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DE RÉGULATION  
DE L'ÉNERGIE

SURVEILLANCE

REPORT 2017

# Functioning of the wholesale electricity and natural gas markets



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## SUMMARY

### Operational transition towards the implementation of REMIT within the European context

Since 28 December 2011, the wholesale energy market monitoring mission performed by the French Energy Regulatory Commission (CRE), has been governed by European regulation No. 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency (REMIT).

The REMIT regulation establishes rules which prohibit abusive practices affecting the wholesale energy markets. Those rules specifically aim to ensure integrity and transparency of wholesale energy markets by:

- prohibiting market manipulation and insider trading;
- requiring market participants to publish any inside information at their disposal.

The operational implementation of the regulation is being pursued at European level, with the cornerstone being centralised collection of data by the Agency for the Cooperation of Energy Regulators (ACER) and sharing of that data with European regulators. The monitoring mechanisms set up by ACER, national regulators and persons professionally arranging transactions (PPAT) serve to detect a growing number of cases which may constitute a failure to comply with REMIT. Financial regulation, which ties in with the REMIT regulation, has evolved with the entry into effect, as of 3 January 2018, of Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments, known as "MIFID II". From this point of view, the year 2018 marks a transition towards the implementation by CRE of the REMIT regulation within the European mechanism aimed at preventing market abuse in the wholesale energy markets and in the financial markets.

For ACER and CRE similarly, work to set up the databases associated with these flows is being continued. In its February 2018 edition of the REMIT quarterly, ACER shared its human and financial resources constraints regarding the information systems devoted to REMIT. Under those conditions, CRE requested the organised market places (exchangers, brokers) to extend the national data collection mechanism beyond 2017 in order to prevent any discontinuation of data supply falling within CRE's scope of monitoring. Work carried out by CRE in connection with the data transmitted by ACER and tests for data completeness and quality for the year 2018 is in progress. The present report therefore covers, in terms of environmental scanning, the data for the 2017 calendar year. The following reports are expected to follow this pattern.

CRE actively takes part in the European groups relating to REMIT and contributes fully to cooperation with ACER, as well as with energy regulators of other Member States, financial and competition authorities for the implementation of the regulation. This cooperation involves monitoring behaviour in the wholesale energy markets which may constitute a breach of the REMIT regulation, within the framework of the provisions of Article 16 of the regulation. That article also provides for cooperation between ACER, the European Securities and Markets Authority (ESMA), the energy regulators of the other Member States and national financial and competition authorities.

Financial regulation is connected with the provisions concerning the ban on market abuse specified by the REMIT regulation. The prohibition of insider trading and market manipulations apply to wholesale energy products, except if they are also financial instruments under the MIFID II Directive, in which case (EU) Regulation No. 596/2014 of the European Parliament and of the Council of 16 April 2014 on market abuse (Market Abuse Regulation (MAR)) applies.

CRE actively takes part in European work on these matters, and, at national level, regularly consults with the Financial market authority (AMF) on the interpretation of the applicable texts and connection between financial regulation and the provisions of the REMIT regulation specifically concerning the qualification of products.

In 2017, the perimeter monitored by CRE represented the equivalent of 1,035 TWh (€51 billion) of electricity and 570 TWh (€10 billion) of gas. As part of its monitoring activities, in 2017 CRE addressed 26 requests for information to market participants.

On 9 April 2018, CRE published its deliberation of 22 March 2018<sup>1</sup> on integrity and transparency of the wholesale energy market. In that deliberation, CRE reminded market participants of their main obligations with regard to the REMIT regulation. In particular, with regard to the prohibition of insider trading, CRE stated that it "*recommends to market participants, especially groups with both electricity or gas production activities or infrastructure and trading activities, to set up relevant control procedures for the circulation and use of insider information (establishment of*

<sup>1</sup> <https://www.cre.fr/Documents/Deliberations/Communication/remit>

*insider lists, setting up of appropriate mechanisms, such as Chinese walls, for processes, installations, ...). Such measures can contribute to preventing insider trading".*

In the event of a suspected breach of REMIT provisions and in compliance with the French energy code, the launch of an investigation may be decided by CRE's chairman who then appoints an officer in charge of carrying out that investigation. An investigation may result, as needs be, in a hearing before the Dispute settlement and sanctions committee (CoRDIS).

The increase in volume associated both with monitoring activities and investigations led to the organisation of CRE's REMIT-related activities centred around the wholesale market monitoring department on the one hand and the department of wholesale market analysis and control in charge of conducting REMIT investigations, on the other hand.

As at the date of publication of this report, eight investigations have been opened by CRE, five for electricity and three for gas.

### Upward trend in commodity prices and the particular climate conditions in 2017

The year 2017, building on the year 2016, was characterised by major and steady growth in the price of coal. The price of oil, gas and CO<sub>2</sub> followed a net upward trend as from the second half of 2017. The price of coal rose by over 30% during the year. Oil jumped by more than 20% on average. The price of the carbon allowance, following the low points of 2016, (almost €4/tonne), increased in 2017 to reach almost €8/tonne at the end of 2017. As at the date of publication of this report, the allowance exceeded €15/tonne.

With regard to climate conditions, the year 2017 saw average temperatures slightly higher than normal seasonal temperatures, but with certain marked variations. Rainfall however, was well below the norm (-17% for the year). These conditions contributed to amplifying certain episodes of tightness in the markets.

The trends of this general context appear in evolution of wholesale electricity and gas prices.

### Wholesale electricity markets: high nuclear unavailability early and late 2017

Within the context of the rise in raw material prices, the year 2017 was considerably marked by tightness in supply during the winter periods in Q1 and Q4, particularly because of the historically low availability of nuclear generation.

Total electricity production in 2017 was down for the second consecutive year, by 0.4% compared to 2016. French production therefore went from 531.3 TWh to 529.4 TWh. The drop in production is related to nuclear and hydraulic generation. It was only partially offset by greater use of thermal fossil and renewable generation. Renewable energy production increased by 12.8%, in line with the increase in renewable capacity. Excluding hydraulic generation, it totalled 23.2 GW and exceeded, for the first time in 2017, installed thermal fossil generation capacity, excluding nuclear capacity.

With regard to nuclear generation, concerns about availability in autumn 2016 began to dissipate with ASN's press conference of 5 December 2016, in which it stated that the restart of most of the reactors concerned by the carbon segregation issue could be envisaged. Announcements concerning the restart of the reactors concerned were made afterwards, with, in particular, ASN's statements of 12 January 2017 and 13 March 2017. Nuclear generation and actual and forecast availability were the subject of other announcements in the final months of 2017. This context fuelled electricity price volatility.

The average baseload spot price for 2017 saw a sharp increase, standing at €45/MWh, i.e. a 23% increase compared to 2016. Intraday prices stood at the same level on average in 2017 and followed the evolution of baseload spot prices. The peak spot price also increased considerably (+17%) to reach €54/MWh. The year 2017 started with a price peak, building on that of the end of the previous year, with spot prices regularly exceeding €100/MWh. Supply/demand tightness in France seen at the end of 2016 continued into Q1 2017, due in particular to a cold spell in the month of January, low hydraulic production and historically low nuclear availability levels.

