchange capacities at the borders, as these exchanges are provided for in the safety margins on the interconnections.

4.1.2 The automatic frequency restoration reserve

The automatic frequency restoration reserve (aFRR) is activated automatically by RTE via a signal sent to all the resources participating in this reserve. Its objective is to absorb the discrepancies between the commercial exchanges planned at the interconnections and the exchanges carried out.

Today, the aFRR is activated by sending a single signal to all participants, with no competition between activations. However, the energy activation of aFRR's capacities will evolve to become the subject of a market mechanism according to an order of economic precedence. The selection of these offerings will be optimised in France by RTE, initially at French level only, and then at European level via the European platform PICASSO (*Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation*). The platform came into service in June 2022, and takes into account all the offerings submitted in Europe, the real-time needs of each TSO and the exchange capacities available at the borders. To date, the implementation by RTE of the activation of the aFRR according to economic precedence on a French scale is planned for autumn 2023. The CRE has also granted RTE a derogation until July 2024 to connect to the European PICASSO platform⁹⁰.

In France, the activation of the aFRR by RTE is optimised through the European IGCC (*International Grid Control Cooperation*) platform, which makes it possible to compensate for needs in opposite directions between member countries, and accordingly to limit simultaneous activations of the aFRR in opposite directions on either side of different borders. RTE joined the project in 2016. To date, TSOs from 24 countries participate in the IGCC platform.

4.1.3 The manual ancillary services

The manual ancillary services are mobilised by RTE through the balancing mechanism, a market organised by RTE since 2004, and through the European platform for the exchange of standard replacement reserve products (hereinafter "TERRE platform") to which RTE connected on 2 December 2020.

The TERRE platform is the result of a cooperation launched in 2014 by the European TSOs that use replacement reserves to balance their system, including RTE. All TSOs using replacement reserves products must participate, in accordance with Article 19 of the EB Regulation.

Any balancing market player with balancing capacity that can be mobilised in less than 30 minutes can participate, starting from 1 MW. The TERRE platform allows, within the limits of the available cross-zonal capacities after the closure of intraday exchanges, to exchange replacement reserve offers called "standard", i.e., with certain predefined technical characteristics harmonised between the TSOs participating in the platform. The offer selection algorithm performs an optimisation every hour, for the next four quarters of the following hour, in order to select the offers to be activated. Balancing offers are remunerated at the marginal price for the zone in which they are activated.

The platform was officially launched on 15 January 2020 and, by the end of 2022, 6 TSOs were connected to it. RTE has been connected since 2 December 2020, and has increased its participation in the platform throughout 2021 and early 2022. Since 21 March 2022, the initial period of operation under control has been completed and RTE has been participating in the TERRE platform on a continuous basis.

On the balancing mechanism, the participants, known as "balancing market players", submit offerings to RTE, from contracted or non-contracted resources. These balancing market players may correspond to sites located in France (withdrawals, injection, storage), or to market players or network operators located abroad, called on via interconnections. The offers define the technical conditions for activation, a price for activated energy and, where applicable, a start-up price. RTE activates this reserve according to its needs and in compliance with a so-called "technical-economic" precedence, which takes into account not only the price of the offers but also their technical characteristics. RTE activates offers to manage the supply-demand balance in France, but also to resolve any congestion on

⁸⁹The Czech Republic TSO (CEPS) joined the cooperation in March 2023.

⁹⁰The CRE Deliberation N° 2022-210 of 21 July 2022 concerning the decision to grant derogations for RTE's connection to European platforms for the exchange of balancing energy from aFRR and fast manual ancillary services.

the grid, to increase the supply of system services or to restore a sufficient level of margin of flexible resources available on the system.

The European exchange platform for standard fast reserve products (hereinafter "MARI platform") was implemented in October 2022. The CRE has granted RTE a derogation until July 2024 to connect to the European MARI platform⁹¹.

All production facilities connected to the transmission network are required by law to offer their available flexibility upwards through offerings submitted to the balancing mechanism. Part of the manual ancillary services is also subject to a capacity reservation by RTE. For 2022, RTE has contracted two thirds of the rapid and replacement reserves (hereafter, "RR-RC") through an annual tender launched on 23 July 2021, with offerings submitted on 9 September 2021. The remaining third was contracted through a daily tender. The RR-RCs enable RTE to have 1,000 MW available at all times that can be activated in less than 13 minutes (RR) and a further 500 MW that can be activated in 30 minutes (RC).

The deliberation of 21 July 2022 validated, for 2023, the increase in the proportion of RR-RC capacity contracted in the daily tender to 50% of contracted capacity.

4.1.4 The balance manager system

The balance responsible party (BRP) system provides a financial incentive for market participants to match consumption and production as closely as possible within their perimeter, with each grid connection point having to be attached to the perimeter of a Balance responsible party. The imbalances (energy deficit or surplus for a given 30-minute period) are accordingly subject to a financial settlement representing the value of the balancing energy that had to be mobilised by RTE, where applicable, to absorb these imbalances. The gap settlement period will change from 30 minutes to 15 minutes on 1 January 2025, in accordance with the provisions of Article 53(1) of Regulation EB.

Up to an hour before real time, production schedules can be modified, and market players can import or export energy via cross-border markets, thereby modifying the BRP deviation and the "physical" position of the French zone. After this moment, and up to five minutes before real time, French market players can continue to trade energy with each other on the French intraday market, without being able to change the production or import/export programmes. These exchanges therefore have an impact on the spreads of the BRPs concerned, but not on the physical balance of the French zone. During this period, RTE is therefore the only market player to take "physical" balancing actions.

4.2 Review of balancing markets in 2022

4.2.1 Overview

Table 12 presents the physical and financial summary of the balancing reserves contracted by RTE and the balancing energies activated.

The procurement costs of the various reserves are covered by the tariffs for use of the public electricity transmission network (hereinafter "TURPE").

The procurement cost of the FCR has increased by €23 million in 2022, in line with the general rise in wholesale market prices. The procurement prices in 2022 remained in line with those observed over the last three quarters of 2021, and around four times higher than those observed in 2020.

The aFRR was contracted in 2022 on the basis of a prescription with a regulated price of €20.5/MWh and is the most expensive reserve contract (128 M€). The procurement cost has fallen by €30 million compared with 2021, as the period of contracting by daily calls for tender in November 2021 proved to be particularly costly (Section 4, §4.2.3).

