

SURVEILLANCE

REPORT 2021

The functioning of the
wholesale electricity
and natural gas
markets

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MESSAGE FROM THE PRESIDENT OF THE CRE

This 15th annual report on the monitoring of the wholesale electricity and gas markets by CRE, which covers the year 2021, is unprecedented in many respects. The energy markets in Europe have indeed undergone an unprecedented supply crisis, driving wholesale prices to historic levels.

While it might have been thought that the gas crisis would be limited to the winter of 2021-2022, Russia's war in Ukraine, beginning on 24 February 2022, which tragically continues as this report is published, has further exacerbated the crisis and could lead Europe to lose in its entirety its main gas supplier, Russia.

The energy price crisis that occurred in 2021 and continues is not speculative or financial in nature. It is a supply-side crisis, and primarily a gas supply crisis.

The year 2021 began with tension on the markets, which can be described as "normal" as being the result of fundamentals such as the strong European and global economic recovery and a cold start to spring, which delayed the filling of storage facilities in Europe.

During the summer, the gradual realisation that Gazprom was leaving its large storage capacities in Europe empty, especially in Germany, the Netherlands and Austria, began to create a crisis situation. In Q4, fears about gas supplies to Europe for the winter of 2021-2022 increased. Gas prices in Europe reached unprecedented levels. The massive inflow of LNG in response to the high prices, combined with a mild winter, in the end saw Europe through the winter.

During this period, the French gas system made a positive contribution to European security of supply: French storage facilities were 95% full at the beginning of the winter, the four French LNG terminals operated at full capacity this winter and the flexibility of the gas transmission system enabled flows to be optimised and interconnections to be used to the full.

The unprecedented rise in gas prices has led to a similar rise in electricity prices, as gas plays an essential role in the generation of electricity, particularly during the winter period, in Europe but also in France.

This tense situation was compounded at the end of 2021 by a specifically French power crisis. The availability of the nuclear fleet, which was already low, deteriorated following the discovery of an irregularity in safety systems of a potentially generic nature at the Civaux plant. This announcement put extreme pressure on forward electricity prices for the winter of 2021-2022. While traditionally among the most competitive, wholesale electricity prices in France are now the highest in Europe.

In April 2022, ACER submitted its report on the functioning of the European wholesale electricity market to the European Commission. CRE agrees with the main conclusions: the European internal market allows for short-term optimisation of the European electricity system, and it is irreplaceable for achieving the European Union's climate objectives in an efficient manner. However, two problems have not been resolved: this market does not currently provide sufficient long-term visibility and the question of consumer protection against periods of high prices remains.

In the immediate future, the current highly volatile situation calls for two types of measures.

On the one hand, the European Union must prepare for an interruption in Russian gas supplies, with exceptional measures such as a cap on wholesale gas prices and temporary public guarantees to avoid cascading failures of players in the wholesale electricity or gas market.

On the other, while it is perfectly legitimate for governments to protect consumers from the consequences of soaring wholesale prices, such measures do not encourage efforts to control consumption, which is essential to deal with the physical supply-side crisis reflected in wholesale prices. It is therefore very important, particularly in France, where the so-called "tariff shield" system is highly protective, to encourage consumers who are able to do so to reduce their consumption, whether through communication campaigns or support for consumption management or load shedding measures.

This major effort to reduce gas and electricity consumption, which must begin as soon as possible, is essential to face the winter of 2022-2023 confidently. It is also fully in line with France's long-term strategy to achieve carbon neutrality.

Finally, in this period of high prices and high volatility, the CRE's market monitoring mission is particularly important. In this regard, it is gratifying that the first sanction decisions for breaches of the REMIT Regulation, taken in 2018 and 2019 by CRE's Committee for the Settlement of Disputes and Sanctions (CoRDIS), were confirmed by the Council of State in June 2021 and February 2022.

Jean-François CARENCO,
President of the CRE

SUMMARY

The year 2021 has seen an unprecedented increase in prices in the wholesale electricity and gas markets

The COVID-19 pandemic health crisis had heavily impacted 2020, with some of the lowest wholesale electricity and gas prices on record. The situation was completely reversed in 2021, which saw the beginning of an energy price increase unprecedented in recent decades. Globally, the economic recovery from the pandemic has contributed to a sharp rise in commodity prices. In Europe, the wholesale gas market has undergone a major supply-side crisis since the second half of 2021 (and will continue to do so in 2022), mainly due to uncertainties regarding supplies from Russia and Gazprom not filling up its storage facilities in Europe. This tension has been reflected in wholesale electricity prices, due to the major role of gas in electricity production, particularly during the winter period. At the end of the year, the significant drop in the availability of nuclear power contributed to the increase in wholesale electricity prices in France, which are now significantly higher than in neighbouring countries.

In this exceptional context, the wholesale gas and electricity markets played their role by reflecting the imbalance between energy supply and demand through high prices.

However, wholesale gas prices have been particularly volatile and reactive to unpredictable and in particular politically driven announcements on gas supply from Russia. Such a situation is, by its nature, conducive to market manipulation and insider trading on the European market as a whole, not only in France.

Under these circumstances, CRE is not in a position, in contrast to previous years, to ensure with a reasonable degree of confidence that the wholesale gas market functioned satisfactorily in 2021.

The wholesale electricity market reflected in the normal way changes in the supply-demand balance and security of supply concerns for the winter of 2021-2022. However, its close links with the European gas market make it dependent on any malfunctions in the latter.

The CRE has strengthened its monitoring of the wholesale markets, in conjunction with ACER and the other European regulators

In this highly disrupted context, the CRE's monitoring of the wholesale markets is of particular importance. On the gas market, the CRE focused its efforts to monitor transactions during the periods when gas prices were most sensitive to announcements, often of a political and non-commercial nature, about European supplies. On the electricity market, the CRE particularly monitored the quality of publications about the state of the electricity generation fleet, given their major impact on prices.

The scope monitored by the CRE, within the context of the REMIT Regulation, represented more than 5.2 million transactions carried out in 2021 on the wholesale energy markets, for more than 1399 TWh exchanged or 111 billion euros in value. About 40 monitoring cases are currently being analysed in depth.

At the end of 2021, five investigations were underway by the CRE and one investigation was referred to the CoRDIS by the Chairman of the CRE in 2021.

The CRE relies on internal detection tools to identify possible cases of market abuse, but also on the notices of suspicions received by various sources, and in particular by the persons organising transactions on a professional basis (PPAT) who, as organisers of trading operations on their platforms, represent a valuable source of information. Under Article 15 of the REMIT Regulation, PPATs are required to notify the national regulatory authority immediately if they have reason to suspect a breach of Articles 3 or 5 of the REMIT Regulation. The CRE considers the monitoring activities carried out by the PPATs to be indispensable and maintains active collaboration with them; 12 notifications of suspicious transactions were thus received by the CRE in 2021.

Against the backdrop of an unprecedented price increase since the creation of the internal energy market, in 2021 the CRE stepped up its controls on the wholesale markets under Articles 3, 4 and 5 of the REMIT Regulation (prohibition of insider trading and market manipulation and obligation to publish privileged information). In particular, it focused on verifying the consistency between electricity prices and fundamentals, including commodity prices and CO₂ quotas and the availability of the nuclear generation fleet.

The CRE is particularly attentive to the quality of publications relating to the unavailability of the electricity generation fleet. In this context, it monitors in particular the publication of privileged information by market players. In addition, in 2021, it published a guideline for the publication of unavailability of electricity generation facilities in France, based on a study aimed at quantifying the average sensitivity of market prices to publications of unavailability of generation facilities in France.

The CRE attaches major importance to European work and projects for the establishment of common rules and practices for the monitoring of energy markets within the European Union. Thus, the CRE actively participates in the European working groups and forums relating to REMIT in close collaboration with ACER, as well as with the energy regulators of the other EU Member States and the financial and competition authorities. ACER published, as early as October 2021, its first analysis on the increase in wholesale electricity prices and was subsequently mandated by the European Commission to conduct an in-depth analysis. In cooperation with the regulators, ACER has also published new guidance on the application of the REMIT Regulation, and in particular the 6th edition of its general guidelines, which thoroughly overhauls the document, 10 years after the publication of the first version, taking into account feedback from regulators and market players.

Finally, the CRE actively contributed in 2021 to ACER's work on improving the quality of data reported by market players to ACER under Article 8 of REMIT and its usage. In the context of this work, ACER updated its guidance on transactional and fundamental data reporting in 2021. In addition, the work conducted in 2021 led to the publication in 2022 of an ACER decision on the reporting of additional data on intraday market coupling, aimed at enabling better monitoring of the intraday electricity market by regulators.

Gas prices, which rose to an all-time high in 2021, were highly volatile and sensitive in the second half of the year to all announcements about supplies to Europe, particularly from Russia

Prices at the PEG had reached particularly low levels in 2020, at 9.3 €/MWh on annual average for the *day-ahead* price with the general decline in raw material prices linked to the COVID-19 health crisis. An overall increase in raw material prices had already begun at the end of 2020 with the economic recovery.

The year 2021 started with weak LNG supplies to Europe. A major cold snap in Asia had tightened the LNG market and led Europe to make intensive use of its storage facilities to meet demand. As a result, the *month-ahead* price on the PEG reached a peak of 21.9 €/MWh on January 12, but remained well below the levels reached in Asia, where LNG was trading at over 85 €/MWh. Throughout the year, storage levels remained low, contributing to a continuous increase in gas prices. Abnormally cold spring temperatures in Europe, supporting consumption, as well as the absence of Gazprom's injections into its own storage facilities, reduced the filling of European storage facilities until winter. The gradual realisation during the summer that Europe's largest supplier, Gazprom, was no longer acting in Europe on a purely commercial basis, greatly amplified the rise in prices, raising fears of supply disruptions for the winter of 2021/2022.

LNG delivery to Asia remained more expensive than delivery to Europe for most of the year to meet Asian demand, but there was increasing competition between Europe and Asia to receive LNG cargoes, contributing to the sustained rise in prices. The global gas supply/demand balance remained very tight, notably due to continued strong Asian demand for LNG, declining Russian gas exports to Europe, incidents on gas infrastructure and increasing demand for gas for thermal power generation to replace coal.

In Q4 of 2021, the low level of European storage facilities led to growing market concern about European supply for the winter of 2021-2022. Unlike other European countries, French storage facilities were not affected by this low filling, thanks to the storage regulation reform carried out in France in 2018. European prices rose sharply, with a first peak at 114 €/MWh for the price *day-ahead* at the PEG on October 5. The quarter was marked by very high volatility, and great sensitivity to all political announcements relating to gas supply, particularly from Russia. The progress of the procedure for commissioning the Nord Stream 2 pipeline (suspended on November 16 by the German regulator Bundesnetzagentur) and successive announcements by the Russian government on gas exports to Europe gave rise to very significant price movements.

Against this backdrop of fears of shortages for the winter of 2021-2022, gas prices reached record highs in the last months of the year, accompanied by unprecedented volatility, before the arrival of LNG tankers in Europe allowed prices to ease at the end of the year. Thus, the PEG *day-ahead* price peaked at 183 €/MWh on 21 December 2021. France, which has four LNG terminals and a high-capacity gas transmission network, was among the European countries that were able to absorb this inflow of LNG.

The sensitivity of prices to announcements about European supplies is conducive to insider trading and market manipulation. The CRE, in conjunction with the other regulators and ACER, because the gas market is European, has therefore performed particularly close monitoring over these periods.

Electricity prices also rose exceptionally, driven by commodity prices and especially gas prices; French prices were particularly high at the end of the year due to the low availability of nuclear power

Wholesale electricity prices are closely linked to commodity prices, and particularly to gas prices, which play a major role, including in France, in the generation of electricity, particularly in winter. The high sensitivity of wholesale electricity prices to gas prices led, especially in the second half of 2021, to an unprecedented increase in electricity prices from the initial opening of the markets. Thus, day-ahead prices in 2021 averaged 109.2 €/MWh, which is double the average level seen in recent years.

Above all, however, the uncertainty over gas supplies to Europe during the winter of 2021-2022 led to similar uncertainty over electricity supplies. At the end of the year, the extension of scheduled shutdowns of the nuclear fleet and the discovery of defects that could affect a large part of the fleet reinforced these fears and led to a new increase in forward prices, this time specifically in France. Forward prices for the winter of 2021-2022 thus reflected market fears about security of supply, anticipating hours of very high prices or even failure to meet demand. Thus, the price for base load delivery in France in Q1 of 2022 peaked at 772 €/MWh on 21 December 2021. This tension on forward prices was reflected in shorter-term prices, in particular through the prices of generation resources with a limited stock of energy, such as hydroelectric generation.

Nuclear generation, which was severely affected by disruptions to maintenance schedules due to the COVID crisis in 2020, had nevertheless returned to a level within the recent historical average by mid-2021, after a still disrupted start to the year. Thermal generation, which was made profitable at the end of the year by electricity prices rising faster than fuel prices, contributed, together with imports, to making up this production deficit. Renewable generation, at 60 TWh in 2021, was close to that of 2020, despite a significant increase in installed capacity, due to unfavourable weather conditions.

In total, France was a net exporter of electricity in 2021 at 43 TWh (exports of 87 TWh, imports of 44 TWh - this level of imports had never been reached in recent years), with a net import situation in November and December 2021.

This report covers data for the calendar year 2021. Where appropriate, highlights of monitoring activity during the first months of 2022 are also included.

The CRE and REMIT: the monitoring of wholesale markets, a European matter

The Energy Regulatory Commission (CRE) has been responsible for monitoring French wholesale electricity and gas markets since 2006. Each year, it publishes its monitoring report on the operation of the French wholesale electricity and gas markets, as well as its quarterly Wholesale Market Observatory.

Since 28 December 2011, the CRE's mission to monitor the wholesale energy markets is in line with European Regulation no 1227/2011 of the European Parliament and of the Council of 25 October 2011 concerning the integrity and transparency of the wholesale energy market (REMIT).

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

In this respect, 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);
- requiring market participants to publish the privileged information they hold (Article 4).

The CRE is also committed to ensuring that persons organising professional transactions (PPAT)¹ comply with the duties to detect and report suspicions of insider trading or market manipulation under Article 15 of the REMIT Regulation.

Finally, the application of certain Articles of the REMIT Regulation has been extended to the French capacity guarantee market. Under Article L. 131-2 of the Energy Code, the CRE guarantees compliance with the prohibition of insider trading (Article 3), the duty to publish privileged information (Article 4) and the prohibition of market manipulation (Article 5) in the context of the capacity duty mechanism.

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

¹ In English *Persons Professionally Arranging Transactions* or PPAT.

The CRE's activity in 2021 in the context of its monitoring mission



5.2 million monitored transactions

1,399 TWh exchanged

More than **111 Md€** exchanged in value



622 alerts received from ACER since October 2017

Approximately **40 cases** under analysis for monitoring

1,655 players registered with the CRE



5 investigations in progress

3 investigations under review by CoRDIS

Wholesale market in France in 2021

Electricity price



109.2 €/MWh in average spot prices, or + **239%** relative to 2020

94.7 €/MWh in average annual forward prices, or + **111%** relative to 2020

Gas price



46.4 €/MWh in average spot prices, or + **398%** relative to 2020

33.7 €/MWh in average annual forward prices, or + **151%** relative to 2020

SECTION 1
AN UNPRECEDENTED PRICE INCREASE IN WHOLESALE ENERGY
MARKETS IN 2021

1. THE SHARP RISE IN WHOLESALE GAS PRICES AND, TO A LESSER EXTENT, OTHER COMMODITIES IN 2021

After a drop in 2020 mainly due to health measures taken around the world, commodity prices rebounded from the end of 2020, in line with the recovery of the health situation and the associated economic rebound. The global economic recovery continued into 2021, driven in particular by monetary policies, with commodity prices rising across the board throughout the year to levels not seen in recent years in Q4. According to the World Bank, the rebound in global growth in 2021 is estimated at 5.5%.

The recovery in global oil demand supported prices for most of the year, which rose by an average of 41.3% relative to 2020. However, this increase was contained at the end of the year with the announcement by OPEP+ of a production increase of 400,000 barrels/day in January and the emergence of the new Omicron variant at the end of November, leading to a barrel price at 77.8\$ at the end of the year. Continued health restrictions in some countries and restrictions on international flights also weighed on demand throughout the year, but at a much lower level than in 2020.

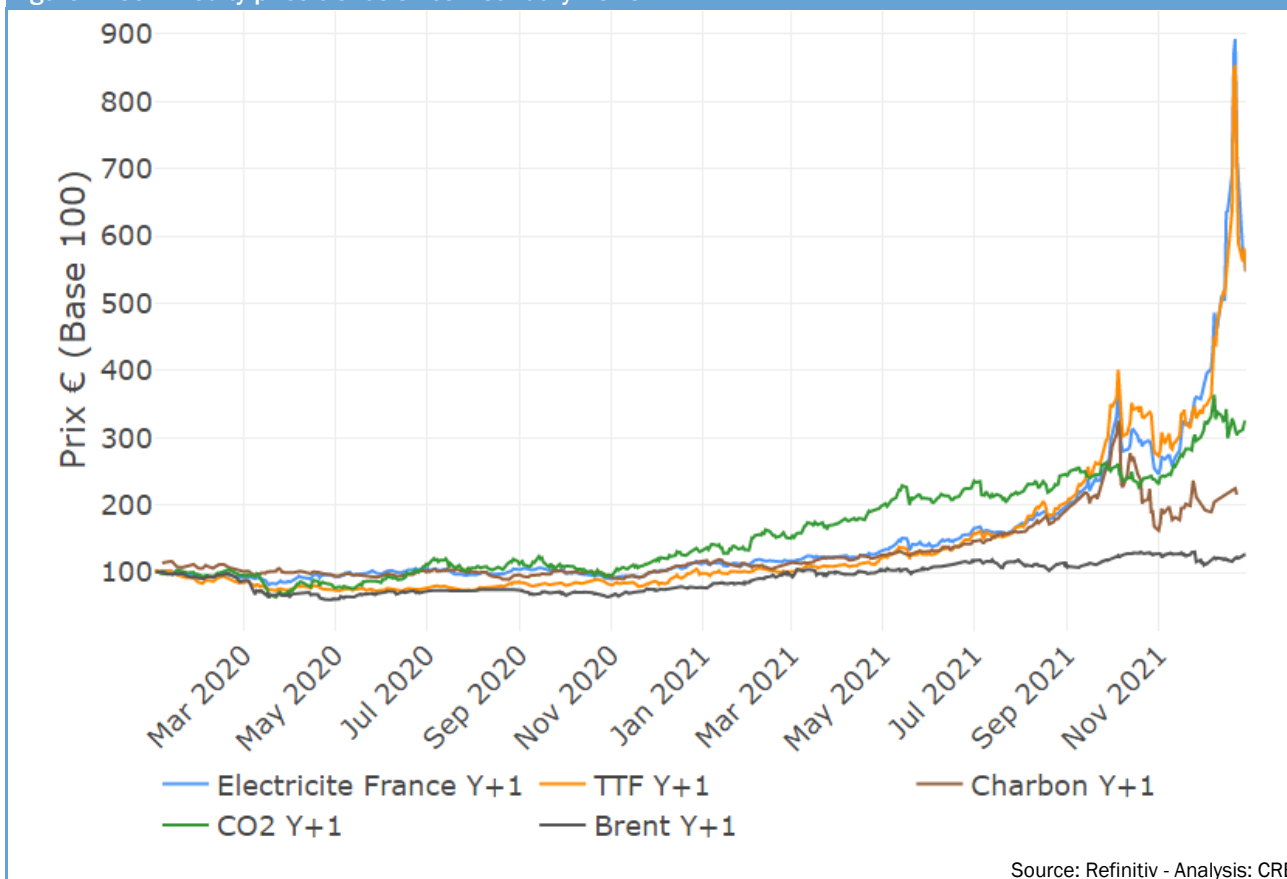
The year 2021 was marked by the strong recovery of economic activity in Asia, whose demand for coal and gas impacted the supply of these commodities in Europe and France. Gas and coal supplies in Asia were severely disrupted in 2021, due to Beijing's unofficial embargo on Australian coal imports decided in October 2020 and the cold snap in the South-East of the continent in January, which led to significant tensions over gas supplies. Following this episode, several Asian countries have set high targets for filling gas storage facilities before the winter of 2021-2022, thus contributing to increasing demand on the continent over the year. Dependent on coal for two-thirds of its electricity, the fuel shortage has been so severe that China has been forced to introduce numerous power cuts over the course of 2021, affecting the country's industrial activity.

The strong Asian demand for LNG at the beginning of the year led Europe to make intensive use of its storage facilities to meet its demand. In the spring, European storage levels remained continuously low, due in particular to abnormally cool spring temperatures in Europe, which contributed to tightening prices. This was compounded by Gazprom's failure to inject into its own storage facilities, which continued throughout the summer. The global balance between gas supply and demand in 2021 remained very tight, notably due to the persistence of Asian demand for LNG, the drop in Russian gas exports to Europe, numerous incidents on gas infrastructures and climatic hazards (droughts) which led to an increase in demand for gas for thermal electricity production.

In the fourth quarter of 2021, growing market pessimism about Russian gas supplies to Europe accelerated the rise and led to very high volatility in gas prices, which reached unprecedented levels. The market was very sensitive to all political announcements related to gas supply. In particular, the progress of the procedure for commissioning the Nord Stream 2 pipeline (suspended on November 16 by the German regulator Bundesnetzagentur) and the Russian government's announcements on the country's gas exports to Europe were closely followed by the markets and led to very significant price movements.

This context, marked by the low filling of European gas storage facilities before the winter and uncertainties about the continuation of Russian gas deliveries, triggered strong fears of gas shortages for the winter of 2021-2022. Gas prices reached record highs in the last months of the year, accompanied by unprecedented volatility, before the arrival of LNG tankers (particularly from the United States) in Europe contributed to an easing in prices.

Figure 1: Commodity price trends since 1 January 2020



2. THE RISE IN GAS PRICES IS HAVING AN IMPACT ON WHOLESALE ELECTRICITY PRICES, WHICH ARE ALSO AFFECTED BY THE LOW AVAILABILITY OF NUCLEAR POWER

The fuel, electricity and CO₂ markets are closely linked, and several factors explain this interaction. In particular, electricity prices are directly affected by the prices of fuels, especially gas, and CO₂ quotas, due to the crucial role of thermal resources to ensure equilibrium between supply and demand, particularly in the winter. The increase in wholesale gas prices in 2021 was therefore largely reflected in wholesale electricity prices, which rose dramatically in 2021. This sharp increase, which affected all of Europe, was accentuated in France in Q4 by low availability of nuclear power generating uncertainty about the security of electricity supply for the winter of 2021-2022.

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. Moreover, 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 possible cost to society.

For this purpose, production is said to be by "economic precedence" (or "*Merit order*"), consisting of stacking the "controllable" means of production in order of increasing variable costs² to adjust production to residual demand, calculated after deducting the so-called "fatal" production of renewable energies (wind, solar, run-of-river, etc.). This principle makes it possible to minimise the variable production costs in the short term. This optimisation is done by each producer within its portfolio of production means.

The European electricity market aims to allow this same minimisation of variable production costs, on the scale of the entire European production park: players with production facilities with lower variable costs can thus operate them instead of more expensive facilities in the production park of other producers.

In an open market, in which participation is free, producers do not sell their output at a price below their variable cost. Each output is therefore offered on the market at least at its variable cost, which depends essentially on the

² The variable cost corresponds to the production cost of the last kWh produced. It represents the share of costs incurred by the actual operation of the means of production (operational costs, fuel costs, start-up costs, CO₂ certificates, waste management costs, etc.).

production chain and fuel prices. Then, the price is fixed for all producers and consumers at the variable cost of the last production means called. This principle, known as marginal price settlement, encourages producers to offer each means of production on the market at a price equal to its variable cost (and not higher), which ensures a real minimisation of production costs.

In an alternative settlement system in which each producer's bid would be paid at its own offer price, producers would have to anticipate the price of the most expensive winning bid and raise their own offer prices to the next lower level, to limit their opportunity loss. Such a "pay-as-bid" settlement method makes it impossible to reduce costs for consumers and is inefficient in terms of the resources required to predict market prices and in terms of the additional production costs associated with de-optimisation of production because bid prices no longer reflect variable costs.

In periods when thermal generation is needed to cover the net demand of the renewable generation, the electricity price is therefore generally set by the variable cost of thermal generation, independently of the average share of thermal generation in the total generation. This explains the strong correlation of the electricity price with fuel prices, when the lower variable cost means are not 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 their variable cost. This profit is intended to cover their fixed costs (which are higher than those of thermal power plants with higher variable costs). Over long periods, we observe that the wholesale price is on average close to the full cost (variable costs and fixed costs) of electricity production.

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

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

Coal is a global market with several world indices that are traded in dollars. Its price is often strongly influenced by Chinese and to a lesser extent Indian demand.

Gas prices in Europe are formed on different marketplaces and depend on consumption, physical flows, delivered LNG volumes, global LNG prices (strongly influenced by Asian demand), storage levels, etc. Before the crisis, a true European gas price index, based on the Dutch TTF market, had been formed for several years, with prices on other European markets, including the PEG in France, evolving with very little deviation from the TTF.

The CO₂ quota market is a regulated market in which supply is managed to meet the demand of obligated buyers, CO₂ emitters. Allowances are purchased to cover emissions from electricity generation and industry. The price of allowances 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 changes in the market. Expectations about the future European energy mix (faster or slower decarbonisation) directly influence the price of CO₂, making coal or gas more attractive for power generation. Thus, when prices of coal, which emits more CO₂, are more advantageous than those of gas for electricity production, this drives up the price of CO₂.

Finally, as explained above, wholesale electricity prices vary according to the variable costs of operating the most expensive power plants needed to meet demand, which are often thermal power plants. Thus, the increase in fuel prices and CO₂ directly affects electricity prices.

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

In 2021, the very significant rise in commodity prices, particularly gas, led to a sharp increase in wholesale electricity prices, of +112.9% relative to 2020, driven by increases in gas prices (150.4%), coal prices (56.5%) and CO₂ (116.4%). Increases in gas, electricity and CO₂ accelerated at the end of the year. Gas prices rose by 164.7% in the last four months of the year, compared with 109.2% in the first eight months. This difference is even more pronounced for electricity (173.9% versus +73.4%). The price of CO₂ also showed almost continuous growth over the year, which accelerated particularly in the last two months of the year (+41.0%). The price of coal, meanwhile, saw its annual peak in early October before seeing a correction after a series of Chinese government measures to support supply.

While the previous phenomenon affected all of Europe, factors specific to the French electricity market exacerbated the rise in prices, foremost among them the availability of the French nuclear park. By mid-2021, the level of availability, which was severely affected in 2020 and early 2021 by maintenance disruptions in the wake of the health crisis, had returned to a normal level. In the fourth half of the year, availability deteriorated again, and uncertainties have arisen about security of supply for the winter of 2021-2022. The availability of the French nuclear park is a factor that very directly affects electricity prices in France, but also to a lesser extent in Europe, due to the important role of interconnections. Lower nuclear production implies greater recourse to thermal generation over a greater number of hours. It can even lead to fears of shortages, when the price can reach very high levels, no longer reflecting production costs but rather the costs of reducing consumption. This last phenomenon is exacerbated by the

high sensitivity of French electricity consumption to temperature due to the high proportion of electric heating in France, which increases the risk of supply-demand balance when the availability of the production facilities is low. Thus, electricity prices reached particularly high levels at the end of 2021, especially with regard to forward prices for Q1 of 2022, whose price was equal to 127 €/MWh on 1 September 2021 and reached 316 €/MWh on 1 December 2021 to peak at 772 €/MWh on 21 December 2021.

In October 2021, ACER published a note³ giving a quantitative presentation of the rise in electricity prices and the link with the rise in gas prices, which is the main cause. This note also presented the medium-term outlook, seen from this date, as well as an overview of measures that could help mitigate the impacts of this increase for vulnerable consumers, or limit the sensitivity of the system to this type of shock, for example through extended gas storage duties or strategic gas reserves.

On 13 October 2021, the European Commission presented a package of support measures to combat rising energy prices⁴. In this context, it entrusted ACER with a mission to evaluate the advantages and disadvantages of the current organisation of the wholesale electricity market, in particular its ability to cope with situations of extreme price volatility on the gas markets and the measures in place to mitigate this volatility, while ensuring the economic efficiency of the energy transition.

ACER published the first part of its evaluation in November 2021⁵. In its report, ACER reiterated the current market principles, and in particular established that the determination of the electricity price on the basis of the marginal price allows the optimisation of the use of the park. ACER's final assessment was published in April 2022⁶.

3. THE EUROPEAN OBJECTIVE OF A 55% REDUCTION IN CO₂ IN 2030, DRIVING THE INCREASE IN THE PRICE OF CO₂ IN 2021

The European Union CO₂ (or *Emissions Trading System* - ETS) aims to facilitate the achievement of politically determined greenhouse gas (GHG) 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, the allowances can then be traded freely by the players on the markets in order to adjust the coverage of their CO₂. The European Union has implemented this system since 2005 to measure, control and reduce the emissions of its industry and electricity producers. The European Union has had this system in place since 2005 to measure, control and reduce emissions from its industry and electricity producers. Its implementation was planned in several phases of increasing duration.

The year 2021 marks the entry into phase 4, which runs until 2030 and is marked by significant ambitions to achieve carbon neutrality by 2050. A new, more ambitious agreement was reached on 11 December 2020, bringing the reduction of emissions from European Union countries to 55% in 2030 compared to 1990 levels (compared to 43% previously). This agreement was adopted in July 2021 in the European climate law.

The entry into Phase 4 already provided for important changes, such as a decrease in the volume of allowances in circulation, the implementation of a dynamic allocation system⁷ the creation of Innovation and Modernisation Funds⁸ and the strengthening of the Market Stability Reserve. In addition, the decrease in the volume of allowances in circulation on the market is accelerating, from a reduction of 1.74% per year (or 38 million tons of allowances per year) to an average of 2.2% (or 48 million allowances).

"Fit for 55", the European Commission's "Climate Action Plan", a package of twelve proposals to help achieve the EU's 2030 climate target, picks up the pace with strong new measures:

- the reduction of GHG emissions from the EU ETS sector increased to -61% in 2030 compared to 2005, i.e. a linear reduction in the number of allowances in circulation in the EU ETS increased to -4.2%/year (instead of 2.2% as initially planned for Phase 4),
- the maritime sector will be included in the EU ETS from 2023,

³ Available on the ACER website: https://extranet.acer.europa.eu/official_documents/acts_of_the_agency/publication/acer's_preliminary_assessment_of_Europe's_high_energy_prices_and_the_current_wholesale_electricity_market_design.pdf

⁴ Communication from the Commission dated 13 October 2021: "Tackling the challenge of rising energy prices: a toolbox of policy instruments and support" (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:660:FIN&qid=1634215984101>)

⁵ Available on the ACER website: https://extranet.acer.europa.eu/official_documents/acts_of_the_agency/publication/acer's_preliminary_assessment_of_Europe's_high_energy_prices_and_the_current_wholesale_electricity_market_design.pdf

⁶ Available on the ACER website: <https://www.acer.europa.eu/events-and-engagement/news/press-release-acer-publishes-its-final-assessment-eu-wholesale>

⁷ Free allowances are adjusted annually based on average activity levels

⁸ The Innovation Fund will support the demonstration of innovative technologies and breakthrough innovations in the industry. The amount of funding available will be equal to the market value of at least 450 million emission allowances.

The Modernisation Fund will support investments in modernizing the power sector and broader energy systems, improving energy efficiency, and facilitating a just transition in carbon-dependent regions in 10 low-income member states.

- the end of free EU ETS allowances will be applied from 2036,
- renewable energies will have to reach a share of 40% in the European mix instead of 32.5%.

While the year 2020 ended with a record increase in the price of CO₂ reaching a peak at 33.4 €/t_{CO2} on 28 December 2020, January 2021 saw a temporary pause in the increase. On the other hand, February and March were marked by spectacular and unprecedented increases in the price, which kept breaking new records. At the end of Q1, the price reached 42.5 €/t_{CO2}, an increase of almost 30% relative to the beginning of 2021 (in 2020 the price increased by almost 37% between the beginning and the end of the year).

During Q2, the price of the CO₂ initially continued to rise in April and early May, as analysts and investors continued to perceive the market as rising, particularly in anticipation of the summer regulatory changes. On 17 May, the price reached a record high of 56.6 €/t_{CO2}. From mid-May, during the month of June and until the end of July, the price paused on a plateau around 52 €/t_{CO2}.

After this period of uncertainty, the price started to rise again during the month of August, supported by the increase in the price of gas since the end of 2020, and on 30 August 2021, the price passed the symbolic mark of 60 €/t_{CO2}. The months of September and October were again marked by a period of relative stability and uncertainty, particularly with regard to possible political interventions to limit the rise.

By the end of 2021, gas and coal price pressures drive the price of CO₂ which reached an exceptional peak of 88.9 €/t_{CO2} on 8 December 2021, before stabilising around 80 €/t_{CO2} by the end of the year.

The increase in the price of CO₂ is initially explained by the market reforms that contributed to the tightening of supply, with a clear upward direction for the coming years. In the second half of the year, tensions on gas and coal led to CO₂ and contributed to the price increase.

The European Securities and Markets Authority, ESMA, published on 18 November 2021 a report on the functioning of the European CO₂ and futures products for CO₂⁹. This report was prepared at the request of the European Commission in its communication of 13 October 2021 on rising energy prices¹⁰. In this preliminary report, ESMA concluded that the allocation of positions in the CO₂ emissions had not changed significantly since 2018 and was generally in line with the expected functioning of this market, in which non-financial players take long positions to hedge their exposure to the price of CO₂ and financial players act as intermediaries to facilitate trading and bring liquidity to the market. ESMA notes that the role of investment funds in the CO₂.

ESMA published its final report on 28 March 2022¹¹, expanding on its previous analysis. It confirms its previously established general findings on the distribution of the players' positions and makes targeted recommendations to improve the transparency and oversight of the European carbon market. Among these recommendations, it recommends that ESMA be given additional powers to monitor this market, giving it access to data on transactions on the primary market. It submits more structural measures for the committee's consideration, weighing their advantages and disadvantages: the introduction of a system of position limits for derivatives of CO₂ quotas and the establishment of centralised monitoring of the carbon market at the EU level, similar to the task given to ACER for the electricity and gas markets.

⁹ Available on the ESMA website: <https://www.esma.europa.eu/press-news/esma-news/esma-publishes-its-preliminary-report-eu-carbon-market>

¹⁰ Communication from the Commission dated 13 October 2021: "Tackling the challenge of rising energy prices: a toolbox of policy instruments and support" (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:660:FIN&qid=1634215984101>)

¹¹ <https://www.esma.europa.eu/press-news/esma-news/esma-publishes-its-final-report-eu-carbon-market>

Figure 2: Evolution of the price of the CO₂ quota

4. 2021, A NORMAL CLIMATIC YEAR, BUT WITH STRONG CONTRASTS

According to the Météo France climate report¹², the year 2021 was, on average, more in line with normal than previous years, which were exceptionally warm. Thus, the average annual temperature over the country was 12.9 °C, which is 0.4 °C above normal and 1.2 °C lower than in 2020 (which is the warmest year in France since 1900). However, the year was very contrasted, alternating between periods of great mildness and periods of fairly marked cold.

In particular, February, June and September were particularly warm and ranked among the 10 warmest months since 1900. The end of December was also very mild.

On the other hand, cold spikes were observed in early January and mid-February and spring was particularly cool, especially in April and May. Thus, May was the second coldest month of May since 2000 (on average more than 1 °C below normal). November was also particularly cold in 2021 with temperatures averaging 0.7 °C below normal. These cold spells have had a significant impact on French electricity consumption, which is particularly sensitive to temperature. In fact, the increase in electricity consumption is estimated to average about 2,400 MW per degree Celsius less in winter.

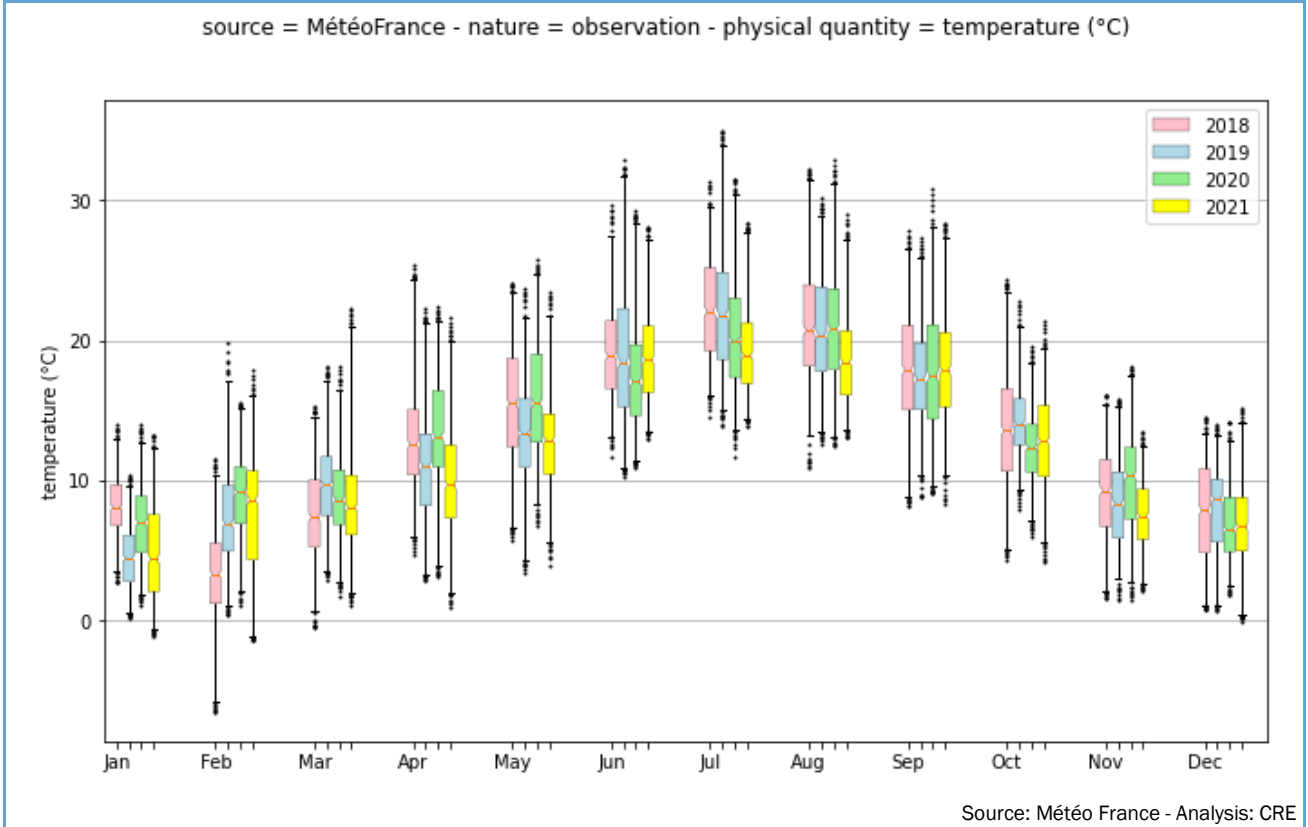
Rainfall was average in 2021, with accumulated precipitation close to normal over much of the territory.

The average sunshine over the territory was also close to normal¹³. On the other, the wind was on average significantly weaker than in a normal year, which led to a lower wind production in 2021 compared to 2020 while the installed capacity increased.

¹² <https://meteofrance.fr/actualite/publications/les-publications-de-meteo-france/2021-les-bilans-climatiques>

¹³ Reference average 1991-2010

Figure 3: Temperature curve in France



SECTION 2

CRE MONITORING OF WHOLESALE MARKETS

1. THE CRE'S MONITORING OF WHOLESALE MARKETS UNDER THE REMIT REGULATION IN 2021

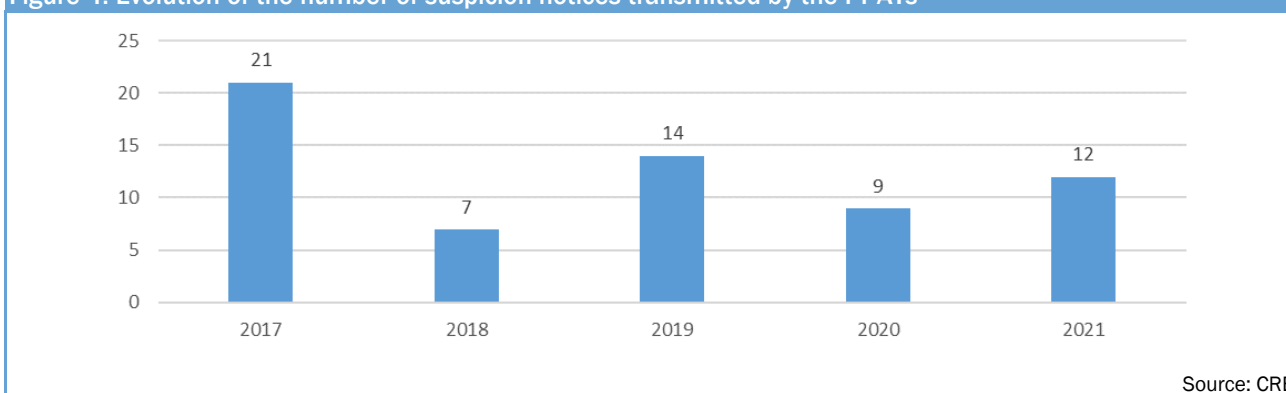
1.1 Statistics by source of detection of potentially suspicious behaviour

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

Internal detection is based on monitoring market conditions, which is particularly important in the exceptional market context of 2021, but also on tools aimed at monitoring market segments to detect specific scenarios and types of behaviour of market players.

External detection is based on suspicious reports received from various sources, including first and foremost the PPATs which, as organisers of trading operations on their platforms¹⁴, are a valuable source of information for the CRE. Figure 4 shows the number of reports of suspected breaches of REMIT notified to the CRE by PPATs in recent years. Under Article 15 of the REMIT Regulation, the PPATs are required to notify the national regulatory authority immediately if they have reason to suspect a breach of Articles 3 or 5 of the REMIT Regulation. Failure to comply with this duty may be sanctioned by the Committee for the Settlement of Disputes and Sanctions (CoRDIS) under Article L. 134-25 of the Energy Code.