The prices of calendar products in France with one, two and three-year timeframes increased, particularly in H2 in the wake of commodity (gas, coal) and CO<sub>2</sub> prices. It can however be highlighted that the significant difference between the one-year timeframe and the two- and three-year timeframes, seen from the end of 2016 for the year 2017, narrowed in 2017 (for deliveries in 2018 and beyond), against a reduction in tightness related to uncertainty about nuclear availability. A pickup in volatility and a surge in Y+1 calendar prices were however observed at the end of the year, once again in connection with nuclear availability announcements. On average in 2017, the Y+1

calendar futures price stood at around €38/MWh but increased throughout the year to reach close to €45/MWh at the end of the year.

The ARENH volume requested for 2018 in the 2017 windows, under those conditions, was 9.2 TWh to supply transmission system operators' losses and 85.4 TWh for end customers. After four consecutive years of increase, volumes traded in the wholesale electricity markets saw a drop for the first time in 2017.

With regard to the capacity market, the first auction took place in December 2016 only for delivery year 2017. Three other auctions took place on the EPEX SPOT market during 2017, and to date, two auctions have taken place in 2018 (8 March and 26 April). While the first auction resulted in a guaranteed capacity (GC) price of almost €1,000 and those in 2017 (for delivery in 2018) of around €930/GC, the auctions that took place at the end of 2017 and in March and April 2018 (for delivery in 2019) resulted in a significant increase in guaranteed capacity prices (€1,850/GC for the auction of March 2018). The growth in the capacity price observed is being examined carefully. In accordance with the provisions of Article L.131-2 of the Energy code, CRE monitors the guaranteed capacity market, for which the prohibitions and obligations specified in Articles 3, 4 and 5 of REMIT apply.

In Q1 2018, CRE undertook discussions with the main participants in the capacity auctions that took place. Seventeen requests for quantitative and qualitative information about participants' strategies were addressed. The precise answers provide details about individual bid strategies and the prices proposed. Most participants did not make any specific comments about the results of the auctions; some of them however expressed their concerns about the price increase observed. CRE is continuing detailed analyses of the auction prices observed, and, in particular of the result of the comparison of the different supply and demand curves of the different market participants.

### **Wholesale gas markets: price increase, growth in LNG supply and tightness in the South (TRS)**

In 2017, the gas market was marked by a major increase in LNG imports (+27% compared to 2016), stable overland imports (+0.4% compared to 2016) and less use of storage (-5.9% compared to 2016). However, the south zone saw some tightness early 2017, linked to a cold spell in January combined with low LNG supply at Fos. This caused a price peak in the TRS as well as numerous bottlenecks in the GRTgaz network in the south-east.

End 2017, in order to address bottlenecks in the south-east, GRTgaz used the locational spread product on several occasions in November and December 2017. These periods of tightness are analysed specifically as part of wholesale market monitoring. Spot prices in gas hubs in Europe increased on average compared to 2016. Prices at the Dutch TTF and the North PEG stood at an average €17.3/MWh and €17.5/MWh respectively compared to €13.9/MWh and €14.2/MWh in 2016. The evolution in spot prices was marked by seasonal price movements as winter approached. The price increase accelerated in Q4 2017 with an almost 20% growth for the PEG Nord and 19% for the TTF compared to the previous quarter. This movement was marked by episodes of volatility.

European futures prices followed an upward trend in 2017, against an increase in commodity prices. In 2017, the 2018 calendar product stood at an average €17/MWh.

In 2017, deliveries at the PEG Nord and the TRS evolved differently. Building on the growth observed since 2005, deliveries at the PEG Nord were up 3.7% compared to 2016. However, deliveries in the TRS were down almost 6% compared to 2016, against an increase in gas exports to Spain.

With regard to volumes traded, trading in the spot markets grew slightly in 2017, with overall volumes up 1.3% and the number of transactions up 3% compared to 2016.

In the futures markets, volumes traded and the number of transactions dropped 12%, with major disparities according to the products. There was a sharp growth in the volume of annual products which almost doubled (+95%). At the same time, there was a drop in trading of seasonal products (-20%) and monthly products (-14%) compared to 2016. This drop was mainly due to low storage capacity reservations for the 2017/2018 storage year.

**SECTION 1**  
**INTEGRATION OF WHOLESALE MARKET MONITORING INTO THE**  
**EUROPEAN SYSTEM**



## 1. OPERATIONAL TRANSITION TOWARDS THE IMPLEMENTATION OF REMIT WITHIN THE EUROPEAN CONTEXT

Since 28 December 2011, the wholesale energy market monitoring mission, performed by the French Energy Regulatory Commission (CRE), has been governed by European regulation No. 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency (REMIT).

The REMIT regulation establishes rules which prohibit abusive practices affecting the wholesale energy markets. Those rules specifically aim to ensure integrity and transparency of the wholesale energy markets by:

- prohibiting market manipulation and insider trading;
- requiring market participants to publish any inside information at their disposal.

In accordance with the provisions of Article L.131-2 of the Energy code, CRE monitors wholesale energy markets and guarantees, in particular, compliance with insider trading prohibition, the obligation to publish insider information and the prohibition of market manipulation. It also guarantees compliance, by persons professionally arranging transactions, with their obligations concerning the detection and notification of suspected insider trading or market manipulation under REMIT.

The operational implementation of the regulation is continuing at European level, with the cornerstone being centralised collection of data by the Agency for the Cooperation of Energy Regulators (ACER) and sharing of that data with European regulators. The monitoring mechanisms set up by ACER, national regulators and persons professionally arranging transactions (PPAT) serve to detect a growing number of cases which may constitute a failure to comply with REMIT. Financial regulation, which ties in with the REMIT regulation, has evolved with the entry into effect, as of 3 January 2018, of Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments, known as "MIFID II".

From this point of view, the year 2018 marks a transition towards the implementation by CRE of the REMIT regulation within the European mechanism aimed at preventing market abuse in the wholesale energy markets and in the financial markets.

### 1.1 Progress in setting up data exchanges

Centralised data collection by ACER began in October 2015 for standard data (e.g. orders and transactions on exchanges or broker platforms) and in April 2016 for non-standard data (e.g. bilateral contracts). ACER relays the data to the regulators concerned, provided that the security criteria defined by ACER are met.

CRE met the security criteria at the end of 2015 and began to receive data in 2016.

For ACER and CRE similarly, work to set up the databases associated with these flows is being continued. In its February 2018 edition of the "REMIT Quarterly"<sup>2</sup>, ACER shared its human and financial resources constraints regarding the information systems devoted to REMIT.

Under those conditions, CRE requested the organised market places (exchanges, brokers) to extend the national data collection mechanism beyond 2017 in order to prevent any discontinuation of data supply falling within CRE's scope of monitoring.

Work carried out by CRE in connection with the data transmitted by ACER and tests for data completeness and quality for the year 2018 are in progress. The present report therefore covers, in terms of environmental scanning, the data for the 2017 calendar year.

The following reports are expected to follow this pattern.