⁹¹The CRE Deliberation N° 2022-210 of 21 July 2022 concerning the decision to grant derogations for RTE's connection to European platforms for the exchange of balancing energy from aFRR and fast manual ancillary services.

Table 12 : Balancing reserves contracted by RTE, activated balancing energies and associated costs

Year 2022	Procurement			Activations			
	Reserve	Direction	MW (average)	M€	Upward		Downward
				GWh	M€	GWh	M€
Primary (FCR)	Upward and downward	539	100.8	418	62.0	420	-59.4
Secondary (aFRR)	Upward and downward	714	127.8	1,442	392.9	1,004	-242.1
Fast (mFRR)	Upward	1,500	23.9	1,928	1,494.3	1,520	-822.9
Supplementary (RR)				986		2,657	
Total		2,753	253	6,300	2,116.9	7,284	-1,461.1

Source: RTE

The cost of contracting fast and supplementary reserves has increased by 11 million euros in 2022. This increase is mainly due to the rise in contracting for daily calls for tender, which increased from 5 to 14 M€. This increase in costs reflects unanticipated tensions in the supply-demand balance in 2022. For example, contracting for the day of 4 April 2022 (Ecowatt Orange signal) cost 3.5 million euros, and the first three weeks of December (low nuclear availability and falling temperatures) cost 3.6 million euros in contracting.

The costs of activation are borne by the balance responsible parties and are paid through the settlement of imbalances, except for the additional costs of activation for reasons other than balancing, which are borne by consumers via the TURPE.

Activations of balancing resources on the balancing mechanism and on the TERRE platform represented a net cost of €671 million in 2022, a sharp increase compared with 2021 (€374 million). The difference compared with 2021 is explained by an increase in activation costs, which is not offset by the increase in activation revenues. The rise in activation costs is due to the increase in the price of activated offers, which follows the upward trend in wholesale electricity prices, with even higher prices since they correspond to offers not accepted on the *spot* markets.

To date, activated energy from FCR and aFRR is valued at the *spot* price. The net value of activated FCR and aFRR energy is also low, as these activations are on average centred on zero. In 2022, a significant proportion of downward aFRR activations in France were avoided through the European IGCC platform, by offsetting upward aFRR activations in neighbouring countries. Taking these offsets into account, the net value of the energies activated for the FCR and aFRR amounts to -€15.6million in 2022.

4.2.2 "FCR" cooperation

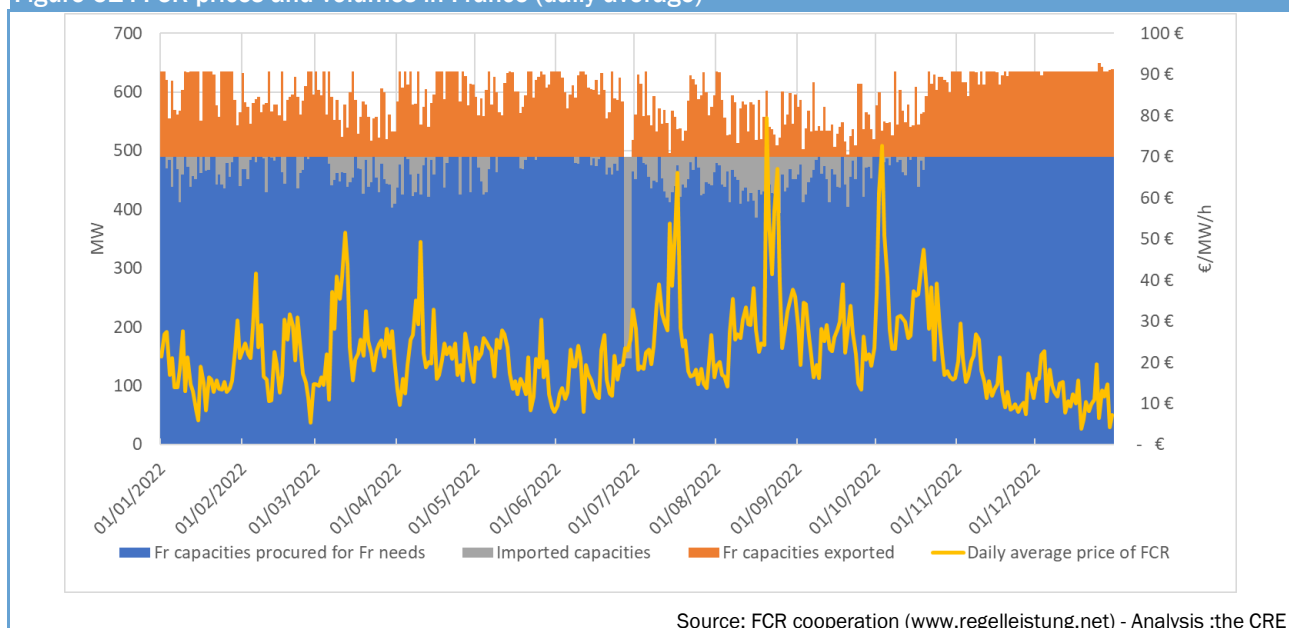
Since 1 July 2020, the FCR is procured by means of a daily tender conducted at 8am each day for the following day, divided into six four-hour slots comprising six different products.

The Figure 61 shows weekly average prices and volumes of FCR built up, imported, and exported in France. The level of RTEs demand has remained constant over the year. The volume effectively procured in France corresponds to the sum of RTE's demand and the export-import balance in relation to the other countries in the cooperation.

The average daily price of FCR varied considerably in 2022 but was mostly contained between €10/MW.h and €30/MW.h (77% of days in 2022). In 2022, the average price of FCR was €22/MW.h, which is lower than the average prices observed in the last quarter of 2021 (€33/MW.h), but still higher than in 2021 as a whole (€17/MW.h). The total procurement cost of the FCR in 2022 is accordingly higher than in 2021.

Most of France's FCR capacity will be exported by 2022, with an average export balance of 45 MW.

Figure 61 : FCR prices and volumes in France (daily average)



4.2.3 The automatic frequency restoration reserves

As part of the construction of a European balancing market, the procurement of aFRR capacity is set to evolve, to be carried out through a daily tender open to all certified market players. In November 2021, this major change was implemented for the first time, then suspended after several weeks, as the CRE noted a structural malfunction in this nascent market⁹².