Figure 4: Evolution of the number of suspicion notices transmitted by the PPATs

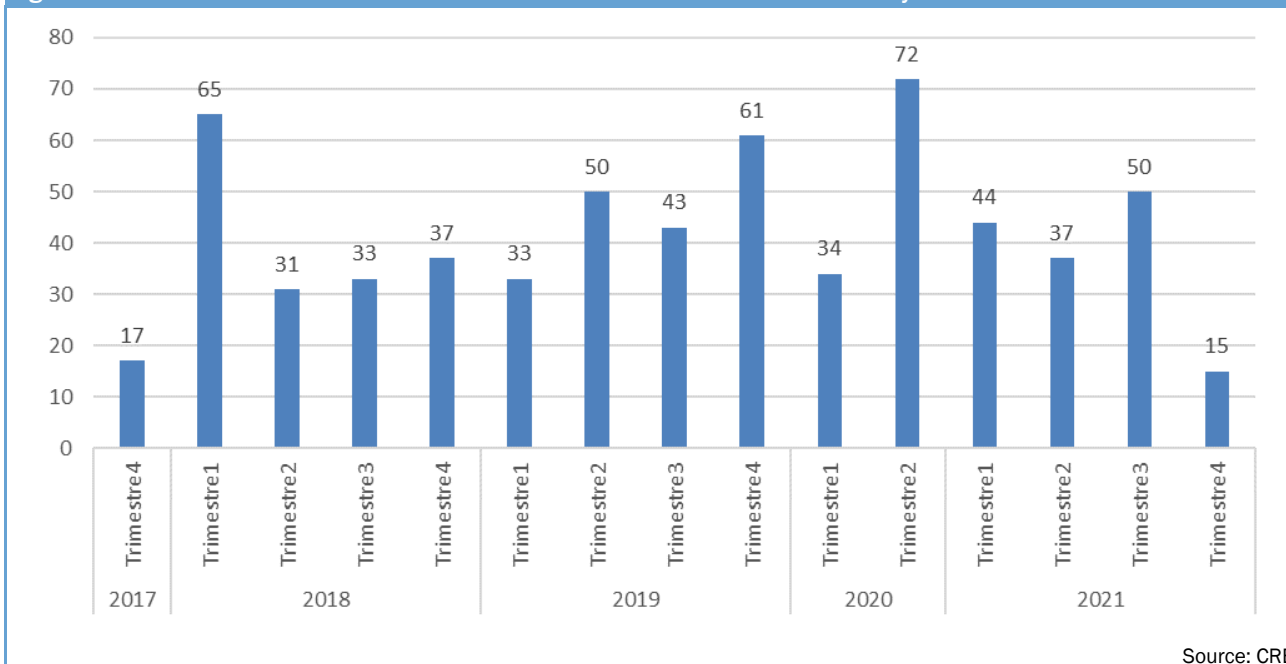


ACER also transmits cases of suspicion that it detects, as well as alerts from its automatic detection systems. On this last point, since the end of 2017, it has been transmitting to national regulators, on a monthly basis, alerts pointing to transactions that it deems suspicious. These alerts make it possible to identify unusual transactions whose analysis by the CRE may lead to the opening of an in-depth analysis, and then possibly an investigation. The transmission of alerts by ACER was disrupted in 2020, due to difficulties encountered by ACER in connection with the spread of working from home following the COVID-19 health crisis, in the context of IT security measures put in place to preserve the confidentiality of transactional data and its analyses. The generation and transmission of alerts returned to normal in 2021, with 146 alerts received by the CRE in 2021.

From October 2017 to March 2022, 622 alerts of potentially suspicious behaviour were transmitted to the CRE by ACER (Figure 5). Among these alerts, some are exclusively related to the French market under the responsibility of the CRE, others concern cross-border products and therefore also other regulators. Among the alerts received, there is a preponderance of alerts about purchases and sales of the same product and at the same price by a market player, which may result from the player's transactions with itself.

¹⁴ Among the PPATs identified as concerned by 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 5: Evolution of the number of automatic alerts transmitted to the CRE by ACER



Similarly, the other regulatory authorities, whether in France or abroad, send the CRE information about potentially suspicious behaviour.

The CRE also receives information about suspicious behaviour from market players. The CRE encourages this vigilance and reminds that any person who suspects a breach of the REMIT Regulation can report it, anonymously or not, to the address monitoring@cre.fr or on the European notice platform provided for this purpose¹⁵.

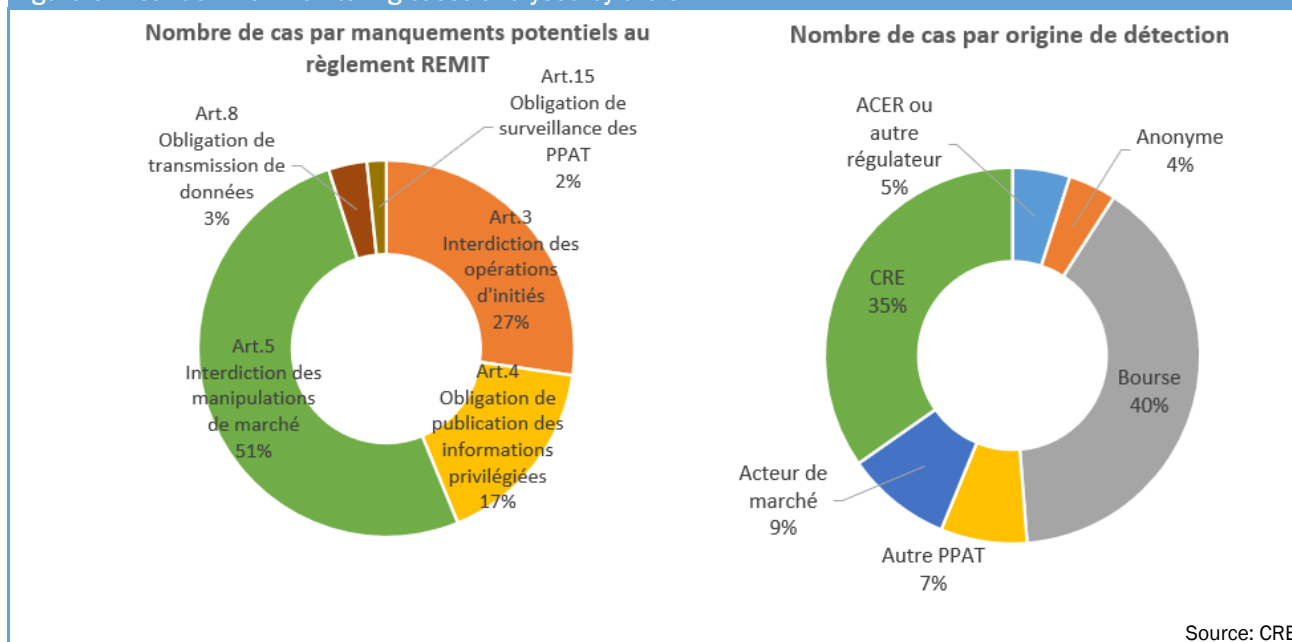
Suspect behaviour detected, either internally by the CRE or through an external report, is first verified to ensure that the suspicion is reasonable. In addition to suspicious cases, the CRE also analyses unusual market events or the specific behaviour of certain players. As of the date of publication of this report, and in addition to the analysis of ACER alerts, some forty analysis cases are currently open by the CRE and under analysis. Some analyses conducted in 2021 led to the opening of investigations in the first half of 2022, and three analyses were closed in 2021 without leading to the opening of an investigation. Investigations of suspected REMIT failures may lead to financial penalties issued by CoRDIs,

Suspected breaches of the REMIT Regulation, which have been analysed, most often concern suspected breaches of Articles 3 and 5 of the regulation (prohibition of insider trading and market manipulation), in 27% and 51% of cases respectively.

¹⁵ <https://www.acer-remit.eu/np/home>.



Figure 6 Breakdown of monitoring cases analysed by the CRE



1.2 Strengthening market monitoring in the context of rising prices

Since mid-2021, the energy markets have been experiencing unprecedented price levels, high price volatility and increased sensitivity to every event related to the energy sector. This exceptional context may be conducive to market manipulation and insider trading, due to the increased volatility and reactivity of the market to published information. It is particularly important in these conditions to ensure effective publication of privileged information, especially about the availability of the electricity generation park.

The CRE has thus stepped up its controls on the wholesale markets under Articles 3, 4 and 5 of the REMIT Regulation (prohibition of insider trading and market manipulation and duty to publish privileged information), by focusing its resources on monitoring the practices of market players and in particular the transactions and orders carried out. In particular, it has focused on verifying the consistency of electricity prices with fundamentals, including the prices of raw materials and CO2 emission allowances, and the availability of nuclear generation.

Finally, the CRE is working with ACER and the European national regulators, particularly in the context of rising prices, to strengthen the ability to detect potential market abuse in this context.

1.3 Monitoring of practices related to the publication of inside information

1.3.1 REMIT does not provide quantitative criteria for the disclosure of inside information.

The proper functioning of wholesale electricity markets requires that information about the state of the electricity system be made public by the different market participants. Otherwise, information asymmetries between market participants could create unjustified advantages and, therefore, harm the good formation of the price and the general confidence in the wholesale energy market.

In this context, the unavailabilities of electricity production facilities, whether fortuitous or planned, must be published in accordance with two European regulations:

- Regulation (EU) No 543/2013¹⁶, known as the Transparency Regulation, which requires the systematic publication of incidental and scheduled unavailability of a certain power level, set at 100 MW for the lowest threshold¹⁷;
- Regulation (EU) No 1227/2011¹⁸, known as the REMIT Regulation, which requires market participants to publish inside information under Article 4(1) of the Regulation. Information about the availability of production facilities constitutes "information" within the meaning of Article 2(1)(b) of REMIT.

¹⁶ Commission Regulation (EU) No. 543/2013 of 14 June 2013 on the submission and publication of data on electricity markets and amending Annex I to Regulation (EC) No. 714/2009 of the European Parliament and of the Council.

¹⁷ See Wholesale Market Monitoring Report 2020 for more details on the publication criteria of the Transparency Regulation

¹⁸ Regulation (EU) No 1227/2011 of the European Parliament and of the Council of 25 October 2011 concerning the integrity and transparency of the wholesale energy market Text with EEA relevance.

Under Article 2(1) of the REMIT Regulation, information is considered to be privileged when four cumulative criteria are met: the information must (1) be information of a precise nature, (2) not have been made public, (3) relate, directly or indirectly, to one or more wholesale energy commodities, and (4) if made public, be capable of materially influencing the prices of those wholesale energy commodities.

Unlike the Transparency Regulation, REMIT does not provide for quantitative criteria for the disclosure of inside information.

The assessment by each market player of the privileged nature of information related to the unavailability of a means of electricity generation must be based on the four cumulative criteria mentioned above, examined on the basis of a case-by-case analysis, which may prove complex. In this respect, some producers wonder, for operational purposes of applying the REMIT Regulation, whether a quantitative threshold for the publication of inside information should be established, as defined in the Transparency regulation, in order to facilitate the evaluation of the potential and significant effect on the price of wholesale energy products.

ACER conducted a public consultation covering this and other topics in 2019¹⁹. ACER's guidance on the implementation of the REMIT Regulation does not provide quantitative criteria for assessing whether or not information about the unavailability of a generating facility has a significant impact on the price of a wholesale energy product.

1.3.2 An additional unavailability of 100 MW does not, on average, have a significant influence on French intraday market prices.

Since 2019, the CRE has been conducting in-depth analyses on the management of inside information by market players (see Wholesale Market Monitoring Reports 2019 and 2020). On 16 September 2021²⁰, the CRE published a study on the sensitivity of the French intraday electricity price to the publication of information on the unavailability of generation facilities in France, in application of the REMIT Regulation.

The analytical methodology used in this study is based on statistical methods estimating the effect of a publication, relating to the fortuitous or planned unavailability of a generation plant in France, on the French wholesale electricity price, between the closing of the auction on the day-ahead market and the time of the last transaction carried out on the French intraday market for the hourly product concerned.

The data used in this study comes from the public transmission system operator RTE and the spot exchange EPEX SPOT.

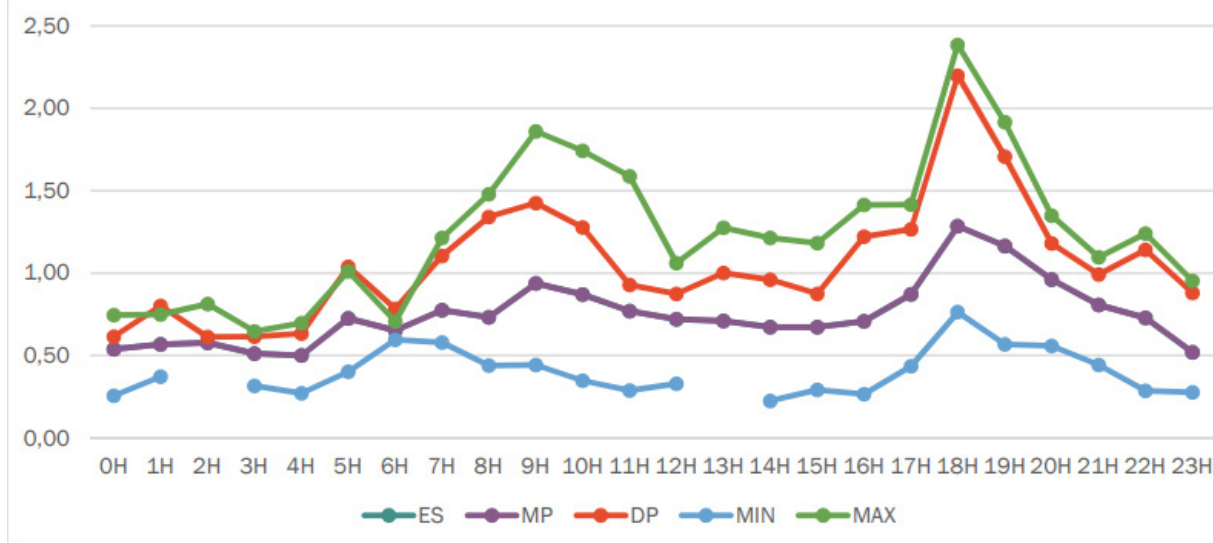
Several intraday price indices exist. For the purpose of the study, 5 different series of intraday prices observed on the EPEX SPOT power exchange for a delivery at hour h and day t are retained:

- ES: EPEX SPOT price index;
- MP: volume-weighted average price of transactions;
- DP: the price of the last transaction;
- MIN: the minimum price among all transactions;
- MAX: the maximum price of all transactions.

¹⁹ The results of the public consultation were presented by ACER during the roundtable organized on 26 November 2019 with associations of market participants and the companies proposing the platforms for the publication of the information required under the Transparency Regulation or the insider information under the REMIT Regulation : https://extranet.acer.europa.eu/en/remit/REMITACER/Roundtable/Documents/Minutes_IIPs_roundtable_meeting_26_November_2019_publication.pdf

²⁰ <https://www.cre.fr/Actualites/la-cre-publie-une-etude-sur-la-sensibilite-du-prix-du-marche-de-gros-de-l-electricite-aux-publications-d-informations-relatives-aux-indisponibilite#:~:text=The results of the study, as defined by the REMIT regulation .>

Figure 7: Comparison of sensitivity coefficients (€/MWh/GW unavailable) of price differentials to published unavailability according to the chosen intraday price index. Estimates obtained with ordinary least squares regression with all unavailabilities taken into account



Source: EPEX SPOT - Analysis: CRE

The study shows that the effect of an additional 1 GW of announced unavailability on the spread between the intraday price and the day-ahead price is estimated to be between 0 and 2.3 euros/MWh, which can be considered as not very "sensitive" in the sense of the REMIT Regulation. It should be noted that, given the analytical methodology used and the broad period analysed from 2015 to 2020, the results reflect averages that minimise certain market operating situations, particularly extreme scenarios of tightness.

The price impacts vary according to the time of delivery, being highest at the end of the peak around 7 pm and lowest around 3 am. The analysis by sector shows a significant price impact for the unavailability of nuclear generation resources, irrespective of the delivery time in question. The price impact is much lower for fossil-fired generation, but their unavailability is too infrequent to have representative statistics. Conversely, the price impact of the unavailability of ENR production means, composed mainly of hydraulic power plants, is higher than for the other sectors and significant between 6 pm and 9 pm.

Furthermore, the methodology adopted by the CRE is not exclusive of other methodologies for determining the sensitivity of the market electricity price to publications of the unavailability of generation resources in France.

1.3.3 In 2021, the CRE provided guidance to the market players on the publication of the unavailability of electricity generation facilities installed in France

The CRE's study on unavailabilities is based on average estimates and does not allow for a systematic conclusion on the effect of such unavailabilities in a particular market situation or on segments of the wholesale market other than intraday.

However, the result of this study is a useful assessment. The French market has one of the largest installed bases and electricity consumption in Europe. The average power demand over the year is about 50 GW, with a minimum of about 30 GW and a peak of about 90 GW. An unavailability of less than 100 MW, i.e. 0.2% of the average power demand, is unlikely to have a significant impact on the price of wholesale energy products, except in exceptional situations.

These observations led the CRE, in its decision of 30 September 2021²⁴, to find that unavailability of electricity generation facilities, which is less than the criteria set out in the Transparency Regulation and listed in the table below, is not likely, as a general rule, to have a significant influence on the prices of wholesale energy products and therefore to be classified as inside information under REMIT.

²¹ <https://www.cre.fr/Documents/Deliberations/Communication/publication-informations-privilegiees-relatives-aux-indisponibilites-des-moyens-de-production-d-electricite-en-france>

Table 1: Criteria for publication of an unavailability in accordance with Article 15 of the Transparency Regulation

	Generator ²²	Production unit ²³
Scheduled unavailability	Unavailable volume \geq 100 MW Changes in availability \geq 100 MW Duration \geq one unit of market time	Unavailable volume \geq 200 MW Changes in unavailability \geq 100 MW Duration \geq one unit of market time
Forced unavailability	Changes in availability \geq 100 MW Duration \geq one unit of market time	Changes in availability \geq 100 MW Installed capacity \geq 200 MW Duration \geq one unit of market time

The CRE therefore considers that, for electricity generating facilities in France, the quantitative criteria for publishing unavailability defined in Article 15 of the Transparency Regulation can be used, as a general rule, to determine the threshold of unavailable volume below which unavailability would not be likely to have a significant impact on the prices of wholesale energy products.

This assessment is not valid when several variations of unavailability accumulate in the park of the same player until the cumulative power exceeds the thresholds for a generation unit defined in Article 15 of the Transparency Regulation.

The CRE recalls that, under Article 4(1) of the REMIT Regulation, each market player must make its own case-by-case assessment of the privileged nature of an item of information, including an assessment of the fact that this information would be likely to have a significant influence on the prices of wholesale energy products if it were made public. This evaluation must take into account in particular the activity of the market participant, the economic situation of the market and the specific characteristics of the market in question at a given time (market size, balance between supply and demand, time of day, etc.).

1.3.4 ACER recommends that inside information be published on a centralised platform

Inside information held by market participants should be made public and readily available to other participants. In this context, ACER has recommended²⁴ market players to use a centralised platform (known as the *Inside Information Platform* or IIP) for their publication.

A publication on a centralised platform allows the privileged information to be considered as effectively disclosed under the REMIT Regulation. The platform wishing to become a IIP must comply with a list of minimum requirements in order to be certified as a PII by ACER.

According to ACER's initial recommendation, the publication of privileged information must be made, as of 1 January 2021, on one of the certified IIP platforms, the list of which is available on ACER's REMIT website (REMIT Portal²⁵).

Due to the health crisis, ACER has indicated to market participants that they may use their website as a transitional solution. Originally set for 31 December 2021, the end of this interim period has been extended to 31 December 2022 (ACER Open Letters dated 20 November 2020²⁶ and 14 December 2021²⁷). The minimum requirements that these websites must meet are specified in question III.7.22 of the ACER Q&A document²⁸.

With regard to the wholesale electricity market in France in particular, RTE has taken the initiative to develop an IIP platform, which is currently in the final phase of certification by ACER. In view of the progress of the certification process at the end of 2021, the CRE has considered²⁹ that RTE's platform could be used during the transitional period defined by ACER by the players who have chosen, or are considering choosing, it as an IIP for the disclosure of privileged information. In the event that RTE does not succeed in having its platform certified by 31 December 2022, the CRE has indicated that it will communicate new guidelines.

²² Article 2(17) of the Transparency Regulation defines "generator" as an individual electricity generator belonging to a production unit.

²³ Article 2(24) of the Transparency Regulation defines "generating unit" as an electricity generating installation consisting of a single generator or a set of generators.

²⁴ See in particular Chapter 4 of the 6^{ème} Current version of ACER guidance on REMIT implementation

²⁵ <https://www.acer-remit.eu/portal/list-inside-platforms>

²⁶ https://documents.acer-remit.eu/wp-content/uploads/20201120_Open-Letter-on-impact-of-Covid-19-on-compliance-deadlines-under-REMIT-1.pdf

²⁷ <https://documents.acer-remit.eu/wp-content/uploads/Updated-Open-Letter-on-extension-of-possibility.pdf>

²⁸ <https://documents.acer-remit.eu/category/remit-reporting-user-package/qas-and-faq-on-remit/>

²⁹ Communication from CRE on ACER's recommendation concerning the publication of privileged information on dedicated centralised platforms: <https://www.cre.fr/Actualites/communication-de-la-cre-sur-la-recommandation-de-l-acer-concernant-la-publication-des-informations-privilegiees-sur-les-plateformes-centralisees-de>

Finally, the CRE reminds that the players in the wholesale electricity and gas market must indicate the IIP platform of their choice, as well as possibly their own website designated as a back-up solution, on their account in the European centralised registration system for players in the wholesale energy markets (CEREMP) (see also question II.4.57 of the ACER question and answer document).

1.4 Supporting the players organising transactions (exchanges, brokers, etc.) in their monitoring mission

Under Article 15 of the REMIT Regulation, persons arranging transactions on a professional basis (*Persons Professionally Arranging Transactions* - PPAT) in wholesale energy products must establish and maintain effective arrangements and procedures to detect violations of Article 3 or 5 of the REMIT Regulation 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 indispensable and maintains an active collaboration with them. This allows 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. In this respect, the CRE has maintained its exchanges in 2021 with the exchanges, brokers and RTE (the only network operator qualified as a PPAT in France) active in France. 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 relations with brokers based in France is organised jointly with the Financial Markets Authority (AMF).

The CRE recalls the duty for PPATs to notify any reasonable suspicion of a potential breach of the REMIT Regulation (Articles 3 and 5 of the REMIT) identified in the exercise of their monitoring functions. The PPAT must notify the National Regulatory Authority (NRA) of the Member State in which the market participant involved in the potential breach has registered³⁰ and the NRA in the Member State(s) of delivery of the wholesale energy product(s) involved.

The notice of suspicion (*Suspicious Transaction Report* - STR) should be clear and precise in order to allow the notified NRA to understand the essential facts of the case and should contain as much information as possible to allow for the assessment of the case. At a minimum the notice should contain the following information:

- Identity of the market player(s) involved
- The time of the potential breach
- The market(s) concerned
- Details of the transaction(s)/order(s)/behaviour(s) involved

In addition, Section 8.3 of the Guidance³¹ on REMIT provides recommendations on what information should 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 carried over by certain PPATs in 2021. The CRE will not hesitate to initiate sanction procedures, within the context provided for by law, against PPATs that do not properly carry out their mission of monitoring wholesale markets.

2. INVESTIGATIONS AND SANCTIONS FOR BREACHES OF THE REMIT REGULATION

In application of Article L.135-3 of the Energy Code, the CRE agents authorised for this purpose by the Chairman carry out the investigations necessary for the accomplishment of the missions entrusted to the Commission. Thus, in the event of a suspected breach of the provisions of the REMIT Regulation, the Chairman of the CRE may appoint an investigating agent to carry out an investigation.

Under Article L.135-12 of the Energy Code, breaches of the provisions of the REMIT Regulation are first recorded by the agents mentioned in Article L.135-3. These breaches are the subject of a report which must be notified to the person(s) concerned.

Under Article L.134-25, the Chairman of the CRE may, if necessary, refer the matter to the Dispute Resolution and Sanctions Committee (CoRDIS).

³⁰ In the centralised European register of energy market participants CEREMP.

³¹ ACER Guidance on the application of Regulation (EU) No 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency - 6th Edition - 22 July 2021

2.1 Investigations conducted by the CRE

Between 2014 and 2021, the CRE opened 13 investigations under the REMIT Regulation distributed as follows: 2 investigations in 2014, 3 in 2016, 2 in 2017, 1 in 2018, 1 in 2019 and 4 in 2021.

All of these inquiries relate to the prohibition of insider trading and market manipulation (Articles 3 and 5 of REMIT) as well as the duty to disclose privileged information (Article 4 of REMIT).

By the end of 2021, of 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;
- two were closed by a CoRDIS sanction decision (Table 2);
- three are currently being examined by CoRDIS;
- for the five remaining investigations at the end of 2021, the investigating officer's analyses were still in progress.

In the context of these investigations, the power to request information (accounting records, invoices and any useful document, including telephone records and existing data exchanges), under Article L.135-4 of the Energy Code and Article 13(2) of the REMIT Regulation, has been implemented.

2.2 Summary of the main decisions taken by regulators in the European Union to sanction breaches of the REMIT Regulation

ACER maintains a summary³² on its website of the main decisions at European level sanctioning breaches of the provisions of the REMIT Regulation.

Table 2: Section decisions at European level in connection with breaches of the REMIT Regulation

Date of decision	Authority, Member State	Market player	Type of REMIT breach	Amount of sanction	Status of the decision
25.04.2022	CRE, France	Electricité de France SA	Article 3 Article 4	500,000 €	Possible appeal
25.04.2022	CRE, France	EDF Trading Limited	Article 5	50,000 €	Possible appeal
30.09.2021	BNetzA, Germany	Energi Danmark A/S	Article 5	200,000 €	Final
30.09.2021	BNetzA, Germany	Optimax Energy GmgH	Article 5	175,000 €	On appeal
24.08.2021	OFGEM, United Kingdom	ESB Independent Generation Trading Limited and Carrington Power Limited	Article 5	6,000,000 (approx. 7 M €)*	Final
25.02.2021	CNMC, Spain	Rock Trading World S.A.	Article 5	60,000 €	Possible appeal
16.12.2020	OFGEM, United Kingdom	EDF Energy (Thermal Generation) Limited	Article 5	6,000,000 £ (approx. 6.7 M €)*	Final

³² Publication ACER Enforcement decisions - Overview of the sanction: <https://www.acer.europa.eu/remit/coordination-on-cases/enforcement-decisions>

25.03.2020	OFGEM, United Kingdom	InterGen (UK) Ltd, Coryton Energy Company Ltd, Rocksavage Power Company Ltd, Spalding Energy Company Ltd	Article 5	37,291,000 £ (approx. 42.5 M €)*	Final
03.01.2020	GREEN, Lithuania	UAB Geros dujos	Article 5	28,583 €	Final
19.12.2019	CRE, France	BP Gas Marketing Limited	Article 5	1,000,000 €	On appeal
December 2019	MEKH, Hungary	Valahia Gas S.R.L.	Article 5	30,000,000 Ft (approx. 90,000 €)	Final
September 2019	MEKH, Hungary	MAVIR ZRt.	Article 5	1,000,000 Ft (approx. 3,000 €)	Final
05.09.2019	OFGEM, United Kingdom	Engie Global Markets	Article 5	2,128,236 (approx. 2,393,427.80 €)	Final
20.02.2019	BNetzA, Germany	Uniper Global Commodities SE + Two traders	Article 5	150,000 € and fines of 1,500 € and 2,000 € respectively for each trader.	Final
21.12.2018	Prosecutor/DUR, Denmark	Neas Energy A/S	Article 5	153,000 DKK (approx. 20,400 €)*	Final
28.11.2018	CNMC, Spain	Multiennergía Verde, S.L.U.	Article 5	120,000 €	On appeal
28.11.2018	CNMC, Spain	Galp Gas Natural, S.A.	Article 5	80,000 €	Final
30.10.2018	Prosecutor/DUR, Denmark	Energi Danmark A/S	Article 5	1,104,000 DKK (approx. 147,000 €)*	Final
05.10.2018	CRE, France	VITOL S.A.	Article 5	5,000,000 €	Final
24.11.2015	CNMC, Spain	Iberdrola Generación S.A.U.	Article 5	25,000,000 €	On appeal

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

Among these decisions, the CRE would like to briefly present the two recent decisions issued in 2022 against the companies EDF and EDF Trading Limited, as well as the only decision issued in 2021 for an amount exceeding 1 M€.

Sanction decisions³³ of the Dispute Settlement and Sanctions Committee of the Energy Regulatory Commission of 25.04.2022 with respect to Electricité de France and EDF Trading Limited

The Dispute Settlement and Sanctions Committee (CoRDIS) of the Energy Regulatory Commission has fined Electricité de France (EDF) €500,000 for failure to comply with Articles 3 and 4 of the REMIT Regulation, and EDF Trading Limited (EDFT) €50,000 for failure to comply with Article 5 of the REMIT Regulation.

In June 2018, the Chairman of the Energy Regulatory Commission (CRE) referred a request for a section to CoRDIS on the basis of Article L. 134-25 of the Energy Code. This request is based on the conclusions of an investigation opened in December 2016, which had found behaviour by EDF and EDFT that was likely to breach the rules defined by the European regulation of 25 October 2011 concerning the integrity and transparency of the wholesale energy market, known as the "REMIT Regulation".

OFGEM's 2021 sanction decision against ESB Independent Generation Trading Limited and Carrington Power Limited

On 24.08.2021, the Office of Gas and Electricity Market (OFGEM) declared that ESB Independent Generation Trading Limited (IGT) and Carrington Power Limited (Carrington), companies incorporated and registered in Great Britain, had agreed to pay £6 million to OFGEM's Voluntary Redress Fund for inadvertently committing market manipulation prohibited by Article 5 of the REMIT Electricity Market Regulation, as well as for a breach of the Grid Code on duties relating to the electricity generation licence.

From March 2019 to September 2020, IGT regularly sent misleading signals to the "National Grid Electricity System Operator" (TSO) on the capacity of its Carrington generating station, as this information is required for the operation of the UK balancing mechanism.

Indeed, OFGEM found that, at the request of IGT's traders, the Carrington plant frequently overstated the stated minimum power generation capacity that Carrington could provide. In addition, it also exaggerated the plant's mobilisation time. This behaviour was implemented by IGT traders when IGT and Carrington were seeking generation on the balancing mechanism. In many cases, the TSO had to purchase more energy from the plant than necessary when the plant was used to balance the power system as a result of this behaviour. This led to the TSO spending money unnecessarily trying to balance the power system.

According to OFGEM, this behaviour constitutes a breach of the duties relating to the electricity generation license. Indeed, this behaviour is characterised by a failure to comply with the requirements of the UK Network Code. This Code, which sets out the technical requirements that generators must comply with when connecting to and using the national electricity transmission network, states that the technical data ("dynamic parameters") submitted by generators to the TSO must reasonably reflect the true expected operating characteristics of a generation unit. By overstating the generation capacity that Carrington could provide, IGT failed to comply with this requirement.

In addition, OFGEM finds that the overestimation of the minimum capacity of energy that Carrington could supply, gave a misleading signal to the TSO, which had to pay IGT for energy that did not correspond to the quantity actually available on the market. Thus, IGT, by giving a misleading signal about supply and demand, also breached Section 5 of the REMIT Regulation prohibiting market manipulation.

IGT considered its approach to changing Carrington's dynamic parameters to be consistent with its understanding of its regulatory duties at the time. IGT also believed that attempting to cover its fixed costs of generation on a larger volume would result in lower balancing costs. OFGEM states that IGT now recognises that its behaviour, involving contracting for more energy from the TSO, led it to spend money at times unnecessarily in trying to balance the electric system.

IGT has admitted that it inadvertently breached Article 5 of REMIT, as well as the duties of the UK Network Code. The company has promptly implemented measures to comply with the duties of the REMIT Regulation and the Network Code, to avoid any recurrence of such breaches.

Given IGT's cooperation in the examination of the case, OFGEM did not consider it necessary to open an investigation, as IGT had agreed to pay £6 million (approximately EUR 7 million) in the "voluntary redress fund" of OFGEM³⁴.

2.3 Active participation of the CRE in inter-AAI cooperation

Exchanges within the inter-AAI working group are one of the levers of innovation and enable the CRE to constantly question its monitoring and investigation methods and, where appropriate, to pool resources relating to investigative powers (e.g. IT tools specific to the needs of investigations), in particular the "enhanced" powers not yet implemented by the CRE to date.

³³ <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>

³⁴ <https://www.ofgem.gov.uk/publications-and-updates/authority-guidance-allocation-redress-funds>

Cooperation with French independent administrative authorities (AAI), initiated in 2019, is a privileged means of exchange with other French independent administrative authorities (ACPR, ADLC, AMF, ART, ARCEP, CNIL, HATVP)³⁵. In 2021, the CRE actively participated in these groups, which worked in particular on the implementation of investigative powers as well as on the recommendations of the study report of the Council of State.

In this respect, it is worth recalling the particularly close collaboration between the CRE and the AMF, based in particular on the memorandum of understanding signed in 2010, the purpose of which is to enable the two authorities to benefit from each other's information and expertise and to ensure that their respective missions are carried out and made fully effective, in accordance with the provisions of Article L. 621-21 of the Monetary and Financial Code and Articles 28 and 29 of Act 2000-108 of 10 February 2000.

3. MONITORING WHOLESALE MARKETS AT THE EUROPEAN LEVEL

3.1 Activities conducted or coordinated by ACER on market monitoring

Several working groups dedicated to market monitoring exist within ACER and the Council of European Energy Regulators (CEER). In particular, they contribute to the operational implementation of the REMIT Regulation by national authorities in a coordinated and coherent manner. They also participate in the development of the non-binding guidelines ("*guidance*") on REMIT published by ACER.

The CRE attaches great importance to the rigorous progress of the REMIT work in the context of a constructive European collaboration and chairs several groups, including the *REMIT Policy Task Force*, a mandate renewed in 2020 for two years. In the first half of 2021, the CRE has obtained the mandate of vice-chair of the *ACER REMIT Committee*. The CRE is delighted with the confidence and recognition of its commitment reflected in these appointments.

3.2 Evolution of ACER's non-binding guidelines

The non-binding guidance issued by ACER to date consists of four main documents:

- general guidance on the application of the REMIT Regulation, and
- three thematic guidelines on practices that may constitute market manipulation under Article 5 of the REMIT Regulation:
 - an orientation about the manipulative practice of the "*Wash Trade*" defined as the making of agreements for the sale or purchase of a wholesale energy commodity, not involving a change in ownership of the security involved or in market risk or involving the transfer of ownership or market risk among participants acting in concert or collusion, released in June 2017³⁶;
 - guidance on manipulative practice such as blocking of carrying capacity or "*capacity hoarding*" in the intraday electricity market, defined as acquiring all or part of available transmission capacity without using it or without using it efficiently, released in March 2018.³⁷;
 - an orientation on the manipulative practice of the "*layering*" and "*spoofing*" in continuous wholesale markets, defined as the issue by a market participant of a large order or orders on one side of the order book in order to make one or more trades on the other side of the order book, released in March 2019³⁸.

ACER has published the 6th edition of its general guidelines on 22 July 2021. This new edition, published 10 years after the first version, recasts the structure of the document, taking into account feedback from regulators and market participants. It also clarifies the scope of application of REMIT and the prohibition of insider trading and market manipulation.

ACER also publishes a list of questions and answers ("Q&A") on the implementation of REMIT, and published updates to this document on 23 July 2021 and 14 December 2021. These updates concern in particular the designation of a platform for the publication of privileged information by market participants.

³⁵ ACPR - Autorité de contrôle prudentiel et de résolution, ADLC - Autorité de la concurrence, AMF - Autorité des marchés financiers, ART - Autorité de régulation des transports (formerly ARAFER), ARCEP - Autorité de régulation des communications électroniques et des Postes, CNIL - Commission nationale de l'informatique et des libertés, HATVP - Haute autorité pour la transparence de la vie publique

³⁶ Available on the ACER website at <https://www.acer-remit.eu/portal/document-download?documentId=u518na123yg>

³⁷ For more information: <https://acer.europa.eu/Media/News/Pages/ACER-publishes-guidance-on-capacity-hoarding-in-intraday-electricity-markets-that-could-constitute-market-manipulation.aspx>

³⁸ For more information: <https://www.acer.europa.eu/Media/News/Pages/ACER-publishes-guidance-on-layering-and-spoofing-in-continuous-wholesale-energy-markets.aspx>

The CRE contributes to the development of common positions on the definition and monitoring of abuse practices in wholesale markets under the REMIT Regulation. It has been an active contributor to the preparation of changes in the general guidelines.

3.3 Progress in the implementation of REMIT data exchange with ACER

The centralised data collection by ACER in the context of REMIT started in 2015. The CRE has been receiving data about the French market since 2016. As the quality of transactional and fundamental data is essential for the conduct of its missions, the CRE is actively involved in ACER's work on this subject. It has thus contributed to defining, with the other European authorities, the main elements to be improved with regard to the harmonisation of data declarations as well as the completeness and quality tests.

ACER publishes documents to clarify the reporting of transactional and fundamental data. Discussions between ACER, reporting parties, regulators and other stakeholders include updates to these documents. The main documents are the procedures manual for data reporting³⁹ and the User Manual for Transactional Data Reporting (*Transaction Reporting User Manual - TRUM*), the latest versions of which were published on 30 April 2021. They are supplemented by a question and answer document (*Frequently Asked Questions - FAQ*) on transactional data reporting, as well as another Q&A document on the reporting of privileged information and fundamental data. New versions of these documents were also published on 30 April 2021.

Work by ACER, but also by other regulators, on improving data collection under Article 8 of the REMIT Regulation and its exploitation for monitoring activities, continued in 2021. Notably, ACER reported in its quarterly newsletter⁴⁰ on the progress of the analysis and data quality improvement work, in particular through projects carried out on four main topics: the completeness of data related to the coupling of daily and intraday markets, the development of data quality indicators, gas transportation contracts and the completeness of data about brokered transactions. In this document, ACER shared its initial findings on broker-intermediated transactions, which show a wide variety of reporting practices and conventions.

As long as this work to improve data quality has not been completed, the CRE will maintain the national data collection system from the organised marketplaces (exchanges and brokers) in order to avoid any discontinuity or interruption in the scope of the CRE's monitoring.

Finally, in January 2022, ACER published⁴¹ a decision on additional data reporting for intraday market coupling for electricity. This decision represents the culmination of work begun in 2019 with the Intraday Coupling operators to improve ACER and regulators' visibility into the shared order book of the XBID Intraday Coupling platform. Due to the design of the XBID platform, orders placed in one market area may be partially or fully visible in all other market areas, depending on the amount of border trading capacity available in real time. Because ACER and the regulators did not have information about the real-time trading capacity available, they could not reconstruct the order books visible to the market participants they monitored. To remedy this shortcoming, the ACER decision provides that the coupling operators, within nine months of the decision (which may be extended), must make available to ACER data about the orders visible at each moment in each market area. The responsibility for making the data available will rest with the intraday coupling operators, and not with the market participants themselves, in contrast to transactional data reporting under Article 8 of REMIT.

³⁹ *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

⁴⁰ "REMIT Quarterly" n° 25, 2nd quarter 2021 : https://documents.acer-remit.eu/wp-content/uploads/REMITQuarterly_Q2_2021_1.0.pdf

⁴¹ Decision No. 01/2022 of the European Agency for the Cooperation of Energy Regulators of 31 January 2022 requesting additional information regarding the data on the single intraday coupling (https://extranet.acer.europa.eu/Official_documents/Acts_of_the_Agency/Individual_decisions/ACER_Decision_01-2022_on_SIDC_data.pdf)

Useful references

On suspected market abuse

In order to ensure the best possible monitoring of the markets, any person with suspicions of market abuse is asked to alert:

- the CRE departments in charge of market monitoring at the following address monitoring@cre.fr;
- or ACER services by visiting the notice platform ad hoc of the Agency: <https://www.acer-remit.eu/np/home>.

On the registration of market participants

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

With regard to REMIT

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

SECTION 3 WHOLESALE GAS MARKETS

1. EVOLUTION OF GAS SUPPLY AND DEMAND IN FRANCE IN 2021

1.1 Balance of the French system

In 2021, gas consumption in France increased by 7%, driven by increased consumption by public utilities in response to colder average temperatures than in 2020.

Injection demand also increased over the year (+4%) due to low levels of French storage after the winter of 2020-2021.

While pipeline imports into France remained relatively stable (+3%), the country's LNG imports, although high, were down from the exceptional level of 2020 (-8%). LNG volumes delivered to Europe were indeed impacted by strong demand from Asia over the year, whose purchase prices were regularly higher than those in Europe.

Total annual exports in 2021 have seen a sharp decrease (-32%), mainly due to the large flows of Algerian gas to Spain and Italy's use of the new trans-Adriatic gas pipeline (TAP) to get supplies.