### 1.2 Cooperation at European level and connection with financial regulation

CRE participates actively in the European groups relating to the implementation of REMIT. It is therefore a member of ACER's coordination group and co-chair of ACER's and the European Council of Energy Regulators' (CEER) REMIT working groups ("AMIT" and "CMIT").

These groups, and the associated task-forces, contribute in particular to the implementation of the REMIT regulation at the operational level. They also take part in drafting guidance published by ACER.

In addition, cooperation with regard to the implementation of the REMIT regulation takes the shape of monitoring transactions which may constitute a breach of REMIT, within the framework of the provisions of Article 16 of the regulation. That article also provides for cooperation between ACER, the European Securities and Markets Authority (ESMA), the energy regulators of the other Member States and national financial and competition authorities.

<sup>2</sup> [https://documents.acer-remit.eu/wp-content/uploads/REMITQuarterly\\_Q4\\_2017\\_1.0.pdf](https://documents.acer-remit.eu/wp-content/uploads/REMITQuarterly_Q4_2017_1.0.pdf)

In that regard, financial regulation is connected with the provisions prohibiting market abuse specified by the REMIT regulation. The prohibition of insider trading and market manipulations apply to wholesale energy products, except if they are also financial instruments under the MIFID II Directive, in which case EU Regulation No 596/2014 of the European Parliament and of the Council of 16 April 2014 on market abuse (Market Abuse Regulation (MAR)) applies.

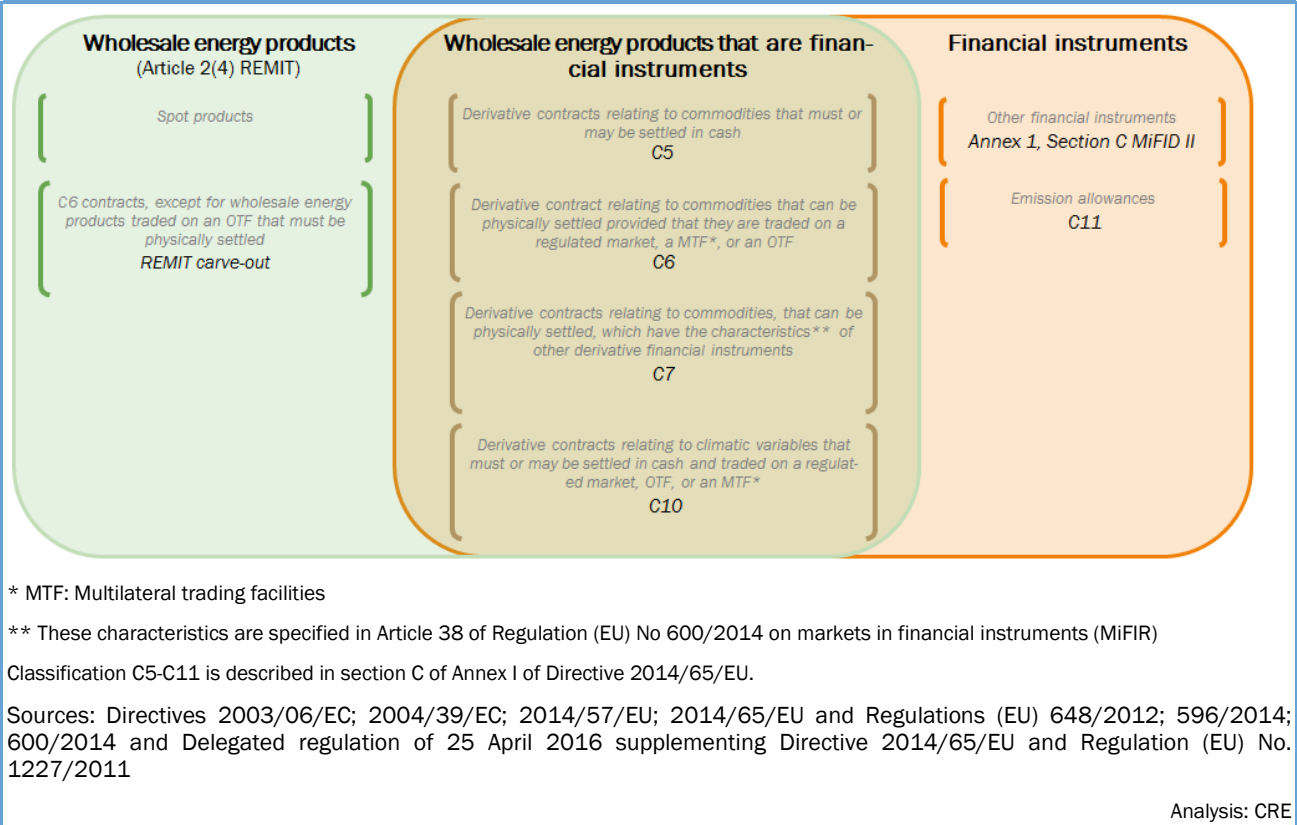
Annex I section C of MIFID II lists specifically the products qualified as financial instruments, which now include CO<sub>2</sub> allowances (see box 1).