In June 2022, in accordance with European regulations, the CRE granted RTE a derogation for a *maximum* of three years for the procurement of aFRR capacity by tender, while proposing a framework to allow this tender to be reopened under sustainable conditions.⁹³

To date, the procurement of aFRR capacity has been done based on a prescription, with RTE allocating its requirements between the reserve managers in *proportion* to the regulatory constructive capacity of their generation units. The allocation of this prescription is free, within a market player's portfolio, or between different market players, through over-the-counter exchanges of reserves notified to RTE.

4.2.4 The balancing mechanism

The Figure 62 shows the volumes of energy activated upwards and downwards by RTE since 2020 for the various reasons.

Activations to manage system balance ("P=C" reason) account for most activations, but the replenishment of system services ("SSY") is a significant cause of downward activation (16% of downward activated volumes in 2022), down on 2021 (23% of activated volumes). Activations due to congestion ("Network") and margins ("Margin") represent very low volumes. Net activated volumes are negative on average, indicating a trend for balance responsible parties to over-cover themselves for fear of having to pay a high price for settling negative imbalances.

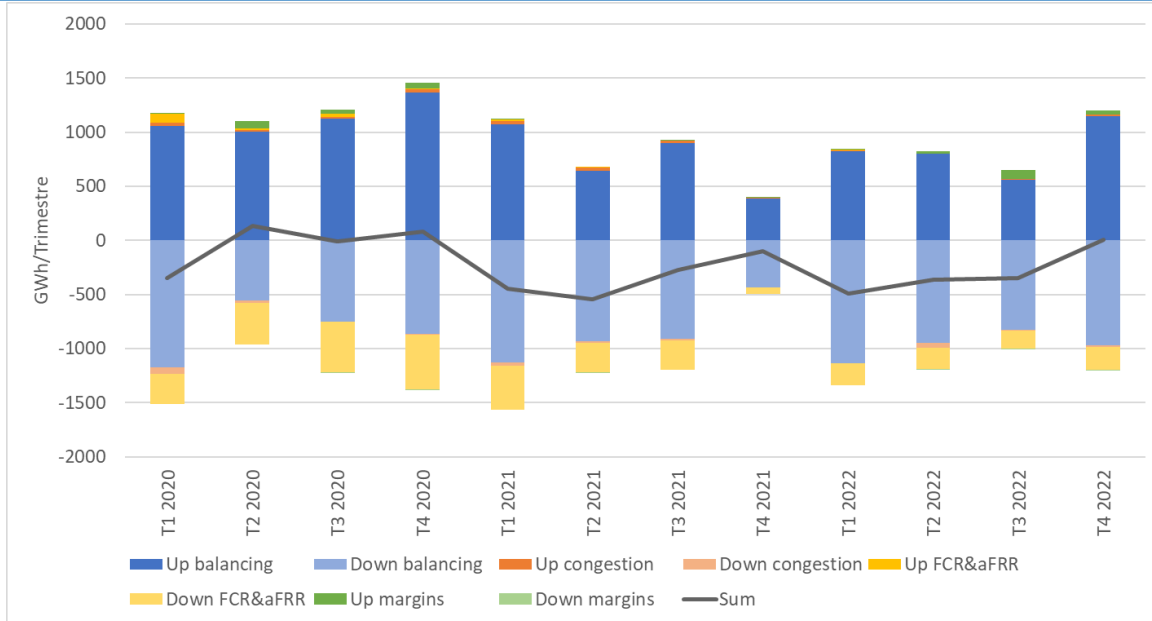
The Figure 63 presents average volumes of adjustments by type of entity and by direction of activation.

⁹²The CRE noted that:

- many production facilities, particularly CCGTs, were certified for the aFRR at the minimum level, i.e. their regulatory constructive capacity;
- only five market players, including two belonging to the same group, took part in the tender in November 2021;
- very different prices were offered on many occasions by production facilities that should nevertheless have similar variable costs.

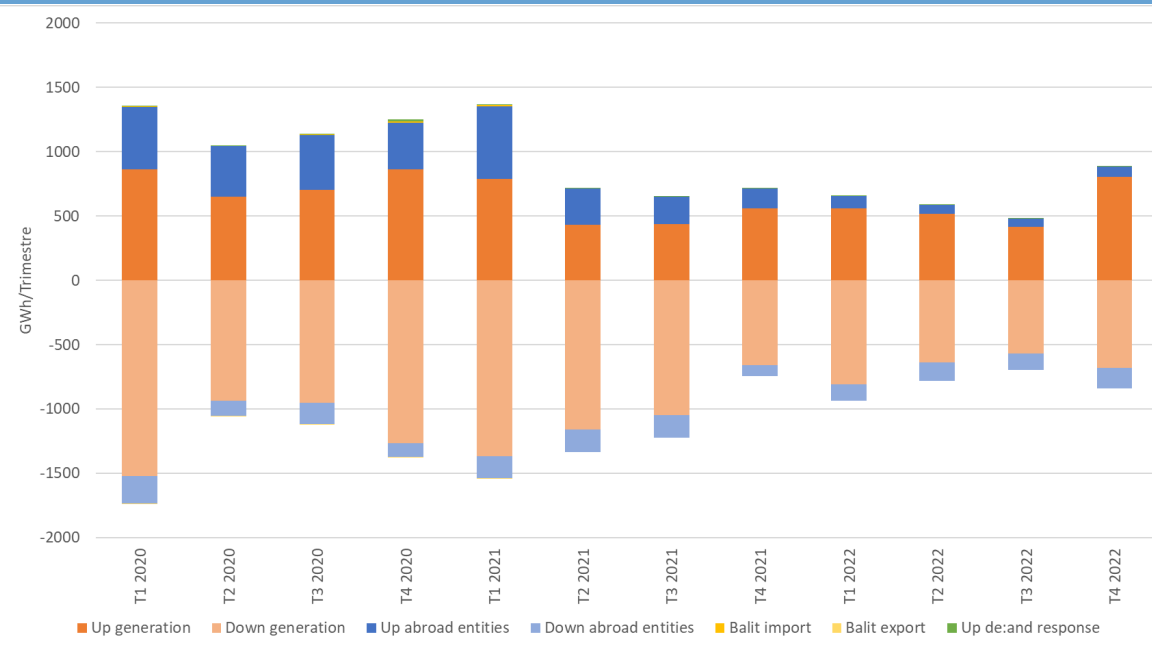
⁹³The CRE Deliberation N° 2022-188 of 30 June 2022 deciding on a derogation under Article 6 of Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market in electricity.