Figure 8: Supplies and outlets in the French system 2021 [2020] (trade flows)

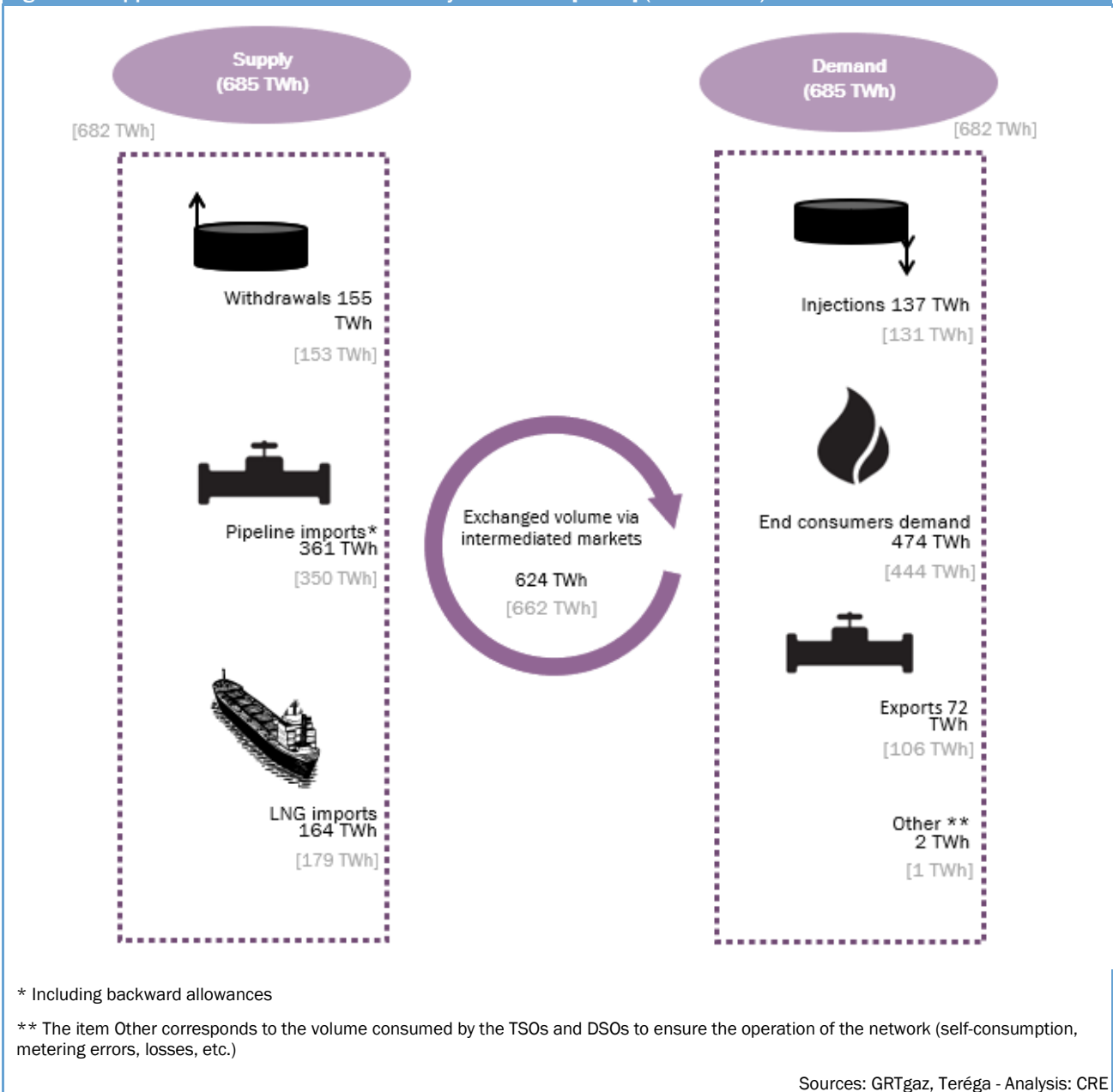
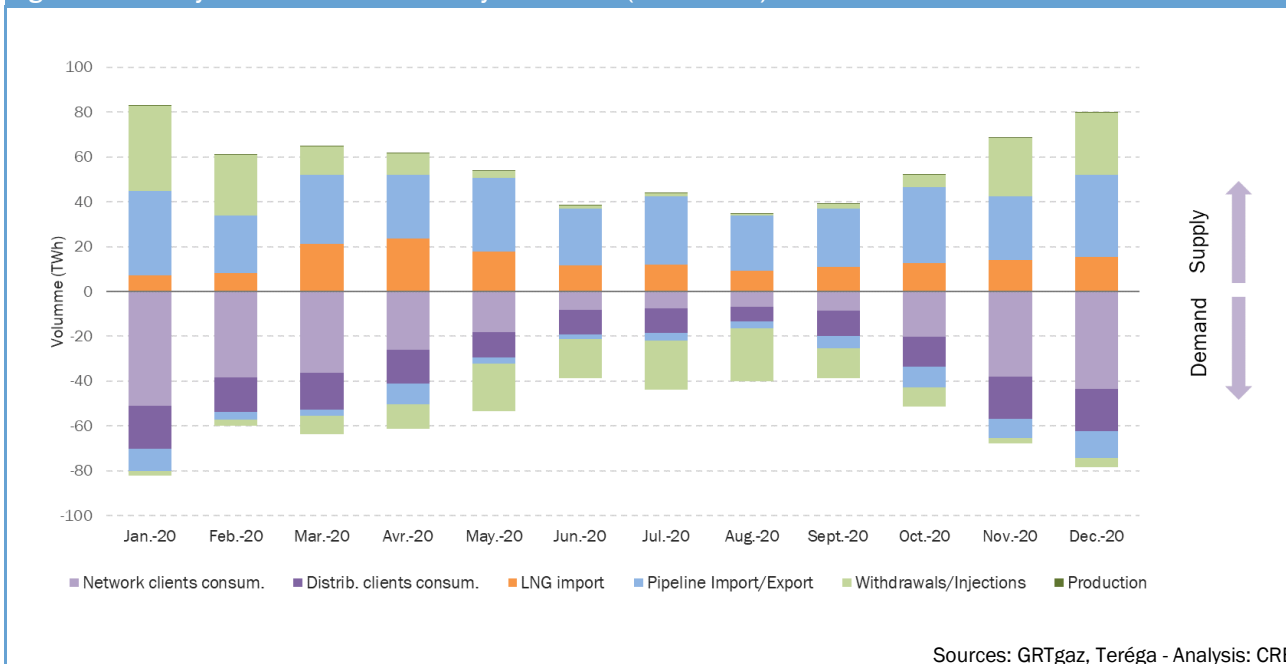


Figure 9: Monthly balance of the French system 2021 (trade flows)



1.2 An increase in consumption due to lower temperatures than in 2020 and the recovery of economic activity

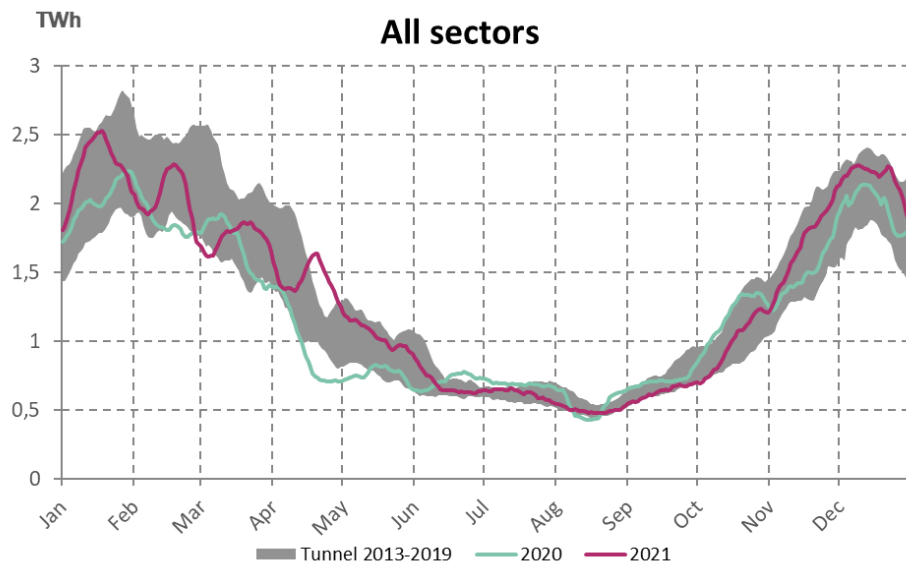
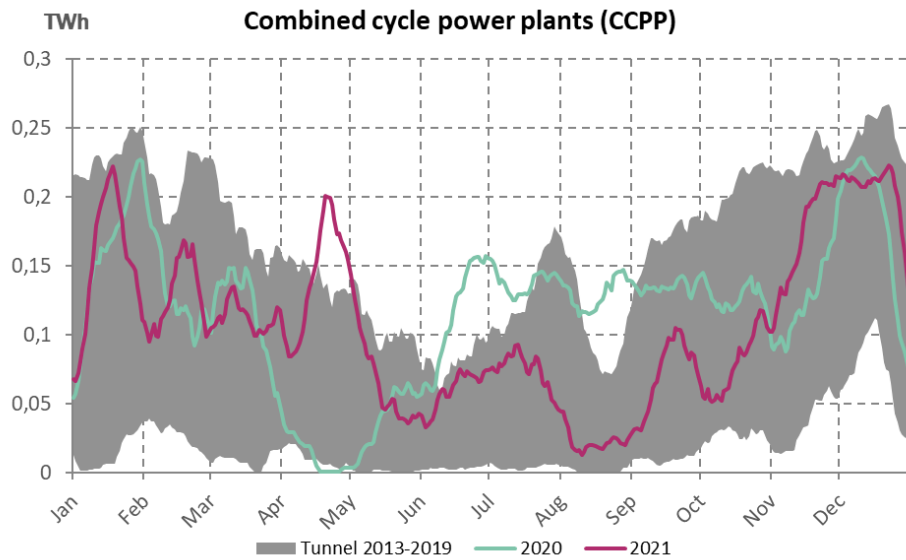
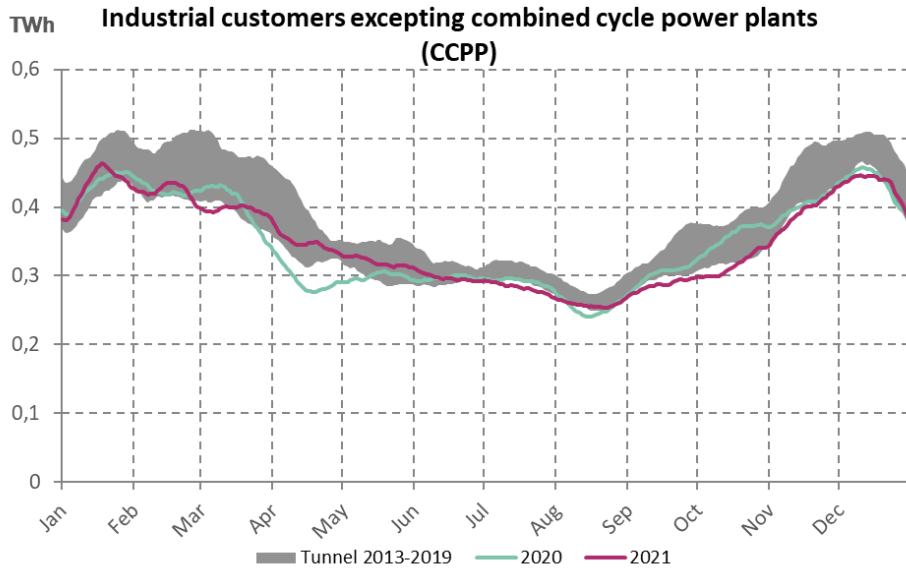
Total consumption in France reached 474 TWh in 2021, an increase of 7% relative to 2020. The increase in consumption was driven by an average temperature drop of 1.4 °C compared to 2020, the warmest year on record. The cooler temperatures in April and May have notably supported heating-related consumption.

In 2021, gas consumption for electricity generation decreased by 5 TWh compared to 2020, reaching 39 TWh. The lower use of thermal generation compared to 2020 principally concerns the summer period, mainly due to the improved availability of the nuclear park and the lower profitability of this generation at this period.

In 2021, consumption by industrial customers remained stable compared with 2020, totalling 132 TWh (-1 TWh). In the first half of the year, it was higher year-on-year than in 2020, when industrial production was affected by the health measures. On the other hand, consumption by industrial customers was on average lower than in 2020 for almost all the months of the second half of 2021, as a result of high gas prices over the period, which were reflected in the production costs of these industries.

Figure 10: Consumption of Combined Cycle Gas Turbine (CCGT) power plants, grid customers excluding CCGT and all sectors





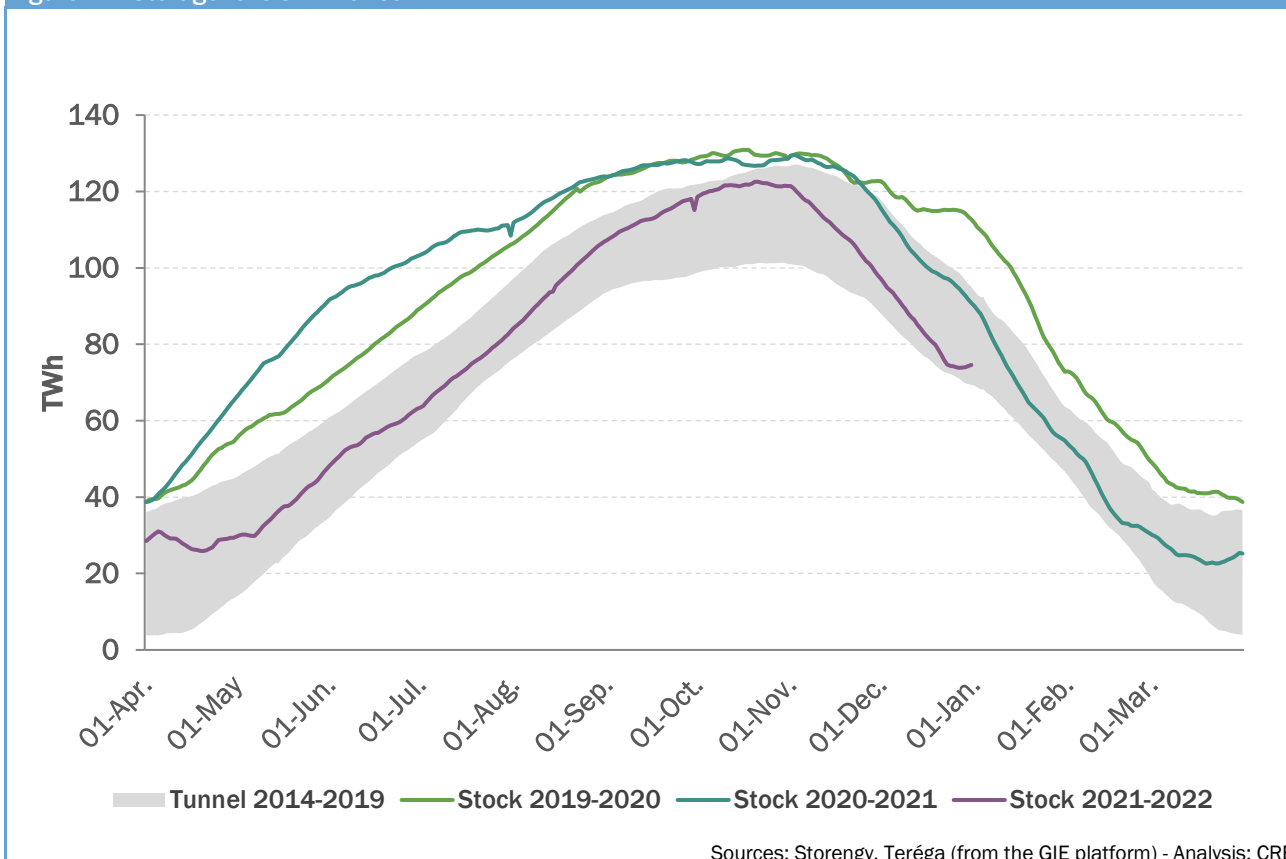
1.3 Storage levels in Europe significantly lower than the last three years for most of the year mainly due to Gazprom's behaviour

Following on from December 2020, the year 2021 has started with intensive withdrawals from European storage facilities. North-East Asia was hit by a cold snap of exceptional magnitude during this period and consequently offered significantly higher LNG purchase prices than Europe, which had to draw intensively on its storage facilities to cope with the sharp drop in LNG supply.

The filling of storage facilities that began in March was slowed down by withdrawals in April and May, in response to temperatures below seasonal norms. Injections into storage facilities over the summer enabled the level of filling to reach 94.5% on 1 January.^{er} November, the date on which French regulations require a minimum filling level of 85%^{42,43}. This level was 100% in 2020. European storage facilities had a filling rate of only 77.0% at that date, compared with 95.0% the previous year. At the end of the year, the tight gas supply and cold weather led to a significant use of storage facilities in France and Europe to meet demand. However, the year ended with a few days of net injections into storage during the holiday season.

The subscription of all storage capacity for the season has ensured that the storage facilities will be well filled for the winter of 2021-2022. This confirms the smooth functioning of the legislative reform of third-party access to gas storage carried out in 2018. In application of the law, the terms and conditions for marketing storage capacity were defined by the CRE in its deliberations of 22 February 2018⁴⁴ and 27 September 2018⁴⁵.

Figure 11: Storage levels in France



Unlike France, several European countries did not have legislation imposing a minimum level of storage before winter. In these countries, market participants with storage capacities use them freely.

⁴² Energy Code, Article L421-7: https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000036436013/

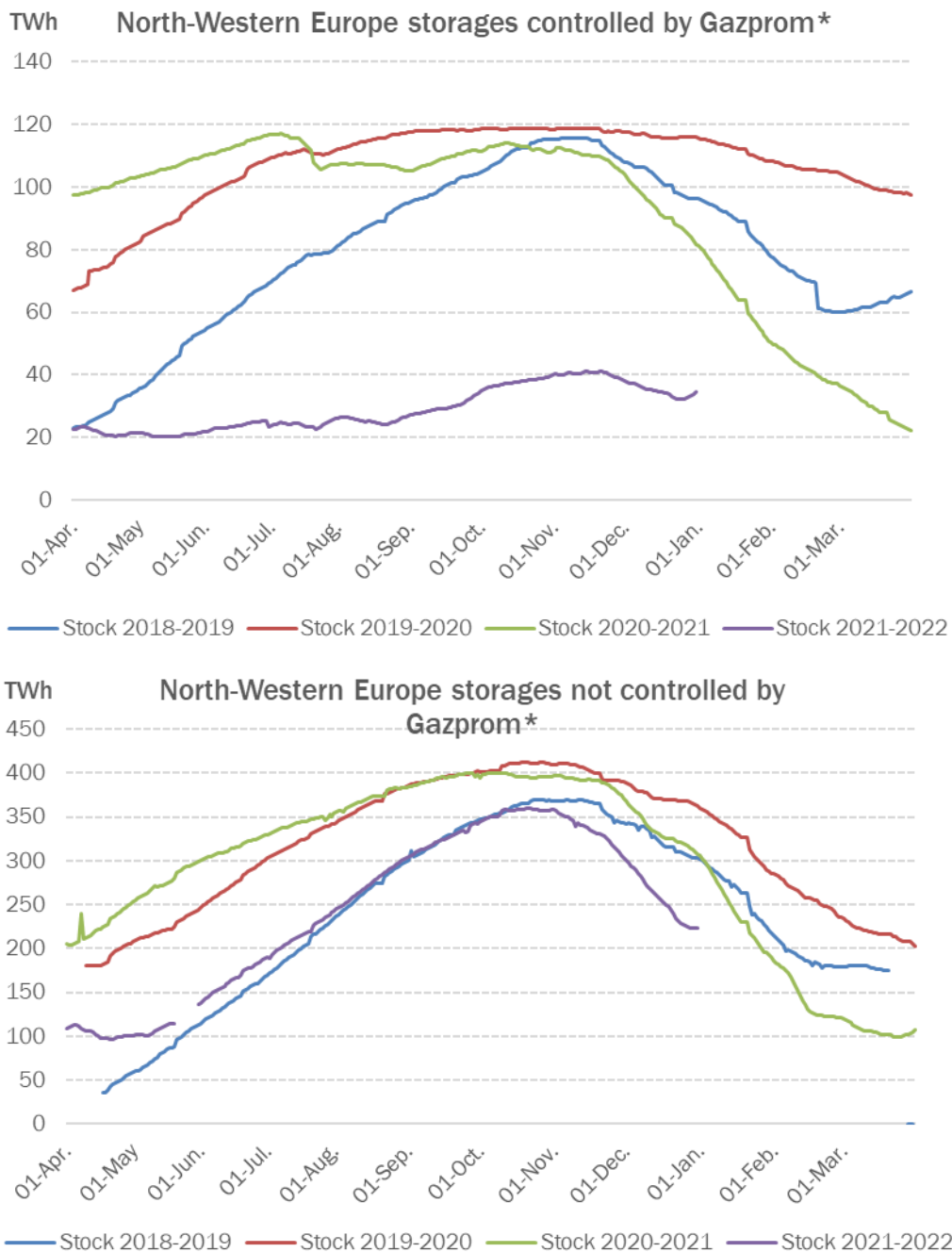
⁴³ Order of 9 May 2018, specifying certain provisions relating to the underground storage of natural gas, Section 2: <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000036936721>

⁴⁴ Resolution of the Energy Regulatory Commission No. 2018-039 of 22 February 2018 on the decision concerning the terms and conditions for marketing storage capacities in the context of the implementation of regulated third-party access to underground natural gas storage in France: <https://www.cre.fr/Documents/Deliberations/Decision/modalites-de-commercialisation-des-capacites-de-stockage>

⁴⁵ Resolution of the Energy Regulatory Commission No. 2018-202 of 27 September 2018, on the decision concerning the terms and conditions for marketing natural gas storage capacity as of October 2018: <https://www.cre.fr/Documents/Deliberations/Decision/Evolution-tarif-ATRT6-au-1er-avril-2018>

A significant portion of the deficit in European storage at the beginning of the winter of 2021-2022 is due to Gazprom's lack of injections into its continental storage, primarily in Germany, Austria and the Netherlands, during the spring and summer of 2021. At the beginning of the European gas winter (1 October), the aggregate level of Gazprom's storage was 68.8% below its average for the previous three years. The other North-Western European storage facilities were in line with previous years, with a deficit of 9.5% on 1 October compared to the average of the last three years.

Figure 12: Level of storage facilities in North-Western Europe (distinguishing those controlled by Gazprom)



* The sites controlled by Gazprom in North West Europe are Bergermeer, Rehden, Haidach GSA, Katharina, Jemgum and Etzel EKB

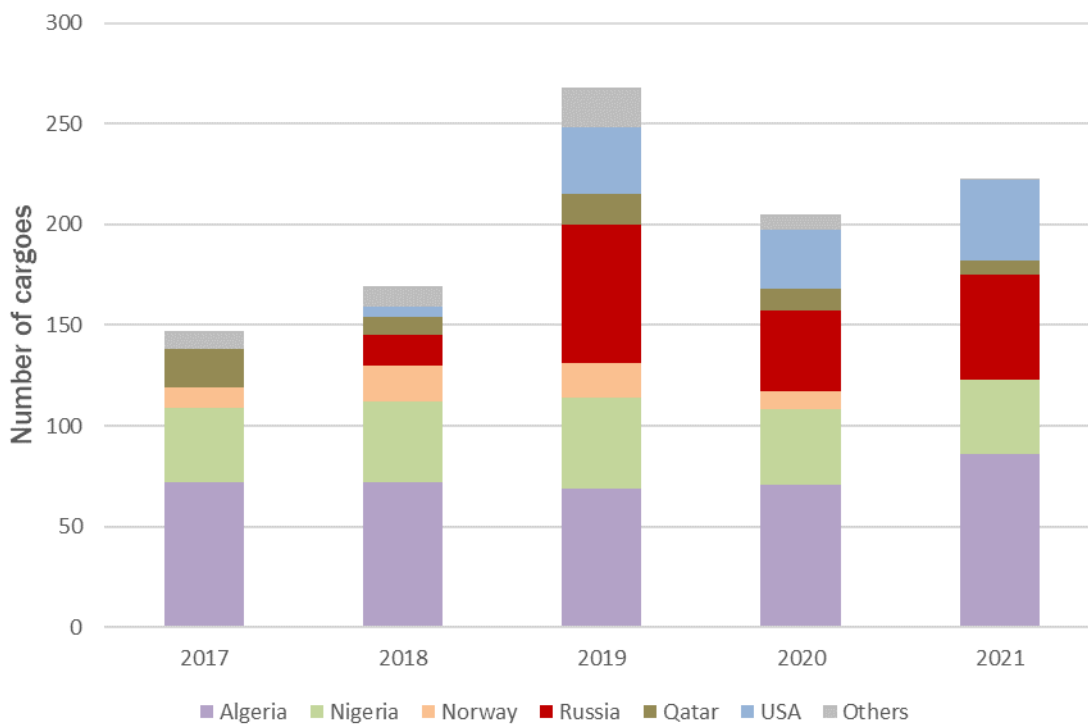
Sources: Refinitiv - Analysis: CRE

1.4 LNG imports down 8% relative to 2020

On a European scale, January saw the largest year-on-year drop in LNG imports (-52.2%), mainly due to the peak in Asian LNG prices during that month, linked to the cold snap that was affecting Asia at the time. Conversely, the largest increase occurred in December, with very high prices in Europe redirecting LNG tankers to Europe, while storage levels in Asia were high.

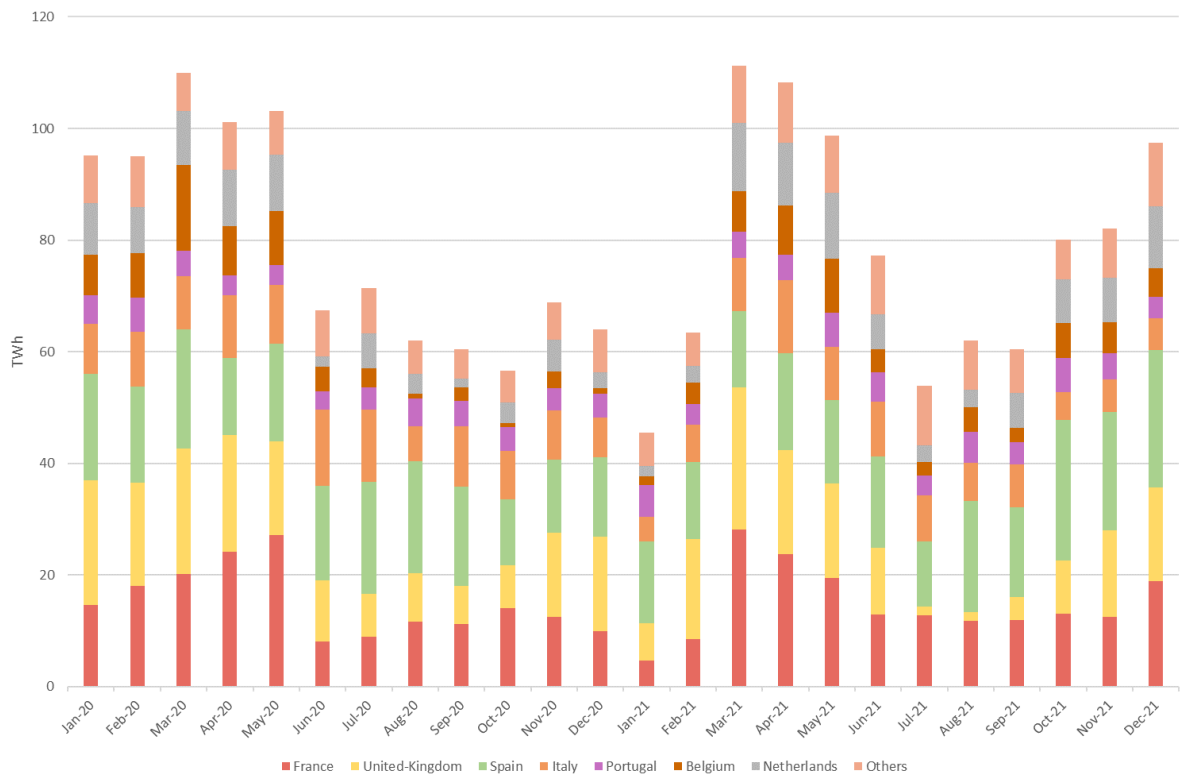
As in the previous year, France is among the three countries importing the most LNG in Europe in 2021, alongside Spain and the United Kingdom. France was even the European country that imported the most LNG between March and April 2021 with 47 TWh.

Figure 13: Number of cargoes received in France in 2021 by country of origin



Source: Argus - Analysis: CRE

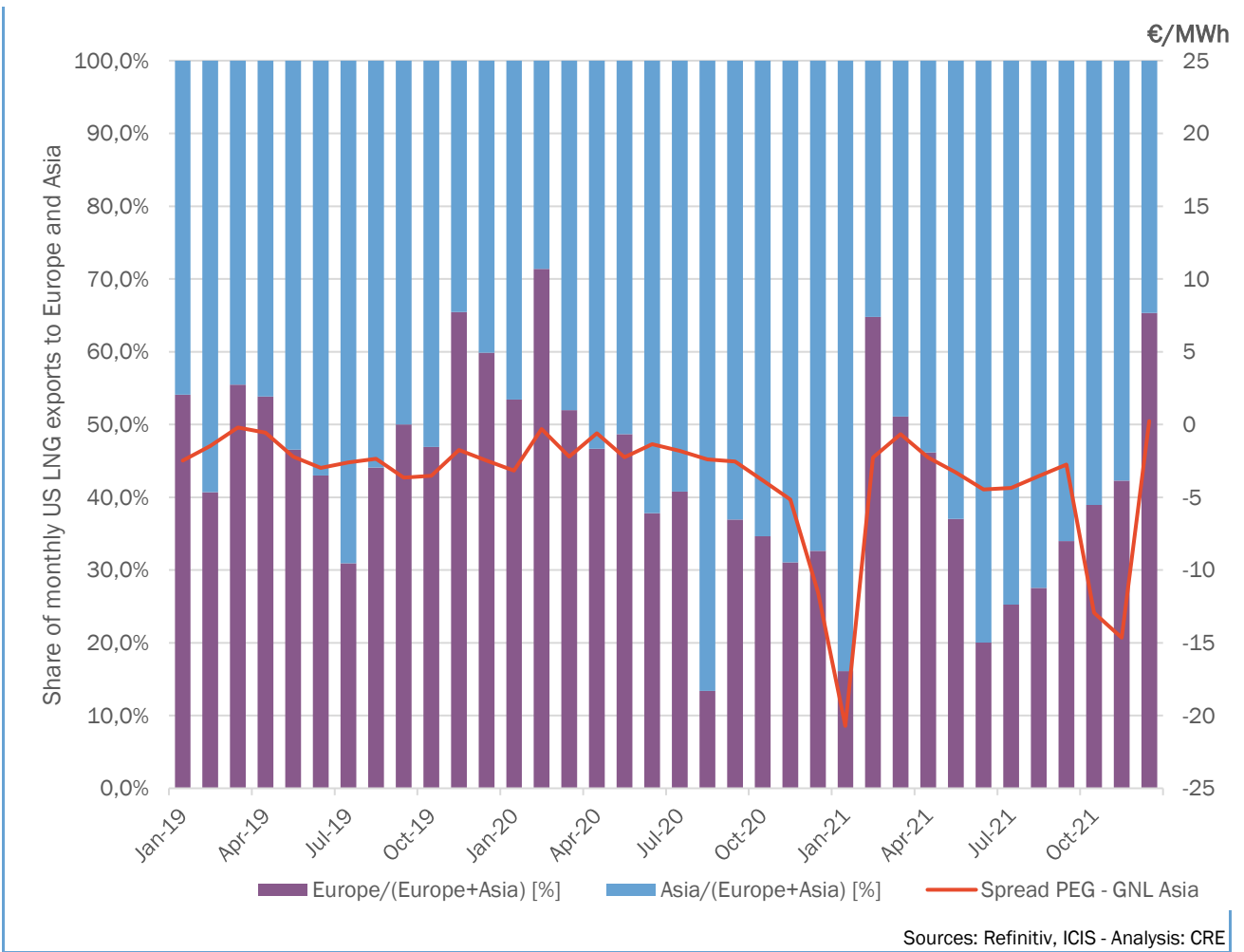
Figure 14: LNG imports by European Union country



Sources: Refinitiv, GRTgaz - Analysis: CRE

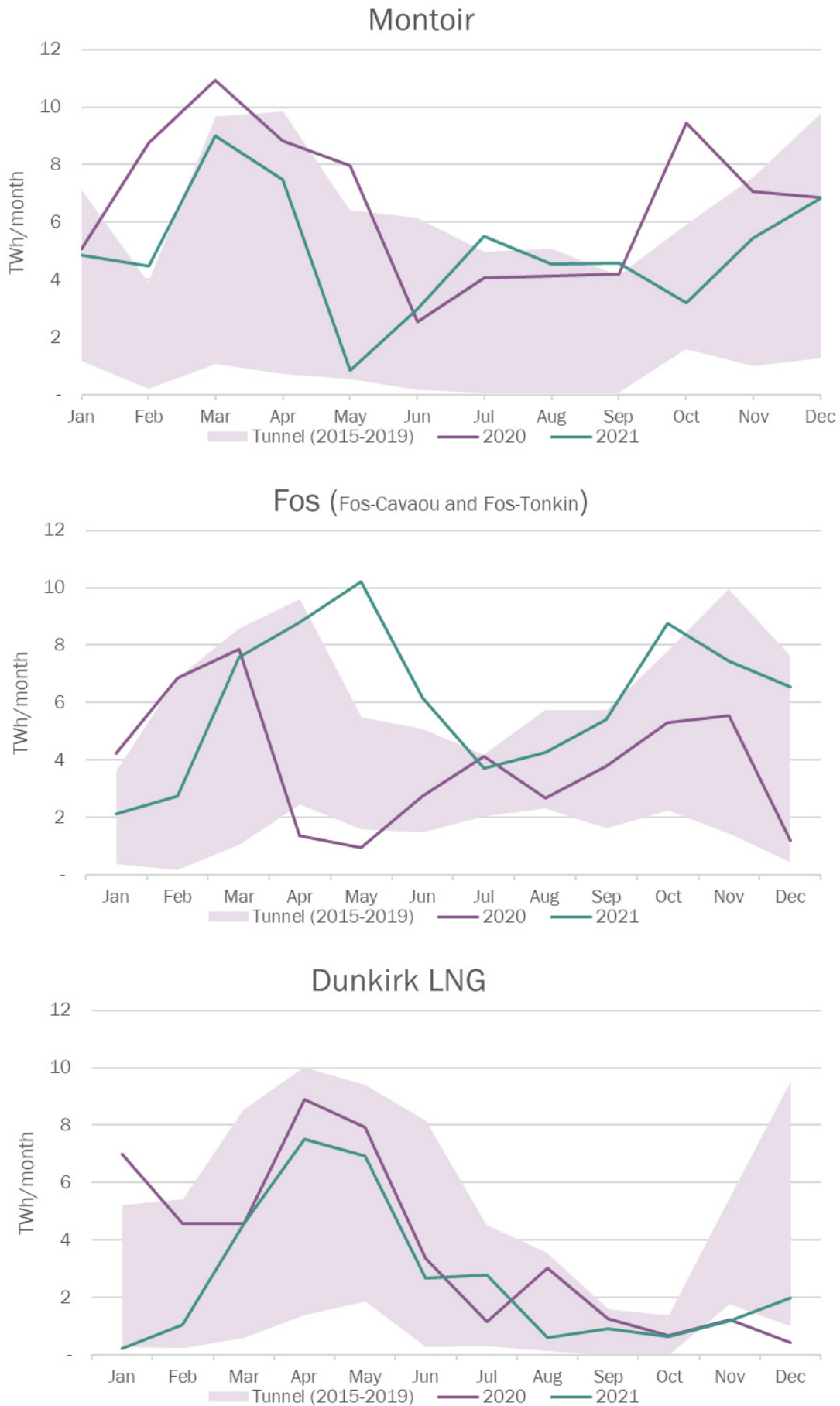
Figure 15: Share of monthly US LNG exports to Europe and Asia





Emissions from the Montoir LNG terminal on the French network were down by 28.7% relative to 2020, while those from the Fos and Dunkirk terminals recorded increases of 13.7% and 3.0% respectively. The Montoir terminal underwent a technical incident in May 2021 which temporarily made gas send-out capacity on the transmission network unavailable.

Figure 16: Emissions from LNG terminals (commercial flows)



Source: GRTgaz - Analysis: CRE



1.5 France's gas pipeline supply was resilient in 2021, with the beginning of a rebalancing linked to more frequent south-to-north flows than in the past

Pipeline imports totalled 361 TWh in 2021, 11 TWh more than in 2020 (+3%). The utilisation rate of the Dunkirk interconnection point between Norway and France increased by 4%. It can also be seen that the utilisation rate of PIV Obergailbach from Germany to France has increased by 14%. The 24.4% annual decrease in Russian gas exports to Europe in 2021 does not seem to have affected French imports via this interconnector. The interconnection at the PIV Pirineos between Spain and France remains predominantly used on the exit side, but shows for the first time in 2021 a strong increase in the use of the entry side. The opposite trend can be observed at the Virtualys interconnection between France and Belgium, with a decrease in entry usage and an increase in exit usage.

Pipeline exports totalled 72 TWh in 2021, 32% less than in 2020, mainly due to the sharp drop in the utilisation rate of PIV Oltingue (-39%) at the exit point to Switzerland, which is explained by the 44% annual drop in the positive spread between gas prices at the PSV (Italy's gas exchange point, downstream of the Oltingue gas exports) and at the PEG

Overall, gas flows in France will remain predominantly north-south in 2021. However, a rebalancing can be observed, with a strong growth in flows from the south to the north linked to frequent episodes in the second half of the year of lower prices in the south of Europe than in the north.

This phenomenon was reinforced at the beginning of 2022. The worrying outlook for Russian gas supply led Europe to rely heavily on LNG for its supplies, favouring the Iberian Peninsula and France, which have far greater LNG capacity than northern Europe.

Figure 17: Rate of use of French interconnections (commercial flows)

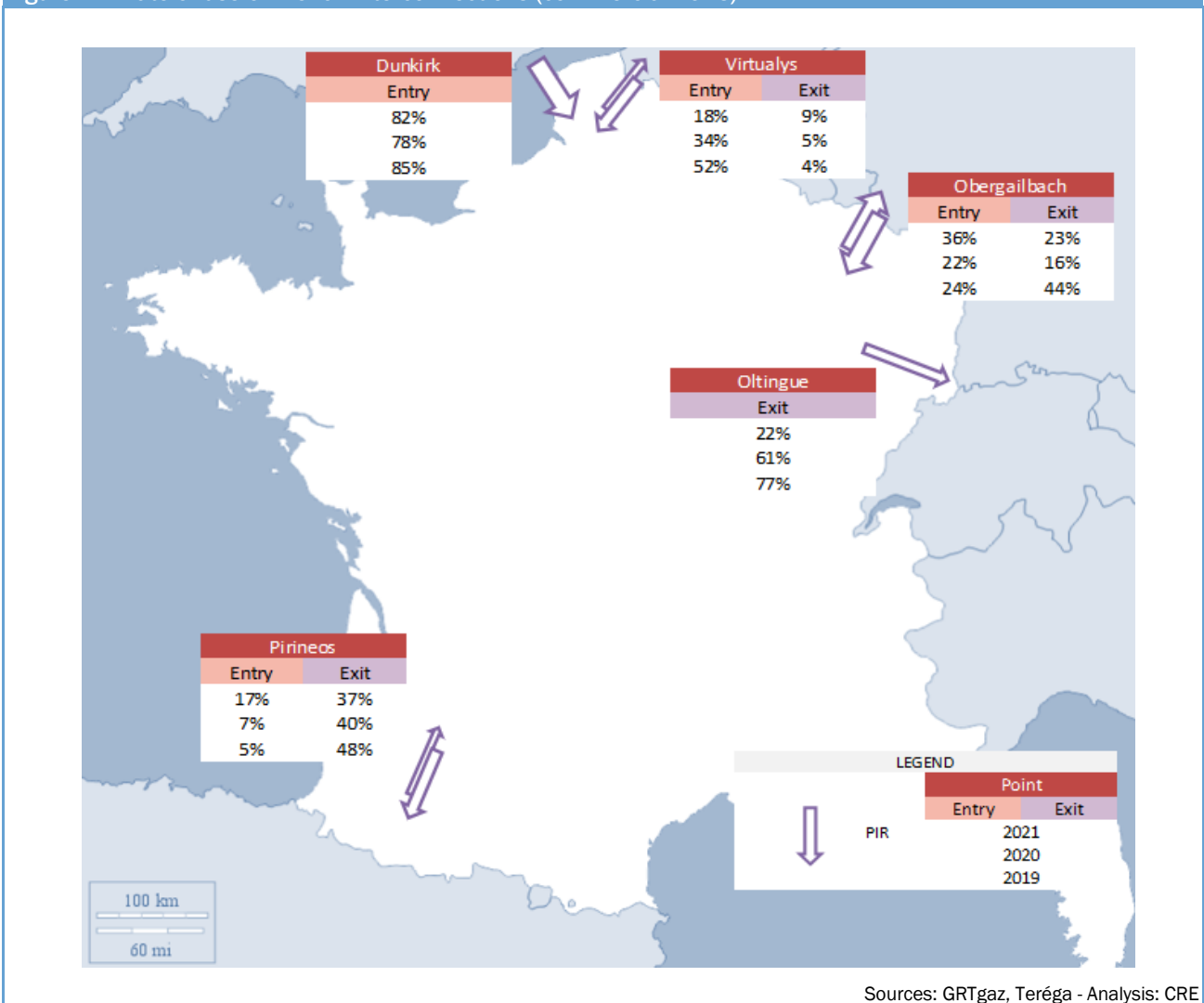
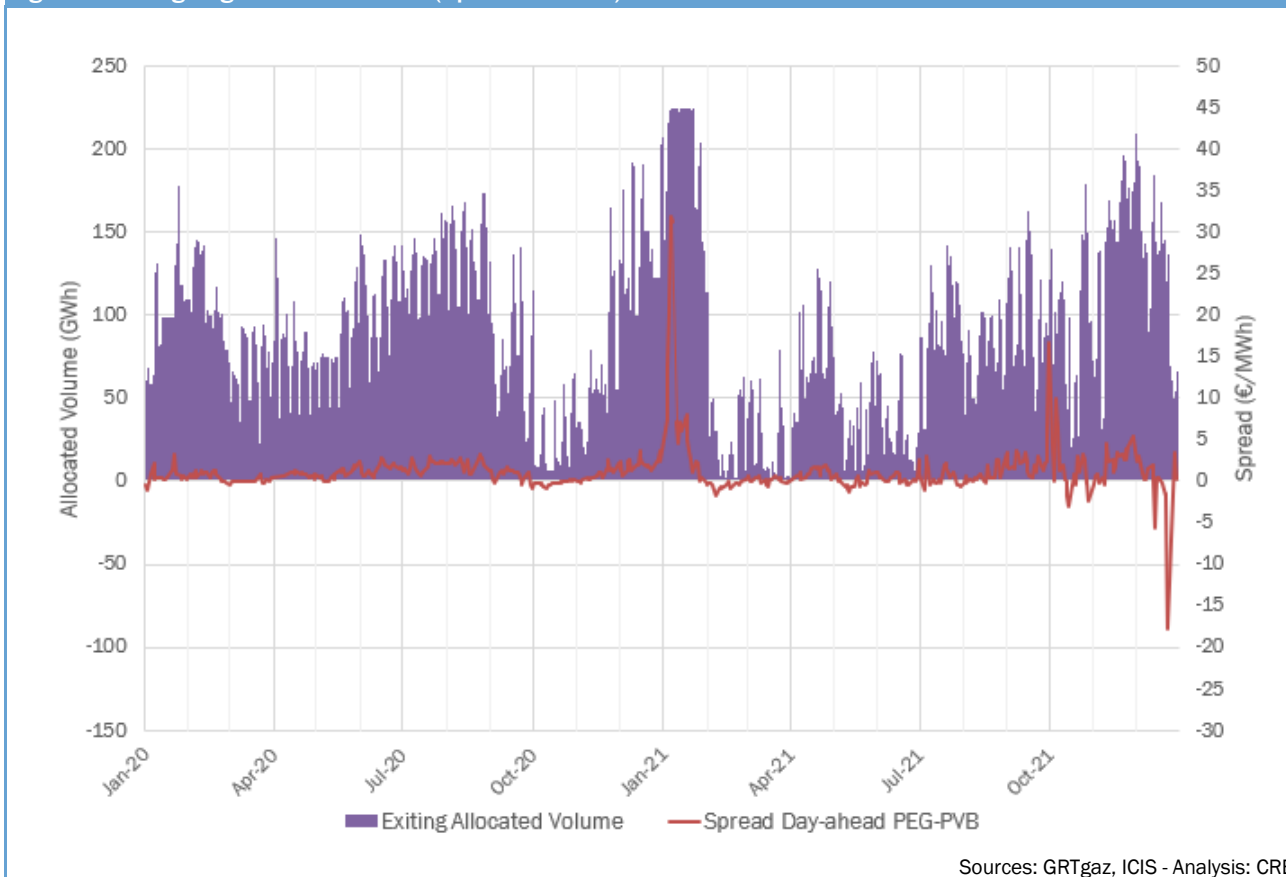


Figure 18: Outgoing flow via Pirineos (Spanish border)



1.6 The locational spread mechanism was used very little in 2021

Locational spread is a mechanism that has been implemented since the winter of 2017/2018 in order to manage congestion on the French gas network, mainly in the North to South main flow direction. The principle is to allow the transmission system operator to call on market players to buy gas upstream of the congestion and resell it downstream.

The tensest period for the network usually corresponds to the gas summer (April-October), characterised by shippers' injections into storage facilities in preparation for the following winter. As summer is a period of low national consumption, the main gas outflows from the French network correspond to injections into the Atlantic and Lussagnet storage facilities and to transit flows to Spain, all three of which are located downstream of the network and thus lead to congestion in a North-South pattern.

In 2021, the localised spread mechanism was triggered only once, in May, for a total allocated volume of 17 GWh. This continues the improvement from last year, when the mechanism was triggered 16 times (1807 GWh), compared to 44 times (659 GWh) in 2019. The average transaction price also continues to fall, from 4.0 €/MWh in 2019 to 1.4 €/MWh in 2020, then to 1.0 €/MWh in 2021.

As a result, the total cost of the mechanism decreased significantly in 2021 compared to previous years. It amounted to 17,000 €, compared to 0.9 M€ in 2020 and 7.2 M€ in 2021.

This improvement is likely related to the rebalancing of flows mentioned earlier.

Table 3: Balance of the activation of localised spread in 2021

	Total 2020	Total 2021
Number of activations	16	1
Total volume allocated (GWh)	659	17
Average transaction price (€/MWh)	1,4	1,0



2. 2021 WAS A YEAR OF RECORD GAS PRICES

2.1 The European economic climate has been strongly bullish on 2021

In 2021, pipeline supply in Europe was mainly from Russia (52.0%) and Norway (37.2%), with the remainder coming from North Africa (16.8%) or Azerbaijan (3.1%).