#### **Box 1: Extract from Annex 1 – Section C of MiFID II: Financial instruments**

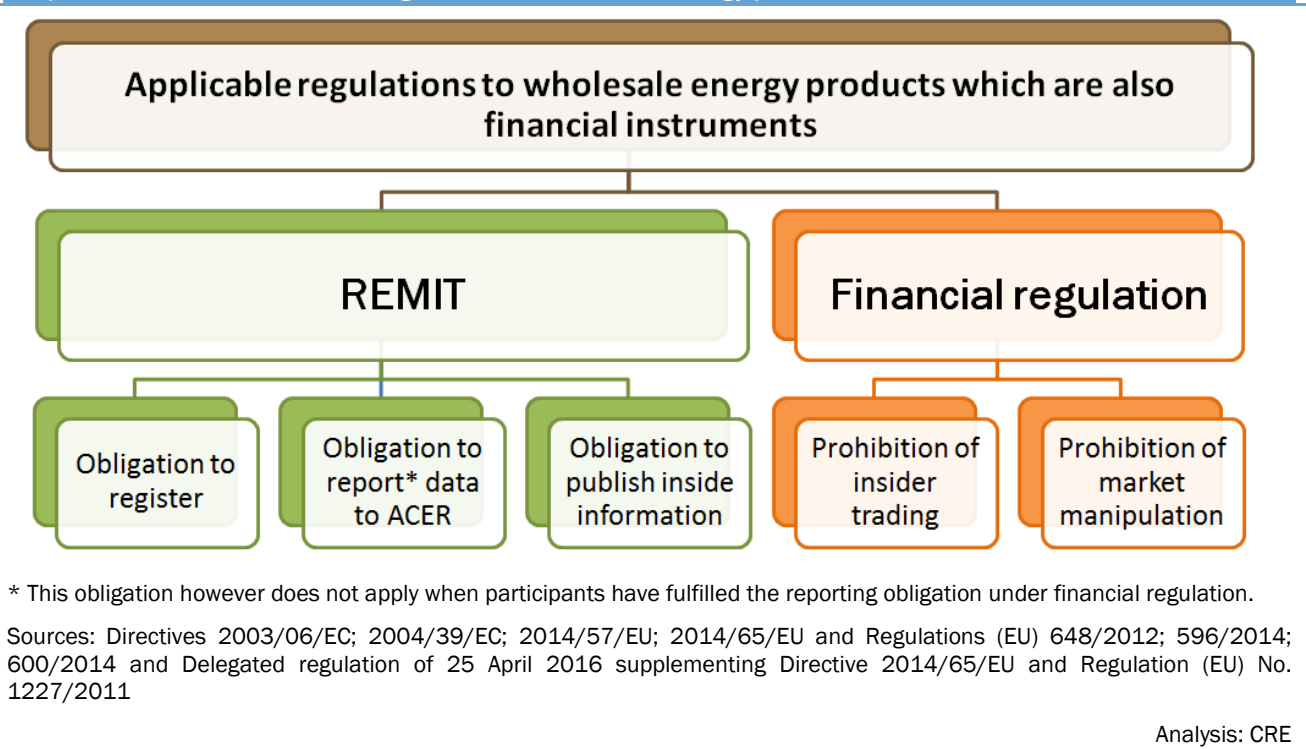
1. Transferable securities
2. Money-market instruments
3. Units in collective investment undertakings
4. Options, futures, swaps, forward rate agreements and any other derivative contracts relating to securities, currencies, interest rates or yields, emission allowances or other derivatives instruments, financial indices or financial measures which may be settled physically or in cash
5. Options, futures, swaps, forwards and any other derivative contracts relating to commodities that must be settled in cash or may be settled in cash at the option of one of the parties other than by reason of default or other termination event
6. Options, futures, swaps, and any other derivative contract relating to commodities that can be physically settled provided that they are traded on a regulated market, a MTF, or an OTF, except for wholesale energy products traded on an OTF that must be physically settled
7. Options, futures, swaps, forwards and any other derivative contracts relating to commodities, that can be physically settled not otherwise mentioned in point 6 of this Section and not being for commercial purposes, which have the characteristics of other derivative financial instruments
8. Derivative instruments for the transfer of credit risk
9. Financial contracts for differences
10. Options, futures, swaps, forward rate agreements and any other derivative contracts relating to climatic variables, freight rates or inflation rates or other official economic statistics that must be settled in cash or may be settled in cash at the option of one of the parties other than by reason of default or other termination event, as well as any other derivative contracts relating to assets, rights, obligations, indices and measures not otherwise mentioned in this Section, which have the characteristics of other derivative financial instruments, having regard to whether, inter alia, they are traded on a regulated market, OTF, or an MTF
11. Emission allowances consisting of any units recognised for compliance with the requirements of Directive 2003/87/EC (Emissions Trading Scheme)

As reiterated in the previous report on the functioning of wholesale electricity, gas and CO<sub>2</sub> markets, wholesale futures energy products that must be physically settled, which are traded on an organised trading facility (OTF) are not considered financial instruments. This exception is known as a "REMIT carve-out". Graph 1 and Graph 2 summarises, based on the definitions in the abovementioned Annex, the classification of products and the applicable regulation.

Graph 1: Simplified classification of wholesale energy products and financial instruments (MiFID II)



Graph 2: Link between financial regulation and wholesale energy products



CRE actively takes part in European work on these matters, and, at national level, regularly consults with the Financial market authority (AMF) on the interpretation of the applicable texts and the connection between financial regulation and the REMIT regulation specifically concerning the qualification of products.

## 2. CRE'S MONITORING AND CONTROL ACTIVITY

In 2017, the perimeter monitored by CRE represented the equivalent of 1,035 TWh (€51 billion) of electricity and 570 TWh (€10 billion) of gas. As part of its monitoring activities, in 2017, CRE addressed 26 requests for information to market participants.

CRE's monitoring activities draw on:

- internal detections made by the wholesale market monitoring department;
- external detections (ACER, other regulators, PPAT, or any other market participant).

CRE has undertaken proactive interaction with PPAT<sup>3</sup> operating in the wholesale French energy markets in order to ensure that they comply with the provisions of Article 15 of REMIT. In accordance with this article, PPAT are required to report to CRE "without delay" if they have reasons to suspect that transactions affecting the French market could constitute market abuse. The procedures and resources implemented by PPAT to detect any market abuse are being carefully examined, in close cooperation with ACER and the regulators concerned. CRE considers that it is important for this first-level monitoring to be as effective as possible to ensure the best possible monitoring of markets (see box 2).

### Box 2: Elements requested by CRE within the framework of the verification of procedures and resources implemented by PPAT

Within the framework of the verification of procedures and resources implemented by PPAT, CRE initially turned to the electricity and gas exchanges based in France, EPEX SPOT and Powernext. In H1 2018, EPEX SPOT and Powernext forwarded to CRE precise elements specifying:

- the governance model and the procedures for preventing conflicts of interest concerning monitoring, the level of organisation and of employees;
- monitoring strategy, the procedures put in place for that strategy and the frequency at which the strategy is revised;
- the structure of the monitoring team, its functions, its resources and the communication and internal decision-making procedures;
- the procedures and alert systems in place and the type of potentially suspicious behaviour under REMIT targeted by these alerts (thresholds, evaluation, etc.), as well as the frequency at which this system is revised;
- policy in terms of notifying suspected breaches of REMIT to the national regulatory authorities;
- internal decision procedures for handling cases (typical lifecycle);
- the annual volume of alerts, broken down by article of the REMIT regulation, and the percentage of cases that are closed or have been reported for a suspected breach.

On 9 April 2018, CRE published its deliberation of 22 March 2018 on integrity and transparency of the wholesale energy market. In that deliberation, CRE reminded market participants of their main obligations with regard to the REMIT regulation.

In particular, as concerns the prohibition of insider trading, CRE stated that it *"recommends to market participants, especially groups with both electricity or gas production activities or infrastructure and trading activities, to set up relevant control procedures for the circulation and use of insider information (establishment of insider lists, setting up of appropriate mechanisms, such as Chinese walls, in terms of processes or installations, ...). Such measures can contribute to preventing insider trading"*.

CRE also reiterated in this deliberation that it *"ensures, a posteriori, compliance of market operations with the REMIT regulation, in particular, with its Article 3"*.

Participants may contact CRE's departments in the event of unusual market events (see box 3).

In the event of a suspected breach of REMIT provisions and in compliance with the French energy code, the launch of an investigation may be decided by CRE's chairman who then appoints an officer in charge of carrying out that

<sup>3</sup> Persons professionally arranging transactions include in general, exchanges, brokers and transmission system operators (TSOs) which are considered PPAT because they act as intermediaries in wholesale energy market transactions.

investigation. An investigation may result, as needs be, in a hearing before the Dispute settlement and sanctions committee (CoRDIS).

The increase in volume associated both with monitoring activities and investigations led to the organisation of CRE's REMIT-related activities centred around the wholesale market monitoring department on the one hand and the department of wholesale market analysis and control in charge of conducting REMIT investigations, on the other hand.