Figure 62 : Monthly activation volumes by reason and net volume



Source: RTE - Analysis :the CRE

Figure 63 : Adjustment volumes by type of entity



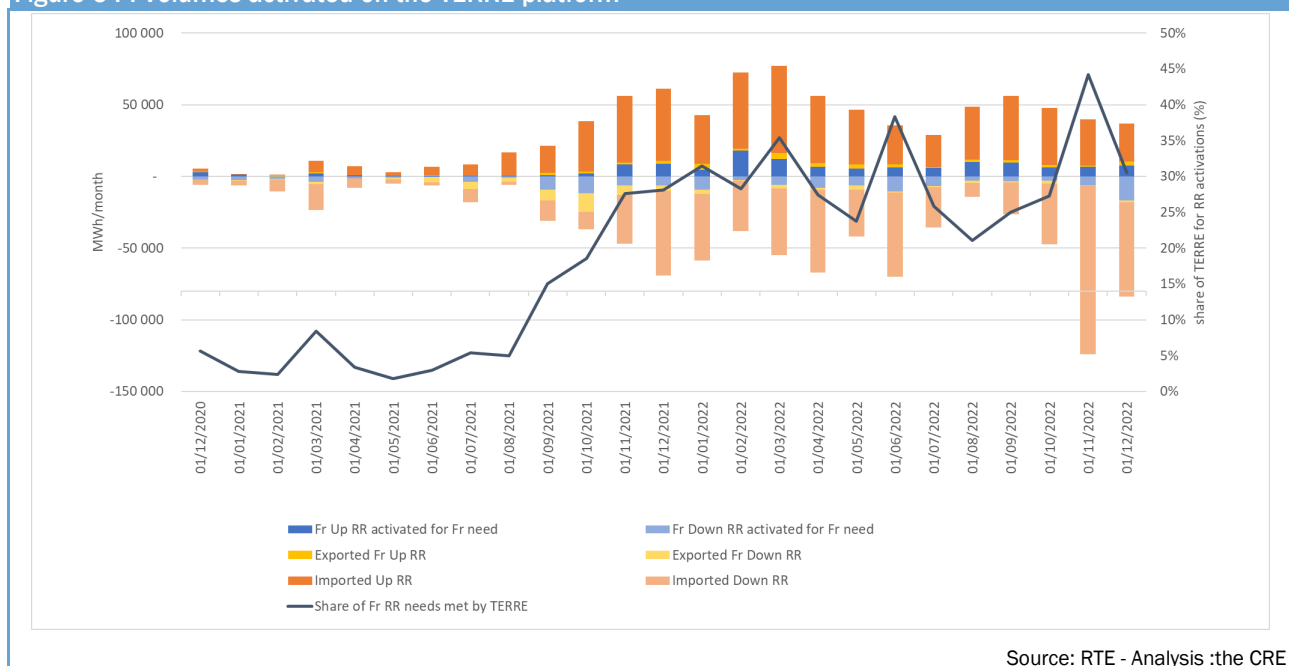
Source: RTE - Analysis :the CRE

There is a large prevalence of injection-type balancing parties (production units), which account for 87.8% of upward activations, and 83.0% of downward activations in 2022. RTE's activations of load shedding are limited, representing 0.6% of the volumes activated by RTE in 2022. Balancing parties located abroad ("exchange points") account for a significant proportion of activations on the balancing mechanism, down compared with 2021 and 2020 (11.6% of activations upwards in 2022, compared with around 35% in 2021 and 2020). This drop in the participation of exchanges can be explained in part using the TERRE platform for entities in countries covered by the platform (Italy, Switzerland, Spain), and by the increase in RTE's balancing needs covered by the platform (see Figure 59).

4.2.5 The TERRE platform

In December 2020, when it was connected, RTE was only connected to the TERRE platform for 4 hours a day. RTE's participation in the TERRE platform has gradually increased to reach use on every time slot since 21 March 2022. The Figure 64 shows the monthly volumes activated by RTE on the TERRE platform.

Figure 64 : Volumes activated on the TERRE platform



RTE has significantly increased its participation in the platform from August 2021. This increase is particularly visible in the volumes activated for RTE's needs. In 2022, RTE activated an average of 30% of its additional reserve requirements on the TERRE platform. Despite the increase in RTE's participation, the liquidity of French offerings on the platform remains low, and most of the French demand is met by foreign offerings, whose prices are currently lower on average than those of the French market players.

4.3 The CRE's monitoring of the balancing markets

Balancing markets represent less important financial stakes than the *spot* and forward energy markets. However, they play a very important role in the smooth running of the electricity system and are evolving rapidly.

The CRE therefore regularly analyses the operation of RTE's balancing mechanism. In this regard, the CRE once again reminds market participants who operate balancing parties such as exchange points on the Franco-Swiss or Franco-German borders that it is forbidden to obtain supplies on the French intraday market in order to respond to a request from RTE for the balancing mechanism. This behaviour is explicitly contrary to the RE-MA rules (Article 4.2.1.2):

"The activation of an offer from a balancing party exchange point must not lead to a supply (for upward offers) or a sale (for downward offers) by the balancing market player on the French intraday market, whether through an explicit flow or an implicit nomination. "

Finally, the CRE reminds market participants that balancing markets are considered to be wholesale energy product trading markets. Market players' actions on these markets are therefore subject to the duties and prohibitions defined in the REMIT regulations. In particular, ACER has communicated⁹⁴ examples of practices that may, under certain circumstances, be considered abusive within the meaning of REMIT.

⁹⁴ACER reported on these practices in issue 24 of the ACER newsletter REMIT Quarterly Q1 2021: https://documents.acer-remit.eu/wp-content/uploads/REMITQuarterly_Q1_2021_1.0.pdf

5. THE CAPACITY MARKET

In its decision of 8 November 2016, following a year-long investigation, the European Commission authorised the French capacity mechanism under EU state aid rules⁹⁵. The practical implementation of the mechanism began in December 2016 for a first year of delivery (AL) in 2017.