The year 2021 has been marked by numerous disruptions in the supply of the two main supplier countries. Indeed, the Russian supply to Europe⁴⁶ fell by 24.4% relative to the average for the last three years. This drop was more significant in the second half (-29.2%) than in the first (-19.6%), which contributed to a significant tightening of the European market before the start of winter. Deliveries in the second half of the year were impacted in particular by an incident in August at the processing plant at the Novy Urengoy gas field, and by Gazprom's failure to subscribe additional transport capacity on various pipelines. Norwegian supplies were disrupted by incidents at Norwegian gas facilities. Compared to the average of the last three years, it was 3.3% lower in the first half of the year, but increased in the second half by 7.3%, as the Norwegian government allowed Equinor to increase its production by 2 bcm in the gas year 2021-2022 to respond to the European gas crisis.

LNG supply to Europe was tight throughout the year, due to sustained competition with Asia. The beginning of 2021 was marked by the cold snap in Asia, which led to a drop in LNG supply in Europe, due to the higher price levels offered by Asia. Driven by a need for injection into its storage facilities, Europe's LNG demand faced global competition in the following months. Asian demand remained buoyed by the strength of the continent's economic recovery and measures by China, Japan and Korea to ensure a minimum level of storage fill before the winter of 2021-2022. From mid-December onwards, very high prices in Europe, higher than those in Asia, allowed an inflow of LNG into Europe.

European storage facilities, which will be heavily used during the winter of 2020-2021, have shown below-standard stock levels throughout the year, which led to fears of a major supply-side crisis in Europe in the event of a cold winter and has contributed to tightening the European market.

In this context of tension and uncertainty, the market has been extremely sensitive to all announcements relating to gas supplies to Europe, particularly from Russia.

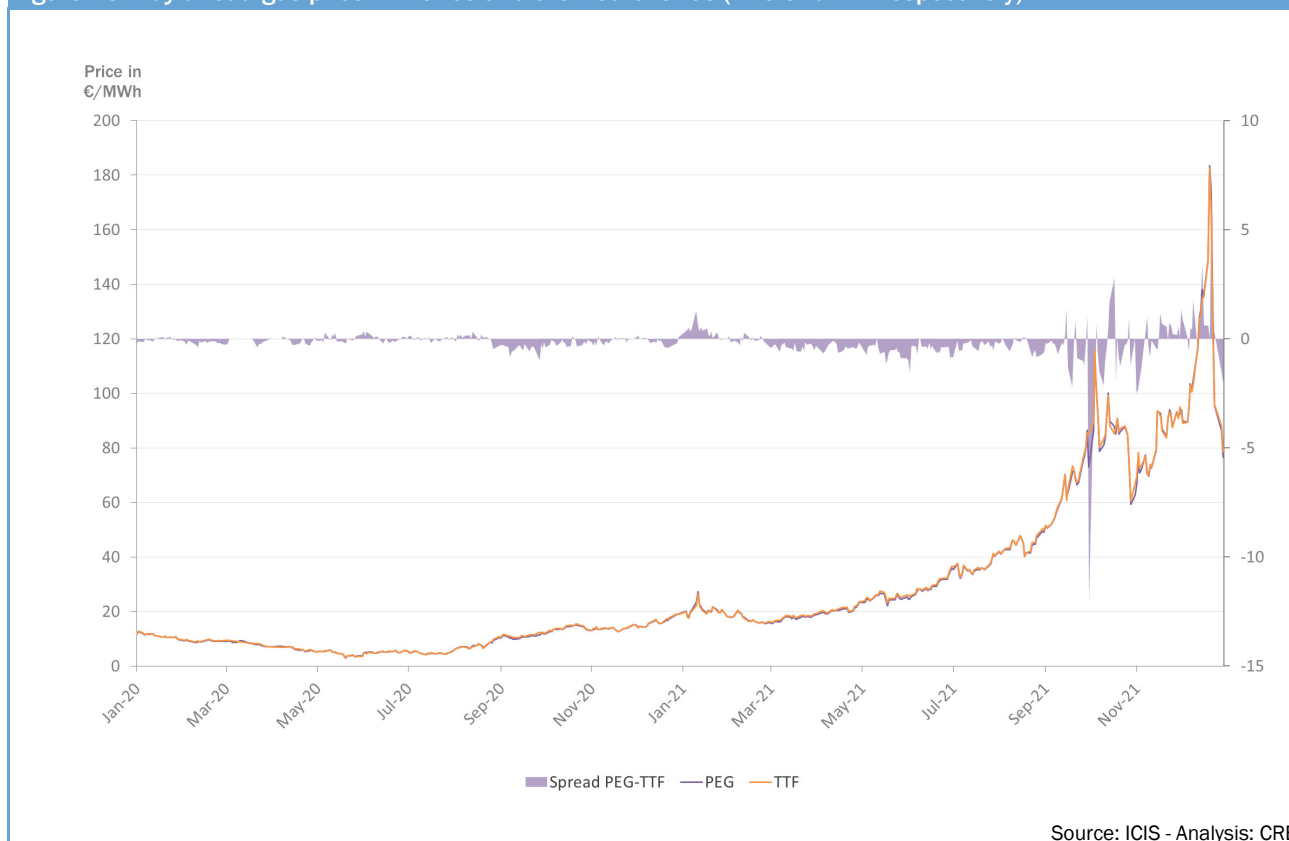
2.2 Short-term prices rise to record highs by year-end

For the year 2021, the average price of the PEG *day-ahead* (46.5 €/MWh) was around five times higher than in 2020 (9.3 €/MWh), and more than twice the historical average level of around 20 €/MWh. After reaching its historical low at the end of May 2020 (2.9 €/MWh), the PEG *day-ahead* reached an all-time high on 21 December 2021 (183.5 €/MWh) in an extremely tense year-end context.

The price differential between PEG and TTF contracts *day-ahead* was on average -0.16 €/MWh in 2021. The price discount at the PEG has indeed increased compared to 2020 (-0.10 €/MWh) and 2019 (0.06 €/MWh), but remains very low relative to the price level. However, the very significant price movements over the last few months of the year have led to greater variability in price differentials between trading points in Europe. As an example, the PEG discount compared to the TTF was 12.1 €/MWh on 1 October 2021.

⁴⁶ North West Europe, Poland and Hungary

Figure 19: Day-ahead gas price in France and the Netherlands (PEG and TTF respectively)



Source: ICIS - Analysis: CRE

2.3 Wholesale gas prices were driven up throughout the year by competition with Asia for LNG

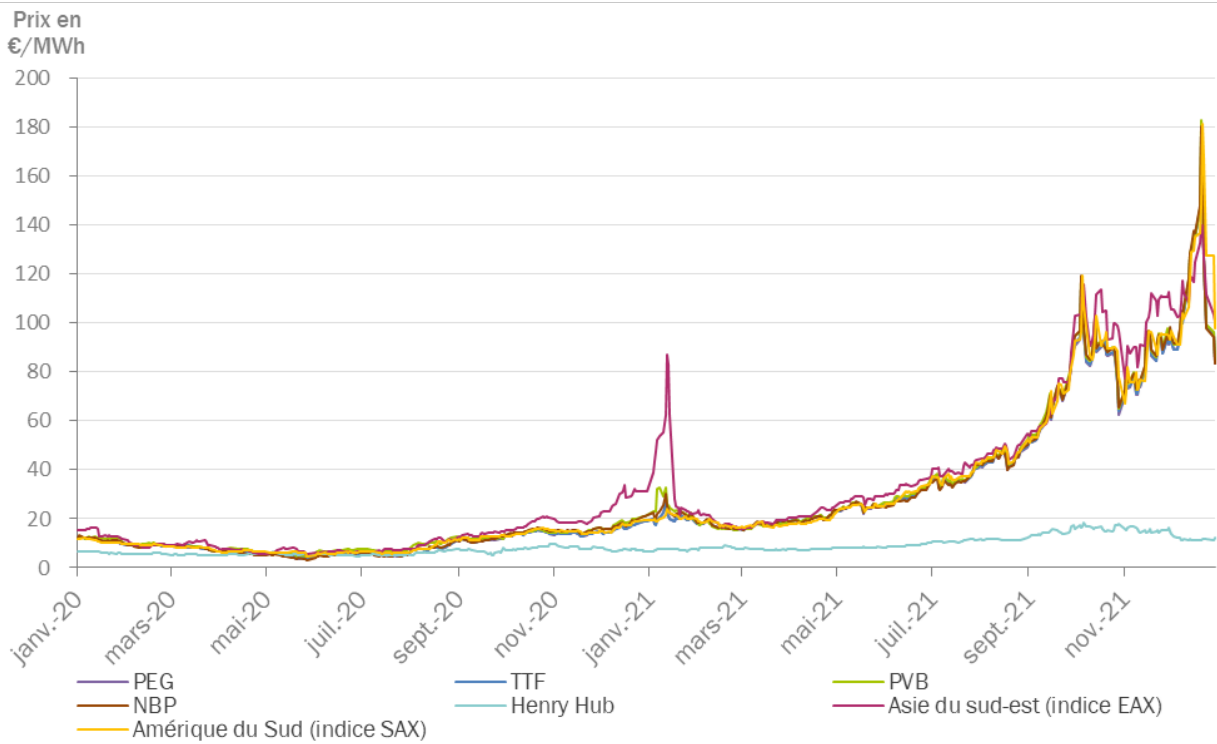
For monthly contracts, the *month-ahead* delivered to the PEG recorded an average price of 44.9 €/MWh over the year 2021 compared to 9.6 €/MWh in 2020, which is almost five times higher. In the context of the Asian LNG shortage at the beginning of 2021, European prices reached a peak on January 12 with a price of 21.9 €/MWh for the PEG *month-ahead*. However, this value is still much lower than the 86.9 €/MWh achieved on the same day for Asian LNG or PVB (32.9 €/MWh), a Spanish trading point whose prices are particularly sensitive to global LNG supply. The price of LNG delivered in Asia maintained a premium over the prices of European trading points for most of the year in order to meet demand on the continent. This price differential increased in October and November with the onset of winter, with a premium over the PEG averaging 13.8 €/MWh compared to an average of 4.9 €/MWh at the beginning of the year. However, the tension on the European market in mid-December was such that European prices were higher than Asian prices for eight days (on average 16.1 €/MWh), which led to a massive inflow of LNG into Europe at the end of the year. Finally, it is worth noting that while prices at the US Henry-Hub benchmark followed the overall upward trend in global gas prices in 2021, they declined in the last two months of the year amidst above-seasonal temperatures in the US, while global gas prices soared.

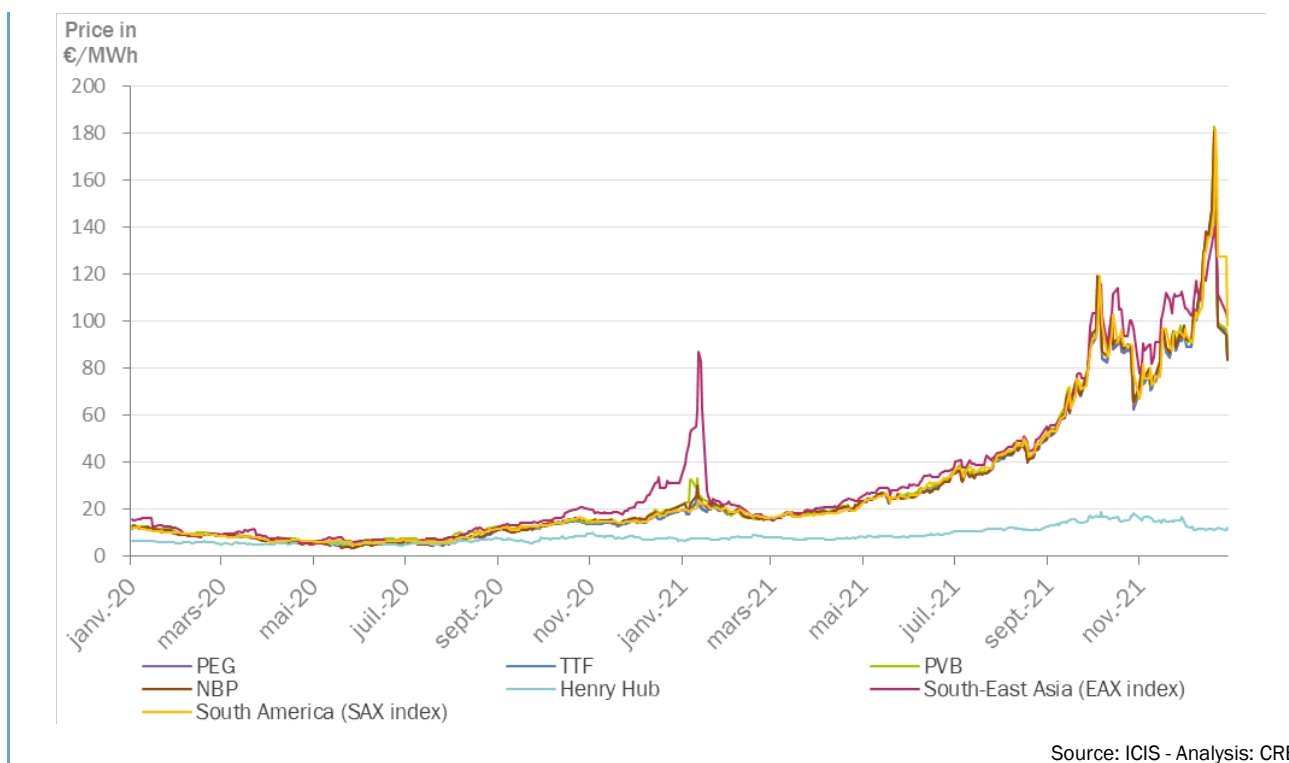
Figure 20: Day-ahead gas price in Europe



Sources: EEX, ICIS - Analysis: CRE

Figure 21: Month-ahead global gas price





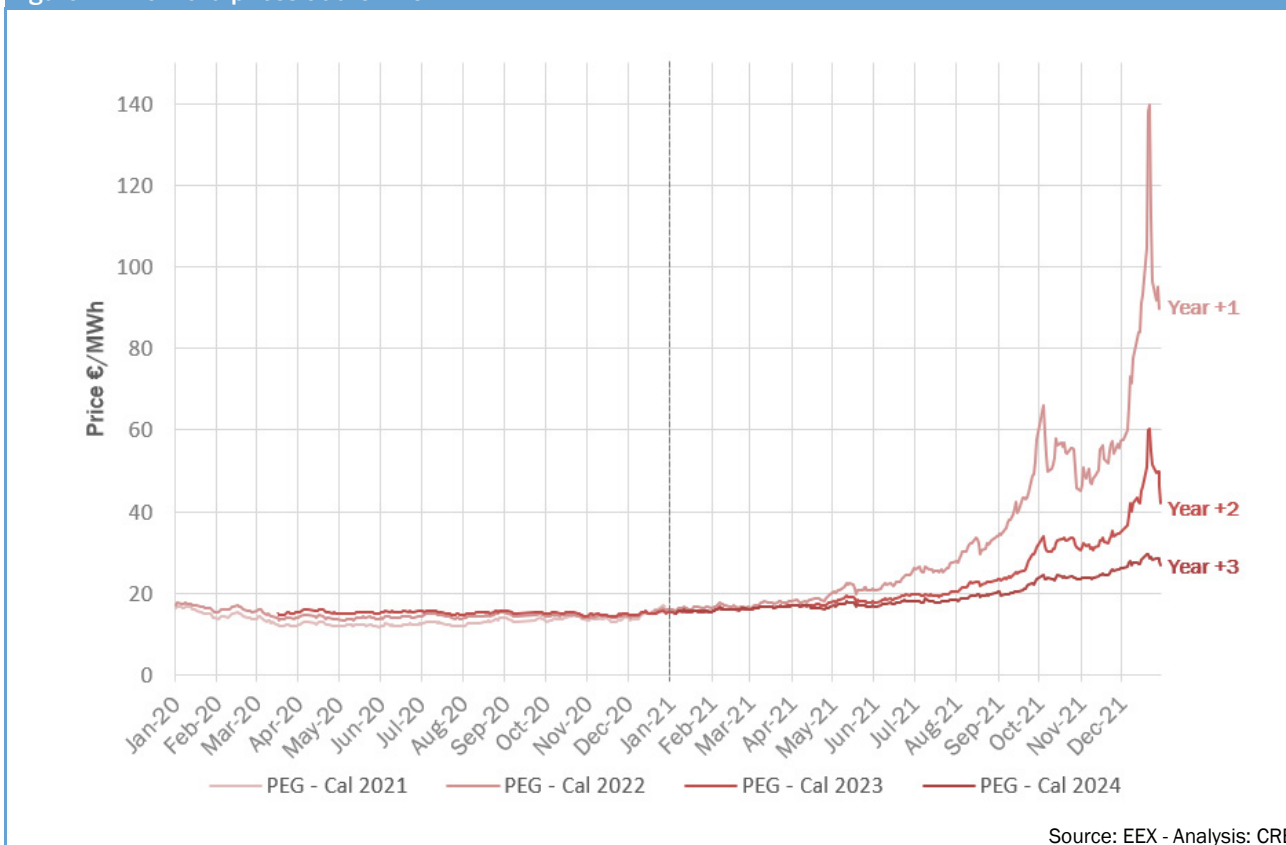
2.4 Futures prices rose in response to supply concerns

Forward gas prices have also seen a dramatic increase compared to 2020. The average price of the calendar contract delivered over the next year rose from 14.4 €/MWh to 33.7 €/MWh, an increase of 152%. Longer-term contracts also saw significant increases, of 59.0% for Y+2 and 28.9% for Y+3.

The structure of forward prices was for almost all of 2020 in *contango*, meaning that the contracts with a delivery period spanning later in time had higher prices than those with a delivery period coming earlier. One reason for this finding was the sense of uncertainty around the economic recovery following the 2020 health measures, which may have led market participants to question the speed of the recovery in demand.

As of December 2020, the situation has reversed and we there is a *backwardation*, meaning that the price levels of shorter-term contracts are higher than those at longer term. This phenomenon continued into 2021, when the price differential between contracts widened as the crisis worsened. This phenomenon continued into 2021, where the spread between contract prices widened as the crisis worsened, which had the effect of supporting the prices of contracts with earlier delivery periods in particular. For example, between the first and second half of 2021, the average spread between Y+1 and Y+2 contracts increased more than tenfold, and between Y+2 and Y+3 contracts more than sixteen fold.

Figure 22: Forward prices at the PEG



2.5 The price spread between summer and winter were unfavourable but did not prevent the allocation of almost all storage capacity in France

The year 2021 have been marked by a significant reduction in price spreads between contracts delivered in winter and summer of the same year. Indeed, tensions around supply have gradually reduced the price differences between Winter and Summer 2021 and Winter and Summer 2022 contracts, sometimes even leading to prices for Summer products being higher than those for Winter products.

The winter/summer 2021-2022 price spread observed a downward trend over the year, which however did not prevent the allocation of all the gas storage capacities for winter 2021-2022, the auctions of which ended in February 2021. All the capacities were subscribed for the third consecutive year, i.e. 128 TWh. The average auction price of this campaign was 1.91 €/MWh, which is lower than the 3.85 €/MWh of the previous year's injection campaign, which is consistent with the significant decrease of the average summer/winter price spread from one year to another. These good results also confirm the proper functioning of the auction terms set by the CRE, with a significant number of shippers participating in the auctions once again.

On the winter/summer 2022-2023 price spread, it was overwhelmingly negative from mid-September 2021 to the end of the year. However, this did not prevent almost all storage capacity (97% as of 20 April 2022) from being subscribed for winter 2022/2023 at the end of the marketing year.

Figure 23: Winter/summer price differential in France



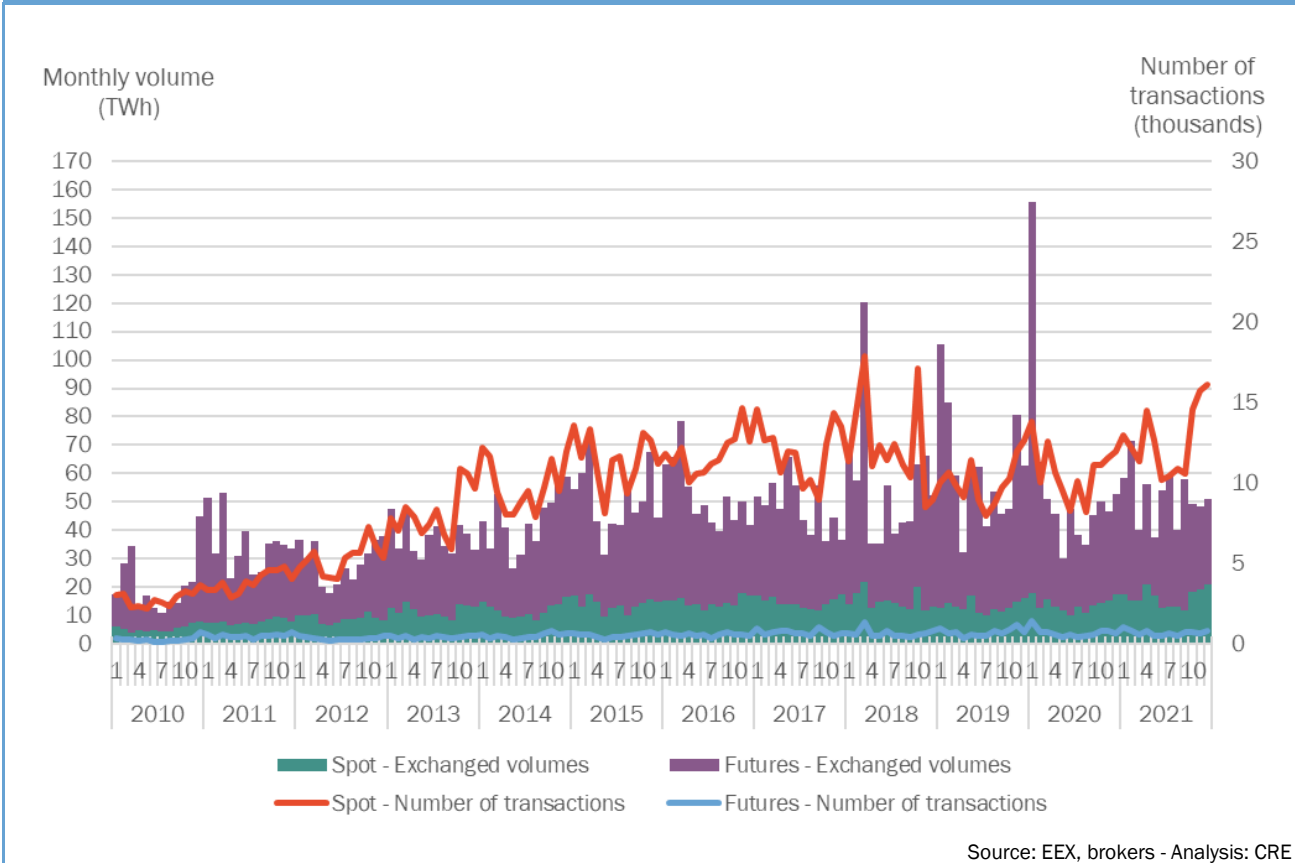
Source: ICIS - Analysis: CRE

3. THE GRADUAL SHIFT TO SHORTER-TERM TRADING CONTRACTS CONTINUES, SUSTAINED BY HIGH PRICES

In 2021, the total traded volume of *spot* contracts continued to grow (+6.9 and +0.5% respectively compared to 2020 and 2019). This increase is reflected in the growing number of transactions for these contracts (+19.6 and +27.2% vs. 2020 and 2019, respectively).

That of futures contracts continues to decline (-0.5% and -17.2% relative to 2019 and 2020, respectively). The number of traded futures transactions is up slightly (respectively +11.2% and -2.8% relative to 2019 and 2020). These observations are in line with the trend observed in recent years in the wholesale energy markets, which shows a gradual shift in trading towards shorter-term products. In addition, the very strong price increase may have limited the appetite for forward products, with the associated cash flow requirements (margin calls) becoming increasingly high.

Figure 24: Evolution of the volumes traded and the number of transactions on the French intermediated market



The growth in the share of shorter-term maturities in the French market continues with an increase in the share of *day-ahead*, *weekend* and *month-ahead* in the total volume traded over the year (respectively +4.6%, +1.7% and +4.5% market share in 2021 compared to the average of the previous three years).

The share of volumes traded for contracts with longer maturities in the total volume traded over the year was down overall, with a respective drop of -7.5% for the seasonal contract and -3.2% for the calendar contract compared to the average of the last three years.

The price increase in 2021 will have led to an increase of 119.4% in the total amount in euros of transactions carried out over the year compared to the average of the previous three years. When compared to 2020, which showed the lowest price levels ever recorded, this increase amounts to 232.3%.

Figure 25: Volumes and values traded by product on the intermediated market

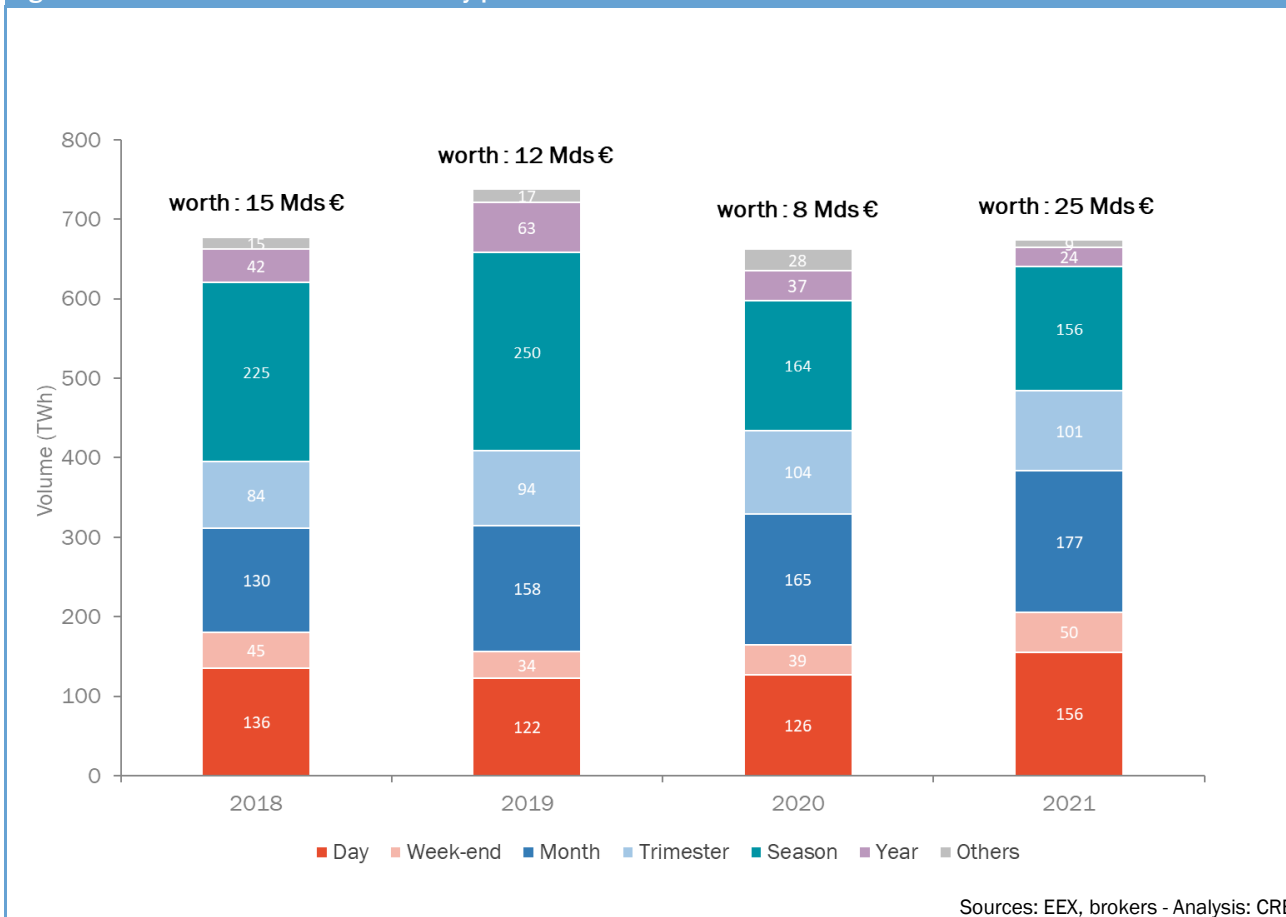
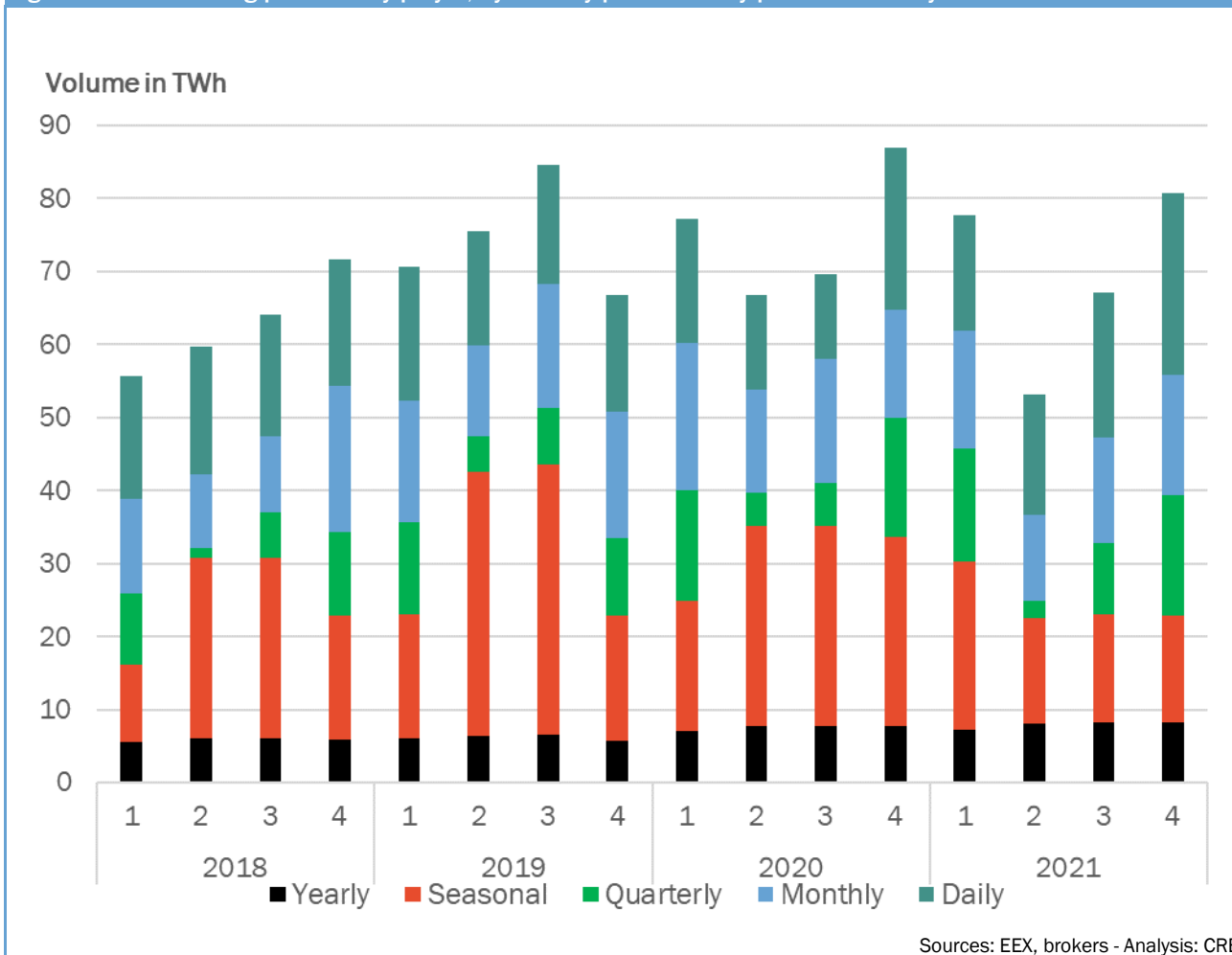


Figure 26 shows the quarterly sum of net physical positions per market participant on the wholesale markets in France by delivery period and by product maturity. Since the exchanges considered do not involve imports or exports, the sum of net buying positions is equal to the sum of net selling positions.

It can be seen that the sum of the net positions is significantly lower than the transaction volumes (Figure 24 and Figure 25), which is explained by successive purchases and sales of the same product by the same player, which offset each other when calculating the net position. This difference may reflect the level of market liquidity.

The total volume of market participants' positions showed a slight decrease of -1.6% relative to the average of the last three years. Seasonal contracts show the largest decrease in volume with -28.8%, especially for the summer product. On Q4 of 2021, during which prices reached exceptional levels, the positions taken by the market players are slightly down but remain in the same range as the same quarters three years ago (-1.5%).

Figure 26: Sum of long positions by player, by delivery period and by product maturity



4. SUMMARY OF THE WHOLESALE GAS MARKETS IN FRANCE IN 2021

The year 2021 has been marked by a strong tension on gas supply in Europe for political reasons, raising fears of a major supply-side crisis in Europe in the winter of 2021-2022 and leading to unprecedented price levels.

After having heavily relied on its storage facilities during the winter of 2020-2021, Europe has seen sustained demand for filling its storage facilities throughout 2021. The European gas market has been affected by Gazprom's failure to fill its storage facilities in Western Europe (excluding France), and by the decline in gas deliveries in Europe, whereas a normal commercial player seeks to increase its deliveries when prices rise.

As Gazprom is the European Union's main external supplier of gas and is essential in the short term for security of supply in Europe, this situation led to a major disruption in the functioning of the gas market in Europe.

In addition, European wholesale prices have shown in 2021 extreme sensitivity to various announcements connected with the behaviour of Gazprom. Such a situation is, by its nature, conducive to market manipulation and insider trading on a European scale.

Under these exceptional circumstances, the CRE is not in a position, unlike in previous years, to ensure with a reasonable degree of confidence that the wholesale gas market has functioned satisfactorily in 2021.

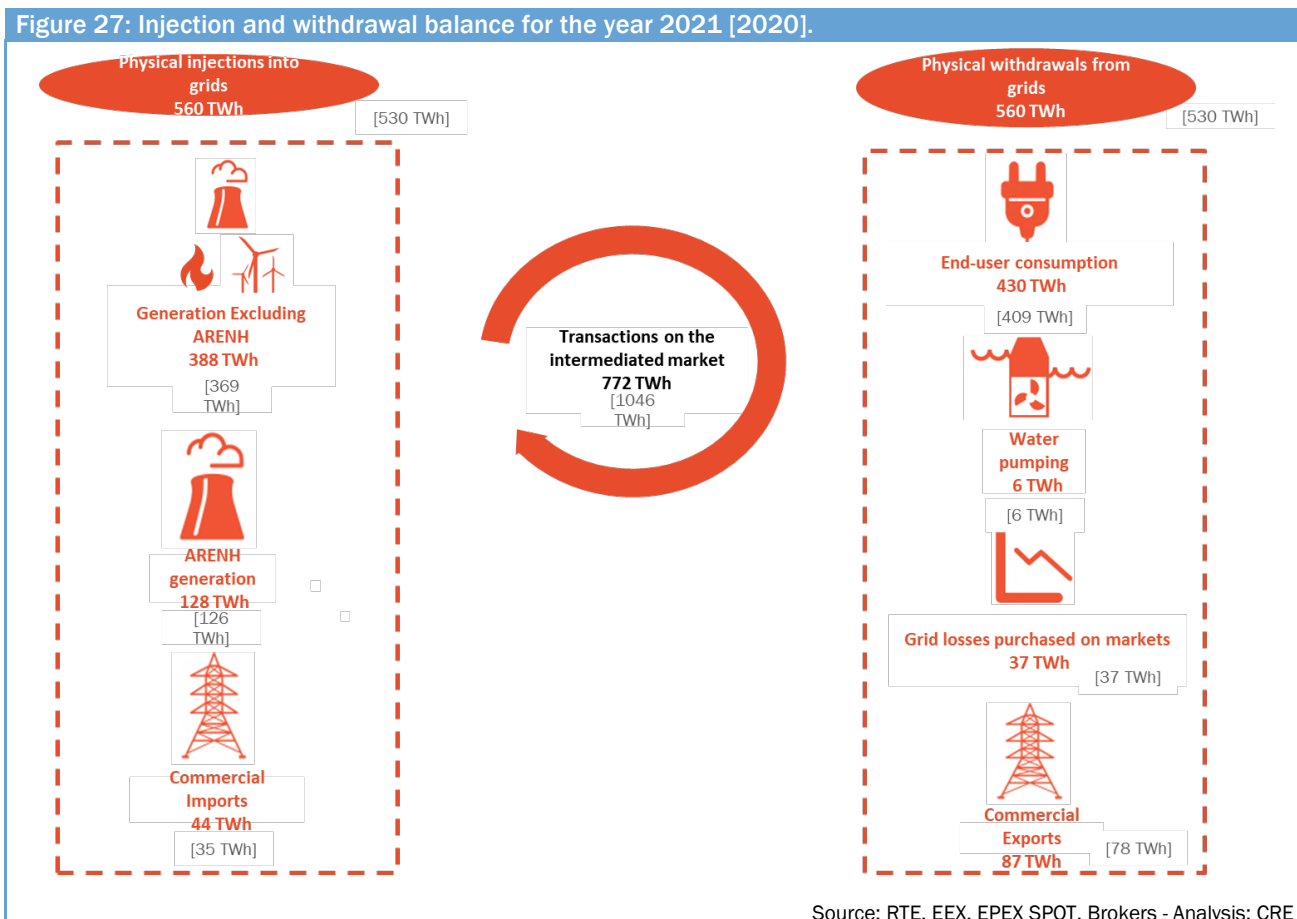
SECTION 4 WHOLESALE ELECTRICITY MARKETS

1. SUPPLY AND DEMAND TRENDS IN FRANCE IN 2021

The wholesale electricity markets in 2021 are firstly marked by the recovery of economic activity after a year 2020 heavily impacted by the COVID-19 pandemic. This recovery led to an increase in consumption and availability of nuclear power.

However, at the end of the year, the decline in nuclear availability pushed production down again and led France to import more to meet consumption.

The following graph shows a simplified view of the main flows for the year 2021 on the French power system and compares them to the figures for 2020 (in square brackets).



Injections into the network have increased significantly, with a rise of 5.6%, from 530 TWh to 560 TWh. This increase is largely due to the recovery of end-customer consumption, but also to greater exports, particularly in the spring and summer of 2021.

ARENH⁴⁷ subscriptions for delivery in 2021 remain stable at 126 to 128 TWh (including 28 TWh for covering losses on the networks) due to the fact that the 100 TWh ceiling for suppliers to end customers excluding losses has been reached.

All sectors combined, total electricity production in France is on the rise again, but remains below historical levels at 522 TWh⁴⁸ (+4.5% relative to 2020 but -2.8% relative to 2019). The French generation balance sheet remains dependent on the availability of the nuclear park, which was poor at the end of the year.

However, France still has a positive export trade balance in 2021 of 43.1 TWh, stable compared to 2020 (43.2 TWh) but down compared to 2019 (55.7 TWh).

⁴⁷ Regulated Access to Historic Nuclear Electricity (ARENH) is a system that came into force on 1 January 2009.^{er} July 2010 forcing EDF to sell part of its nuclear electricity to alternative suppliers at regulated prices of 42 €/MWh in 2021.
⁴⁸ Electricity balance sheet 2021, RTE



Figure 28: Quarterly volumes traded at borders



Source: RTE - Analysis: CRE

1.1 Consumption to resume in 2021 after the health crisis

The year 2021 saw a recovery in consumption in a context of improvement in the health crisis and cooler temperatures than in 2020 (which had been the warmest year since 1900). Gross consumption in 2021 was 472 TWh (449 TWh in 2020, an increase of 5.1%) (Figure 29).

Corrected consumption⁴⁹ by RTE in France in 2021 is up compared to 2020, amounting to approximately 468 TWh⁵⁰ (460 TWh in 2020), an increase of 1.7%. This increase is explained by the economic recovery, as the health crisis had a strong impact on consumption in 2020. However, adjusted consumption is still 1.2% lower than the pre-crisis level in 2019 (477 TWh).

⁴⁹ To facilitate structural comparison from one year to the next, RTE corrects consumption by taking into account climatic contingencies and calendar effects. Indeed, in France, electricity consumption is strongly dependent on temperature. Electricity is consumed both for heating in winter (France is equipped with a large number of electric heaters) and for air conditioning in summer (but the effect is more marginal). In addition, since 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.

⁵⁰ See RTE 2021 electricity balance: <https://bilan-electrique-2021.rte-france.com/>.



Figure 29: Gross consumption in France (weekly average)



1.2 Nuclear production returns to normal levels in 2021, but the discovery of irregularities at the Civaux plant brings the availability of the nuclear park to historic lows at the end of the year

1.2.1 The consequences of the health crisis continue to disrupt an already busy maintenance schedule for the nuclear park

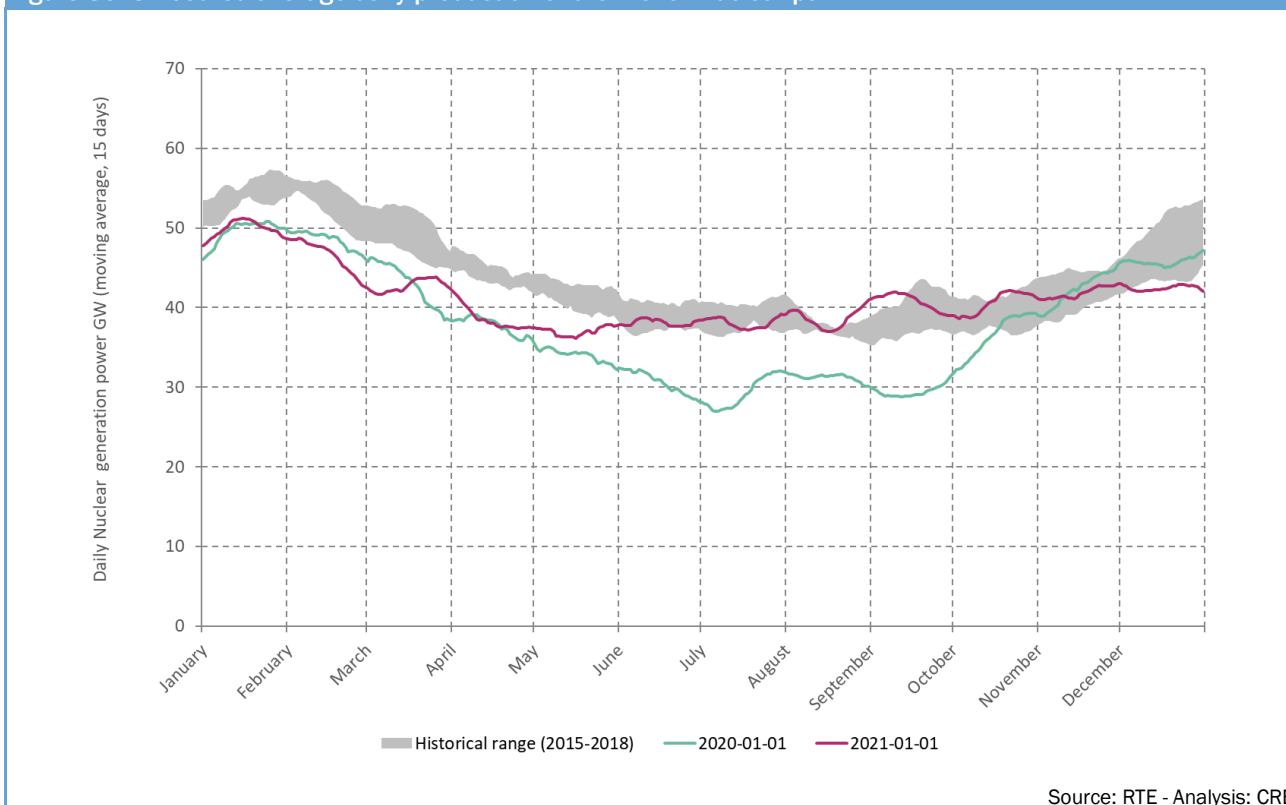
Before the health crisis, the year 2021 had already been identified⁵¹ as involving a heavy maintenance schedule for the park. Between 2021 and 2025, 32 nuclear units will undergo a ten-yearly outage, including seven in 2021 and seven in 2022 (compared to the usual five ten-yearly downtime).