As at the date of publication of this report, eight investigations were opened by CRE, five for electricity and three for gas. Of these eight investigations, the first one concerning electricity was closed without being brought before CoRDIS since it related to facts from before the adoption of Law No. 2013-312 of 15 April 2013 which empowered CoRDIS to sanction any breaches of REMIT (see the 2015-2016 report on the functioning of the electricity, gas and CO<sub>2</sub> markets published on 18 October 2016).

Throughout the year 2017, CRE contributed to European work to draft common positions on the analysis and qualification of different practices that could constitute market manipulation under Article 5 of the REMIT regulation. This work resulted in the publication by ACER of a second document providing guidance on capacity hoarding<sup>4</sup> in the intraday electricity market, defined as the acquisition of all or part of the available transmission capacity without using it or without using it effectively. Work on this guidance is, in particular, part of the evolution of wholesale electricity markets in Europe towards coupling of coupled markets using available crossborder capacity, in particular for the timeframes closest to real time (intraday market, future balancing platforms). When capacity is used effectively, it enables the most efficient resources to be used reducing supply costs, which is beneficial to the end customer.

**Box 3: Best practices**

In order to ensure the best possible market monitoring, it is requested of any person suspecting market abuse to alert:

- CRE's departments in charge of market monitoring at the address: [surveillance@cre.fr](mailto:surveillance@cre.fr);
- or ACER's departments by going on the Agency's ad hoc notification platform: <https://www.acer-remit.eu/np/home>.

CRE also intends to remind market participants that they are required, in compliance with Article 9 of REMIT, to register *"with the national regulatory authority in the Member State in which they are established or resident or, if they are not established or resident in the Union, in a Member State in which they are active"*. They must be registered with a national regulatory authority before carrying out transactions in the wholesale energy markets and declaring information relating to these activities.

Every market participant is responsible for following the accuracy and updating of information recorded. Any change regarding the information supplied in the registration form must be communicated rapidly to the regulatory authority concerned. It must be corrected, as needs be, as soon as possible. Contacts, contact details and data reporting entities are examples of data fields that frequently contain errors. For any question concerning registration, market participants may contact CRE's wholesale market monitoring department at: [enregistrement.remit@cre.fr](mailto:enregistrement.remit@cre.fr)

<sup>4</sup> <https://acer.europa.eu/Media/News/Pages/ACER-publishes-guidance-on-capacity-hoarding-in-intraday-electricity-markets-that-could-constitute-market-manipulation.aspx>



**SECTION 2**  
**CONTEXT OF THE ENERGY MARKETS**

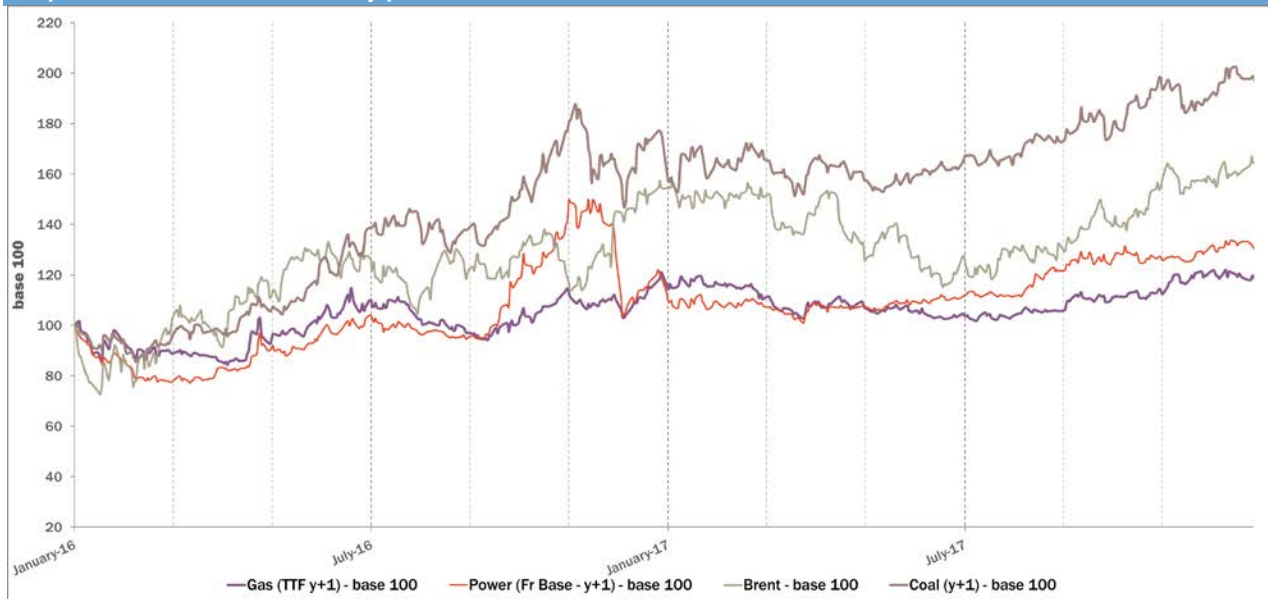
The year 2017, building on the year 2016, was characterised by major and steady growth in the price of coal. The price of oil, gas and CO<sub>2</sub> followed a net upward trend as from H2 2017. Similar evolutions were seen for electricity prices, with futures prices showing a marked increase as from the second half of the year.

The climate in 2017 was warmer in general compared to normal temperatures and to those of 2016. Adverse weather conditions, though marked as the months progressed, had consequences on electricity demand in France and Europe, with perceptible effects in the wholesale markets. Temperature variations recorded during the year were reflected in electricity consumption, particularly during the winter cold spell in Q1 2017. In addition, rainfall levels in 2017 were below normal according to the French meteorological centre.

### 1. INCREASE IN THE PRICE OF COAL IN 2017 AND MARKED GROWTH IN OIL PRICES AS FROM H2

The upward trend in the prices of the main energy commodities (oil, coal, gas and electricity) was confirmed, in particular as from the first half of 2017 (Graph 3). These prices reached their highest levels since the end of 2014.

Graph 3: Evolution in commodity prices



Sources: EEX, ICIS Heren, Reuters, ICE



## 1.1 Upward trend in oil prices in 2017 due to the 9-month extension of OPEC's and Russia's agreement to cut oil output and the drop in American stocks

The year 2017 was characterised by rising oil prices (Graph 4). The Brent oil price stood at an average €47.9/barrel in 2017, i.e. up more than 20% compared to 2016. The price jump occurred mainly as from Q4 2017. Prices went from €44.3/barrel in Q3 2017 to €52.2/barrel in Q4 2017, i.e. a 17.8% increase. Variations in the price of oil in dollars were more pronounced throughout 2017, with the barrel price at almost \$50 at the start of the year and \$70 at the end. Foreign exchange effects therefore attenuated the price increase, which however steepened in the first months of 2018.

Graph 4: Price of oil



This upward trend was caused by a stabilisation in the increase in global oil production. It stood at 97.95 mbpd in 2017 compared to 97.20 mbpd in 2016, i.e. only a 0.77% increase.