5.1 Reminder of the key principles of the French capacity mechanism

The provisions of articles L. 335-1 and the followings of the French Energy Code establish a system of capacity duties. This stipulates that "each electricity supplier contributes, according to the consumption characteristics of its customers in terms of power and energy, on the continental metropolitan territory, to the security of electricity supply". Each supplier is thus required to obtain capacity guarantees to cover the consumption of its customer portfolio during periods of peak national consumption. These guarantees can be obtained by investing in new production or curtailment facilities, or by obtaining them from capacity operators and on the market. The cost of this duty, introduced to ensure security of supply for consumers, is passed on by suppliers to their customers.

The required parties and operators can exchange capacity guarantees bilaterally, on the over-the-counter market (OTC) or via the market organised by EPEX SPOT in the form of an auction. In continuous operation, there are 15 of these auctions ahead of a given delivery year.

The formation of the price of capacity guarantees results from the market meeting of the supply of operators, who commit to the availability of their resources, and the demand of the obliged parties, corresponding to the contribution of their consumers to the risk of system failure.

In theory, the price of capacity should be set at the cost of the cheapest means of meeting the security of supply criterion. The rules defining the mechanism's ceiling price are in line with the tension that should arise if the generating plants fleet is undersized: "[The price cap] corresponds to the minimum annual capacity revenue needed to ensure the economic viability of developing or maintaining the capacity required to meet the security of supply criteria defined by the public authorities over the medium-term horizon covered by the Generation Adequacy Report."

5.2 The price of capacity for the 2023 delivery year reflected the risk of failure due to the fall in nuclear availability

The year 2022 is essentially marked by auctions for the 2023 and 2024 delivery years.

Table 13 : Fixing prices and volumes traded for auctions for the 2023 delivery year

Auction	24/03/2022	28/04/2022	23/06/2022	08/09/2022	13/10/2022	08/12/2022
Price (€/MW)	€42,397/M W	€42,487/M W	€41,950/M W	€41,899/M W	€45,000/M W	€60,000/M W
Volume (GW)	4.7 GW	4.9 GW	4.85 GW	4.42 GW	5.65 GW	11.6 GW

Source: EPEX SPOT

Table 14 : Fixing prices and traded volumes for auctions for the 2024 delivery year

Auction	28/04/2022	23/06/2022	13/10/2022	08/12/2022
Price (€/MW)	€20,000/MW	€20,010/MW	€34,091/MW	€23,057/MW
Volume (GW)	4.6 GW	4.5 GW	4 GW	4.8 GW

Source: EPEX SPOT

The average price of capacity for the 2023 delivery year, used as the reference price for additional capacity in the regulated electricity tariffs, is €45,622 /MW, compared with €26,250 /MW for the 2022 delivery year.

The price of the last auction for the 2023 delivery year, which is used to set the price for the settlement of capacity imbalance(PREC) and also the cost of the additional supply of capacity to the market following the capping of

⁹⁵The operating principles of this market were reiterated in the monitoring report on the operation of wholesale markets 2016-2017 (Section 3 page 45 : 2.5 First exchanges of capacity guarantees in 2016).

ARENH, is €60,000/MW, i.e., the administered price ceiling⁹⁶ (€23,899.9/MW in 2021 for the 2022 delivery year). During this last auction, the balance between supply and demand was not achieved, and a volume of 450 MW of capacity demand could not be delivered.

The balance of the capacity market for the 2023 delivery year has been strongly affected by the 5.5 GW drop in the volume of capacity certified by EDF for its nuclear fleet, because of the low availability forecast for the winter of 2022-2023.

At the same time, rising electricity prices have boosted the profitability of fossil-fired production. Using the methodology detailed in the 2019 and 2018 wholesale market monitoring reports, the CRE notes that the *missing money*⁹⁷ for all thermal technologies for 2023 is zero, and in particular coal and oil-fired turbines. However, the disappearance of the *missing money* of the thermal means did not allow to lower the price of the capacity because the system was not balanced.

The level of capacity certification (Table 15) compared with the estimated capacity obligation (Table 16) shows the supply-demand imbalance that has emerged on the capacity market for 2023 delivery year.

Table 15 : Level of capacity certification for 2022 and 2023 delivery years

Sector	December 2021 (2022 delivery year) (GW)	December 2022 (2023 delivery year) (GW)	Growth (GW)
Nuclear	45.4	39.9	-5.5
Lac/STEP	9.9	10.4	+0.5
ENR + other <i>of which batteries</i>	15.4 0.2	15.8 0.4	+0.4 +0.2
Load shedding	3.5	3.1	-0.4
Gas	6.8	7.2	+0.4
Coal	1.6	1.6	
Oil	1.9	1.9	
Total - excluding inter-connections	84.7	80.3	-4.2
Interconnection	7.6	8.4	0.8
Total - with interconnections	92.2	88.7	-3.4

Source: RTE register

Table 16 : Estimated capacity obligation updated by RTE in December 2021 (in GW)

Estimated obligation updated by RTE in December 2021	Estimated obligation for the 2022 delivery year (GW)	Estimated obligation for the 2023 delivery year (GW)	Growth (GW)
Low forecast	90.6	90.4	+0.2
Middle forecast	91.7	91.8	+0.1
High forecast	93	93.4	+0.4

Source: RTE

In view of the fall in consumption observed in the winter of 2022-2023, the capacity market is likely to be "long" after the event. The price of capacity for the 2023 delivery year should accordingly fall during the rebalancing auctions.