In this context, the strict lockdown between March and May 2020 accentuated the unavailability of the French nuclear park in the short and medium term⁵², with "cascade" effects on scheduled downtime in the longer term: in order to avoid having too many investments shut down simultaneously, the shutdowns had to be rescheduled, while respecting operational constraints for fuel management and guaranteeing security of supply, particularly for the winter of 2020-2021. In fact, EDF has carried out, as of March 2020, a total reconfiguration of the scheduled downtime of its nuclear power plants for the years 2020 to 2022.

⁵¹ See RTE's forecasted balance sheet since 2017: <https://www.rte-france.com/analyses-tendances-et-prospectives/les-bilans-prevision-nels#Lesbilansprevisionnels>

⁵² See 2020 Wholesale Market Monitoring Report: <https://www.cre.fr/Documents/Publications/Rapports-thematiques/rapport-de-surveillance-des-marches-de-gros-de-l-electricite-et-du-gaz-naturel-en-2020>

Figure 30: Smoothed average daily production of the French nuclear park



Thus, 2021 began with historically low park availability for the period (5 GW drop in availability from the low range in February/March 2021).

However, beginning in April 2021, park availability gradually improved to return to historical averages beginning in June 2021 and continuing through the end of November 2021.

The availability forecasts for the nuclear park have deteriorated significantly during the fall of 2021, prompting RTE to update its security of supply analyses⁵³. Several events took place, including⁵⁴:

- up to thirteen nuclear reactors were initially scheduled to be shut down in December 2021, seven of which were to be restarted before the end of the year (the other six are engaged in longer shutdowns, five of which are ten-yearly downtime);
- five of the seven downtime originally scheduled to end in December 2021 have had their outage duration extended;
- in addition, four reactors (Cattenom 4, Paluel 1, Belleville 1, Gravelines 4) were shut down in December for periods of two to three weeks;
- finally, on 15 December 2021, EDF informed of the detection of irregularities in the emergency injection circuit in the two Civaux reactors (which were shut down at the time). The identification of these faults led EDF to extend the shutdown of these two reactors to replace the faulty equipment (one of them was due to be restarted at the end of December), and also to shut down the two Chooz reactors, built using the same technology (N4 level - 1450 MW), for an in-depth inspection. This shutdown reduced the expected controllable power in January 2022 by 4.5 GW, at the worst time for the power system.

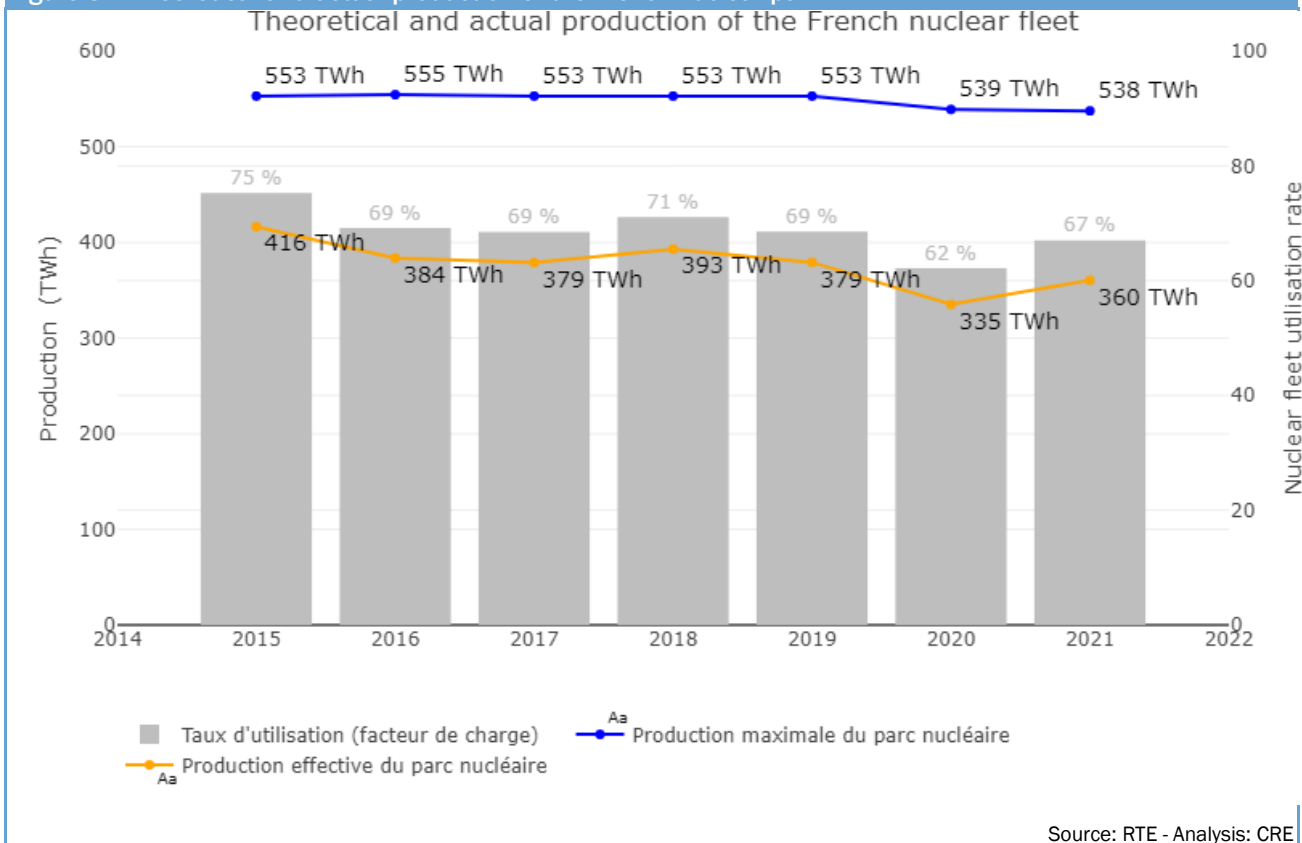
The year 2021 finally saw an 8% increase in nuclear generation (360 TWh) compared to the year 2020, which had an exceptionally low level of generation (335 TWh compared to 379 TWh in 2019).

Compared to 2019, production is down by 5%. Nevertheless, in 2019 the two Fessenheim units were still operating, so the effective utilisation rate of the park decreased by only 2%, from 69% to 67%.

⁵³ <https://www.rte-france.com/actualites/niveau-de-vigilance-sur-lapprovisionnement-en-electricite-rehausse-pour-le-mois-de>

⁵⁴ See https://assets.rte-france.com/prod/public/2021-12/Reactualisation_PDH_-_complete.pdf

Figure 31: Theoretical and actual production of the French nuclear park



1.2.2 Identification of the irregularity at the Civaux site could have a significant impact on the nuclear fleet

During the ten-year shutdown of the Civaux nuclear power plant's No. 1 reactor, which began on 21 August 2021, EDF conducted an ultrasonic inspection of several welds in the safety injection system (RIS).⁵⁵ The safety injection circuit is a backup system that injects boronated water into the main primary circuit of the reactor to cool the core in the event of a breach in the primary circuit. The objective is to maintain a sufficient level of water in the core to cool down the fuel.

Ultrasound inspections carried out on the Civaux No. 1 reactor revealed the presence of defects near the welds of certain pipe bends. At first glance, it seems to be stress corrosion cracking.

EDF has decided to preventively shut down the Civaux No. 2 reactor on 20 November 2021, in order to carry out early checks on welds, with the ten-year shutdown of the reactor scheduled for a few months later. The initial results of the checks on this reactor have revealed irregularities in the same welds as on reactor no. 1. As a result, EDF decided on 9 December 2021, to extend the shutdown of the core of reactor no. 2 in order to carry out extensive investigations and any repairs that might prove necessary.

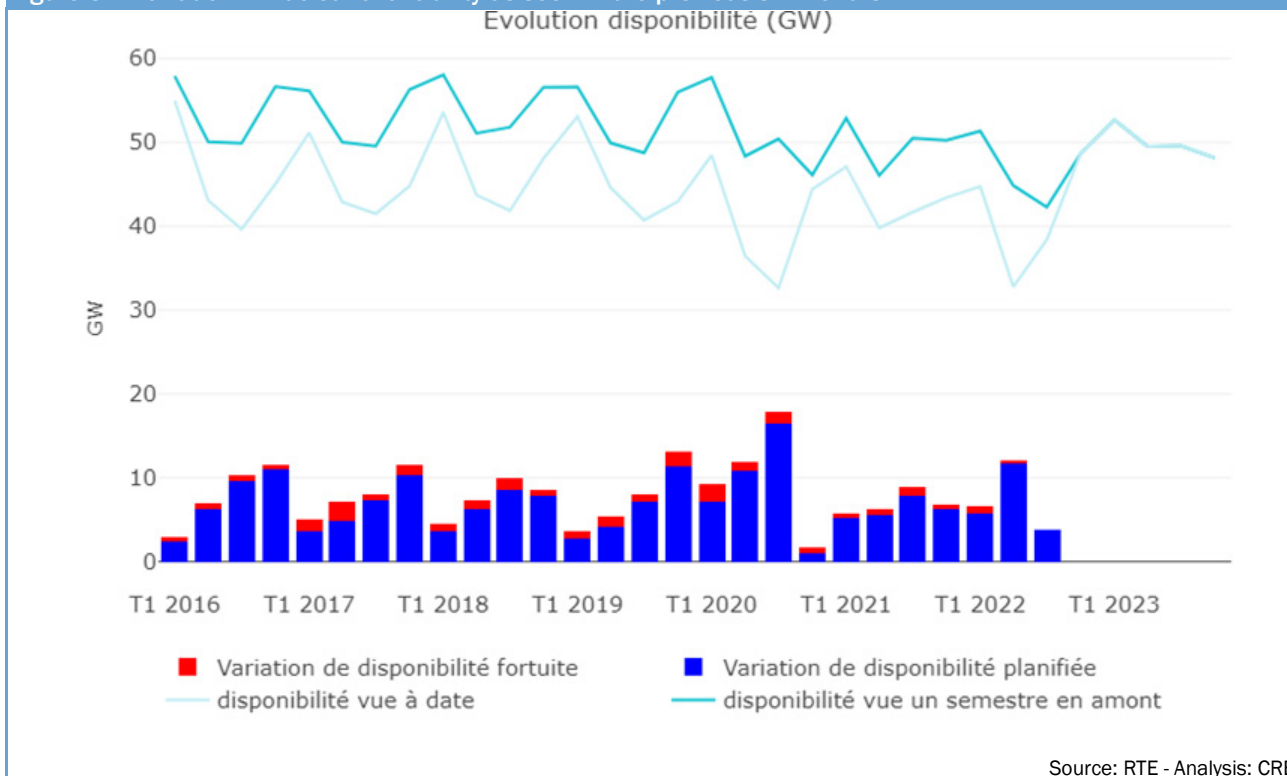
Since a generic irregularity relating to 1450 MW reactors cannot be ruled out, EDF decided on 15 December 2021 to shut down the two reactors of the Chooz B nuclear power plant, which are of the same type as the Civaux reactors, as a precautionary measure starting 16 December 2021, in order to carry out checks.

At this stage, the impact of this irregularity on 2021 has remained concentrated on the four N4 reactors. On average in Q4 of 2021, the actual availability of the park was 6.8 GW lower than that forecast six months earlier. This figure is high but remains within historical averages.

⁵⁵ https://www.irsn.fr/FR/Actualites_presse/Actualites/Pages/20211216_NI-Detection-fissures-tuyauteries-RIS-reacteurs-1-2-Civaux.aspx#.YhynUejMJPY



Figure 32: Variation in nuclear availability as seen in the previous six months



The difference between the actual and the forecast schedule should be more issued for 2022, where the forecast availability has already shown a significant drop. In fact, several elements tend to indicate that the incident at Civaux would also concern the 1300 MW reactors.

On 14 January 2022, during the third ten-yearly inspection of reactor no. 1 at the Penly power plant (1300 MW), an irregularity was identified near a weld on a portion of piping in one of the four lines of the safety injection system.

On 8 February 2022, analysis of the results of non-destructive examinations carried out during the last 10-yearly outage of the 56 reactors in the nuclear park and the results of the latest laboratory assessments led EDF to draw up a prioritised list of reactors on which inspections will be carried out with optimised resources, taking into account feedback from Civaux and Penly.

1.3 Evolution of installed capacities: the solar industry is accelerating its growth

The year 2021 was marked by the acceleration of the development of the solar park in France (+ 2.7 GW), an increase of 26% of the installed base compared to the end of 2020. This is the largest increase in photovoltaic power in France, as the average development rate was previously +12%/year, i.e. twice as low.

The wind farm also continues its development, recording an additional 1.2 GW (+7% relative to 2020). The rate of development stagnates and is below the average over the 2014/2020 period.

However, these growth rates are insufficient to achieve the national objectives. As a reminder, the target of the PPE⁵⁶ for renewable electricity generation is 24.1 GW in onshore wind power by 2023 and 33 GW by 2028. These targets for solar are 20 GW and 35 GW respectively. The installed base at the end of 2021 is 13.1 GW for PV and 18.8 GW for wind.

The installed capacity of fossil-fired power plants is decreasing (19 GW) due to the closure of the coal-fired plant in Le Havre. The decrease is expected to continue in 2022 due to the closure of the remaining coal-fired units (~ 2 GW),⁵⁷ included in the multi-year energy program (PPE) and confirmed by Law no. 2019-1147 of 8 November 2019 on energy and climate. However, in the light of the nuclear availability crisis, the closure of the last two coal investments will likely be postponed.

Installed hydraulic capacity is stable at 25.7 GW.

⁵⁶ Multiannual energy programs : <https://www.ecologie.gouv.fr/programmations-pluriannuelles-lenergie-ppe>

⁵⁷ There are only three coal-fired power generation sites left in France in 2020: Cordemais, Saint-Avold and Gardanne. Gardanne has been unavailable since the end of 2020.

Despite the development of wind and solar power, the production of renewable energies (excluding hydro) decreased slightly in 2021 to 60 TWh, compared to 61.5 TWh in 2020.

The main reason for this decrease is the drop in the load factor for wind power, which is set at 22.6% in 2021 compared to 26.3% in 2020, leading to a 7% drop in production despite the growth of the park.

The solar sector has also seen its load factor decrease (13.7% versus 14.7% in 2020). The important growth of the park has allowed an increase in production of 13%.

Table 4: Evolution of the installed capacity of renewable energy sources

	2014	2015	2016	2017	2018	2019	2020	2021	TCAM ⁵⁸ 2014/2021
Wind power (GW)	9,3	10,3	11,8	13,5	15,1	16,5	17,6	18,8	+ 10.6
Solar (GW)	5,3	6,2	6,8	7,7	8,5	9,6	10,4	13,1	+ 13.9

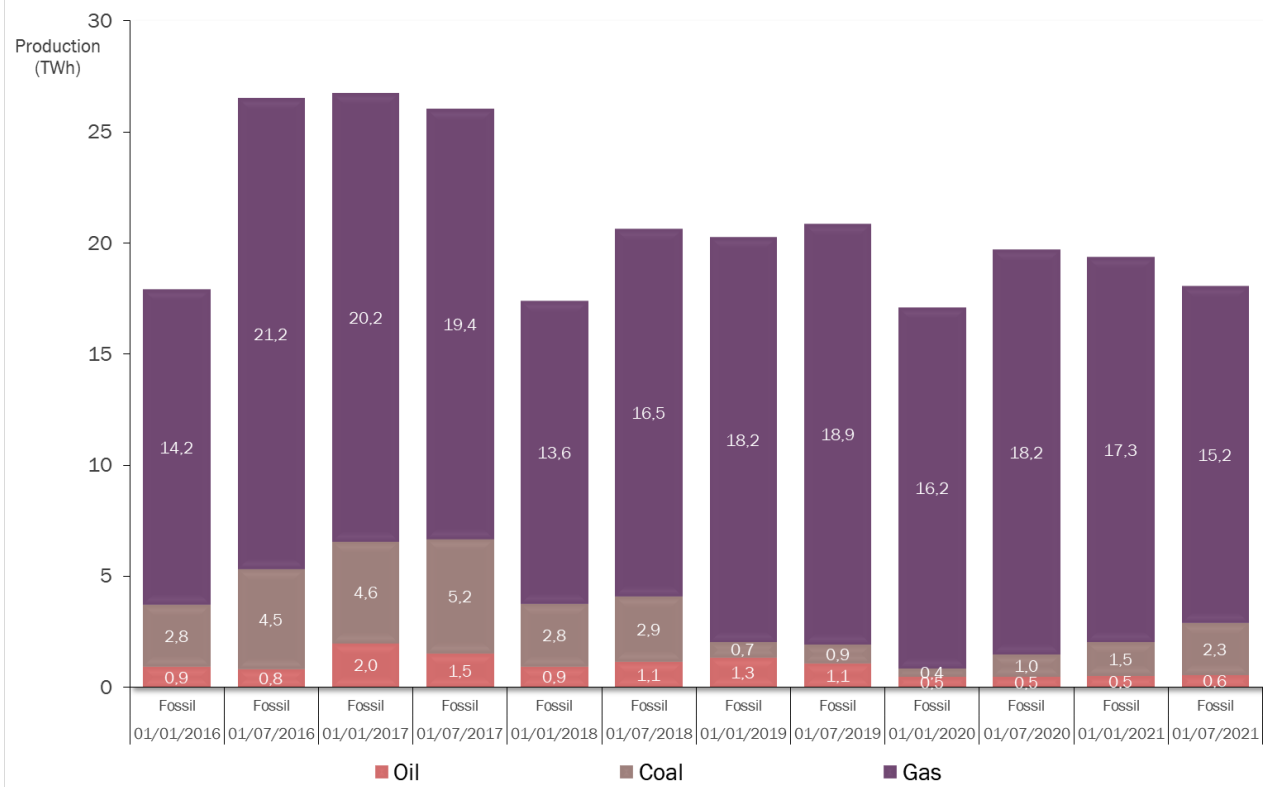
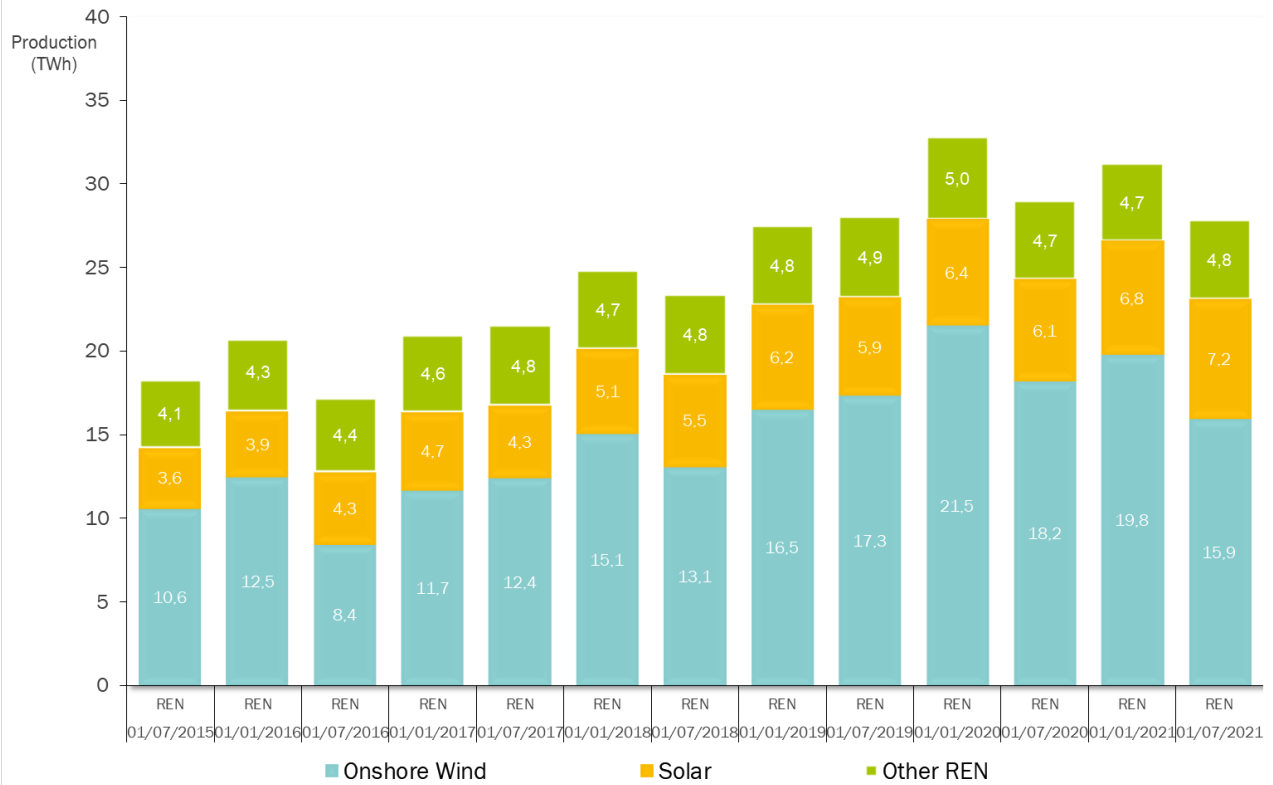
Figure 33: Comparative evolution of the installed capacities of renewable energies (excluding hydro) and fossil-fired energies (excluding nuclear)



⁵⁸ Average annual growth rates.



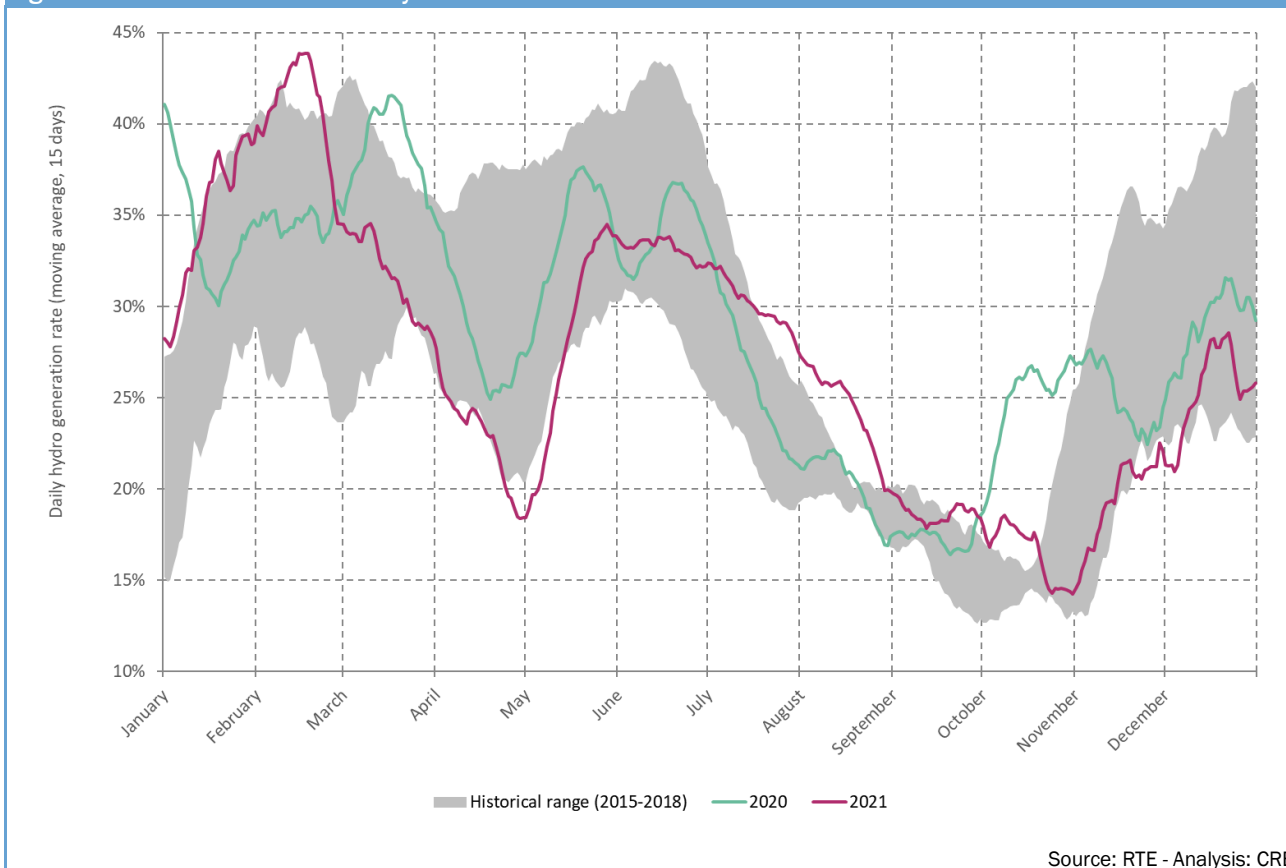
Figure 34: Comparison of the half-yearly productions of renewable energies (excluding hydro) and fossil thermal energies (excluding nuclear)



1.4 After being heavily used at the beginning of the year, the hydraulic stock ended the year at low levels

Due to the good hydrological conditions in 2020, the hydraulic stock in January 2021 was higher than in 2019 and 2018 (2.4 TWh). The hydropower industry was heavily relied on to compensate for the low availability of nuclear in January and February 2021, as shown in the following graph.

Figure 35: Production rate of the hydraulic sector



In parallel, precipitation was very heterogeneous⁵⁹. After a rainy January, precipitation was deficient until April with a deficit close to 50% in March and April. This deficit, coupled with high production, led to historically low stocks from May onwards.

Although the late spring and early summer saw a high level of precipitation over much of France, there were fewer disturbed passages thereafter and rainfall was deficient until late autumn, with deficits exceeding 30% in August and November. As a result, stocks remained at low levels until November.

The beginning of the winter of 2021-2022 was then marked by the return of very heavy precipitation and lower demand on the industry. Stocks returned to the historical low range at the end of the year.

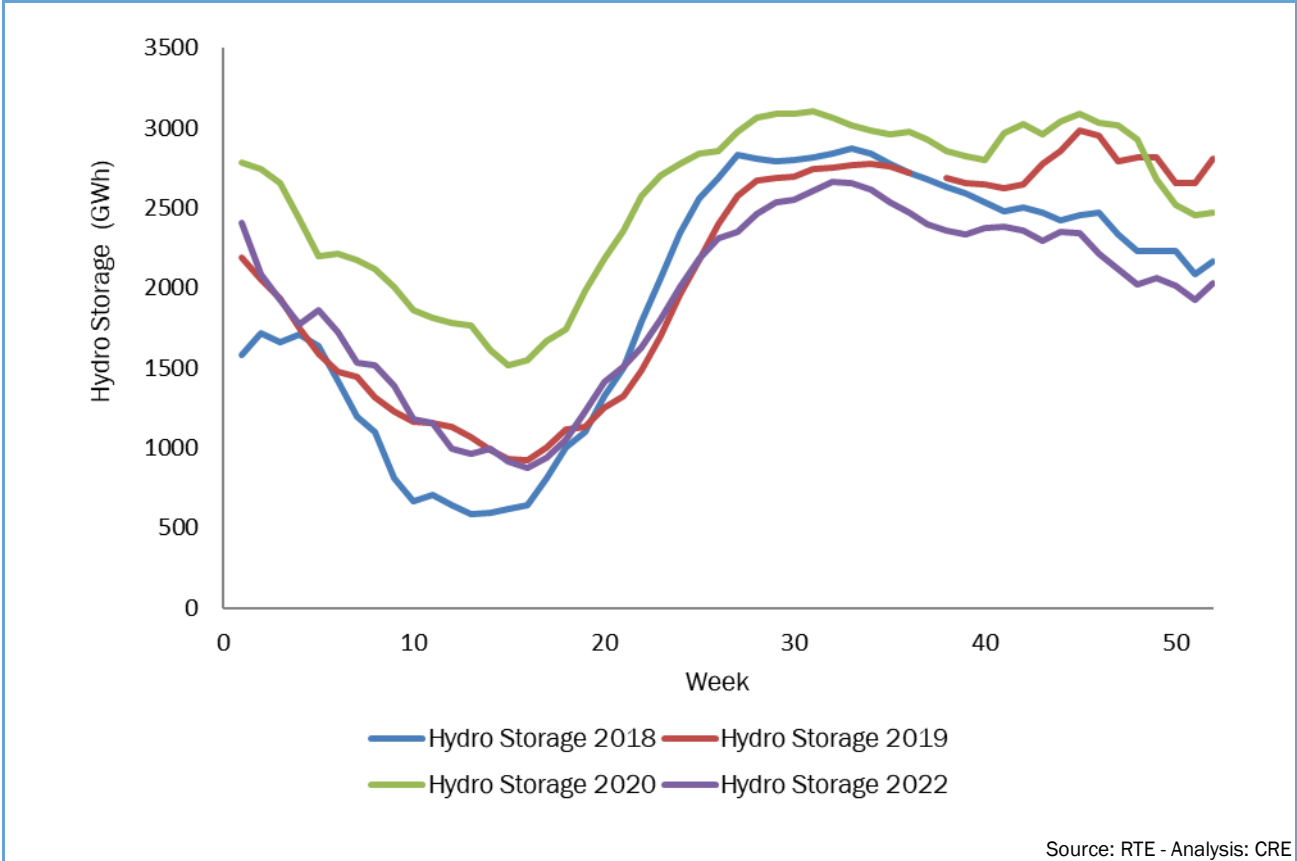
There are no specific unavailabilities in 2021.

Hydro generation (62.5 TWh) is slightly down compared to 2020 (-5%) and also compared to the generation average since 2012 (-2.4%). The technologies with the largest production falls compared to 2020 are lake power plants (-12%) and STEP (-8%).

Hydraulic stocks end 2021 at 2 TWh, the lowest level since 2017.

⁵⁹ Climate Report 2021, Météo France: <https://meteofrance.fr/actualite/publications/les-publications-de-meteo-france/2021-les-bilans-climatiques>

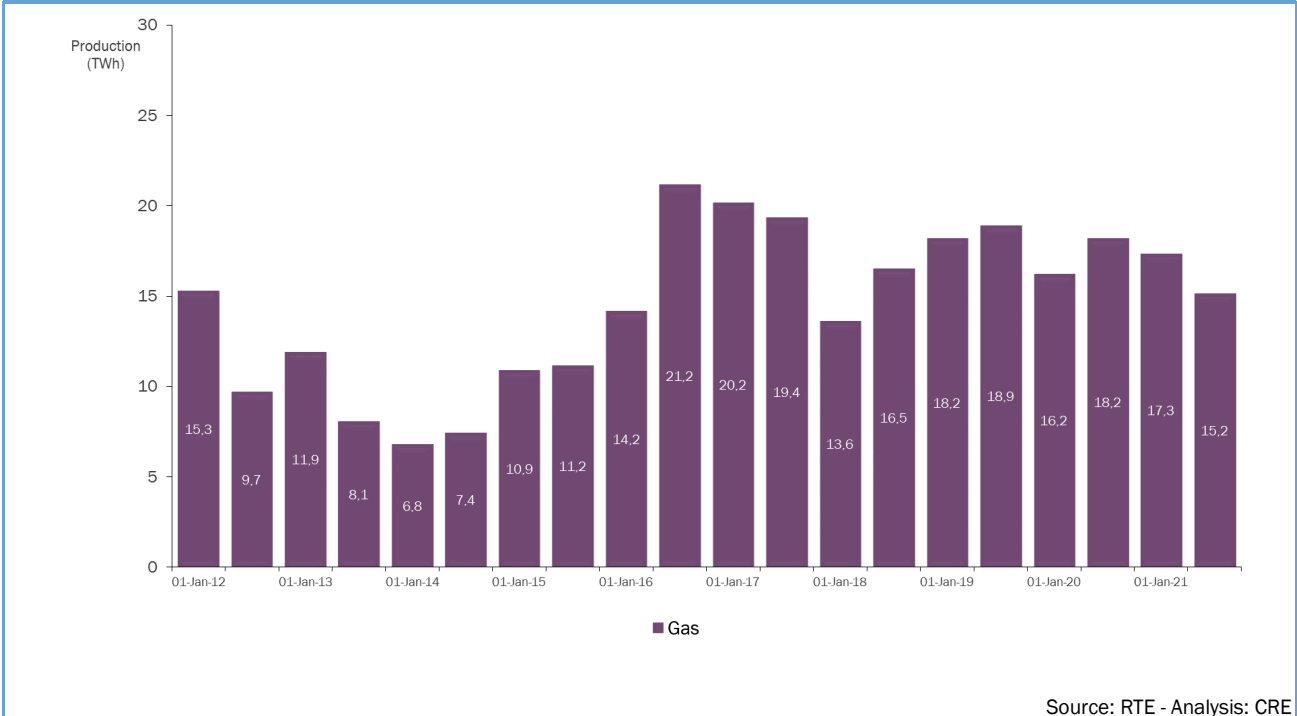
Figure 36: Evolution of the hydraulic stock



1.5 The production of the gas sector has decreased in a context of unprecedented increase in gas prices

The gas sector, which accounts for the majority of fossil-fired generation, is once again posting a drop in production (-5.6% in 2021 compared to 2020 and -12.5% relative to 2019) and amounts to 32.5 TWh. This drop in production is part of an overall context of exceptionally high gas costs throughout 2021.

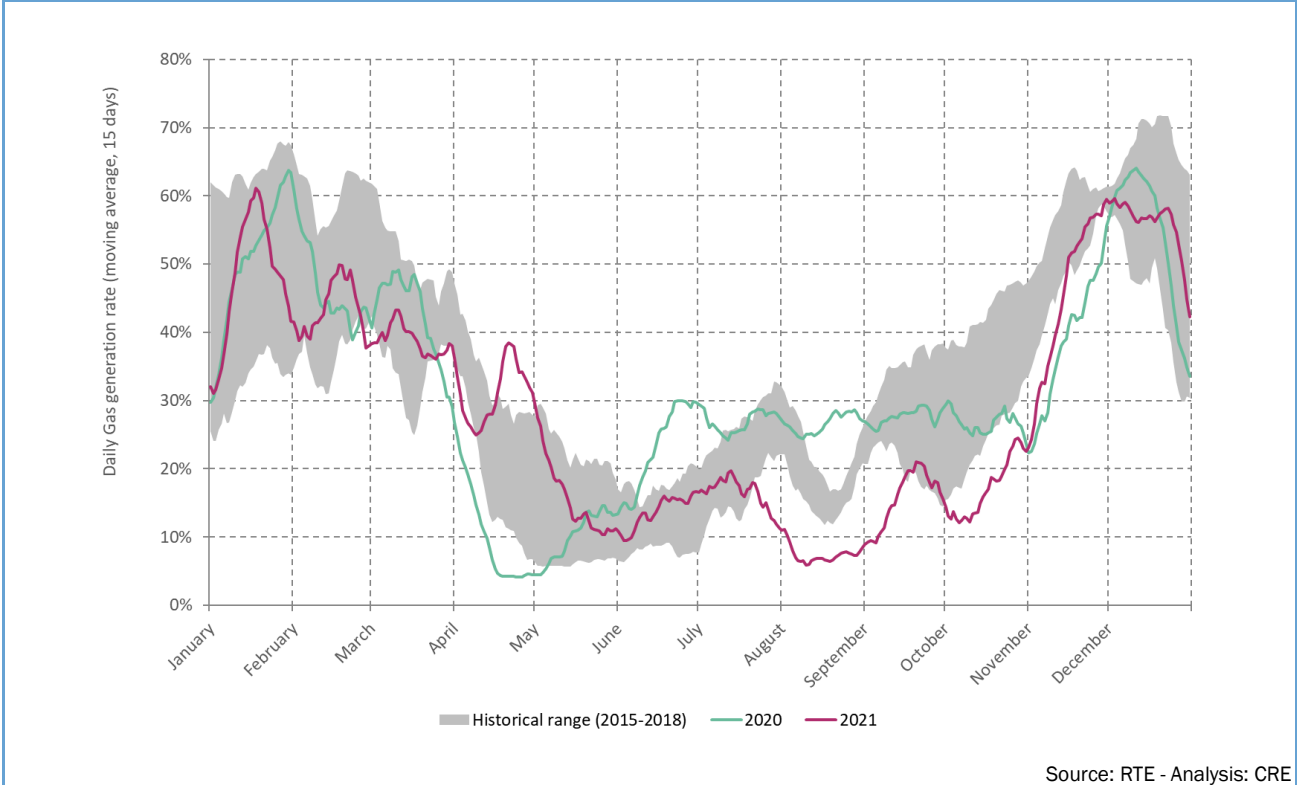
Figure 37: Evolution of the half-yearly generation of electricity by gas



While generation from most sources is rising again to meet the rebound in electricity consumption, gas-fired generation is declining for the second year in a row, illustrating the impact of soaring prices on the economic precedence of the various generation resources. The decline in generation is particularly noticeable between August and November 2021.

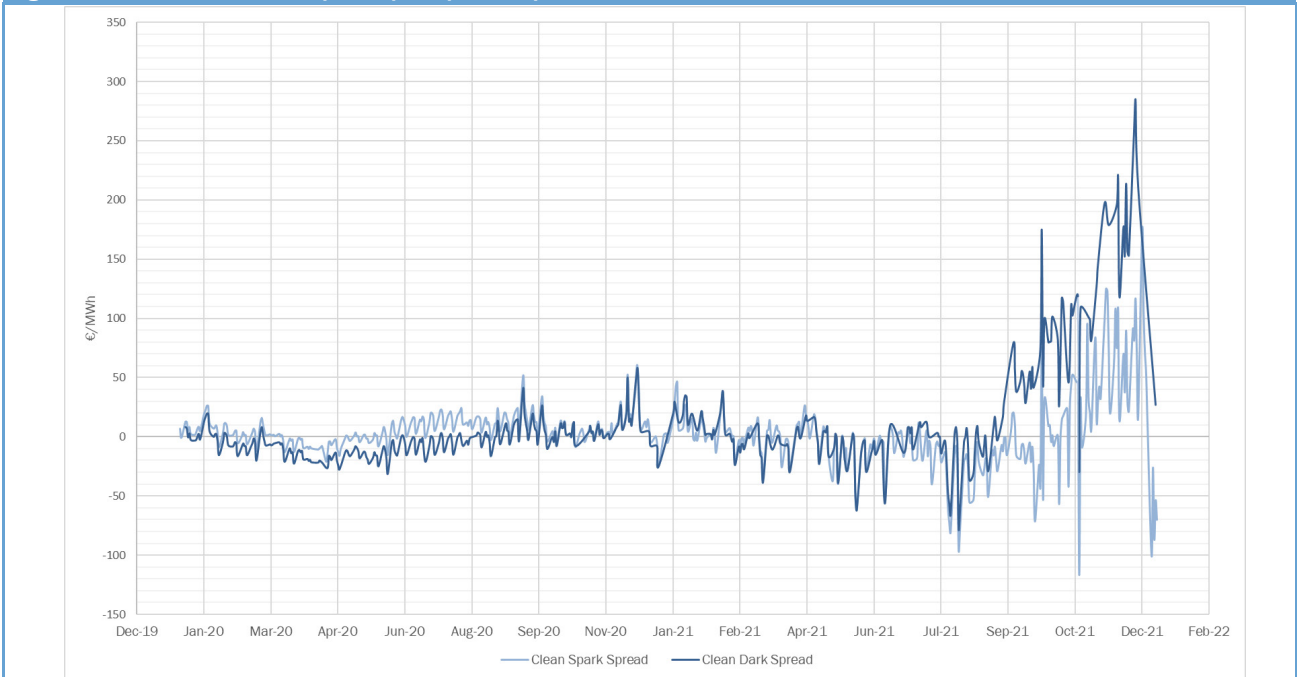
Thermal generation from gas resumed at the end of the year to cover the increase in demand and the decrease in availability of the nuclear park. In December, production returned to very high levels, as the rise in electricity prices was even higher than that of gas prices, which resulted in higher profitability for the gas sector. The *clean spark spread* presented in Figure 39 represents this theoretical profitability of the gas sector, significantly improved at the end of 2021.

Figure 38: Production rate of the gas sector



Source: RTE - Analysis: CRE

Figure 39: Clean dark and spark spot spreads peak



Sources: ECX, Heren, EEX, EPEX Spot - Analysis: CRE

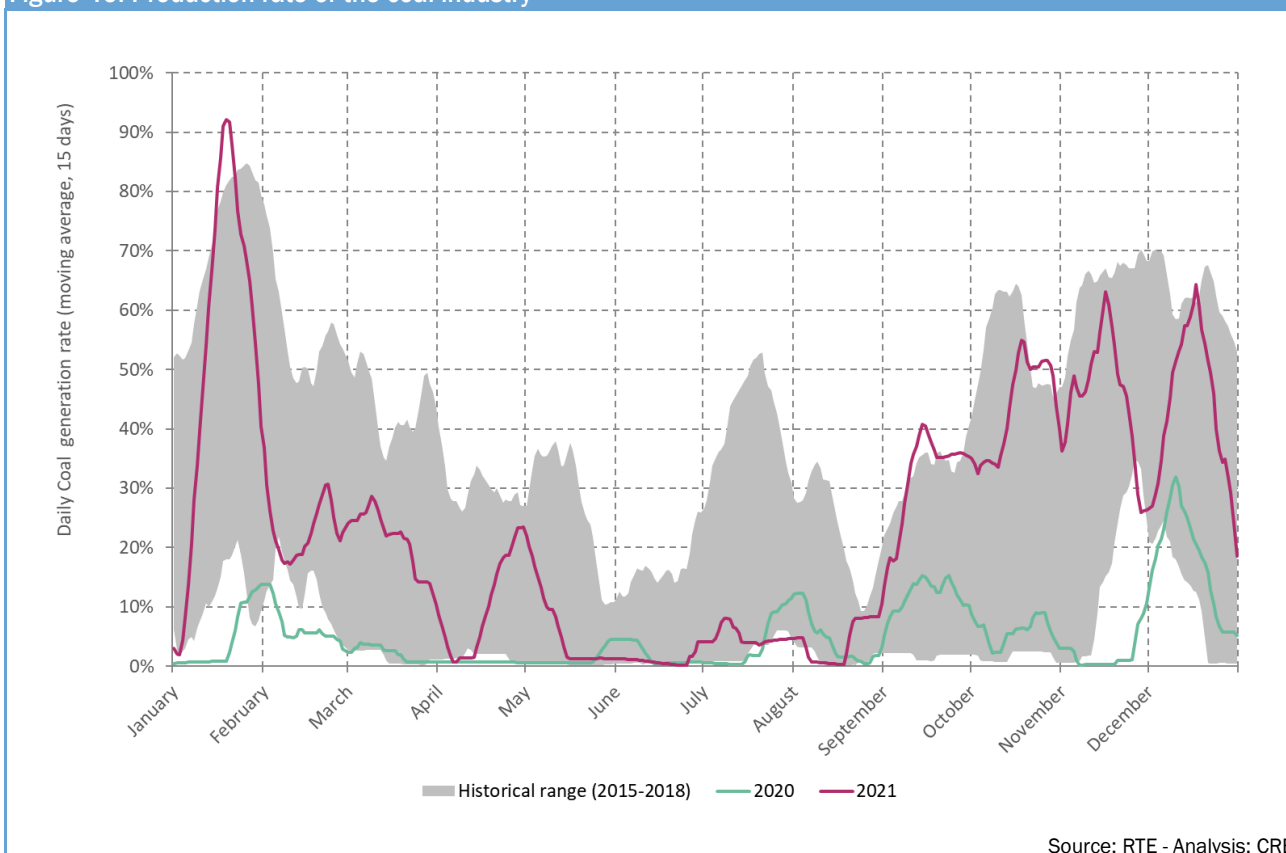


1.6 The rise in gas prices has favoured coal-fired power generation in 2021, which remains very small in the French energy mix

The production of coal-fired power plants reached 3.8 TWh in 2021, almost twice the amount produced in 2020. However, this production still represents a very small share of the French energy mix, at less than 1% of national consumption. The sharp rise in electricity prices has made the remaining coal-fired power plants particularly profitable, as illustrated by the increase in the *clean dark spread* from September. With coal prices rising less than gas prices, coal-fired plants were comparatively more profitable than gas-fired plants.