The year 2017 saw most OPEC<sup>5</sup> members and Russia (November 2016) implementing and complying with the agreement aimed at limiting these countries' production throughout the year in order to support the price of the barrel. Therefore, the increase in production was limited for OPEC (39.28 mbpd in 2017 compared to 39.23 mbpd in 2016) and Russia (14.32 mbpd in 2017 compared to 14.22 mbpd in 2016). This agreement was extended in November 2017 and remained applicable for the first nine months of 2018.

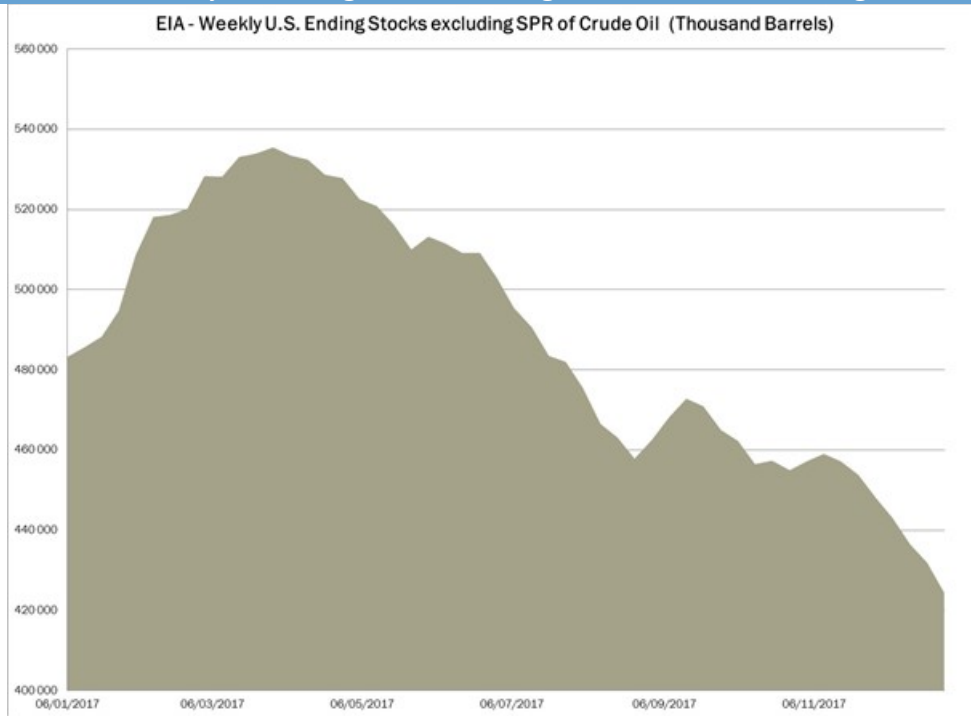
The limit on production of OPEC countries and Russia enabled an increase in Canada's production (+0.35 mbpd, i.e. +7.6%) and USA's production (+0.70 mbpd, i.e. +4.8%).

Within this context, crude oil stocks in the USA were used heavily in 2017. After reaching historical levels in the month of March 2017, commercial stocks began to fall drastically as from Q2 2017 (Graph 5). This drop in stocks sent an upward signal to the market. In addition, global oil demand increased by 1.7%, going from 96.87 mbpd to 98.52 mbpd. This increase came mainly from strong demand in China (+0.5 mbpd, i.e. +3.55%) and other Asian countries, excluding Japan, (+0.3 mbpd, i.e. +2.79%).

<sup>5</sup> Organisation of oil-exporting countries (OPEC)



Graph 5: Evolution of the weekly U.S. Ending Stocks excluding SPR of Crude Oil according to EIA



Source: U.S. Energy Information Administration (EIA)

**1.2 Over 30% increase in the price of coal in 2017 against a reduction in supply in China and high demand in Europe**

The futures price of the coal (API2) Y+1 calendar product stood at €65.1/t on average in 2017 compared to an average €48.5/t in 2016, i.e. a more than 30% increase (Graph 6). This upward trend extended the increase recorded in 2016 following the low points of Q1 2016. The average price went from €61.8/t in Q1 2017, to over €70/t at the end of the year.

Graph 6: Futures contracts for Coal API2 Y+1



Source: Argus API2

In H1 2017, coal prices increased slightly and stood at an average €61.3/t, compared to €57.7/t in H2 2016. Then, in H2 2017, the increase in coal prices accelerated, reaching an average €68.9/t, i.e. a 12% growth compared to H1 2017.

The growth in coal prices is mainly due to the drop in Chinese production, with China, in compliance with its objectives, setting up measures to reduce production capacity in mines as part of its policy to combat pollution. In addition, the prospect of high demand in the electricity sector in Europe, because of the low level of hydraulic reserves especially in the south of Europe, also contributed to pushing coal prices upwards.

**2. TEMPERATURES IN 2017 SLIGHTLY ABOVE NORMAL BUT WITH MAJOR VARIATIONS. A YEAR ALSO MARKED BY LOW RAINFALL**

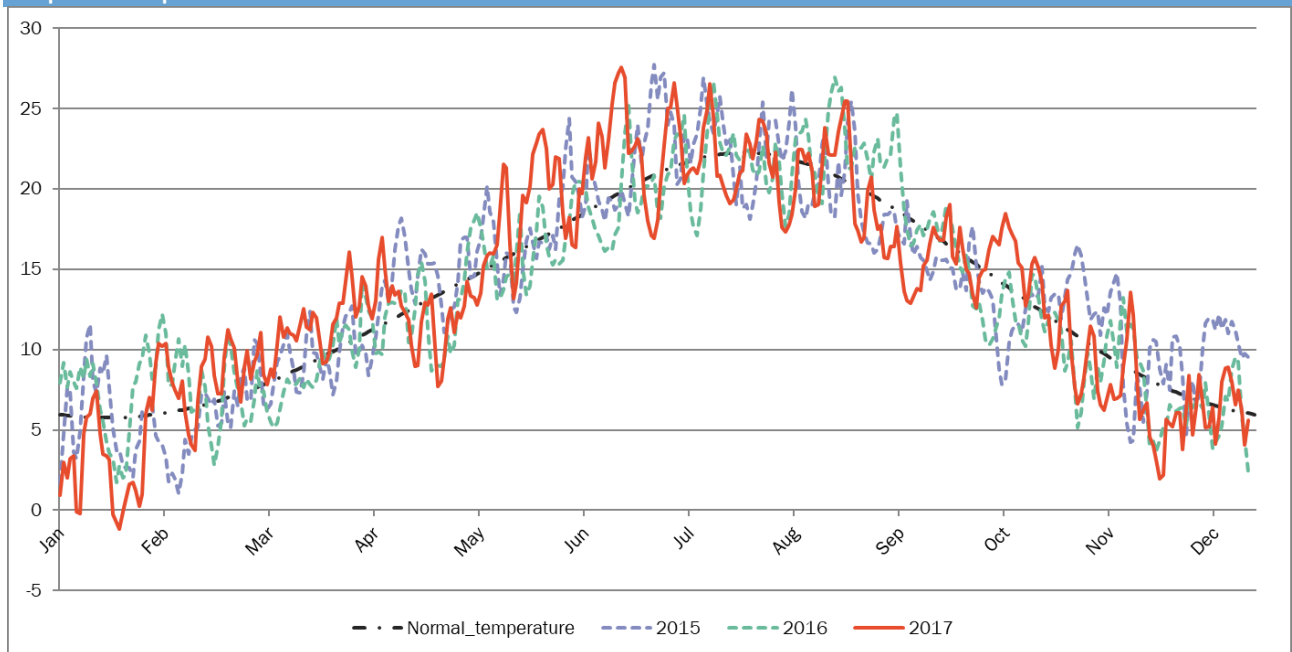
Temperatures during the year 2017 (Graph 7) were higher than those of 2016 (+0.29°C) and normal seasonal temperatures (+0.22°C).