Looking ahead to 2024, the system appears to be less strained thanks to higher nuclear certification (42.9 GW as at December 2022 for the 2024 delivery year compared with 39.9 GW for the 2023 delivery year at the same date)

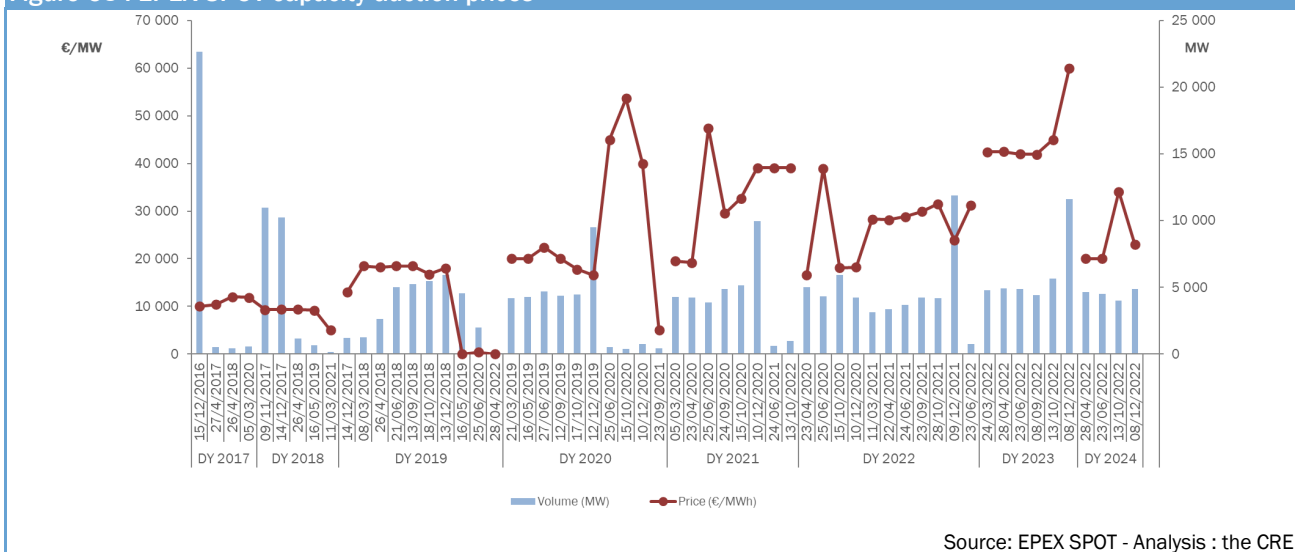
⁹⁶In order to send out a signal for the development of new capacity and to encourage lower consumption, the mechanism provides that the price of capacity gaps may rise to the administered price (€60,000/MW) in the event of a shortage of capacity in France.

⁹⁷For a given capacity, the revenue required to maintain it in operation (if it is existing) or to build it (for new capacity) but which is not provided by the energy market.



and the continued high anticipated profitability of thermal resources. The prices observed during the first auctions for the 2024 delivery year were between €20,000 and €35,000/MW.

Figure 65 : EPEX SPOT capacity auction prices



6. SUM UP OF WHOLESALE ELECTRICITY MARKETS FUNCTIONING IN FRANCE IN 2022

The year 2022 saw a continuation of the exceptional crisis that began in 2021 on the European electricity market, and on the French market in particular. This supply crisis, reflected in extremely high prices, is due to two separate underlying crises: the crisis in European gas supplies, and the crisis in the availability of French nuclear power plants following the discovery of the "stress corrosion" phenomenon affecting part of the nuclear fleet. As a result, the French electricity system was, exceptionally, a net importer over the whole of 2022, by a total of 16 TWh.

The mild winter, the fall in consumption due to energy-saving measures and the reaction of industrial consumers to high prices, as well as the return to operation of part of the nuclear fleet, meant that the electricity system did not experience any effective shortages (i.e. load shedding) during the winter of 2022-2023, despite the risks identified during the year.

In 2022, nuclear production reached a historic minimum since the end of construction of the nuclear fleet, at 279 TWh, i.e., 82 TWh less than in 2021 and 56 TWh less than in 2020, a year marked by exceptional disruptions due to the health crisis. Apart from imports, this fall in production was mainly offset by the rise in gas-fired production, as hydroelectricity was penalised by unfavourable weather conditions. Renewable energy production excluding hydro increases by 5% in 2022, despite a 13% increase in installed capacity, due to less favourable wind conditions. Coal-fired production is declining and remains marginal.

High gas prices have automatically led to a rise in electricity prices in Europe, as gas-fired production is needed to balance supply and demand. However, fears about security of supply in France for the winter of 2022-2023, mainly linked to the availability of nuclear power, have pushed up electricity prices sharply in relation to fuel costs.

The exceptionally high forward prices for the winter of 2022-2023 in France can be explained by the fact that market participants were prepared to pay high risk-premia to avoid being exposed to further price rises, in the context of uncertainty about the availability of nuclear power over the winter. In addition, the CRE's survey of market players in the summer of 2022 showed that only few market players were prepared to take the risk of selling forward electricity in France for the winter of 2022-2023 without physical hedging.

Forward prices have an influence on short-term prices, through the means of production with limited energy stock (mainly hydro), offered on the market taking into account the opportunity cost of no longer having this production available for the most expensive future periods. As a result, hydro production was very low during the summer of 2022, in order to preserve stocks for the winter of 2022-2023.

Spot prices were driven up during 2022 by the combined effect of gas prices and forward electricity prices for the winter of 2022-2023, averaging €276/MWh over the year. They reached their peak in the summer of 2022, a period during which low French production resulted in recourse to imports. In the end, spot electricity prices were higher in France than in Germany, while gas prices were lower overall.

In addition, the beginning of April 2022 was marked by exceptionally cold weather for the period, leading to a rise in consumption and great tension on the electricity system: exceptional price peaks were reached, up to



€2,990/MWh on 4 April 2022, leading to the automatic raising of the price ceiling on the European market coupling from €3,000/MWh to €4,000/MWh.

Based on the information available, within the scope of its investigation powers and at this stage of its analyses of trends in wholesale electricity prices, the CRE is not aware of any behaviour likely to be qualified as market abuse under REMIT for 2022 and is continuing its monitoring.

Regarding balancing markets, the implementation of the TERRE platform was completed in March 2022 with the beginning of RTE's ongoing participation. The other existing market mechanisms continued to play a satisfactory role, with no major impact on price levels. The rapid changes and complexity of these markets mean that the CRE must continue to monitor them closely.

Finally, the capacity mechanism auctions revealed the great tension anticipated on the supply-demand balance, with the ceiling price of €60,000/kW being reached in December 2022 for the first time, during the last auction for the 2023 delivery year.