Coal has therefore been both a peak load source for the winter of 2020-2021 due to low nuclear availability, but also a semi-base load source from September onwards, replacing gas. However, total production remains marginal as a result of the gradual closure of the park and the unavailability of coal. The Le Havre plant closed in March 2021. Unit 5 of Gardanne did not operate in 2021. Only the Cordemais and Saint-Avoid power plants had normal operation.

Figure 40: Production rate of the coal industry



Source: RTE - Analysis: CRE

1.7 Marginality of the different production channels in 2021

A production channel is said to be marginal when the last production unit called on to satisfy demand belongs to this channel. Its marginal cost of production then determines in theory the market price on the *day-ahead* auction. The marginality of a sector can be very different from its share in the annual production.

However, as the CRE stated in its decision of 6 May 2021⁶⁰In practice, it is difficult to identify the marginal channel.

The main problem in identifying the marginal resources is the proximity of the variable costs of the means of production of different channels.

In addition, producers are not required to bid on the auction *day-ahead* a variable cost offer: they may want to include their start-up costs or agree to sell at a loss over an hour to avoid restart costs or to participate in balancing reserve markets.

⁶⁰ Resolution of the Commission de régulation de l'énergie of May 6 2021 bearing approval of the RTE report on the emission factor associated with the French electricity market: <https://www.cre.fr/Documents/Deliberations/Approbation/approbation-du-rapport-de-rte-sur-le-facteur-d-emission-associe-au-marche-de-l-electricite-francais>

Finally, the definition of "marginal technology" itself can pose a problem, since it is often the case that several inputs (possibly of different technologies) must adapt their production to cope with even an infinitesimal variation in demand. This may be the case: (i) because of market coupling and flow-based pricing, which means that the price of a zone is not necessarily determined by a single means of production; and (ii) when the management of one means, even if infinitesimal, impacts others. For example, "block" offers on the market that cover several time steps and are accepted or rejected simultaneously.

Finally, it should be noted that the so-called "stock" production means participate in the auction *day-ahead* on the basis, not of their variable production cost, but of their opportunity cost, calculated by taking into consideration the value that future production would have. The technologies concerned are hydroelectric power and, to a lesser degree, nuclear power, for investments that do not have enough fuel to operate at full power until their planned reload date.

Thus, the determination of the marginal rates of the different channels has a normative character.

Hydraulics and water use value

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

Opportunity cost management is essential to ensure that the flexibility of limited inventory resources (hydro, battery and nuclear in some cases) is available at the highest voltage hours of the electrical system and that all the water is not unnecessarily turbined early in the year.

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

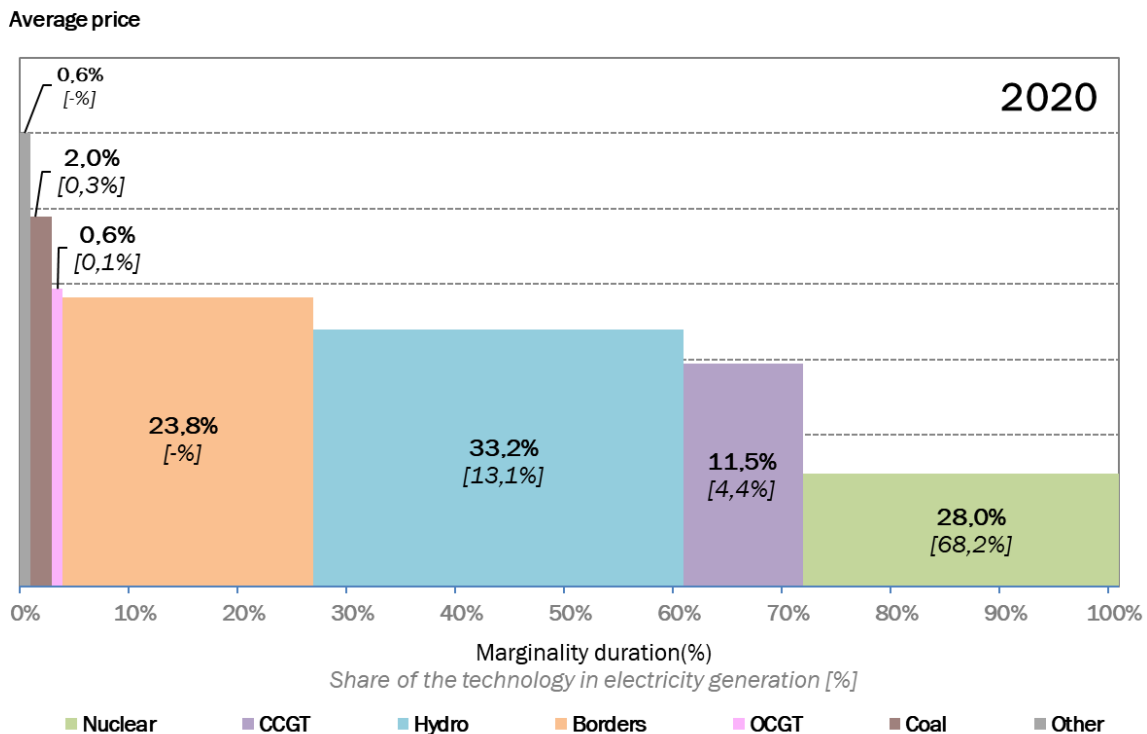
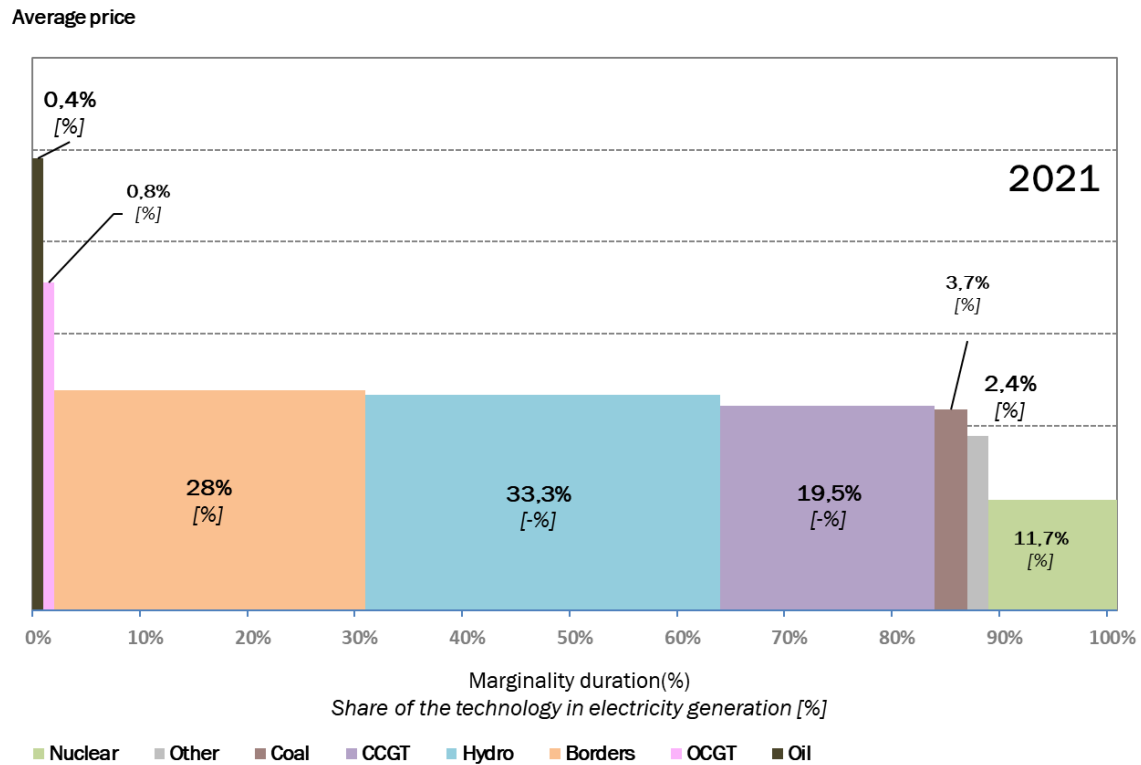
1. If France is coupled to at least one country (coupling threshold of 0.01 €/MWh), and if there is no means of production whose marginal cost is less than 1 €/MWh of the spot price, then the border is one of the marginal resources;
2. The means of production⁶¹ whose marginal cost is close to the spot price also form part of the marginal resources. The contribution of each means to marginality falls with the difference between the spot price and its marginal cost⁶²;
3. If France is not coupled to at least one country, and if there is no way with a marginal cost close to the spot price, then marginality is defined as "other".⁶³

⁶¹ Planned in the call programme

⁶² The formula has been adapted to take into account price increases. The contribution now decreases more slowly as a function of the difference between the *spot* price and its marginal cost

⁶³ The price increase was also taken into account in defining the "other" technology

Figure 41: Marginality of the different production channels in 2020 and 2021



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

The increase in consumption in France, and in Europe more broadly, has had the effect of changing the marginality in 2021.

Nuclear power accounts for only 11.7% of the marginality, whereas it accounted for 69% of electricity generation in France in 2021. Nuclear's share of marginality falls by nearly 15 points compared to 2020. This result illustrates the baseload operation of this technology, which sets the price mainly during consumption peaks and when inter-connections are saturated for export.

More than half the time, prices *spot* are close to the value of use of a hydro facility or are equal to those of another market coupled with the French market. This trend is confirmed in 2021 with an even higher share of interconnections, which can be explained by the significant imports at the end of the year to compensate for the decrease in nuclear availability.

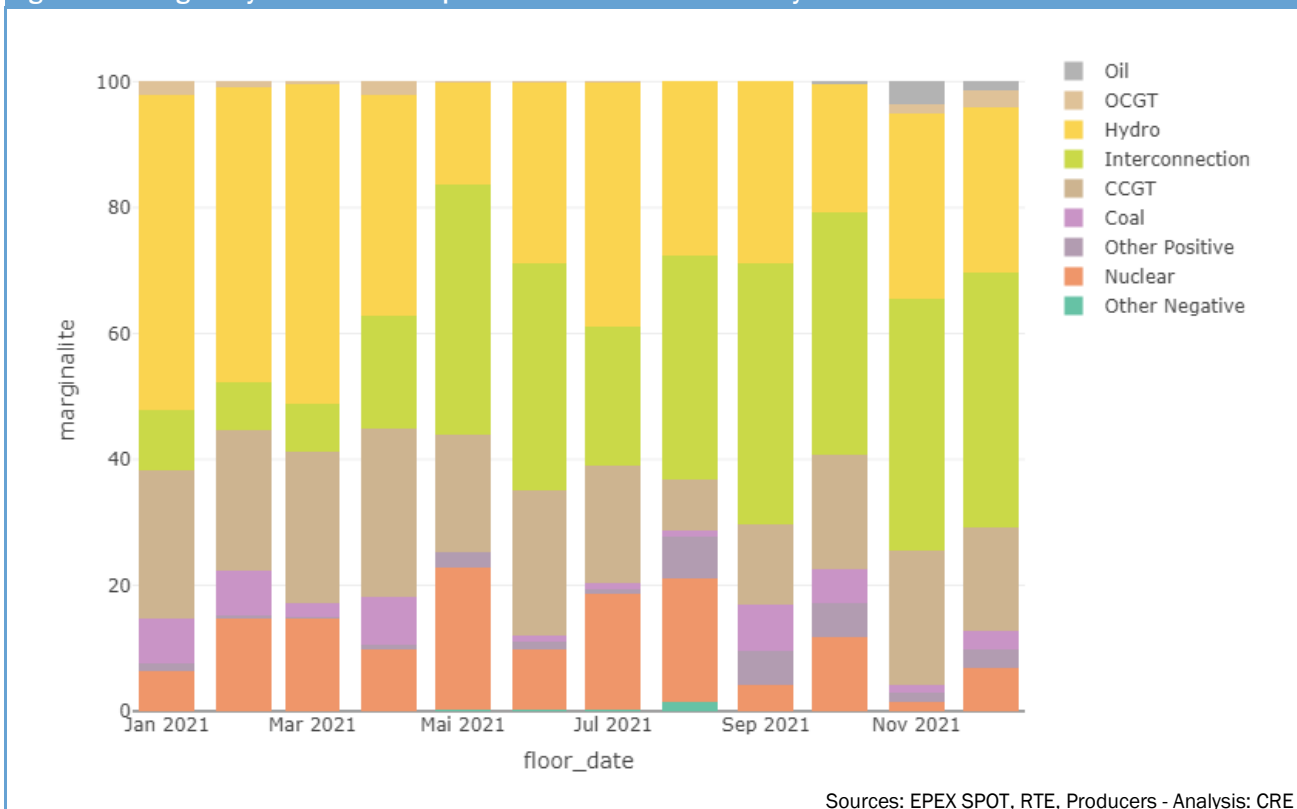
The drop in nuclear availability at the end of the year also benefited all fossil-fired power plants.

Firstly, combined cycle gas turbines are confirming their position as a semi-base load in France, with an increasing share of marginality, but a decreasing share of total generation.

The increased profitability of coal relative to gas has put it back in the *merit order*. Although the share of energy produced by coal in France is very low (0.75%), the marginality of this sector in 2021 is 3.7%. In addition, gas-fired TACs and oil-fired units are again present and see their marginality increase.

All else being equal, the average price of all technologies increases sharply in 2021. This phenomenon illustrates the sensitivity of marginal costs, including hydro and nuclear, to the price of commodities and CO₂. This is particularly true of opportunity cost management.

Figure 42: Marginality of the different production channels in 2021 by month



2. WHOLESALE ELECTRICITY PRICES

2.1 Generalised spot price increase in a context of pressure on fuel prices and economic recovery

Spot prices play an essential role in the smooth operation of the European electricity system by determining the generation mix used to meet forecasted consumption, hour by hour, the day before. 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 the year 2021 increased exceptionally compared to 2020 to an average of 109.2 €/MWh for the year, an increase of 239% relative to 2020 (32.2 €/MWh) and 176% relative to 2019, a more normal year (Figure 43).

Such a high level has never been reached before. The spot price rose in the first half of the year with the increase in fuel prices and CO₂ allowances. It then rose dramatically and unprecedentedly from the end of August 2021 and particularly at the end of the year with the surge in gas prices and the low availability of nuclear. Thus, the spot price reached 367.9 €/MWh on average during the week of 19 December 2021 (reaching an all-time high of 453 €/MWh

on 22 December 2021) before falling back to around 140 €/MWh in the last week of the year, thanks to higher temperatures.

The gas crisis in Europe (particularly from the summer of 2021) has therefore spread to the European electricity market through the increase in the operating costs of gas-fired power plants. Moreover, the variable cost of operating thermal power plants also depends on the price of CO₂ needed to cover the greenhouse gas emissions, which has also seen an exceptional increase in 2021, from about 30 €/t_{CO2} end of 2020 to more than 80 €/t_{CO2} at the end of 2021 (Figure 2).

The first part of 2021 was marked by a gradual increase in spot prices linked to the rise in raw material prices, punctuated by price variations linked to consumption, with prices at times exceeding 100 €/MWh in January due to low temperatures. Spot prices increased more strongly in June, supported by commodities and in a context of low wind generation in Europe. The French price reached 73.5 €/MWh on average over June, its highest level since January 2017, despite mild temperatures in France and good nuclear availability. The price differentials with other European countries enable the French export balance to rise to 6.7 TWh over this month.

Tensions on the European market continued unabated through the summer and into October, with record daily prices being observed in most European countries. Fuel prices, coal, CO₂, but especially gas, has risen sharply, while renewable energy production has remained low. Numerous price peaks have been observed in Europe and a few occasional windy episodes have led to negative prices, particularly in the summer⁶⁴. As in June, French prices, benefiting from the high availability of nuclear power, remained among the lowest in the region *Central West Europe*⁶⁵ favouring high exports.

The last two months of the year saw a sharp increase in the crisis in Europe. In France, the price reached spectacular levels of 217 €/MWh on average in November and 274.6 €/MWh in December, with a peak of 452.9 €/MWh reached on 22 December 2021. France becomes a net importer during the last two months of the year, facing a sharp drop in nuclear generation (+30% unavailability), a drop in wind generation and very low hydro stock levels while demand increases due to cold temperatures.

Intraday prices logically show levels very close to the prices of spot and averaged 109.5 €/MWh for hourly products, more than three times that of 2020. (Table 5).

Table 5: Average price day-ahead and intraday

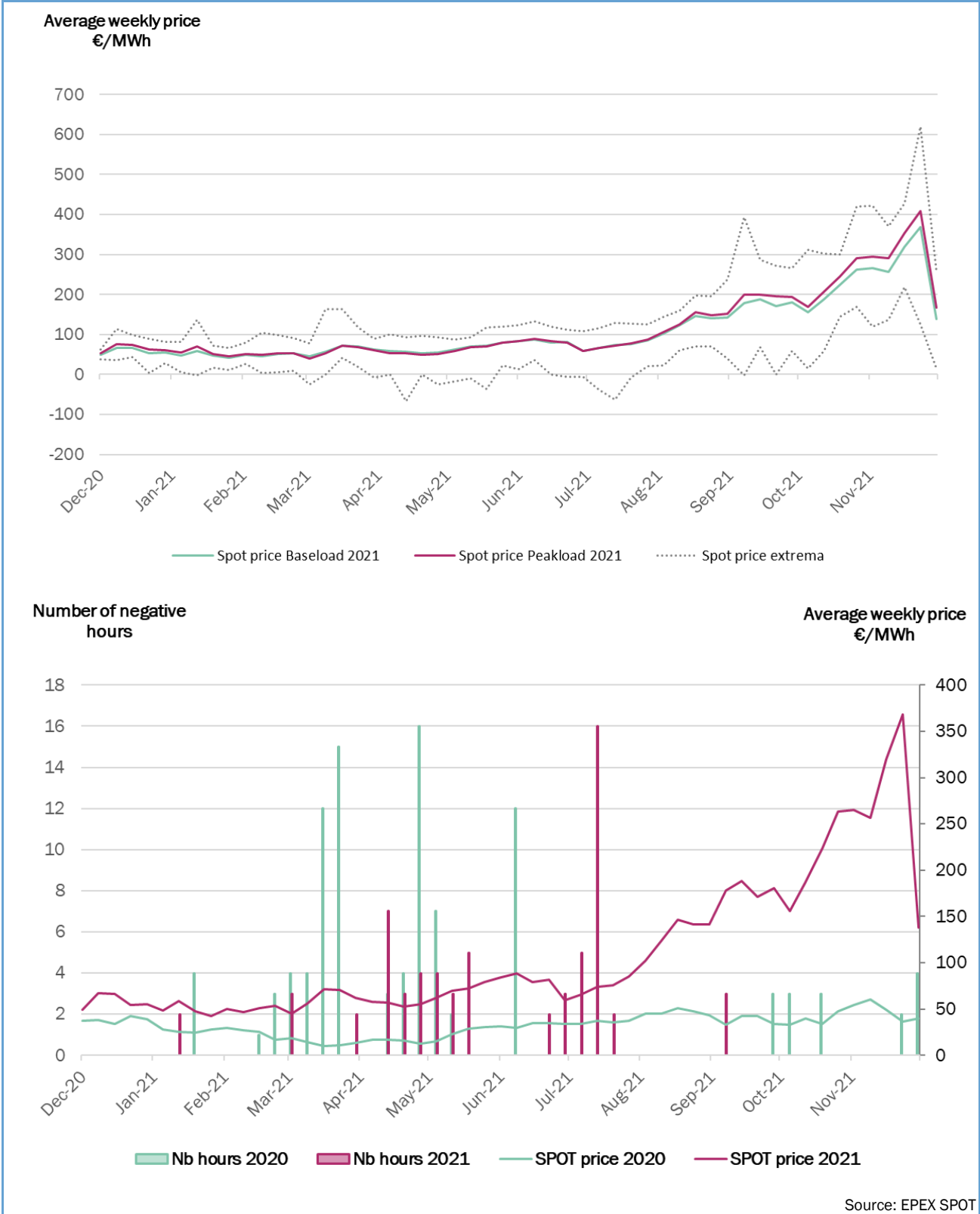
Period	Day-Ahead average price	Intraday average price
2018	50.2 €/MWh	50.9 €/MWh
2019	39.5 €/MWh	39.7 €/MWh
2020	32.2 €/MWh	32.9 €/MWh
2021	109.2 €/MWh	109.5 €/MWh

Source: EPEX SPOT

⁶⁴ Negative prices are rare, but increasingly frequent, episodes that occur in particular when supply exceeds demand (consumption peaks, overproduction of fatal production means such as wind or solar power) and when the production means in operation are not flexible enough to modulate their production quickly and profitably. The market price can then fall sharply, or even become negative, signalling to the market the need to reduce production or increase consumption. The price then no longer reflects the variable cost of the generating facilities over a given period, but the producers' trade-off between their shutdown and restart costs and the cost of selling their energy at a negative price over this period.

⁶⁵ Region composed of Germany, Austria, Belgium, France, Luxembourg and the Netherlands.

Figure 43: Price evolution day-ahead in France (weekly average prices, extrema and number of negative hours)



2.2 Difference between spot prices and EDF's marginal costs in 2021

With regard to price formation *spot*, CRE analyses the differences between market prices *spot* and the marginal costs declared by EDF from the calculations of its daily optimisation models.



Since 2017, the indicator presented by the CRE is determined as the monthly arithmetic average of the differences between the spot price and the marginal cost⁶⁶ of the EDF park, divided by the average spot price.

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

On average, the price-cost gap in 2021 was 2.6%, a higher level than those observed in 2019 and 2020, but lower than 2018's 3.5% (see 2019 and 2020 monitoring reports).

The various discrepancies made public in successive monitoring reports⁶⁷ are shown in the following table.

Table 6: 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%

The CRE stresses that this indicator is based on declarative data and does not prejudge the correct level of EDF's marginal costs. In addition, 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 player on the spot market. Therefore, a higher marginal share of interconnections in 2021 could help explain a higher value of this indicator. Finally, the marginal costs declared by EDF are opportunity costs for stock hydro and part of the nuclear generation.

Without prejudice to further controls, the CRE considers that the average deviation measured in 2021 does not reflect the exercise of clear market power by EDF.

2.3 Convergence of French spot prices with neighbouring countries

Market coupling spot allows for the optimisation of interconnection management and market liquidity, by means of an "implicit" allocation that allocates in a single process the energy requested or offered by market players and the capacity at the interconnectors. Market participants can buy and sell electricity the day before for the next day through power exchanges⁶⁸. Thus, the daily market prices are identical as long as the interconnection capacities are not saturated and the exchanges are made in the direction of the price differentials from a country where the price is lower to a country with a higher price.

Market coupling plays an essential role for interconnected European countries, allowing them to benefit from synergies between generation mixes and national demand structures, 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, on the one hand by remaining the most exporting country in Europe, and on the other hand by benefiting from essential imports for electricity supply in winter.

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 electrically connected countries of the European Union since June 2021⁶⁹.

⁶⁶ That is, the cost to EDF of producing 1 additional MWh from its generating fleet. EDF declares this quantity for each hour to the CRE.

⁶⁷ The method for calculating the average gap changed in 2017.

⁶⁸ The transmission capacity needed for energy exchange is allocated "implicitly" in the auction system. Since 2015, the coupling of the CWE zone is done via a multi-border optimisation method based on the flows "flow-based". Special cases exist, where capacity allocation can be carried out "explicitly", instead of or in parallel with "implicit" allocation.

⁶⁹ The particular case of Switzerland should be noted, where the daily and intraday markets are not coupled. On the other hand, there are long-term contracts, which have free priority access to interconnection capacity.



In 2021, convergence is broadly stable compared to 2020. Convergence rates are up between France and Belgium (51% on average in 2021 compared to 48% in 2020) and Germany (49% on average in 2021 compared to 46% in 2020), while they have fallen between France and Spain (35% on average in 2021 compared to 39% in 2020) and Italy (31% on average in 2021 compared to 37% in 2020).

Figure 44: Convergence rate (price difference +/- 0.01 €/MWh) of quarterly spot prices with European neighbours

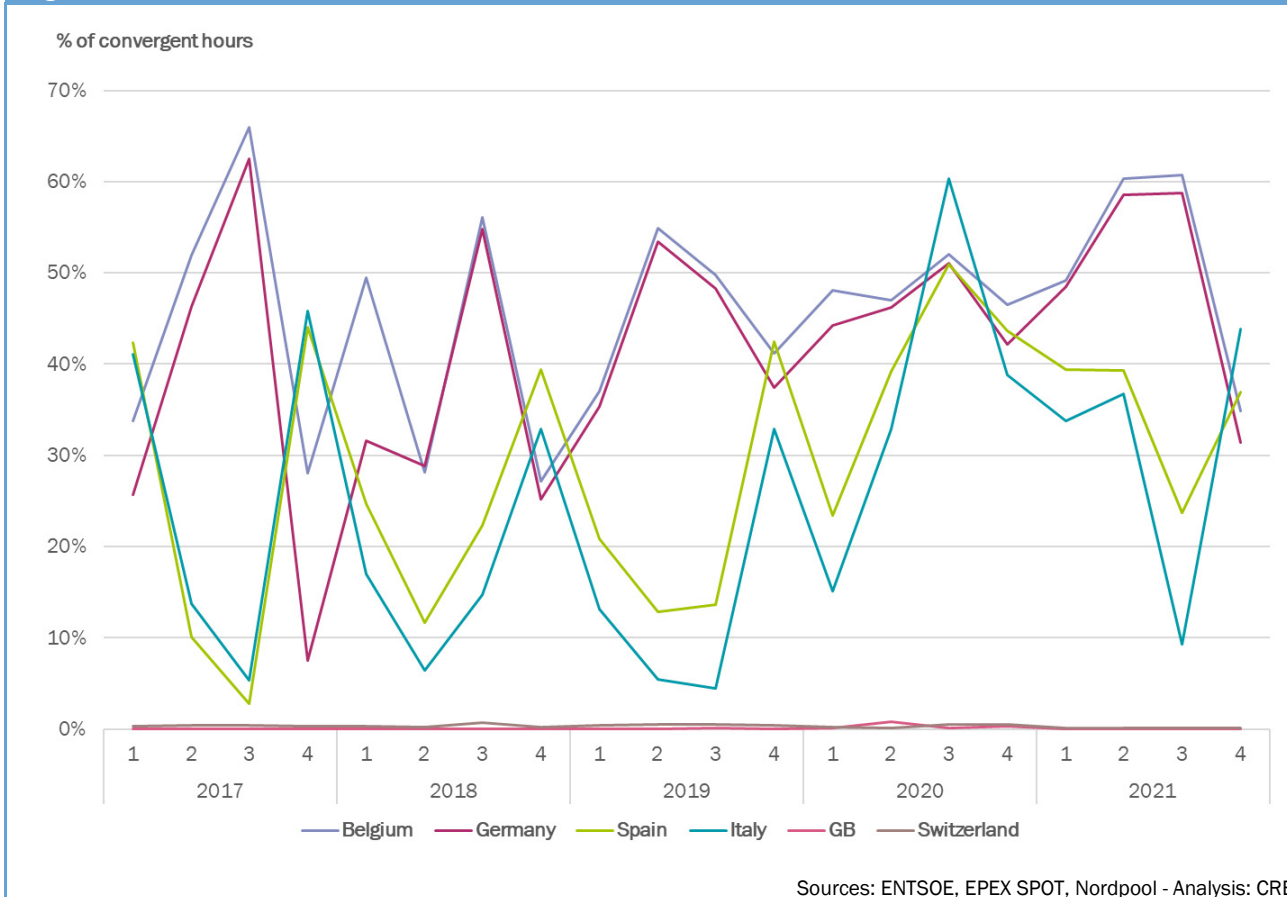


Figure 45 below highlights the closest European countries according to their price level and according to the season in 2021. They visually bring together the countries that have the highest coupling rates (defined for this graph as an absolute price difference of less than 1 €) between them.

Price convergence between countries varies according to the season. In particular, during the winter, colder temperatures mean greater demand on interconnections, resulting in more frequent decoupling and greater price differences between the various European countries with different temperature sensitivities and electricity mixes. For example, France is often an importer during the winter, while it exports a lot in the summer when its surplus nuclear generation is less expensive than that of its European neighbours who are more dependent on gas and coal.

Figure 45: Winter 2021 and summer 2021 coupling rate matrices of countries against each other on the spot market; the average price per season and per country is given for information

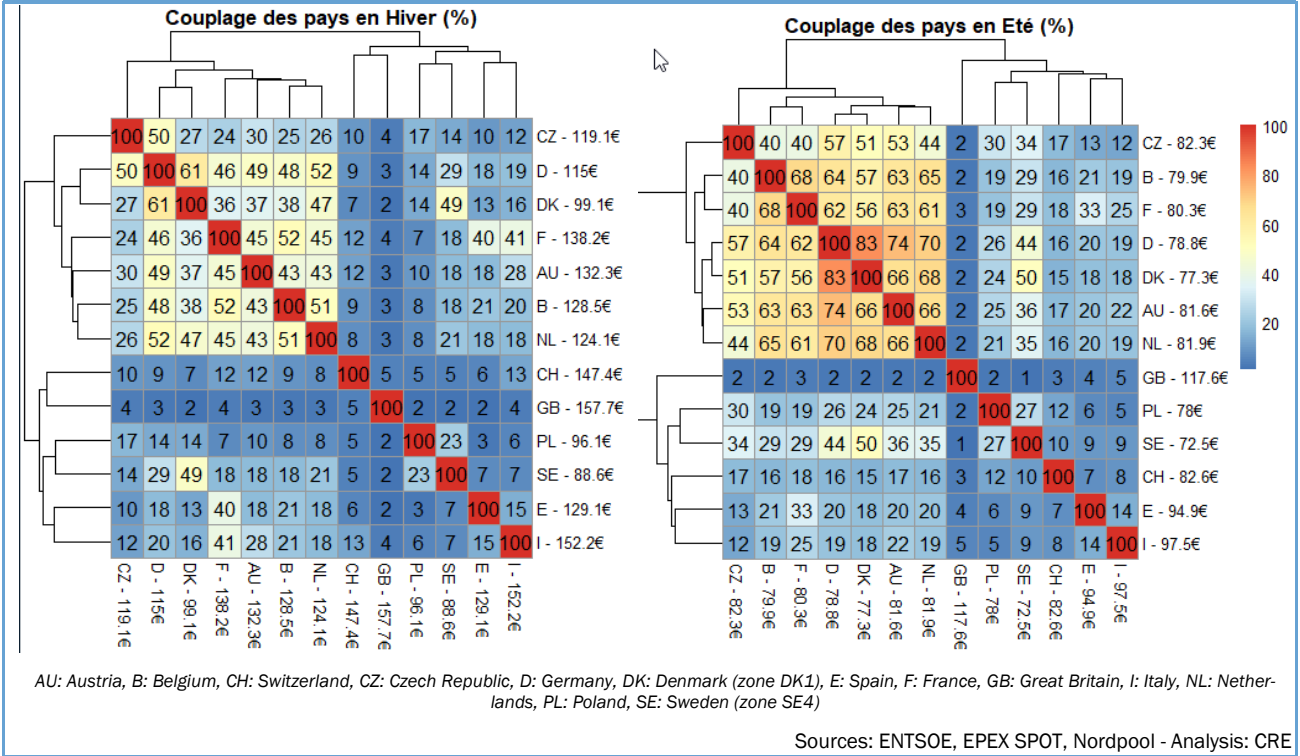
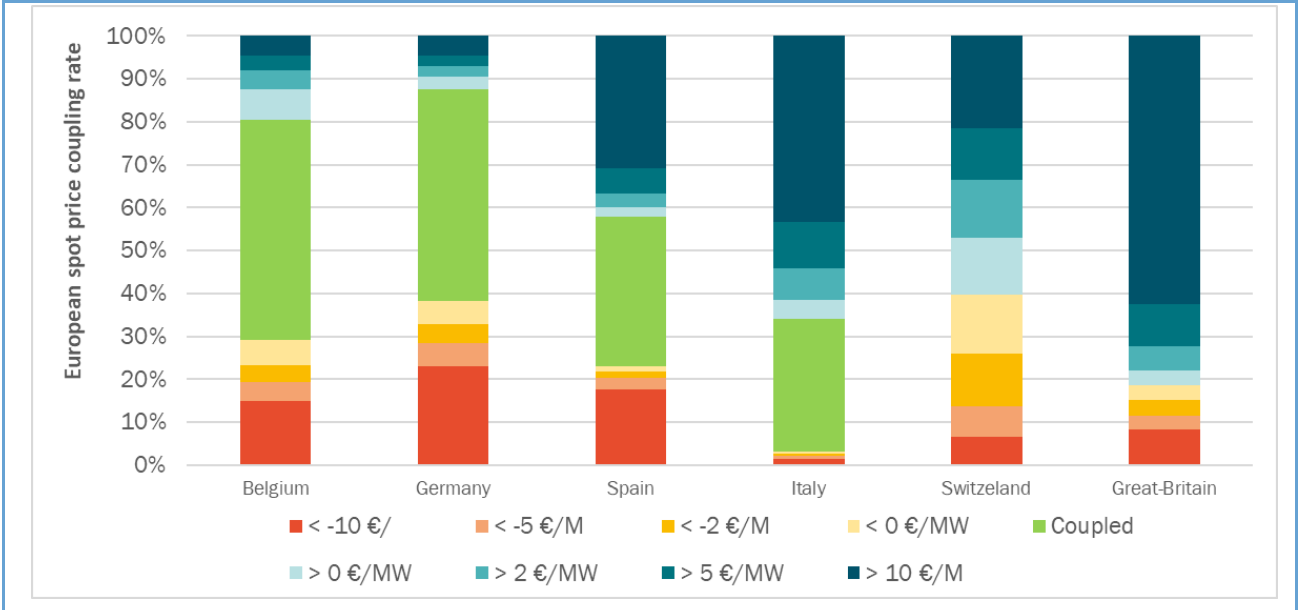


Figure 46: European spot price differences with the French price in 2021 (country price - French price)



	Germany					Belgium					Switzerland				
	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
January	-25,6	-5,5	-11,8	-3,0	-6,7	-5,4	1,8	-0,7	-0,1	-2,0	-1,7	8,9	1,2	4,5	1,0
February	-11,5	-8,6	-3,8	-4,3	-0,3	-3,6	-1,4	1,0	2,1	-0,4	4,0	4,2	2,1	7,9	4,9
March	-3,7	-10,9	-3,2	-1,3	-3,1	-1,0	2,5	3,8	0,2	-3,6	1,5	5,0	1,9	2,3	6,0
April	-5,9	-1,5	-1,1	3,6	-9,5	2,5	4,2	-0,2	1,3	-6,1	-1,2	0,6	0,6	3,8	0,5
May	-3,8	-0,9	0,6	2,7	-1,9	3,0	10,1	0,8	0,5	0,4	-0,4	-1,3	0,9	2,0	2,5
June	-2,7	0,1	3,3	0,4	0,6	0,0	7,6	-1,8	-0,2	0,9	-0,6	0,8	2,6	-0,1	0,1
July	-1,6	-1,9	2,0	-3,3	3,0	-1,0	1,5	0,1	-3,6	-1,0	-0,4	-0,9	0,2	-0,6	2,6
August	-1,2	-2,2	3,5	-1,9	5,4	-0,2	2,3	0,3	-1,2	2,2	0,0	-0,3	0,5	-1,2	5,2
September	-2,6	-7,1	0,2	-3,5	-6,9	0,2	6,8	-2,0	-3,0	0,9	0,3	-0,4	1,9	-1,3	2,7
October	-21,4	-12,5	-1,7	-3,9	-33,0	-0,7	10,4	-1,0	1,5	-7,2	3,0	7,3	1,4	0,3	25,8
November	-23,1	-11,1	-4,9	-1,3	-40,9	3,2	9,9	-1,5	-0,2	-14,9	1,6	-2,6	0,0	1,3	9,8
December	-26,0	-6,8	-4,5	-4,9	-53,6	-1,7	4,8	-0,1	-1,0	-29,2	5,8	2,8	4,4	2,9	7,6
Average price	34,2	44,5	37,7	30,5	96,8	44,6	55,3	39,3	31,9	104,1	45,9	52,2	40,9	34	114,9
	Spain					Italy					Great-Britain				
	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
Janvier	-6,5	15,0	0,8	3,1	0,7	0,2	13,3	6,5	7,9	2,0	-16,6	21,4	7,4	4,0	29,8
Février	0,6	6,2	7,4	9,6	-20,5	5,2	8,1	10,7	12,5	8,5	6,5	9,2	10,8	10,2	13,0
Mars	7,8	-8,1	15,0	3,9	-4,8	8,6	9,8	19,7	7,6	9,9	13,0	16,3	17,8	11,7	16,1
Avril	8,9	9,1	12,3	4,2	1,9	7,2	14,9	15,2	11,0	6,0	13,6	24,5	12,5	14,1	12,7
Mai	12,9	20,5	11,2	6,4	11,8	7,3	17,3	12,5	6,2	14,2	14,0	26,3	10,4	10,2	30,6
Juin	17,5	16,1	17,9	4,8	9,8	15,4	13,0	15,6	1,3	8,9	10,5	19,2	15,3	3,7	17,4
Juillet	14,0	10,5	13,8	1,2	14,0	15,3	9,6	13,0	2,6	22,0	11,5	12,7	8,0	-0,9	30,4
Août	15,4	5,9	11,6	-0,6	28,6	23,4	7,0	11,8	1,2	28,5	14,6	9,2	8,2	3,5	47,9
Septembre	12,2	9,3	6,6	-5,2	20,8	11,8	14,6	15,1	0,5	23,3	14,3	12,4	5,0	0,9	84,8
Octobre	7,1	-0,6	8,6	-1,3	27,4	5,3	9,6	13,5	4,1	46,1	1,6	7,3	3,6	10,1	40,3
Novembre	-4,2	-5,8	-3,7	1,8	-23,6	4,4	-0,9	2,1	7,4	9,3	-6,9	2,4	5,8	9,0	2,9
Décembre	1,2	6,9	-2,7	-6,5	-35,5	9,0	9,6	5,8	5,3	16,6	5,9	14,9	9,7	12,3	14,1
Prix moyen	52,2	57,3	47,7	34,0	111,9	54,4	60,7	51,2	37,8	124,7	51,7	64,9	49	39,6	137,6

Sources: ENTSOE, EPEX SPOT, Nordpool - Analysis: CRE

On average the spot prices in Italy, Spain, Great-Britain and Switzerland were higher in 2021 than the spot price for French electricity, as has historically been the case. Indeed, Italy, Spain and Great Britain are characterised by very gas-intensive electricity mixes and have been importing heavily in order to benefit from cheaper energy, particularly in the face of soaring gas prices. On the other, German and Belgian prices are still lower. Nevertheless, while price differentials were reduced in 2020 compared to 2019, reflecting the easing of the market due to the COVID-19 crisis, the absolute differentials were much larger in 2021 compared to historical levels.

The months of April, November and December 2021, were months of high French imports compared to historical levels. These imports were due to cold weather conditions in April that had an unusual effect for this period on French consumption. While the last quarter of the year is generally export-oriented for France, this trend was reversed in 2021 in a context of high unavailability of the nuclear park (+30 %), low hydro stocks and low wind generation. This situation is visible in the price differentials between neighbouring countries and France. Thus, in April the price gap is larger than usual in favour of Germany and Belgium, while the French price seems closer to the Spanish and Italian prices compared to historical levels. Similarly, during the months of November and December 2021, it can be seen that the French price deviated very significantly upwards compared to its German, Belgian and Spanish neighbours. The price in Italy, however, remained more expensive than the French price. The very high price levels in this period have proportionally increased the absolute price differences between the countries.

2.4 Forward prices in France and Europe

Wholesale forward prices, particularly the annual contract, play a major role in the economics of the power system: they determine a large proportion of the price paid by consumers, and also constitute a large part of the revenue of generators.

Futures markets allow for the exchange of electricity in advance of given delivery periods in the future. They pool products for different time horizons ranging from a few days to several years in advance. A market participant requiring physical delivery⁷⁰ at a given maturity can take two approaches: a purchase on the spot market by hedging

⁷⁰ There are two types of forward delivery:

- o Physical delivery: the contract provides for a delivery of electricity that will be "debited" from the seller's BR balance perimeter and "credited" to the buyer's.
- o Financial delivery: the parties agree on a price and a price reference (the market spot D-1 generally). 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.
- o From a financial point of view, these two types of delivery are equivalent.