In H1 2017, the temperatures observed were warmer than in H1 2016, with, in particular, a positive average difference of 0.4°C. In H2 2017, temperatures recorded were also slightly higher than in H2 2016 (+0.2°C above temperatures for the period).

These low average differences conceal a major disparity as the months progressed compared to normal seasonal temperatures. January, September, November and December were cooler, with average differences compared to normal seasonal temperatures between -0.5°C and -2.58°C. Conversely, the rest of the year saw warmer temperatures, with an average positive difference of up to +2°C compared to normal seasonal temperatures. These variations fuelled part of the volatility of electricity spot prices.

Average overall rainfall was far below normal across all of France in 2017 (-17%). In fact, there was very low rainfall throughout the entire territory in 2017.

Graph 7: Temperature curve in France

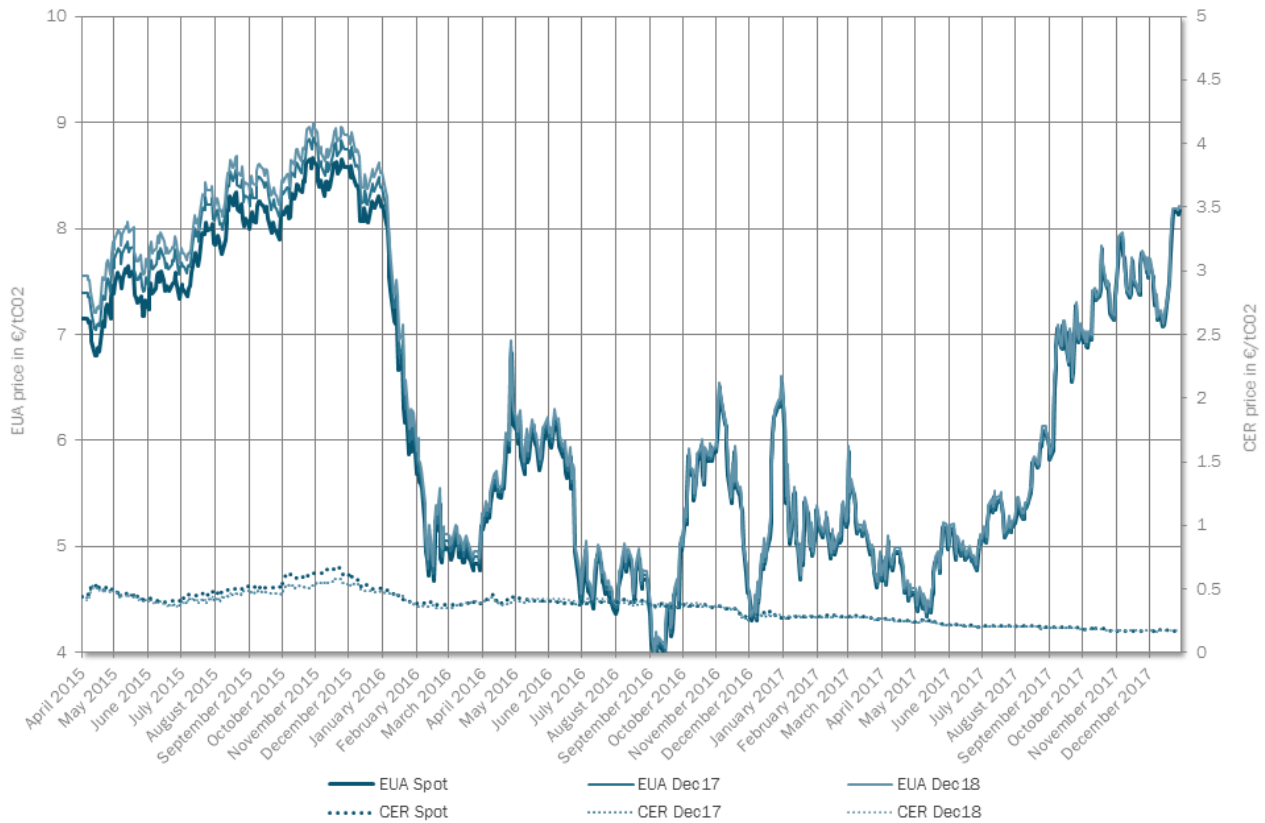


Source: Thomson Reuters

### 3. PRICE OF THE CO<sub>2</sub> ALLOWANCE UP SIGNIFICANTLY AS FROM THE START OF Q3 2017

The price of the CO<sub>2</sub> allowance evolved in 2017 in the wake of commodities prices. The first half was marked by volatile evolutions at a low level (€6.15/tCO<sub>2</sub> early January 2017 and €4.40/tCO<sub>2</sub> in June). As from June 2017 and during the second half of 2017, the CO<sub>2</sub> allowance price increased significantly and at the end of December, it exceed €8/tCO<sub>2</sub> for the first time since January 2016. This trend continued in 2018 and as at the date of publication of this report, the CO<sub>2</sub> allowance price was over €15/tonne. This allowance price increase was related in particular to announcements about the reform of the European allowance market, revision of phase 4 and the reduction in excess allowances, which reached their lowest level since 2013.