KEY FIGURES

1. GAS MARKET

Table 17 : Fundamentals of the French gas market

Market fundamentals	Yearly values			Yearly variation 2022/2021	
	2020	2021	2022	In percentage	In value
Entry and exit flows					
Supply (TWh)	682	685	731	7%	46
Storages withdrawals	153	155	107	-31%	-48
Imports	529	526	617	17%	91
<i>Pipeline</i>	350	361	320	-11%	-41
<i>LNG</i>	179	164	297	81%	133
Production	2	4	7	63%	3
Demand (TWh)	682	685	731	7%	46
Storages injections	131	137	145	6%	8
End consumers demand	444	474	431	-9%	-43
<i>Distribution consumers</i>	269	303	253	-17%	-50
<i>Consumers connected to the transmission system</i>	176	171	178	4%	7
Exports	106	72	154	114%	82
Other	1	2	2	-18%	0
Deliveries at PEG (TWh)	864	854	931	9%	77

Sources: GRTgaz, Teréga - Analysis : the CRE

Table 18 : Gas prices in France

Price	Yearly values			Yearly variation 2022/2021	
	2020	2021	2022	In percentage	In value
Spot prices (€/MWh)					
PEG day-ahead (avg.)	9,3	46,5	98,1	111%	51,6
Day-ahead PEG Nord/TTF Spread (avg.)	-0,1	-0,2	22,3	-13806%	22,5
Forward prices (€/MWh)					
PEG M+1 (avg.)	9,4	47,4	112,8	138%	65,4
PEG Y+1 (avg.)	13,4	33,7	107,3	218%	73,6
M+1 PEG/TTF spread (avg.)	-0,04	0,18	6,86	3748%	6,7
Summer-ahead/Winter-ahead spread (avg.)	4,2	0,9	6,9	670%	6,0

Sources: EEX, ICIS - Analysis : the CRE

Table 19 : Gas trading in France

Trading activity	Yearly values			Yearly variation 2022/2021	
	2020	2021	2022	In percentage	In value
Natural gas exchanged at PEG* (TWh)	662	674	1302	93%	629
% of national consumption	149%	142%	302%		160%
Trading volumes in the French intermediated markets					
Spot market (TWh)	193	206	328	59%	122
Intraday	35	40	52	32%	13
Day Ahead	91	111	163	47%	52
Exchange (DA, WD, WE, other spot)	161	199	287	44%	88
Brokers (DA, WD, WE, other spot)	32	7	41	465%	33
Forwards market (TWh)	470	468	975	108%	507
M+1	106	103	206	100%	103
Q+1	36	46	107	130%	60
S+1	67	72	149	107%	77
Y+1	25	6	6	-3%	0
Exchange (all maturities)	21	35	63	78%	27
Brokers (all maturities)	449	432	912	111%	480
Number of transactions in the French intermediated markets					
Spot market	132 050	157 874	244 163	55%	86 289
Intraday	33 042	38 901	47 584	22%	8 683
Day Ahead	78 792	98 887	133 495	35%	34 608
Exchange (DA, WD, WE, other spot)	128 163	154 981	234 352	51%	79 371
Brokers (DA, WD, WE, other spot)	3 887	2 893	9 811	239%	6 918
Forwards market	5 093	5 663	15 354	171%	9 691
M+1	2 255	2 396	6 279	162%	3 883
Q+1	337	377	1 110	194%	733
S+1	311	288	819	184%	531
Y+1	203	55	69	25%	14
Exchange (all forward maturities)	1 169	1 586	5 635	255%	4 049
Brokers (all forward maturities)	3 924	4 077	9 720	138%	5 643

* Deliveries resulting from trading on intermediated markets in France

Sources: EEX, brokers - Analysis : the CRE

Table 20 : French gas market participants

Market participants on French gas markets	Yearly variation 2022/2021				
	2020	2021	2022	In percentage	In value
Number of active shippers by type of point					
PEG	115	114	117	3%	3
PIR	53	62	68	10%	6
PITD	44	43	45	5%	2
PITS	47	53	56	6%	3
Number of companies importing LNG					
Montoir	8	11	8	-27%	-3
Fos Tonkin	1	2	2	0%	0
Fos Cavaou	5	4	11	175%	7
Dunkerque	2	2	5	150%	3

Sources: GRTgaz, Teréga - Analysis : the CRE

2. ELECTRICITY MARKET

Table 21 : Installed production capacity in France

	Yearly values			Yearly variation 2022 / 2021	
	2020	2021	2021	In percent	In value
Installed capacity (GW)	136,2	139,1	143,7	3,3%	4,6
Nuclear	61,4	61,4	61,4	0%	0
Hydro	25,7	25,7	25,7	0%	0
Fossil-fuel	18,9	18,0	17,5	-3%	-0,47
Coal	3,0	1,8	1,8	0%	0,00
Oil	3,4	3,4	3,1	-10%	-0,32
Gas	12,6	12,8	12,6	-1%	-0,15
RES (excluding hydro)	30,2	34,1	39,1	15%	5,06
On-shore Wind	17,6	18,8	21,2	13%	2,37
Solar	10,4	13,1	15,8	21%	2,69
Biomass	2,2	2,2	2,2	0%	0,00

Source: RTE

Table 22 : Production of different technological sectors in France

	Yearly values			Yearly variation 2022 / 2021	
	2020	2021	2022	In percent	In value
Generation (TWh)	546,6	535,4	497,5	-7,1%	-37,8
Nuclear	393,0	379,2	335,2	-12%	-44
Hydro	67,4	59,5	64,4	8%	4,9
Fossil-fuel	38,0	41,1	36,6	-11%	-4,4
Coal	5,7	1,6	1,4	-13%	-0,2
Oil	2,1	2,4	1,7	-31%	-0,7
Gas	30,2	37,1	33,6	-9%	-3,5
RES (excluding hydro)	48,3	55,6	61,3	10%	5,7
On-shore Wind	28,1	33,8	39,2	16%	5,4
Solar	10,6	12,1	12,6	5%	0,5
Biomass	9,5	9,7	9,4	-3%	-0,3
Consumption including network losses (TWh)	446	472	453	-4%	-19,0

Source: RTE

Table 23 : Imports and exports in France

	Yearly values			Yearly variation 2022 / 2021	
	2020	2021	2022	In percent	In value
Import (TWh)	34,6	43,8	72,9	66,3%	29,1
Import Peak (TWh)	13,2	16,3	26,2	60,7%	9,9
Import Offpeak (TWh)	21,3	27,5	46,7	69,7%	19,2
Export (TWh)	77,8	87,0	56,4	-35,2%	-30,6
Export Peak (TWh)	27,2	30,3	18,4	-39,2%	-11,9
Export Offpeak (TWh)	50,6	56,6	37,9	-33,0%	-18,7
Export balance (TWh)	43,2	43,1	-16,5	-138,3%	-59,7