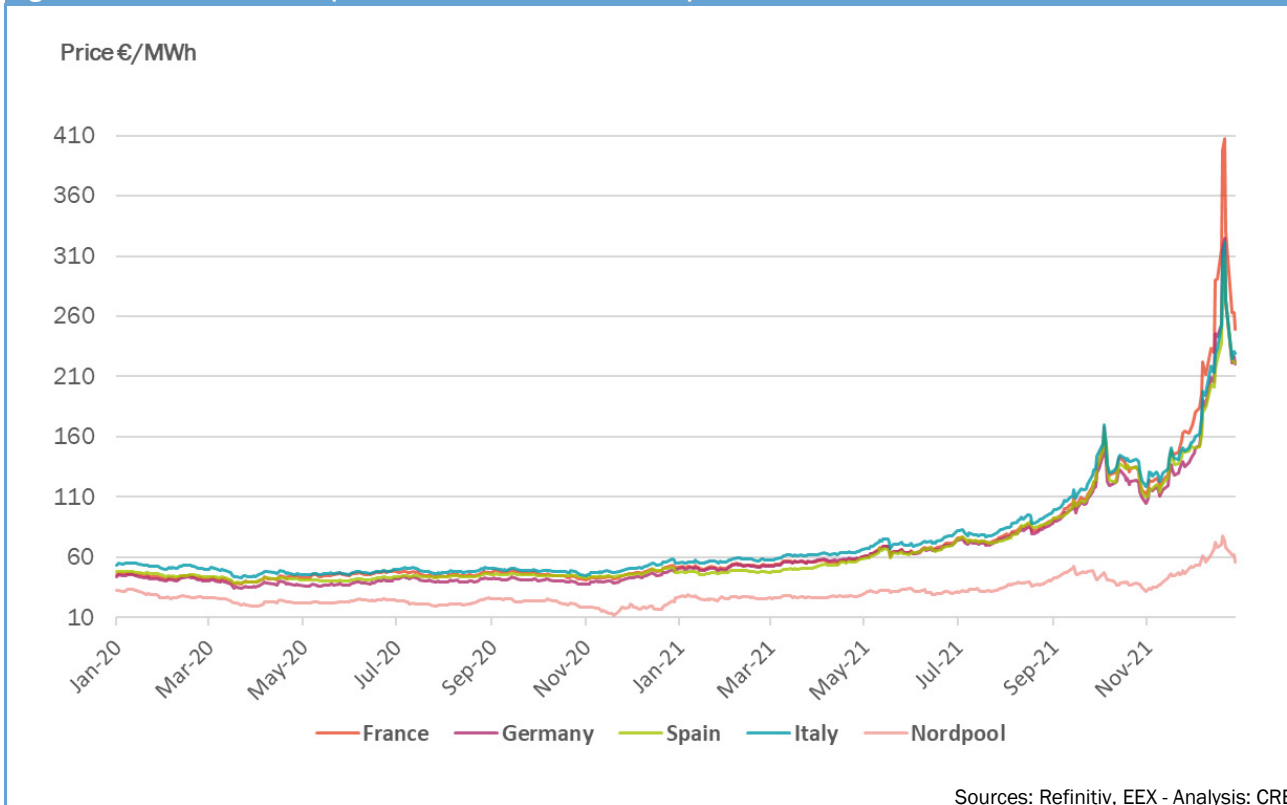


the price risk with a futures product with financial settlement, or directly a purchase of a physical product on the futures markets.

For financial delivery products, settlement prices are valued daily until the last delivery day of the contract and ultimately correspond to the average spot price realised over the delivery period of the contract. These contracts are used by market players to exchange price variation risks. For example, for a producer, it is a matter of "securing" a volume and a price before delivery, or for a supplier, it is a matter of determining a supply price to consumers or "securing" a supply margin. In the longer term, forward prices are a signal for investment and can serve as a reference in the negotiation of long-term contracts.

The futures markets have been strongly affected by the general rise in commodity prices, particularly gas, and CO₂ in Europe in 2021. They were also particularly affected at the end of the year by concerns about the 2021-2022 winter.

Figure 47: Price of calendar products Y+1 base load in Europe on EEX



The rise in commodity prices began in October 2020 in the context of an economic recovery. This trend has continued steadily through the first part of 2021. The price of French calendar product Y+1 base (for delivery in 2022) which was 52.5 €/MWh on 4 January 2021, a value fully in line with historical averages, increased to 89.7 €/MWh on 31 August 2021, an increase of 71%. However, the price differential between the French and German prices remained relatively stable and low during this period, averaging 0.8 €/MWh.

From September onwards, the increase in the calendar price for delivery in 2022 accelerated sharply and the French price reached a first record at 168.4 €/MWh on 5 October 2021, triggered by a sharp spike in gas prices in a context that was already stressed for electricity production in France, with a 630 MW drop in the availability forecast of the French nuclear park for Q1 2022. In particular, the increase in the 2022 calendar product price was primarily caused by⁷¹ the increase in the Q1 2022 quarterly product, reflecting a particular stress for the winter period (Figure 48). Gas prices eased from October 6, with the Russian president's announcement of the prospect of increased Russian supplies to Europe. However, French electricity prices for delivery in 2022 did not fall as much as other European prices, marking a stall that has persisted since. Thus, the France-Germany differential, which had been relatively low until then, moved up to 9.8 €/MWh on 7 October.

From 8 October until mid-November, the price remained relatively stable at around 127 €/MWh on average, in a context of more reassuring announcements on Russian gas supplies to Europe. Then, the price rose again and the increase accelerated significantly, as uncertainties on the gas supply side increased (see section 4, § 2.1). In one month, the price almost doubled from 125.4 €/MWh on 15 November to 230 €/MWh on 15 December 2021.

⁷¹ The price of the calendar product, delivered over the whole year, is linearly related to the prices of the products of lower granulometry which compose it (quarterly, monthly, etc.). Thus, it is well representative of the average of the prices of the four quarters (or twelve months) of the year that compose it.

Extreme price pressure is seen from December 16 to 23, peaking at 407.5 €/MWh on 22 December 2021, before falling back and ending the year at November levels.

The distinctly French nature of the electricity supply-side crisis materialised in the sharp rise in the price differential with Germany, on 29 December 2021 the differential was: 29 €/MWh for the annual forward contract, 93 €/MWh for Q1 2022, and even 176 €/MWh for February 2022.

Ultimately, the calendar product French calendar price for base load delivery in 2022 traded in 2021 at an average of 94.7 €/MWh, an increase of 111% relative to the average price for 2020 for delivery in 2021 (44.9 €/MWh) and 86% relative to the average price for 2019 for 2020 (50.8 €/MWh). The German 2022 calendar price traded on average at €/MWh 88.8 in 2021, which is approximately 119% higher than the 2020 price for 2021 (€/MWh 40.5) or 85% higher than 2019 for 2020 (€/MWh 48.1).

Although the 2022 annual revenue was significantly influenced by the increase in commodity prices and the CO₂, the most exceptional variation was in the quarterly product at the beginning of 2022 (Q1 2022), due to concerns about the security of electricity supply in France for the winter of 2021-2022.

Figure 48: Quarterly product prices for Q1 2022 French and German base load (Heren index) compared with the price of gas and the forecast availability of French nuclear power plants for the period



The falls in nuclear park availability occurred in a context of historically low forecast availability of the nuclear park (forecast below 50 GW on average in Q1 2022) and while the margins for electricity supply security were low and placed under "special vigilance" by RTE⁷². The market reacted strongly with prices soaring. The price for the first quarter 2022 increased from 373 €/MWh to 560 €/MWh between December 15 and 16, 2021 (Heren price data).

It can also be noted that the overall filling rate of hydraulic reservoirs was lower than in previous years. Indeed, in week 40 (October 4 to 7 October), the level of stocks stood at ~ 2.37 GWh in 2021, while in 2019 it stood at ~ 2.65 GWh (i.e. 10.6 % higher). This low trend continued and even worsened at the end of the year. For example, in week 50 (December 13-19), the inventory level was at 2.01 GWh in 2021 while it was at 2.66 GWh in 2019 (32 % higher).

Although uncertainty was widespread in Europe, the French price reacted more strongly than its European neighbours, due to the unavailability of nuclear power.

⁷² On 22 November 2021, RTE published its analysis of the supply-demand balance for the winter of 2021-2022 (<https://www.rte-france.com/analyses-tendances-et-prospectives/les-analyses-saisonnieres>). The company reported low voltage risks between now and the end of 2021, but higher risks in January and February 2022, although with much lower predictability, particularly with regard to the hazards of maintenance on the nuclear fleet, resulting from the postponement of maintenance due to the health crisis in 2020. Finally, RTE's analysis remains broadly in line with its March 2021 analysis, with a tendency for the risk level to increase, in particular due to the current shutdowns of four nuclear reactors, which have been identified as likely to be extended by EDF.



Announcements on the availability of nuclear power plants have a major influence on the French wholesale price, and a much more limited influence on the German price. The proper publication of privileged information, and in particular the accuracy and effectiveness of publications, and the absence of intervention on the markets before publication, are major issues for the CRE's monitoring of the wholesale markets.

The anticipation of strong stress for the winter of 2021-2022 has manifested itself in extreme prices for base load futures products but also, and to a greater extent, for peak load products.

Figure 49: Price difference between peak load and base load French futures (financial at the top and physical at the bottom)



While the price differential between the peak load and base load prices of futures products for delivery in 2022 was relatively constant from the start of 2021, it increased significantly from the end of September onwards, particularly for the Q1 2022. The spread peaked on October 5 (as well as on 7 October, at 122.5 €/MWh, for physical products) and remained at a high level throughout October. From mid-November onwards, this spread widened further and reached a new level of 158.5 €/MWh on 26 November 2021 on the OTC market. Finally, from December 16 to December 23, the spread soared, reaching 506.9 €/MWh on December 22 for the Heren price, before falling back to November levels at the end of the year.

This observation suggests that, as early as October, players were anticipating high stress during the winter of 2021-2022, and even security of supply concerns. These fears were of course exacerbated after EDF's announcements on 15 December 2021.

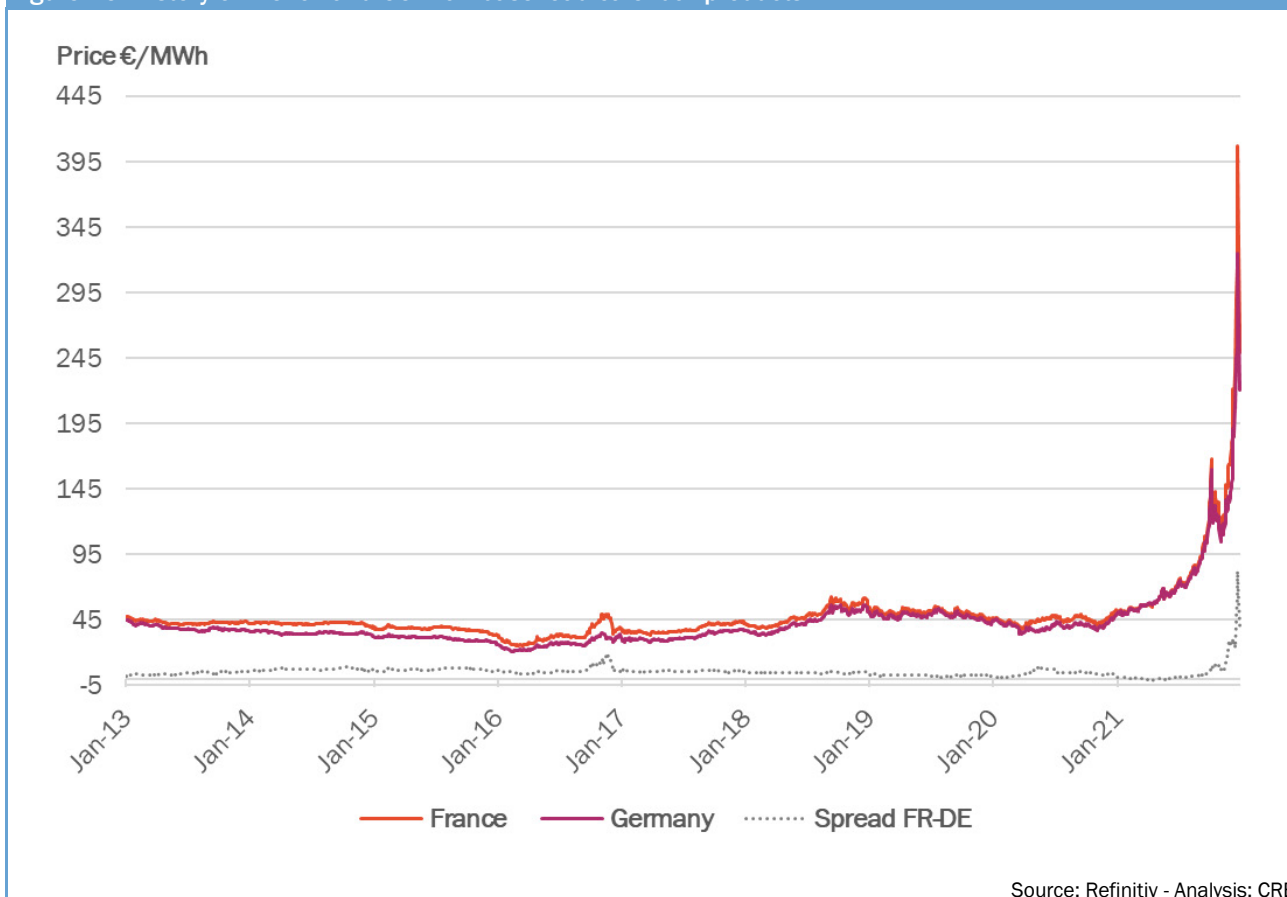
The market could thus have anticipated extremely high prices during certain hours, higher than the marginal cost of the last unit called (price setting by explicit load shedding or demand elasticity, or even reaching the ceiling of 3,000 €/MWh on the day-ahead auction).

The same trend can be observed for financial products as for physical products, even if price differentials can be observed, reflecting a high degree of volatility. However, there is no significant positive difference between the prices of physical products and financial products, as was observed for the Q4 2020 product⁷³, but rather, a significant variability in this difference.

⁷³ See the 2020 Monitoring Report: <https://www.cre.fr/Documents/Publications/Rapports-thematiques/rapport-de-surveillance-des-marches-de-gros-de-l-electricite-et-du-gaz-naturel-en-2020>



Figure 50: History of French and German base load calendar products in Y+1



In order to put into perspective the exceptional nature of the crisis in 2021, a history of the prices of French and German calendar products base load on Y+1 maturity since 1 January 2010 is presented.^{er} January 2013 is presented on the Figure 50. The average electricity price over the period 2013-2020 is approximately 42.5 €/MWh (94.7 €/MWh in 2021) with a maximum over the period of 62.6€/MWh reached in 2018 (407.5 €/MWh in 2021, i.e. 6.5 times higher) and a minimum of 25.5 €/MWh reached in 2016 (50.1 €/MWh in 2021). The year 2016 was marked by low prices (on average 33.4 €/MWh), which contrast with older or recent price levels.

The prices observed in 2021 are exceptional compared to the historical variations undergone from the initial opening of the electricity markets in Europe. Indeed, the average French price in 2021 exceeded twice the historical average price (2012-2020) and even exceeded the previous historical record of 2018 by 1.5 times. Moreover, the levels reached at the end of 2021 are well above (6.5 times higher) the previous historical record of 2018.

Modelling electricity forward prices from fuel prices, CO₂ and the availability of the French nuclear power plant.

The year 2021 was marked by an unprecedented rise in electricity prices, the origin of which is closely linked to the rise in the price of gas and, to a lesser extent, coal and CO₂, on the other hand, to the decrease in the availability of the French nuclear generation park, which is decisive for security of supply, particularly during the winter. As a first approximation, this relationship can be evaluated empirically with a simple linear regression model over a long period of time, in order to verify the stability of the relationship between forward electricity prices and the explanatory variables previously defined, especially during the exceptional period of 2021.

The selected parameters of the model are as follows:

Explained variables:

- Electricity prices (OTC indices published by ICIS Heren) of different successive quarterly products "chained" one after the other (chaining of Q1, chaining of Q2, etc.).
- French and German prices; base load and peak load products.

Explanatory variables:

- Price of CO₂ December+1 (source Refinitiv).
- Coal price Y+1 (source Refinitiv).

- Average availability of the French nuclear park over the various chained quarterly products (source publications on the RTE platform). This explanatory variable must be considered with caution. Indeed, in reality, the evolution of nuclear availability has non-linear effects on the price. Moreover, a shutdown published in one period may in some cases have an impact on the products of the following period, insofar as market players may fear or anticipate in a probabilistic way possible shutdown extensions.
- Gas prices on the different quarterly chained products (source ICIS Heren).

Model training period:

- From 1 January 2015 to 12 April 2021.
- Removing the exceptional periods (2021 price hike and price peak from 12 September 2016 to 12 December 2016). The October-November 2016 period was marked by rising futures prices in Europe and more particularly in France. Indeed, as presented in the 2016-2017 monitoring report, announcements about the availability of French nuclear generation facilities were made in September (problems with tank cracks), putting pressure on the supply-demand balance, particularly for the Q1 of 2017. The period was marked by exceptional uncertainty about the availability of the nuclear park and high price volatility.

Results:

The results show that the selected variables explain well the level of electricity prices in France. Indeed, the coefficients⁷⁴ R^2 are high (above 0.95) and the chosen explanatory variables are very significant⁷⁵. The model works even better for German futures prices.

However, three periods can be highlighted in which the model's errors are significant, meaning that prices deviate from the historical relationship with fundamentals, particularly for chained products of Q1:

- October-November 2016 price spike,
- the 2020 health crisis (March to end of 2020),
- and the recent period from 05 October 2021.

Figure 51 below shows the predicted values and errors of the model over the entire period, including the exceptional periods, although the model was calibrated only over the period excluding the exceptional periods.

⁷⁴ The coefficient of determination represents the proportion of electricity price variability explained by the model; a value of 1 means that 100 % of the variance of the explained variable is explained by the model.

⁷⁵ For a given predictor, the star number (or t-statistic) assesses whether or not there is a significant association between the predictor and the outcome variable, i.e., whether the beta coefficient of the predictor is significantly different from zero. Thus, if the predictor has *** (maximum value), it means that it is highly significant in the model.

Figure 51: Modelling results compared to raw data for the chained product of French first quarter



Sources: Refinitiv, Heren, EEX - Analysis: CRE

The prediction error on the exceptional periods is higher, on the one hand because the model has not been calibrated on these periods due to the methodological choices presented above, and on the other hand because these periods all represent a particular context that modifies the "normal" relationship between electricity prices and fundamentals. However, it can be seen that over the period from 12 April 2021 to the end of August 2021, the model works well, despite the very significant change in the absolute level of prices, indicating that electricity prices then remain consistent with fundamentals, according to the average historical relationship that links them (this period was not included in the model calibration period)

On the other, the prediction error observed from the beginning of September is of a greater magnitude. The market thus seems to be following, from the end of September 2021 and until the end of the year 2021, a very unusual situation for the Q1 2022 compared to the historical relationship with commodity prices and nuclear availability. This also reflects the limitations of linear modelling between electricity prices and explanatory variables in situations of very high stress: in these periods of security of supply fears, the market may anticipate extremely high price hours, or even default, which increases average expected prices well beyond the average historical linear relationship with fundamentals.

The same analysis, conducted on German prices, also shows a high modelling error on Q1 2022.

3. VOLUMES TRADED ON WHOLESALE MARKETS

Trading in wholesale markets takes place either over-the-counter or on the exchange. The vast majority of 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 the exchanges (mainly EEX) but also intermediated by brokers and then cleared with an exchange for settlement through the clearing house (transactions mainly cleared on EEX). Products with physical settlement are mainly intermediated by brokers.

On the futures markets (OTC, EEX), the products traded in France range from a 3-year horizon (calendar product Y+3) to a day before delivery (day-ahead product). Most of the day-ahead and intraday trade is traded on the EPEX Spot and Nordpool exchanges, the designated operators in France of the European coupling of daily and intraday markets. Exchanges on day-ahead products are carried out via daily auctions (daily coupling or Single Day-ahead

Coupling - SDAC); Intraday products are traded on a continuous market (intraday coupling or Single Intraday Coupling - SIDC - and the national market).

On the futures markets, the volumes traded on the French market are down by 30 % in 2021 (632 TWh) compared to 2020 (907 TWh). This trend is observed for all forms of exchanges, with an 8 % drop in volumes traded on the exchange (164 TWh in 2021 compared with 178 TWh in 2020), a 25 % drop in OTC for financial products (243 TWh in 2021 compared with 324 TWh in 2020) and a 44 % drop in OTC for physical products (226 TWh in 2021 compared with 405 TWh in 2020). The number of transactions is also down by 20 % between 2020 and 2021, as is the average volume of transactions.

The futures market has tended to become more financialised over the period observed. This growth in financial settlement products may reflect a preference for reducing counterparty risk in futures market trading. Indeed, while the terms of collateralisation and margin calls are variable in physical settlement products, financial settlement products systematically eliminate counterparty risk through the clearinghouse. However, the significant decline in trading volumes in physical delivery products was not offset by an increase in trading in financial delivery products, leading to an overall decline in trading volumes compared to 2019 and 2020.

Figure 52: Volumes traded on the exchange or via brokers on the futures markets

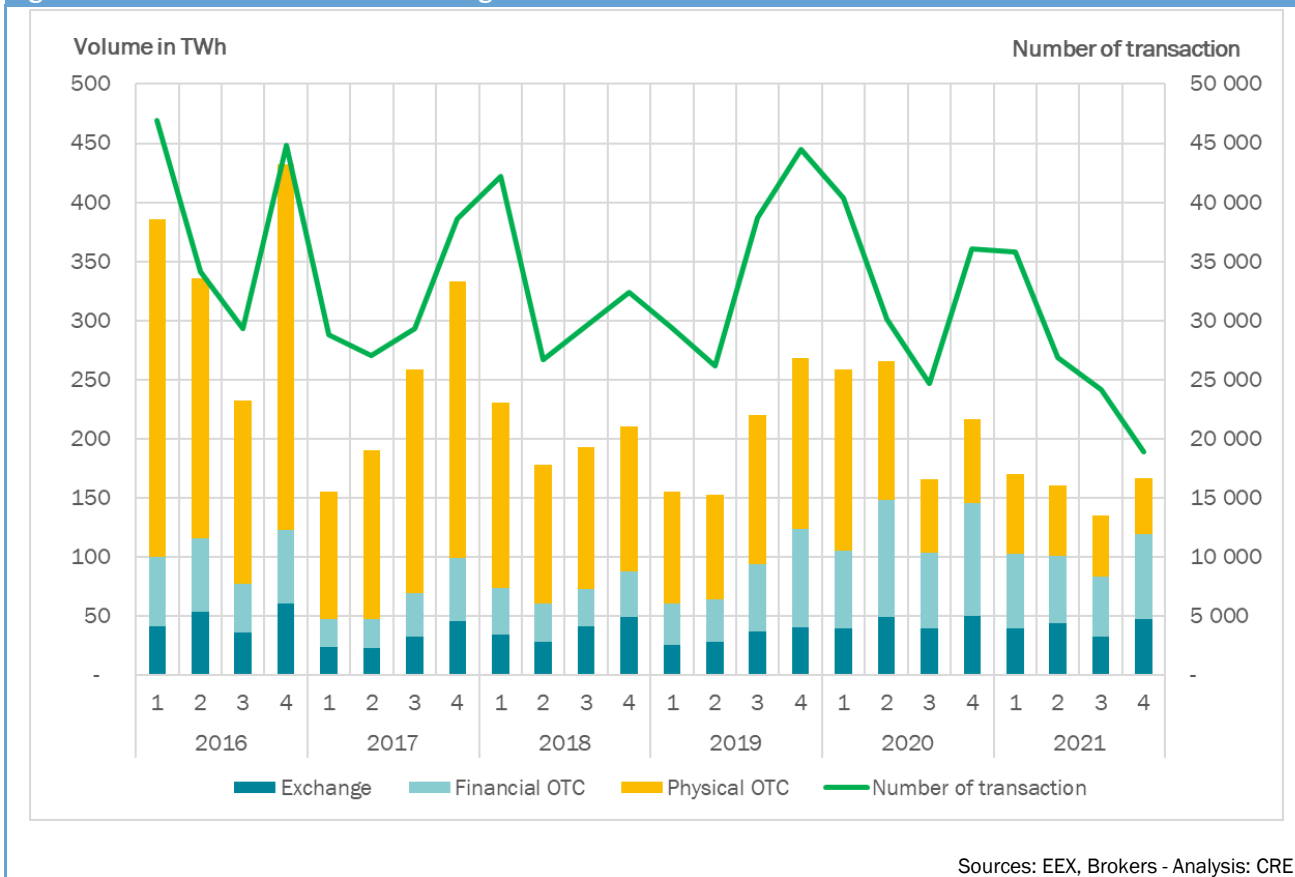


Figure 53 shows all volumes traded on the wholesale markets by maturity, on the futures markets as well as the daily and intraday markets. Between 2020 and 2021, most of the volumes traded for each product type are decreasing: volumes traded for annual products decrease by 24 %, from 320 TWh traded in 2020 to 244 TWh traded in 2021, volumes traded for quarterly products decrease by 26 %, from 299 TWh traded in 2020 to 222 TWh traded in 2021, the volumes traded for monthly products decreased by 40 %, from 215 TWh in 2020 to 128 TWh in 2021, and the volumes traded for weekly products decreased by 65 %, from 51 TWh in 2020 to 18 TWh in 2021. On the other, the volumes traded for daily and intraday products are stable, with 144 TWh traded for daily products and 11 TWh for intraday products. The year 2021 thus saw a general decline in long-term products compared to 2020, especially for products with shorter maturities (monthly and weekly). This could be related to higher prices and volatility and is particularly issued for physical delivery products.

Forward products represent the largest share of products traded on the wholesale markets, as market participants mostly hedge their medium- or long-term exposure and are required to adjust this hedge over time. The shorter-term markets, daily and intraday, are essential for optimising the generation portfolio and the use of interconnections, even if they represent smaller volumes traded. The daily market still has very significant volumes, especially because it can be used to buy or sell electricity whose price is already covered by a purchase or sale of a forward contract with financial delivery. Intraday products, on the other hand, represent only a share of around 1 % of trading. Since



2018, the Nord Pool exchange has been enabling trades on the French intraday market, like the EPEX Spot exchange.

Figure 53: Volumes traded on wholesale markets by maturity (physical and financial combined)

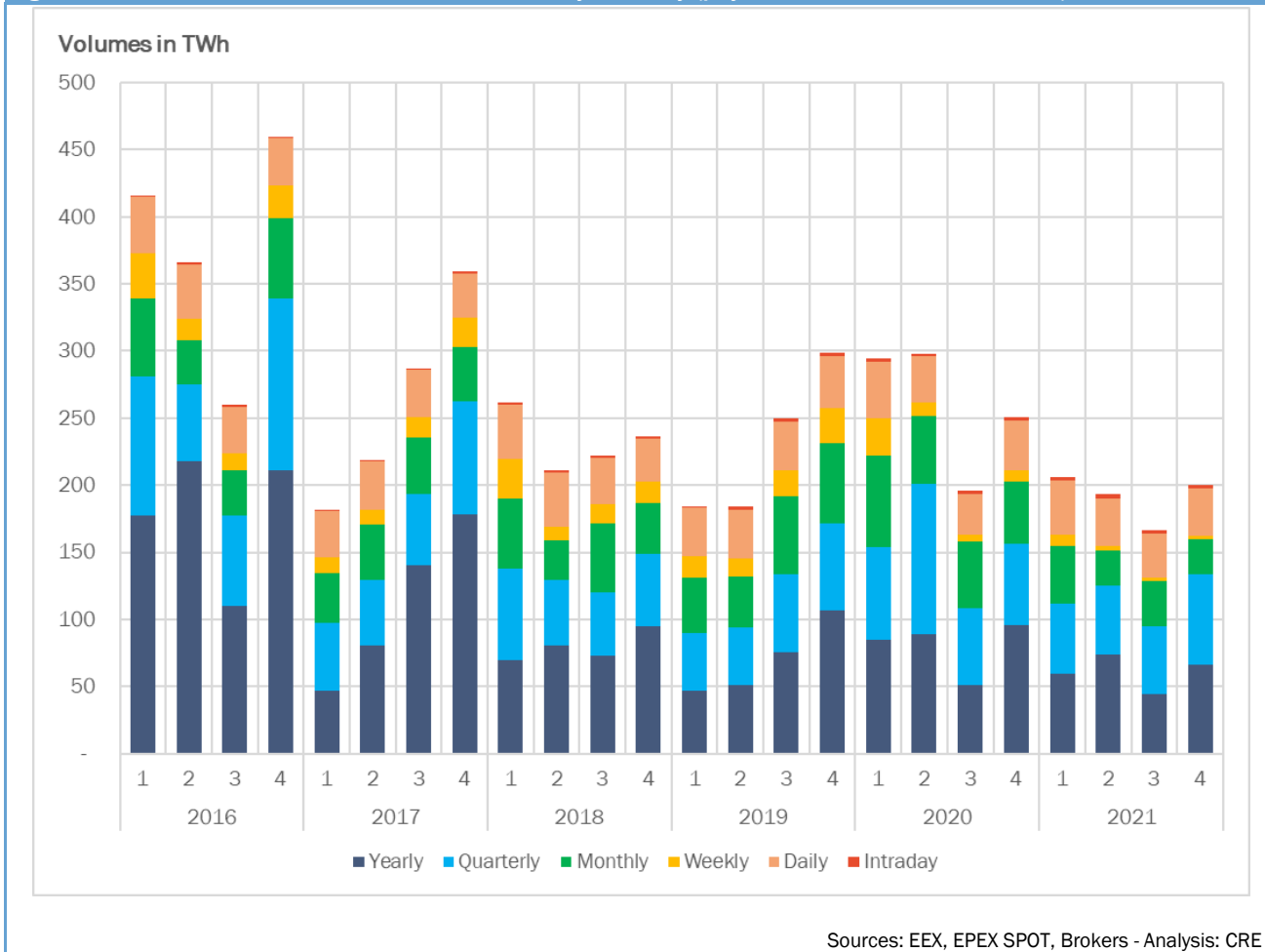
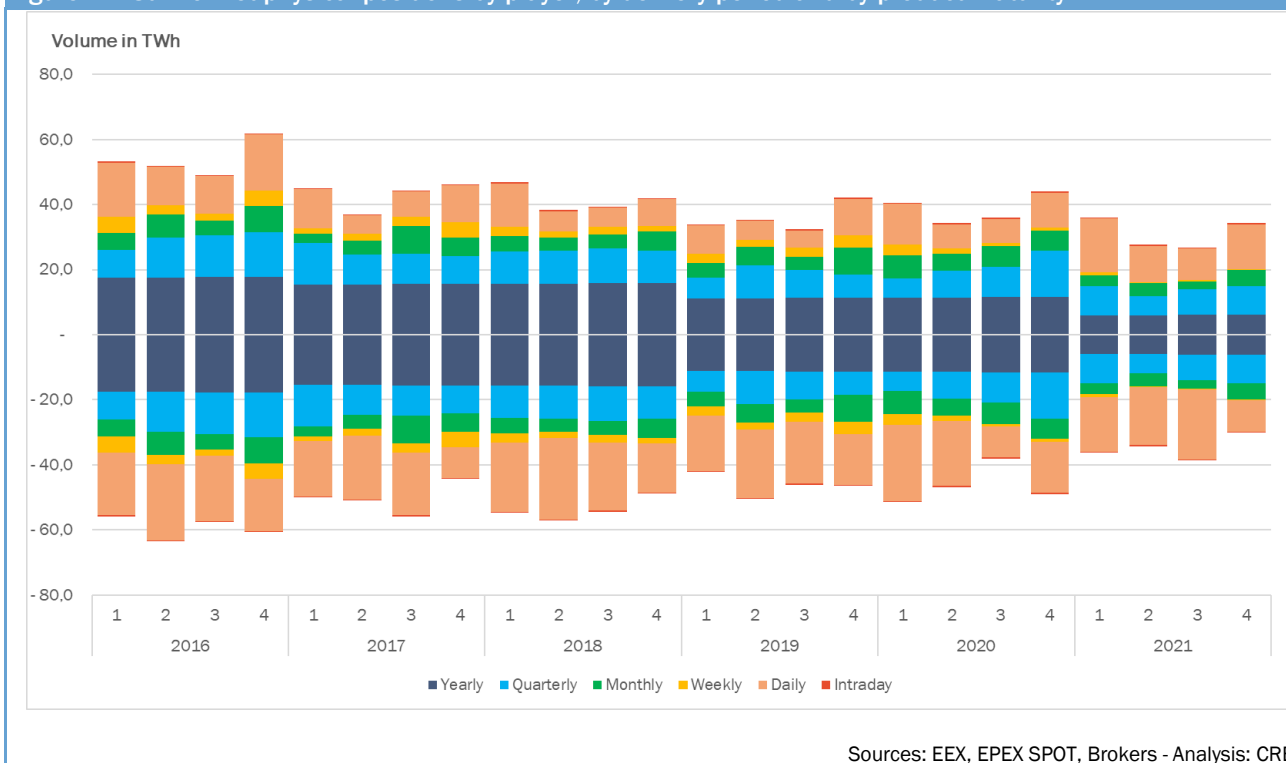


Figure 54 shows the sum of net physical positions delivered in France by wholesale market participants by delivery period and by product maturity. Unlike the previous graphs, the dates correspond to the delivery periods and not the trading periods. The sum of net positions per player is lower than the traded volumes (Figure 53) due to the fact that a player can buy and sell a product to reach a net position corresponding to the sum of these volumes. This phenomenon is particularly important for products with a long quotation period (futures products, especially annual and quarterly), and may reflect the level of liquidity of the markets. At daily and intraday maturities, the sum of sell positions is greater than the sum of buy positions: this reflects the overall exporting balance of the spot market in France through market coupling.

For 2021, the sum of net positions is down, notably in terms of annual products. This can be explained in particular by the decrease in nuclear production anticipated for 2021, which may lead to a limitation of the surplus nuclear production sold on the forward markets by EDF.

Figure 54: Sum of net physical positions by player, by delivery period and by product maturity



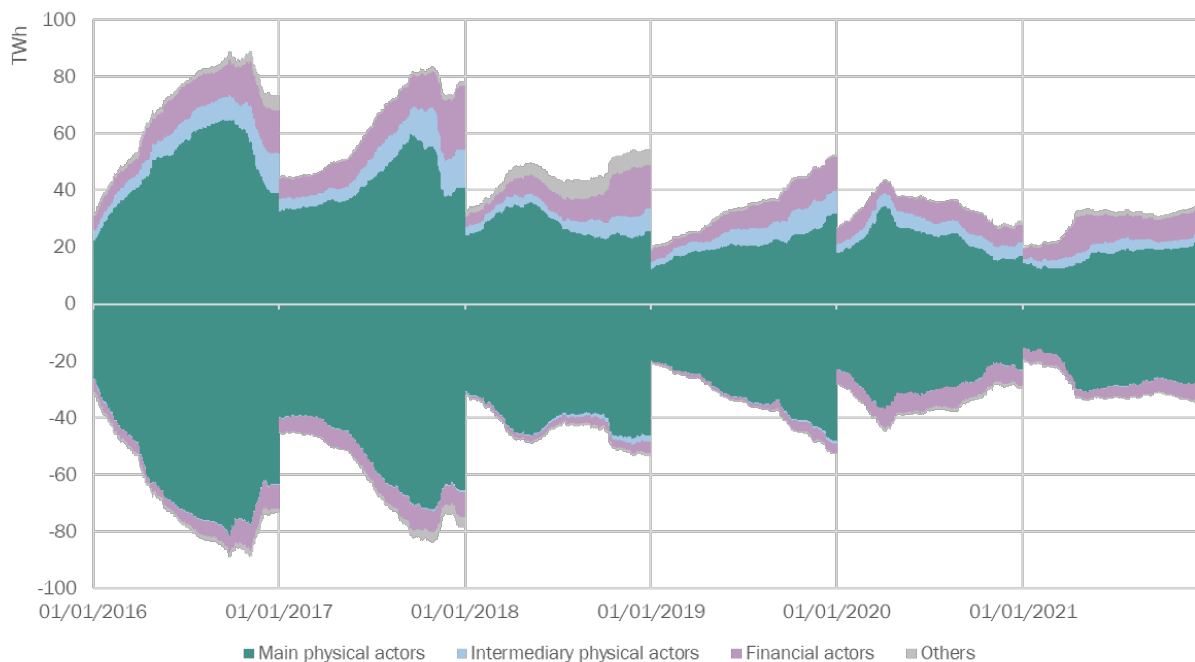
Players' position on annual product has been contracting since 2016. Figure 55 illustrates the evolution of open positions of the players by category, for annual base load, physical and financial combined. Note that this is the evolution of open positions over the year preceding delivery: a one-year lag should be considered with the Figure 54.

The stakeholder categories were constructed as follows:

- the main physical players of energy, composed of energy suppliers and producers,
- the physical intermediary players, composed of consumers, aggregators, etc.,
- financial players, consisting of investment funds, *trading house* etc. active in the French electricity market.

Over the entire period, physical players represent a large majority of open positions for the annual base load product. At the beginning of the period, the evolution of positions for physical players seems to be correlated with the evolution of prices in relation to ARENH prices and with the availability of French physical power generation assets. In 2020, there is a strong decrease in open positions from the beginning of the health crisis, which reflects in particular the decrease in nuclear availability anticipated for 2021. During 2021, it is observed that open positions remain moderate: lower availability of generation assets may have reduced supply to the market. The activity of financial players appears to be constant, and relatively limited, over the entire period: the activities of financial players on the market are *a priori* with little correlation to the physical market.

Figure 55: Evolution of the position of the players by category, for the basic annual product, physical and financial products combined (vision Y+1)



Sources: EEX, Brokers - Analysis: CRE

4. BALANCING MARKETS AND THEIR MONITORING BY THE CRE

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 balancing⁷⁶ and Article L. 321 11 of the 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 be able to balance consumption and generation at any time, RTE, as the party responsible for the stability of the power system, requests services from balancing service providers to modulate power generation, consumption or storage. To ensure this balance, different types of reserves can be mobilised: on the one hand, the automatic ancillary services composed by the frequency containment reserves (FCR) and the automatic frequency restoration reserves (aFRR), and on the other hand, the manual reserves, composed of the manual frequency restoration reserves (mFRR) and the replacement reserves (RR). In addition, balance responsible parties (BRP) are financially incentivised to balance their injections and imports on the one hand, and their withdrawals and exports on the other hand, before 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. 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 by RTE from French and foreign balancing service providers, through the FCR cooperation which RTE joined in early 2017. This cooperation gives rise to calls for tender conducted jointly by the TSOs of 8 countries (Germany, Austria, Belgium, Denmark, France, the Netherlands, Slovenia and Switzerland)⁷⁷.

⁷⁶ Commission 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=it sets out rules for,for the purposes of balancing.>

⁷⁷ The TSOs of Denmark and Slovenia joined the cooperation in January 2021.

Only the procurement of the FCR is subject to a market-based mechanism, the activation is done proportionally by all the participating units according to the frequency deviation. Moreover, exchanges between countries resulting from the activation of the FCR are never constrained by exchange capacities at the borders, as these exchanges are included in the safety margins on the interconnections.

4.1.2 The automatic frequency restoration reserve

The secondary reserve is activated automatically by RTE through 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.

The energy activation of secondary reserve capacities will evolve to be subject to a market-based mechanism. This evolution is planned for December 2022. The activations will then be subject to bids submitted by players close to real time, whose selection will be optimised in France by RTE and at the European level through the European aFRR platform, PICASSO, which will take into account all the bids submitted in Europe, the real time needs of each TSO and the cross-zonal capacities available at the borders.

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, 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 must participate in it, in accordance with Article 19 of Regulation (EU) 2017/2195, the so-called electricity balancing regulation.

Any balancing service provider (BSP) with balancing capacities 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 algorithm optimisation function performs an optimisation per hour, for the four quarters of the following hour, in order to select the offers to be activated. Balancing offers are remunerated at the marginal price of the bidding zone in which they are activated.

The platform was officially launched on 15 January 2020 and by the end of 2021, 6 TSOs were connected to it. RTE has been connected since 2 December 2020, and has increased its participation in the platform throughout 2021. At the end of 2021, RTE was participating 21 hour a day. Since 21 March 2022, RTE has been participating in the TERRE platform continuously.

On the balancing mechanism, the BSPs can offer to RTE their available none procured resources and must offer their procured resources. These offers define the technical characteristics of the unit or the group of units, a price for the activated energy and, if necessary, a start-up price. RTE activates this reserve according to its needs and in compliance with a so-called "technical-economic" precedence, which considers 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 possible congestion on the grid, to increase the capacity of available FCR and aFRR or to restore a sufficient level of margin of flexible resources available on the system.

On 1 June 2021, RTE launched a daily call for tenders to procure one third of its procured mFRR and RR. The annual call for tenders, which previously allowed RTE to procure mFRR and RR, is maintained to procure the remaining two thirds. The procured mFRR and RR allow RTE to have at its disposal at any time 1000 MW that can be activated in less than 13 minutes (mFRR) and 500 additional MW that can be activated in 30 minutes (RR). All generation facilities connected to the transmission system are required, by regulation, to offer their available upward capacity to the balancing mechanism. RTE use the balancing mechanism to activate offers from producers, consumers or balance service providers located abroad, through the interconnections.

In the next few years, RTE will join the mFRR platform, implemented in 2022, to exchange offers of mFRR. To date, RTE has no cooperation project for the joint contracting of these reserves.

4.1.4 The balance manager system

The balance responsible party (BRP) system provides a financial incentive for market players to match injection and withdrawals as closely as possible within their perimeter, with each network connection point being attached to the perimeter of a BRP. The imbalances (energy deficit or surplus for a given 30-minute period) are thus subject to a

financial settlement representing the value of the balancing energy that had to be mobilised by RTE, if necessary, to absorb these imbalances.

Generation schedules can be modified up to one hour before real time, and players can import or export energy through the cross-border markets, thus modifying the BRP position and the "physical" position of the French zone. After this moment, and up to five minutes before real time, the French players can continue to exchange energy between themselves on the French intraday market, without being able to modify the generation or import/export programs. These exchanges therefore have an impact on the imbalances of the concerned BRPs, but not on the physical position of the French bidding zone. During this period, RTE is therefore the only player to take "physical" balancing actions.

4.2 Balance of the balancing markets in 2021

4.2.1 Overview

Table 7 below gives the physical and financial balance of the balancing reserves contracted by RTE as well as the activated balancing energies.

Table 7: Balancing reserves contracted by RTE and activated balancing energies

Year 2021	Procurement			Activations			
	Reserve	Direction	MW (average)	M€	Upward GWh	M€	Downward GWh
Primary (FCR)	Upward and downward	537	77,8	492	166,9	479	-120,0
Secondary (aFRR)						1007	
Fast (mFRR)	Upward	1505	13,1	2095	727,2	1457	-352,7
Supplementary (RR)				1700		2331	
Total		2723	249,6	5496	873.3	5274	-602

The aFRR was contracted for the majority of the year on the basis of a prescription with a regulated price and is the most expensive reserve to procure (159 M€). The procurement by daily calls for tenders, started in November 2021, had to be stopped urgently by the CRE.

The price of the FCR rose sharply at the end of 2021. The procurement of the FCR for October 2021 cost 18.4 M€, which is more than the total procurement costs for the year 2020, which was particularly cheap. However, the cost in 2021 is still lower than the cost of procurement before the implementation of the FCR cooperation (e.g., 92 M€ in 2015).

The cost of procuring mFRR and RR increases compared to 2020, but remains low compared to the procurement costs of previous years (23.6 M€/year on average between 2016 and 2020). These procurement costs are covered by the tariffs for use of the public electricity transmission network (hereinafter "TURPE", for tarif d'utilisation du réseau publique d'électricité).

The activations of balancing resources on the balancing mechanism represented in 2021 a net cost of 374 M€, a strong increase compared to 2020 (221 M€). Almost half of the net cost (185 M€) comes from the last quarter of the year 2021. The significant increase of the net cost is mainly explained by the increase of the price difference between downward and upward offers on the balancing mechanism. Indeed, in the case of downward activations, the BSP buys energy from RTE instead of injecting it, thus helping to reduce an energy surplus on the system. The increase in the price differential between downward and upward offers therefore increases the gap between the revenues from downward activations and the cost from upward activations, thus leading to an increase in the net cost.

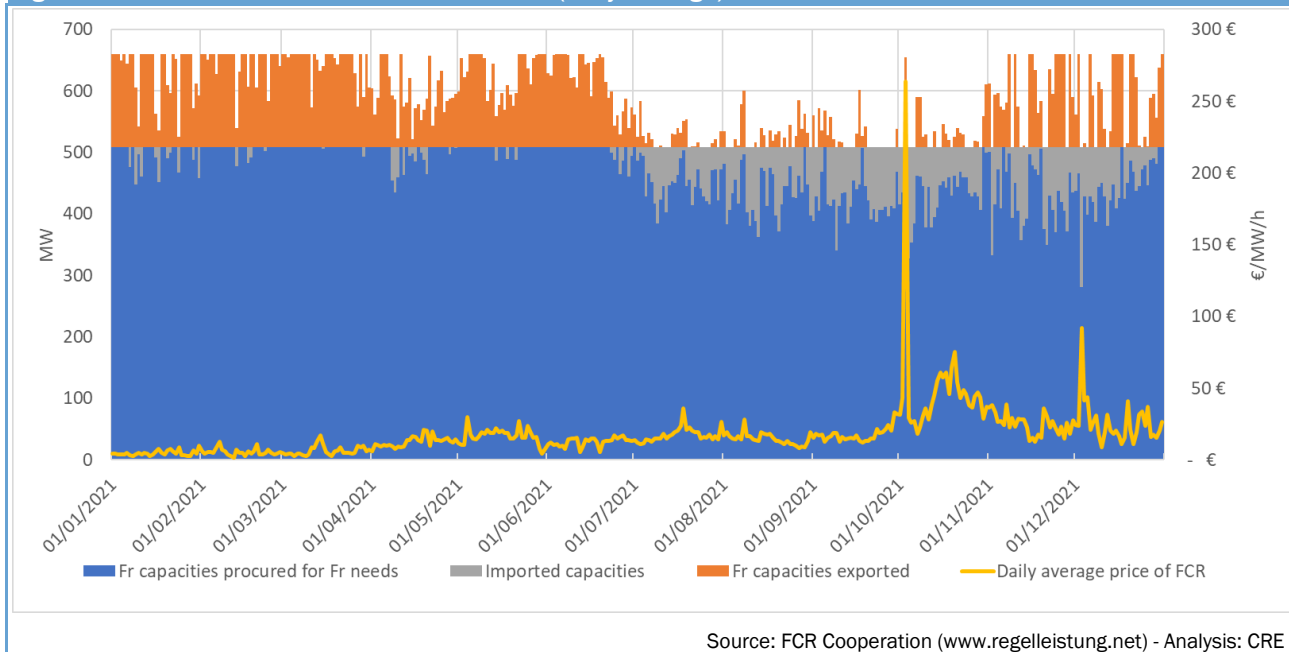
The net value of activated FCR and aFRR energy is low, as activations are, on average, centered around zero and the upward and downward prices are the same, equal to the day ahead price. Activation costs are supported by the BRPs and are paid through the settlement of imbalances, except for the additional costs from activations for non-balancing reasons, which are supported by the TURPE.

4.2.2 "FCR" cooperation

As of 1 July 2020, the FCR is procured through a daily call for tenders conducted at 8:00 each day for the following day, divided into six four-hour slots constituting six different products.

Figure 56 shows the daily averages of prices and volumes of the procured FCR, imported and exported in France. The level of RTE's demand is constant over one 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.

Figure 56: Prices and volumes of FCR in France (daily average)



In 2021, the cost of procuring the FCR has been highly variable. The year 2021 can be broken down into two parts, with the first half of the year when France is clearly an exporter, and the second half of the year when France is an importer overall. The cost of procuring the FCR was still contained in Q1 of 2021 with prices similar to the beginning of 2020. It stabilised in Q2 and Q3 of 2021 at a price nearly four times higher than the average procurement costs of 2020 before increasing again in Q4 of 2021. The cost of procurement of the FCR has come down in early 2022 but remains higher than in 2020.

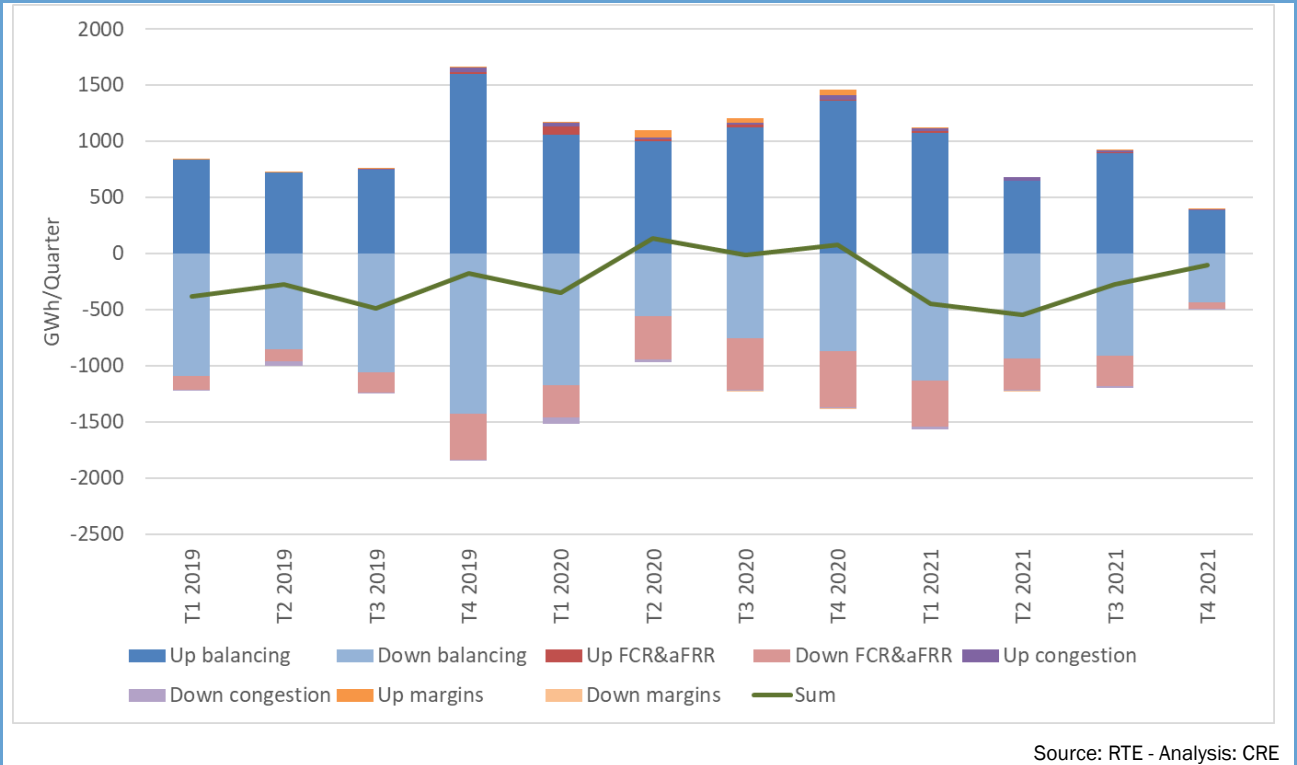
4.2.3 The secondary reserve

A long-planned change in the method of procuring aFRR, allowing RTE to procure these capacities with players through a daily call for tenders, was implemented on 3 November 2021. Concerned by the particularly high daily procuring costs, of around 3 M€ per day, and noting the apparent malfunctioning of this market, the CRE asked RTE in a letter dated 23 November 2021 to activate immediately the procedure known as "fall back", to temporarily resume the prescription procurement method's previously in effect. This was done on 24 November 2021. Thus, since November 24, the aFRR is once again procured via a prescription by the required players. The total aFRR capacity is distributed by RTE among the producers in proportion to the regulatory constructive capacities of their power plants, and remunerated at an administered price of about 20 €/MWh. The distribution of this prescription is free, within the portfolio of a player, or between different players, through exchanges of reserves by mutual agreement notified to RTE.

4.2.4 The balancing mechanism

Figure 57 shows the volumes of upward and downward energy activated by RTE since 2019 for the different reasons.

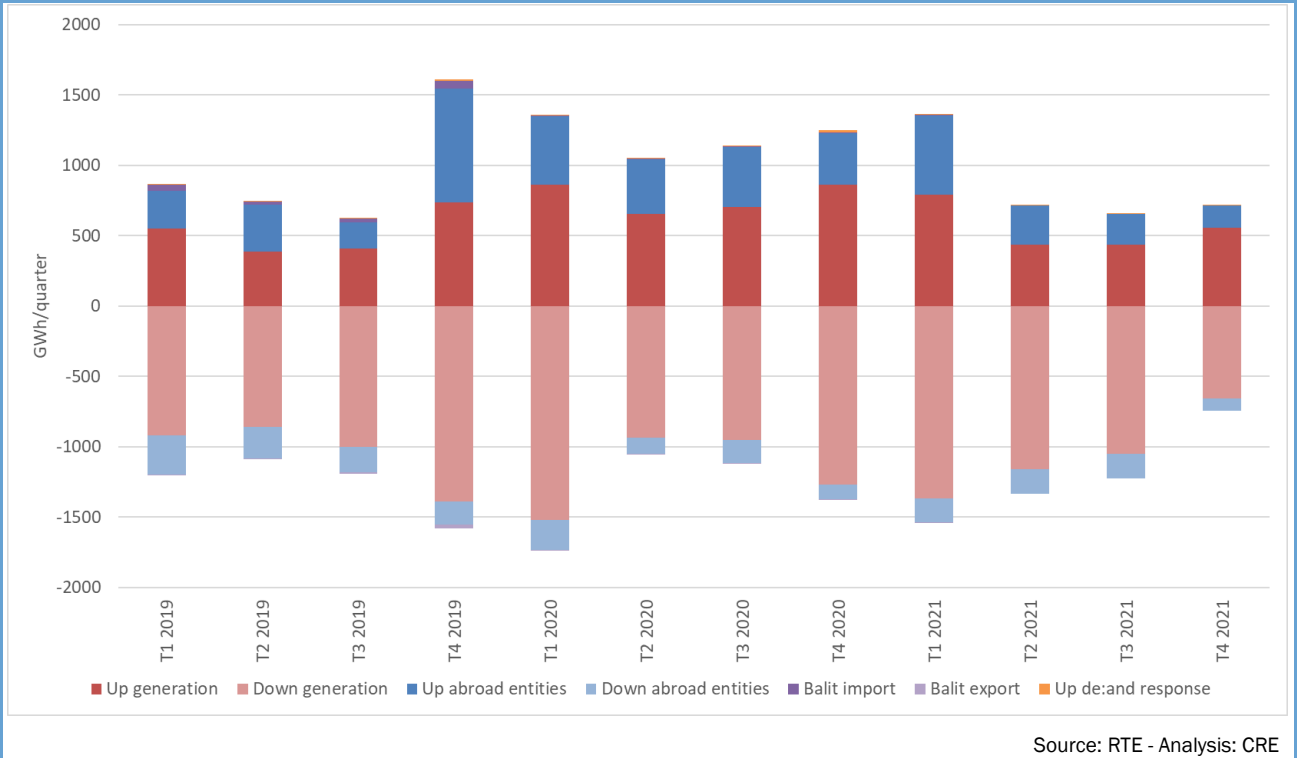
Figure 57: Monthly activation volumes per reason and net volume



Activations for balancing reasons ("P=C" reason) account for the majority of activations, but the replenishment of FCR and aFRR is also a significant downward activation cause (25% of downward activated volumes in 2021), and increased sharply compared to 2019. Activations due to congestion management ("Network") and replenishment of margins ("Margin") represent very low volumes. Net activated volumes are on average negative, indicating a tendency of BRPs to deliver excess energy.

Figure 58 shows the average volumes of adjustments by type of entity and by direction of activation.

Figure 58: Adjustment volumes by type of entity

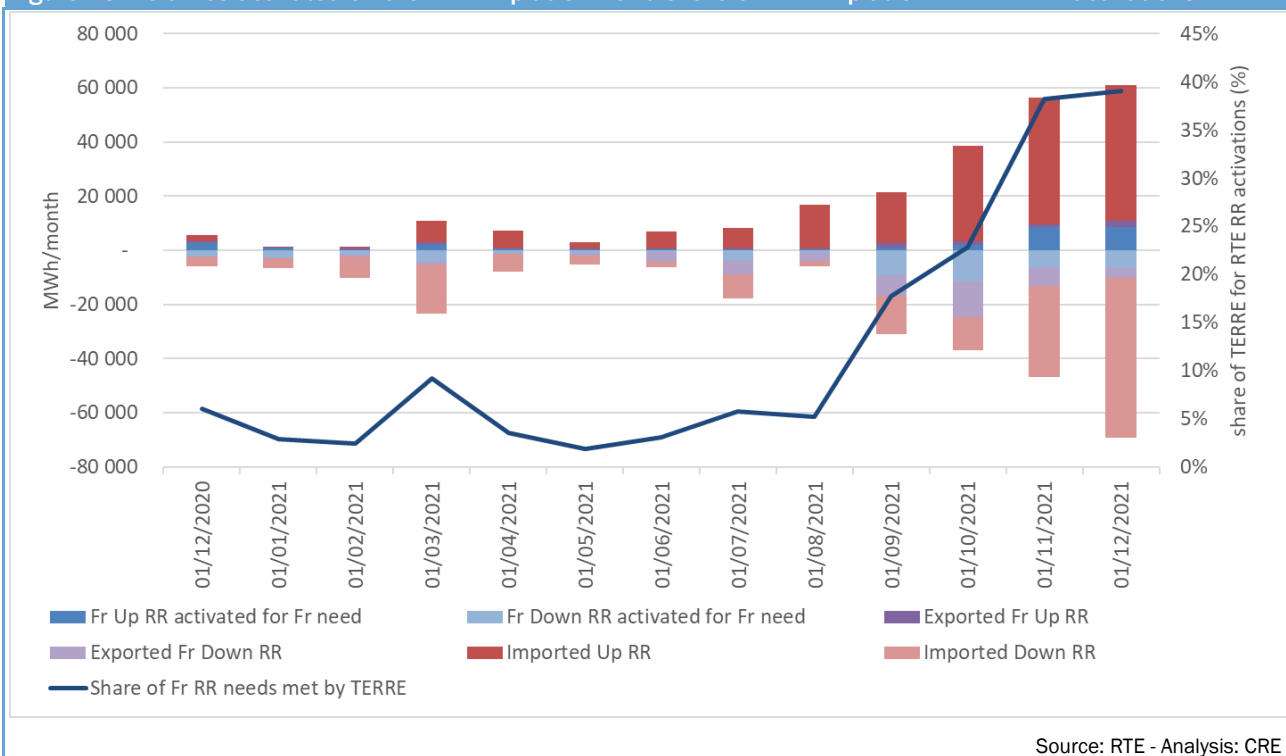


There is a large prevalence of injection-type units (generation units), but also an important role for balancing entities located abroad ("exchange points"), in particular for upward adjustments. Load shedding represents about 0.5% of the upwards volumes activated by RTE in 2021, but constitutes a much larger share of RTE's balancing margins.

4.2.5 The TERRE platform

At the beginning of 2021, RTE was only connecting to the TERRE platform 4 hours a day. RTE's participation in the TERRE platform increased throughout the year and by the end of 2021, RTE was using it 21 hours a day. Since the 21st of March 2022, RTE has been using the platform continuously. The TERRE platform is the first European balancing platform to be commissioned, and therefore represents a major step for the development of European balancing markets. Figure 59 shows the monthly activated volumes by RTE on the TERRE platform.

Figure 59: Volumes activated on the TERRE platform and share of TERRE platform in RTE RR activations



RTE has significantly increased its participation in the platform from August 2021, this increase is particularly visible on the volumes activated for RTE needs. Over the last two months of 2021, RTE activated on average 39% of its RR needs on the TERRE platform. Despite the increase in RTE's participation, the liquidity of French market on the platform remains low and the majority of RTE's demand is met by foreign offers. In March 2022, only 3 French BSPs were actively participating in the TERRE platform and were only offering part of their balancing capacities. A greater participation of French BSPs is necessary to continue to increase the use of the platform by RTE.

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 proper functioning of the power system and are evolving rapidly.

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

"The activation of an offer from a balancing entity located abroad must not lead to a supply (for upward offers) or a sale (for downward offers) by the balancing service provider on the French intraday market, either through an explicit flow or an implicit nomination."

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

5. THE CAPACITY GUARANTEE MARKET AND ITS MONITORING BY THE CRE

In its decision of 8 November 2016, following a year-long investigation, the European Commission authorised, under the European Union's state aid rules, the French capacity mechanism⁷⁸. Practical implementation of the mechanism began in December 2016 for a first year of delivery (YD) in 2017.

5.1 Reminder of the main principles of the French capacity mechanism

The provisions of Articles L. 335-1 ff. of the Energy Code establish a capacity duty system. It provides 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 generation or curtailment resources, or by purchasing 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.

Committed parties and operators can exchange capacity guarantees bilaterally, on the over-the-counter market (OTC) or through the market organised by EPEX SPOT in the form of an auction. In continuous operation, there will be 15 auctions organised before a given delivery year.

The formation of the price of capacity guarantees is the result of the meeting, on the market, of the operators' offer, committing themselves to the availability of their resources, and the demand of the required players, corresponding to their consumers' contribution to the risk of system failure.

The price of capacity should increase up to the cost of the cheapest means of meeting the security of supply criterion. The rules defining the mechanism's price ceiling are in line with the tension that should appear in the event of undersising of the park: "[the ceiling price] corresponds to the minimum annual capacity revenue that ensures the economic viability of developing or maintaining in service the capacities necessary to meet the security of supply criterion defined by the public authorities over the medium-term horizon studied by the Generation Adequacy Report".

5.2 Capacity price for the 2022 delivery year remains high due to low nuclear availability

In 2021, the capacity mechanism rules did not allow auctions for delivery years after 2022 to take place⁷⁹. This year is therefore essentially marked by the 2022 delivery year auctions.

Table 8: Balance prices and traded volumes for the 2022 delivery year auctions

Auction	23/04/ 2020	25/06/ 2020	15/10/ 2020	10/12/ 2020	11/03/ 2021	22/04/ 2021	24/06/ 2021	23/09/ 2021	28/10/ 2021	09 De- cember 2021
Price (€/MW)	16 641,70	38 966,40	18 100,1	18 222	28 300,4	28 152,8	28 816,4	29 899,5	31 500,8	23 899,9
Volume (GW)	5,03	4,33	5,93	4,2	3,1	3,3	3,7	4,2	4,2	11,9

The average capacity price for 2022, which is used as a reference price for the capacity top-up in the TRVEs, is 26,249 €/MW, compared to 31,242 €/MW for 2021.

The price of the last auction, used to set the price of settlement of discrepancies (PREC) but also the cost of the additional supply of capacity to the market following the capping of the ARENH, is 23,899.9 €/MW (39,095 €/MW in 2021).

The balance of the capacity market in 2022 remains tight since June 2020, which saw a sharp drop in the level of certification of the nuclear park.

⁷⁸ The operating principles of this market were recalled in the monitoring report on the operation of the wholesale markets 2016-2017 (Section 3 page 45:2.5 First exchanges of capacity guarantees in 2016).

⁷⁹ In anticipation of potential structural changes related to the v4 and v5 rules, the authorities have chosen to postpone the opening of the 2023 and 2024 LAs.

The lockdown of the French population set up to fight the epidemic of COVID-19 altered the dynamics of maintenance activities on nuclear installations during unit downtime. Delays in the completion of work have led to an increase in the duration of downtime.

On 5 May 2020, EDF reassessed downward the estimated volume of capacity guarantees made available in the capacity market for the 2020, 2021 and 2022 delivery years.

This reassessment of the estimated level of certified capacity, combined with the previous reassessments that have taken place from the start of the lockdown (17 March 2020), was of a significant magnitude, particularly in view of the previously tense situation of the mechanism before taking into account the effects of the health crisis.

Table 9: Evolution of the forecast supply-demand balance of the capacity mechanism

	Potential margins ⁸⁰ before the COVID-19 crisis	Reassessment of the "evolved" NCC between 17 March 2020 and 05 May 2020	Potential margins at 16 May 2020
Delivery year 2022	[2.4 GW; 1.6 GW]	-3.0 GW	[-1.4 GW; - 0.6 GW]

As a result, the price of capacity for the 2022 delivery year rose sharply in the June 2020 auction, from 16.6 €/CW to 38.9 €/CW.

In September 2020, RTE re-evaluated the total French duty and estimated that, in a difficult economic context, it should decrease sharply for LA 2020, 2021 and 2022. This reassessment of peak demand caused a drop in capacity prices for LA 2022. The prices on the 15 October 2020 and 10 December 2020 auctions thus returned to the initial level of around 18,000 €/MW.

The level of certification reported on the register in 2021 subsequently showed that the forecast availability of controllable capacity had gradually deteriorated. Nuclear and coal certification saw a decline of nearly 1.5 GW between December 2020 and December 2021.

For coal, the decrease in availability for AL 2022 is mainly due to the shutdown of the coal-fired unit 5 at the Gardanne power plant, which was previously certified at over 500 MW.

In the nuclear sector, there is considerable uncertainty as to the projected availability of the nuclear park in 2022. On the one hand, EDF has reorganised its maintenance schedule, which has enabled some units to increase their level of certification (for example, by studying a reduction in maintenance shutdowns at Flamanville and Gravelines). On the other, several generic incidents have been identified in 2021 (premature corrosion of cladding, detection of cracks in reactor safety injection system piping) and have increased the risk that some units will also be affected in 2022.

However, it should be noted that EDF's announcements at the end of 2021, about the shutdown of N4 units, were made after the last capacity auction on 9 December 2021, and therefore did not influence the price of capacity for 2022. These unavailabilities could have an impact on the next balancing auctions for the AL 2022 product.

Table 10: Evolution of the certification on the capacity register for AL 2022 (GW)

Branch	December 2020	December 2021	Evolution
Nuclear	46,3	45.4	-0.9 GW
Coal	2,2	1.6	-0.6 GW
Oil/diesel	1,8	1.9	+0,1 GW
Interconnection	9,2	7.6	-1.6 GW

In general, the certification of nuclear power has been in continuous decline for several years. This decrease is explained by the effective decrease in the production rate of this sector, the closure of the Fessenheim power plant, but also partly by the modification of the abatement coefficient applicable to this sector, from 2020, for the calculation of certified capacity. This has been reduced from 1 to 0.95 and reflects, according to RTE, a better appreciation of the correlation between periods of tension in the power system and the availability of nuclear power during these periods.

There is also a strong deterioration in the contribution of interconnections compared to RTE's initial forecast (-1.6 GW). The decrease in the certification of capacity from interconnections between December 2020 and 2021 is

⁸⁰ Views from the registry and under the central demand scenario. A certification of about 2.5 GW of shaving is considered for 2021.

linked to the non-certification of the Eleclink interconnection (theoretical capacity of 1 GW), whose commissioning was initially planned for the year 2021, but which has been postponed for the moment.

The fire that affected the IFA 1 and Eleclink interconnections on 14 September 2021 also has a downward impact on the certification of the IFA 1 interconnection for AL 2022: its capacity was limited to 1,000 MW (instead of 2,000 MW) until its rehabilitation in March 2022.

Table 11: Evolution of the nuclear certification on the capacity register (GW)⁸¹

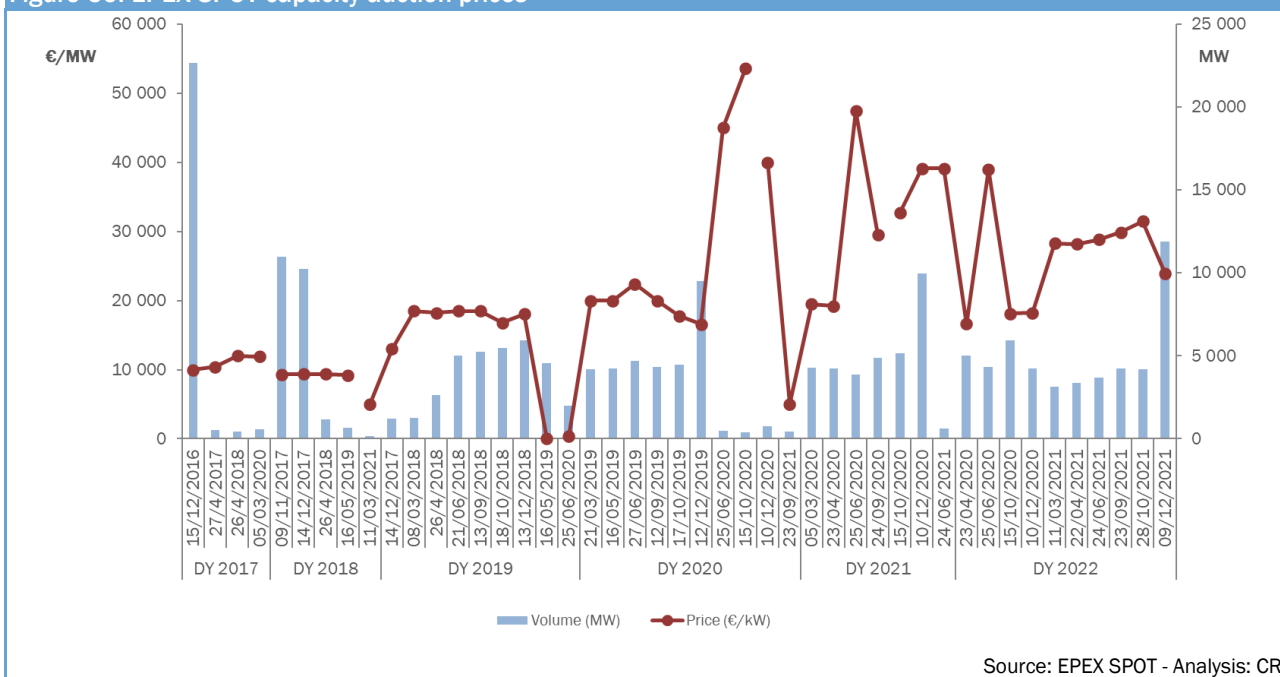
Nuclear certification (GW)	AL 2018	AL 2019	AL 2022
	56,6	55,2	46,3

During the year 2021, RTE's consumption forecasts have not shown any strong evolution. At the beginning of the year, RTE initially forecast an duty of between 90.8 and 93.9 GW, depending on four demand scenarios. At the Following the publication of its BP 2021⁸²In March 2021, RTE updated the estimate of the French duty for the year 2022, which should be between 90.6 and 93 GW⁸³.

In terms of price, capacity for 2022 delivery saw an increase in March 2021 (28,300 €/MW) and then remained stable around 30,000 €/MW until December 2021 when the year-end auction saw a decrease of 7,500 €/MW.

It should be noted that energy and commodity prices on the market did not reveal any problem of *missing money*⁸⁴ in France for combined-cycle gas-fired generation facilities. Nevertheless, using the methodology detailed in the 2019 and 2018 wholesale market monitoring reports, the CRE notes that the *missing money* of other advanced thermal technologies is not zero for 2022, especially for coal.

Figure 60: EPEX SPOT capacity auction prices



5.3 The CRE considers that a wide-ranging and comprehensive review of the architecture of the capacity mechanism should be launched

On 4 August 2021, RTE published a feedback on the first years of operation of the mechanism from 2017 to 2019. This feedback, together with RTE's latest 2021 Generation Adequacy Report, shows that the capacity mechanism has played a positive role in ensuring the security of supply of the power system.

However, RTE's analyses have also highlighted several malfunctions.

⁸¹ At 04/23/2018 for LA 2018 and LA 2019 and 12 July 2021 for LA 2022

⁸² <https://www.rte-france.com/analyses-tendances-et-prospectives/les-bilans-previsionnels#Lesbilansprevisionnels>

⁸³ RTE has confirmed these values on 15 December 2021

⁸⁴ for a given capacity, the revenue required to maintain it in operation (if it is existing) or to build it (for a new capacity) but which is not provided by the energy market.



In parallel, The increase in the cost of "capacity" in consumers' bills in recent years led the CRE to question the cost-benefit ratio of the system in its deliberation of 14 January 2021 on the proposal for regulated electricity sales tariffs. The CRE shared its analyses in its decision of 23 September 2021 about the capacity mechanism.

The CRE agrees with the main conclusions of RTE's feedback, and notes that:

- the benefits of the mechanism for the community, highlighted by the REX, come at the cost of a significant financial transfer from consumers to capacity operators;
- the scope of the mechanism is questionable, especially in a context of high electricity prices that ensure the profitability of decarbonised baseloads;
- the decentralised nature of the duty did not bear fruit between 2017 and 2019, and did not prove to be a determining factor in the development of load shedding capacities;
- the diffuse temporality of exchanges does not allow the emergence of a reliable price signal, and leads some capacity operators without *missing money* to include reserve prices in their bids on auctions.

Consequently, the CRE considers that the work on the v5 rules must start immediately and be the occasion for a wide-ranging and exhaustive reflection on the architecture of the capacity mechanism; in particular, this work must reexamine the structuring choices of the French mechanism, namely its perimeter and its decentralised nature, with the aim of improving its operation and reducing the cost for consumers. These changes should also improve the CRE's ability to monitor this market.

6. FUNCTIONAL BALANCE OF THE WHOLESALE ELECTRICITY MARKETS IN FRANCE IN 2021

The year 2021 was marked by an unprecedented crisis in electricity prices.

This is not a financial or speculative crisis, but a supply-side crisis, with the conjunction of two phenomena, each of which has an unprecedented scope.

On the one hand, security of gas supply for the winter of 2021-2022 was a major concern throughout the second half of 2021, which led to a rise in the price of gas in Europe to unprecedented levels, of the order of five times the historical average price of gas. Gas-fired generation plays an essential role in balancing the electricity system in Europe and in France, particularly during the winter months. As a result, wholesale electricity prices in Europe have also risen sharply since mid-2021.

On the other, the availability of the French nuclear park has also been a source of concern for the markets, from mid-2021 onwards and increasingly so. This latent crisis materialised when EDF announced on 15 December 2021, a potentially generic irregularity on the N4 units.

In both cases, the triggers led to fears that security of electricity supply would not be ensured in the event of a cold winter of 2021-2022. The wholesale electricity markets played their part by reflecting this unprecedented imbalance between supply and demand with very high prices.

At this stage of its analyses, and subject to further investigation, particularly about the progress of announcements on the availability of nuclear power plants, the CRE considers that the wholesale electricity market in France has functioned correctly in 2021. However, it should be noted that the CRE is not in a position to draw a similar conclusion for the gas market (see section 4 §7). Because of the close relationship between the two sectors, the wholesale electricity market could be directly affected by any malfunctioning of the wholesale gas market.

The availability of the nuclear park remained low at the beginning of the year due to maintenance disruptions related to the health crisis, but quickly improved and returned to normal in the summer, before deteriorating again at the end of the year. Gas-fired generation was affected by rising gas prices, especially in the summer of 2021, but recovered at the end of the year in a context of low nuclear availability, made profitable by the sharp rise in wholesale electricity prices despite high gas prices. Despite strong growth in installed capacity in 2021, renewables, wind and solar, undergone unfavourable weather conditions in 2021, and their total output declined compared to 2020.

Short-term electricity prices have rebounded strongly in 2021 after a year of exceptionally low prices in 2020. This dramatic increase is directly related to the rise in gas prices, which was sustained throughout the year but was significantly exacerbated in the last quarter, in the context of rising consumption and low nuclear availability. The upward factors, mainly linked to raw material prices, affected most European countries more or less uniformly. At the end of the year, prices in France rose more significantly, notably due to low nuclear availability for the winter of 2021-2022.

Electricity forward prices were also strongly affected by the rise in gas and commodity forward prices: the strong relationship between the two in the short term logically extends to the forward markets. At the end of the year, very

high gas prices and strong uncertainties about the availability of the nuclear park contributed to extremely high prices, with forward prices for Q1 of 2022 peaking at 772 €/MWh.

The balancing markets underwent significant changes in 2021, with the ramping up of the TERRE balancing platform and the start of contractualisation of the secondary reserve through calls for tender, which had to be suspended at the end of the year. The other existing market mechanisms continued to play their role satisfactorily, with no major impact on price levels. Because of their rapid evolution and complexity, these markets require sustained vigilance on the part of the CRE to monitor them.

Finally, the capacity mechanism auctions in 2021 only covered the 2022 delivery year, as the following years have not yet been opened. The prices of capacity guarantees for the year 2022 have been high at most of the auctions since June 2020, reflecting the tension linked mainly to the additional drop in the certification of the nuclear park, whereas the capacity balance was already tense for 2022 before taking into account the effects of the health crisis. The CRE is in favour of setting up a large-scale review of the mechanism's architecture with the aim of improving its operation and reducing its cost for consumers.

KEY STATISTICS

1. GAS MARKET

Table 12: Fundamentals of the gas market in France

Market fundamentals	Yearly values			Yearly variation 2020/2021	
	2019	2020	2021	In percentage	In value
Entry and exit flows					
Supply (TWh)	761	682	685	0%	3
Storages withdrawals	122	153	155	1%	2
Imports	639	529	526	-1%	-3
<i>Pipeline</i>	421	350	361	3%	11
<i>LNG</i>	219	179	164	-8%	-15
Production	0	2	4	95%	2
Demand (TWh)	761	682	685	0%	3
Storages injections	143	131	137	4%	6
End consumers demand	479	444	474	7%	30
<i>Distribution consumers</i>	288	269	303	13%	34
<i>Consumers connected to the transmission system</i>	190	176	171	-3%	-5
Exports	135	106	72	-32%	-34
Other	4	1	2	119%	1
Deliveries at PEG (TWh)	868	864	854	-1%	-10

Sources: GRTgaz, Teréga - Analysis: CRE

Table 13: Gas prices in France

Price	Yearly values			Yearly variation 2020/2021	
	2019	2020	2021	In percentage	In value
Spot prices (€/MWh)					
PEG day-ahead (avg.)	13,6	9,3	46,5	400%	37,2
Day-ahead PEG Nord/TTF Spread (avg.)	0,1	-0,1	-0,2	63%	-0,1
Forward prices (€/MWh)					
PEG M+1 (avg.)	14,6	9,4	47,4	404%	38,0
PEG Y+1 (avg.)	18,3	13,4	33,7	152%	20,3
M+1 PEG/TTF spread (avg.)	0,13	-0,04	0,18	-546%	0,2
Summer-ahead/Winter-ahead spread (avg.)	4,0	4,2	0,9	-79%	-3,3

Sources: EEX, ICIS - Analysis: CRE

Table 14: Gas trading in France

Trading activity	Yearly values			Yearly variation 2020/2021	
	2019	2020	2021	In percentage	In value
Natural gas exchanged at PEG* (TWh)	738	662	624	-6%	-39
% of national consumption	154%	149%	132%		-18%
Trading volumes in the French intermediated markets					
Spot market (TWh)	173	193	207	7%	14
Intraday	33	35	39	11%	4
Day Ahead	88	91	107	18%	17
Exchange (DA, WD, WE, other spot)	137	161	194	20%	33
Brokers (DA, WD, WE, other spot)	37	32	13	-58%	-18
Forwards market (TWh)	564	470	417	-11%	-53
M+1	112	106	95	-11%	-11
Q+1	40	36	36	0%	0
S+1	124	67	66	-2%	-1
Y+1	25	25	2	-91%	-22
Exchange (all maturities)	17	21	21	-1%	0
Brokers (all maturities)	547	449	396	-12%	-53
Number of transactions in the French intermediated markets					
Spot market	124 139	132 050	155 160	18%	23 110
Intraday	31 883	33 042	39 041	18%	5 999
Day Ahead	74 127	78 792	92 498	17%	13 706
Exchange (DA, WD, WE, other spot)	114 095	128 163	152 813	19%	24 650
Brokers (DA, WD, WE, other spot)	10 044	3 887	2 347	-40%	-1 540
Forwards market	5 828	5 093	5 135	1%	42
M+1	2 673	2 255	2 312	3%	57
Q+1	390	337	331	-2%	-6
S+1	446	311	266	-14%	-45
Y+1	146	203	31	-85%	-172
Exchange (all forward maturities)	1 019	1 169	1 430	22%	261
Brokers (all forward maturities)	4 809	3 924	3 705	-6%	-219

* Deliveries from exchanges on intermediated markets in France

Sources: EEX, brokers - Analysis: CRE

Table 15: French gas market players

Market participants on French gas markets	Yearly values			Yearly variation 2020/2021	
	2019	2020	2021	In percentage	In value
Number of active shippers by type of point					
PEG	127	115	114	-1%	-1
PIR	60	53	62	17%	9
PITD	41	44	43	-2%	-1
PITS	56	47	53	13%	6
Number of companies importing LNG					
Montoir	5	8	11	38%	3
Fos Tonkin	4	1	2	100%	1
Fos Cavaou	4	5	4	-20%	-1
Dunkerque	5	2	2	0%	0

Sources: GRTgaz, Teréga - Analysis: CRE

2. ELECTRICITY MARKET

Table 16: Installed production capacity in France

	Yearly values			Yearly variation 2020 / 2021	
	2019	2020	2021	In percent	In value
Installed capacity (GW)	135,6	136,2	139,1	2,2%	2,9
Nuclear	63,1	61,4	61,4	0%	0
Hydro	25,7	25,7	25,7	0%	0
Fossil-fuel	18,5	18,9	18,0	-5%	-0,96
Coal	3,0	3,0	1,8	-39%	-1,16
Oil	3,4	3,4	3,4	0%	-0,01
Gas	12,2	12,6	12,8	2%	0,21
RES (excluding hydro)	28,2	30,2	34,1	13%	3,89
On-shore Wind	16,5	17,6	18,8	7%	1,17
Solar	9,6	10,4	13,1	26%	2,68
Biomass	2,1	2,2	2,2	2%	0,04

Source: RTE

Table 17: Production of the different technological sectors in France

	Yearly values			Yearly variation 2020 / 2021	
	2019	2020	2021	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)	470	446	472	6%	26,4

Source: RTE

Table 18: Imports and exports in France

	Yearly values			Yearly variation 2020 / 2021	
	2019	2020	2021	In percent	In value
Import (TWh)	28,3	34,6	43,8	26,7%	9,2
Import Peak (TWh)	10,7	13,2	16,3	23,2%	3,1
Import Offpeak (TWh)	17,6	21,3	27,5	28,9%	6,2
Export (TWh)	84,0	77,8	87,0	11,8%	9,2
Export Peak (TWh)	28,9	27,2	30,3	11,4%	3,1
Export Offpeak (TWh)	55,1	50,6	56,6	12,0%	6,1
Export balance (TWh)	55,7	43,2	43,1	-0,2%	-0,1

Source: RTE

Table 19: Balance at the borders

	Yearly values			Yearly variation 2020 / 2021	
	2019	2020	2021	In percent	In value
Balance at border (TWh)					
CWE	2,7	0,6	-10,1	-1746%	-10,7
Italy	18,9	15,4	17,6	15%	2,2
Spain	9,7	5,2	6,1	15%	0,8
Switzerland	13,1	13,2	15,6	18%	2,4
Great Britain	11,2	8,8	13,9	59%	5,2
Total (TWh)	55,7	43,2	43,1	-0,2%	-0,1

Source: RTE

Table 20: Clean dark and spark spread and coal

	Yearly values			Yearly variation 2020 / 2021	
	2019	2020	2021	In percent	In value
Contract (Y+1)					
Coal (€/t)	62,0	50,8	80,4	58%	29,6
Clean dark spread peak (€/MWh)	17,9	16,3	37,8	132%	21,5
Clean spark spread peak (€/MWh)	14,7	18,9	28,9	53%	10,0

Sources: ICE, EPEX SPOT, EEX

Table 21: Injections - Withdrawals balances of the French electrical system

	Yearly values			Yearly variation 2020 / 2021	
	2019	2020	2021	In percent	In value
Physical injections into grids (TWh)	564	530	560	5,7%	30,5
Generation Excluding ARENH	415,0	369,0	388,4	5%	19,4
ARENH generation	121,0	126,1	127,9	1%	1,8
Commercial Imports	28,0	34,6	43,8	27%	9,2
Physical withdrawals from grids (TWh)	564	530	560	5,7%	30,5
End-user consumption	443,0	409,2	430,1	5%	20,9
Water pumping	7,0	6,3	6,0	-5%	-0,3
Commercial Exports	84,3	77,8	87,0	12%	9,2
Grid losses purchased on markets	30,0	36,4	37,1	2%	0,7

Source: RTE

Table 22: French electricity market players

	Yearly values			Yearly variation 2020 / 2021	
	2019	2020	2021	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 23: Spot and forward prices in the French electricity market

	Annual values			Annual variation 2020/2021	
	2019	2020	2021	Percentage	Value
Spot market prices					
Intraday price France €/MWh	39,7	32,9	109,5	232,6%	76,6
Baseload day-ahead price France €/MWh	39,4	32,2	109,2	239,0%	77,0
Peakload day-ahead price France €/MWh	42,5	35,0	116,6	232,8%	81,5
Baseload day-ahead France-Germany spread €/MWh	-1,8	-1,7	-12,3	611,2%	-10,6
Peakload day-ahead France-Germany spread €/MWh	-2,09	-2,29	-11,51	402,7%	-9,2
Day-Ahead France-Germany convergence rate %	44%	46%	49%	7,3%	0,0
Forward market prices (Heren)					
M+1 price France €/MWh	45,1	36,4	133,0	265,0%	96,6
M+1 France-Germany spread €/MWh	3,1	3,4	23,9	607,2%	20,5
Q+1 price France €/MWh	48,6	42,0	134,9	221,5%	92,9
Q+1 France-Germany spread €/MWh	4,1	6,1	23,9	289,2%	17,8
Y+1 price France €/MWh	50,8	44,9	95,4	112,3%	50,4
Y+1 France-Germany spread €/MWh	3,1	4,7	6,4	35,0%	1,6
Y+1 Peakload/Baseload ratio					
France	1,3	1,3	1,3	-0,2%	0,0
Germany	1,2	1,2	1,2	-0,4%	0,0

Sources: EPEX Spot, Heren

Table 24: Spot and forward volumes on the French electricity market

	Annual values			Annual variation 2020/2021	
	2019	2020	2021	Percentage	Value
Spot market					
Volumes in the EPEX SPOT intraday market TWh	11,9	17,2	16,3	-5,1%	-0,87
Portion of intraday cross-border volumes TWh	70,8%	76,0%	72,5%	-4,5%	-0,03
Volumes in the EPEX SPOT day-ahead market TWh	113,0	122,0	123,0	0,8%	1,00
Forward market					
Volumes TWh					
Market share of OTC financial products	26,6%	35,7%	38,4%	7,4%	0,03
Market share of OTC physical products	56,9%	44,6%	35,7%	-20,0%	-0,09
EEX market share	16,4%	19,6%	25,9%	32,1%	0,06
Number of trades					
Market share of OTC financial products	138 784	131 234	105 772	-19,4%	- 25 462
Market share of OTC physical products	20,8%	25,0%	29,6%	18,5%	0,05
EEX market share	64,9%	51,0%	47,3%	-7,3%	-0,04
Y+1 product					
Volumes TWh	219,3	252,7	172,3	-31,8%	-80,4
Number of trades	7 654	9 099	7 522	-17,3%	- 1 577
Q+1 product					
Volumes TWh	169,5	233,4	171,8	-26,4%	-61,5
Number of trades	13 330	14 153	10 456	-26,1%	- 3 697
M+1 product					
Volumes TWh	188,2	198,3	117,5	-40,7%	-80,7
Number of trades	42 071	40 081	28 445	-29,0%	- 11 636
W and D products					
Volumes TWh	109,5	72,6	38,5	-47,0%	-34,1
Number of trades	63 887	47 248	46 118	-2,4%	- 1 130

Sources: EPEX Spot, Nordpool, EEX, Brokers

Table 25: Concentration Index (HHI) of the different wholesale electricity market segments in France

	HHI - Market Concentration	
	2020	2021
Deliveries		
Forward market (Physical) - purchases	560	704
Forward market (Physical) - sales	579	749
EPEX - purchases	1386	1246
EPEX - sales	2788	2681
Injections		
Production	6447	6650

Sources: EPEX Spot, Brokers

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