Source: RTE

Table 24 : Balance at the borders

	Yearly values			Yearly variation 2022 / 2021	
	2020	2021	2022	In percent	In value
Balance at border (TWh)					
CWE	0,6	-10,1	-27,4	172%	-17,4
Italy	15,4	17,6	17,9	2%	0,3
Spain	5,2	6,1	-9,1	-251%	-15,2
Switzerland	13,2	15,6	12,1	-23%	-3,5
Great Britain	8,8	13,9	-9,9	-171%	-23,9
Total (TWh)	43,2	43,1	-16,5	-138,3%	-59,7

Source: RTE

Table 25 : Clean dark and spark spread and coal

	Yearly values			Yearly variation 2022 / 2021	
	2020	2021	2022	In percent	In value
Contract (Y+1)					
Coal (€/t)	50,8	80,4	209,0	160%	128,6
Clean dark spread peak (€/MWh)	16,3	37,8	446,0	1081%	408,2
Clean spark spread peak (€/MWh)	18,9	28,9	344,0	1092%	315,1

Sources: ICE, EPEX SPOT, EEX

Table 26 : Injection - Withdrawals balances for the French electricity system

	Yearly values			Yearly variation 2022 / 2021	
	2020	2021	2022	In percent	In value
Physical injections into grids (TWh)	530	560	510	-8,9%	-49,9
Generation Excluding ARENH	369,0	388,4	309,4	-20%	-79,0
ARENH generation	126,1	127,9	127,9	0%	0,0
Commercial Imports	34,6	43,8	72,9	66%	29,1
Physical withdrawals from grids (TWh)	530	560	510	-8,9%	-49,9
End-user consumption	409,2	430,1	411,0	-4%	-19,1
Water pumping	6,3	6,0	7,4	23%	1,4
Commercial Exports	77,8	87,0	56,4	-35%	-30,6
Grid losses purchased on markets	36,4	37,1	35,5	-4%	-1,6

Source: RTE

Table 27 : French electricity market participants

	Yearly values			Yearly variation 2022 / 2021	
	2020	2021	2022	In percent	In value
Balance responsible party	189	203	219	8%	16,0
Active electricity producers	16	38	37	-3%	-1
ARENH receiving party	21	26	27	4%	1
Customers suppliers	27	41	41	0%	0
Import/export operators	42	64	75	17%	11
Block trading operators	79	110	98	-11%	-12
Active on the spot exchange	72	106	112	6%	6

Sources: RTE, EPEX SPOT, Brokers

Table 28 : Spot and forward prices on the French electricity market

	Annual values			Annual variation 2022/2021	
	2020	2021	2022	Percentage	Value
Spot market prices					
Intraday price France €/MWh	32,9	109,5	276,4	152%	166,9
Baseload day-ahead price France €/MWh	32,2	109,2	275,9	153%	166,7
Peakload day-ahead price France €/MWh	35,0	116,6	289,3	148%	172,7
Baseload day-ahead France-Germany spread €/MWh	1,7	12,3	40,4	228%	28,1
Peakload day-ahead France-Germany spread €/MWh	2,3	11,5	49,8	333%	38,3
Day-Ahead France-Germany convergence rate %	46%	49%	34%	-31%	-0,2
Forward market prices (Heren)					
M+1 price France €/MWh	36,4	132,7	394,9	198%	262,2
M+1 France-Germany spread €/MWh	3,4	23,9	108,4	354%	84,6
Q+1 price France €/MWh	42,0	134,5	541,6	303%	407,1
Q+1 France-Germany spread €/MWh	6,1	23,8	204,7	760%	180,8
Y+1 price France €/MWh	44,9	95,2	367,2	286%	272,1
Y+1 France-Germany spread €/MWh	4,7	6,3	69,4	994%	63,0
Y+1 Peakload/Baseload ratio					
France	1,3	1,3	1,6	27%	0,4
Germany	1,2	1,2	1,3	10%	0,1

Sources: EPEX SPOT, Nord Pool, EEX, ICIS Heren

Table 29 : Spot and forward volumes on the French electricity market

	Annual values			Annual variation 2022/2021	
	2020	2021	2022	Percentage	Value
Intraday market - TWh					
Buy - EPEX Spot	9,9	9,9	12,3	24%	2,4
Sell - EPEX Spot	10,2	9,9	12,6	27%	2,7
Buy - Nordpool	0,0	0,6	0,6	7%	0,0
Sell - Nordpool	0,0	0,7	0,6	-11%	-0,1
SPOT market - TWh					
EPEX Spot	122,0	123,4	115,0	-7%	-8,4
Buy - Nordpool	0,0	5,1	7,3	43%	2,2
Sell - Nordpool	0,0	4,1	4,6	10%	0,4
Forward market					
Volumes TWh	962,6	798,9	574,5	-28%	- 224,4
Market share of OTC financial products	38%	40%	51%	28%	11%
Market share of OTC physical products	43%	39%	30%	-24%	-9%
EEX market share	18%	21%	19%	-9%	-2%
Number of trades	135 657	166 845	154 417	-7%	- 12 428
Y+1 product					
Volumes TWh	235,6	198,2	129,1	-35%	- 69,1
Number of trades	10 198	9 594	7 874	-18%	- 1 720
Q+1 product					
Volumes TWh	127,2	98,3	72,2	-26%	- 26,0
Number of trades	11 710	10 314	11 019	7%	705
M+1 product					
Volumes TWh	141,2	100,2	60,2	-40%	- 40,0
Number of trades	31 175	28 012	32 126	15%	4 114

Sources: EPEX SPOT, Nord Pool, EEX, Brokers

Table 30: Concentration index (HHI) for the various wholesale electricity market segments in France

	HHI - Concentration de marché	
	2021	2022
Livraison		
Forward markets (Physical) - purchases	627	1075
Forward markets (Physical) - sales	715	599
Futures markets (Financial) - purchases	1086	954
Futures markets (Financial) - sales	1118	895
EPEX - purchases	1246	1614
EPEX - sales	2681	2040
Injections		
Generation	6650	5874

Sources: EPEX SPOT, Brokers

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