Graph 8: Evolution in the price of the CO<sub>2</sub> allowance



Source: ECX – Analysis: CRE

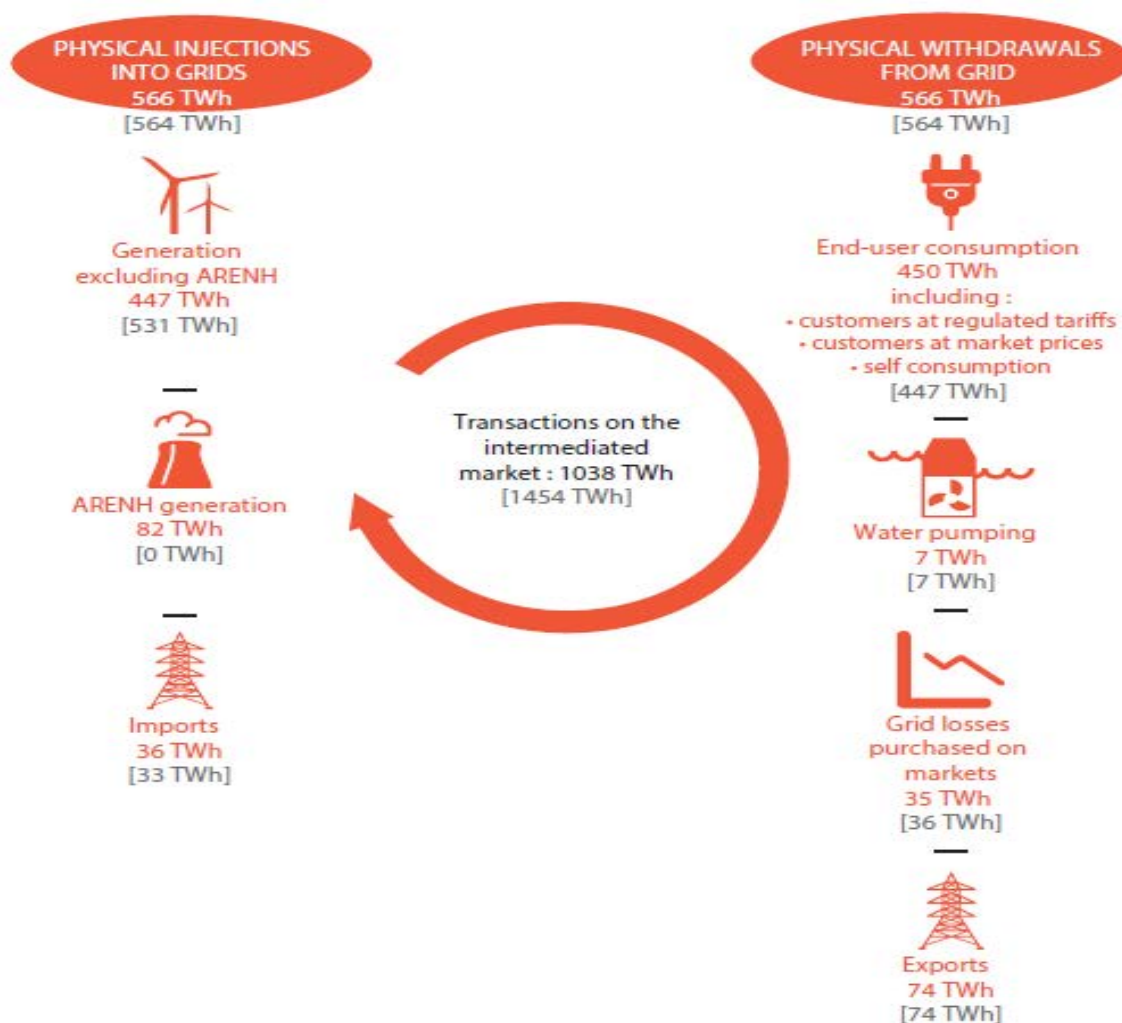
**SECTION 3  
WHOLESALE ELECTRICITY MARKETS**

## 1. THE YEAR 2017 BUILDING ON THE END OF 2016 MARKED BY MAJOR NUCLEAR UNAVAILABILITY EARLY AND LATE 2017

Against the increase in commodities prices, the year 2017 was also considerably marked by tightness in supply during the winter periods in Q1 and Q4 particularly because of historically low nuclear availability.

Graph 9 presents a simplified version of the main flows for 2017 in the French electricity system and compares them to the figures for 2016 (between brackets).

Graph 9: Injections and withdrawals for 2017 [2016]



### 1.1 Consumption stable in 2017 compared to 2016

Total consumption in France in 2017 was relatively stable over the year compared to 2016 levels, going from 447 TWh to 446 TWh, i.e. a variation of -0.2% (Graph 10). The major increase in consumption during the first weeks of the year 2017, until mid-February, linked to a period of very cold temperatures, was offset by a drop in consumption up until spring because of higher than normal seasonal temperatures. A pickup in consumption has been seen in the last three months of the year.

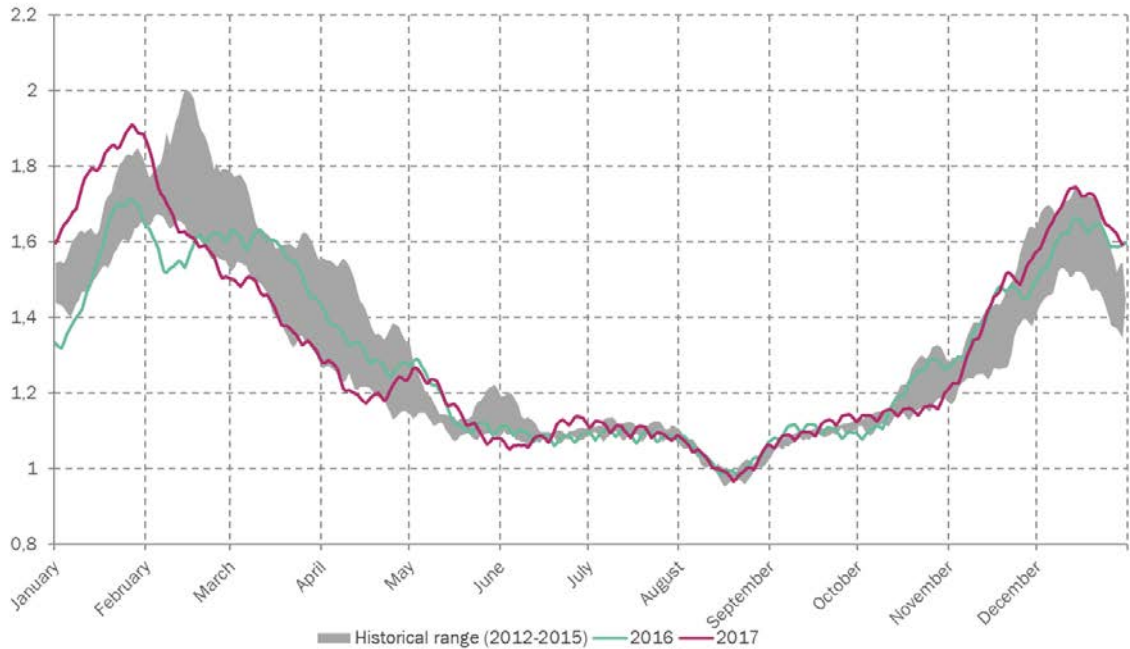
With regard to physical injections into the network, electricity deliveries were also stable between the years 2016 and 2017, with a limited 0.18% increase, from 564 TWh to 565 TWh. ARENH subscriptions<sup>6</sup> in 2016 for delivery in 2017 went from 0 to 82 TWh because of alternative suppliers arbitrating between market products and the ARENH product. ARENH in fact became competitive again with the increase in calendar prices, which, on several occasions

<sup>6</sup> The ARENH product corresponds to baseload energy delivered over the year, but also to guaranteed capacity. Arbitrage is between, on the one hand, the sum of calendar product prices and capacity prices, and on the other hand the ARENH price set at €42/MWh.

during the year, exceeded €42/MWh against uncertainty about nuclear availability seen from the end of 2016. The ARENH volume requested for 2018 in the 2017 windows was 9.2 TWh to supply transmission system operators' losses and 85.4 TWh for end customers.

**Graph 10: Consumption in France**

Daily consumption (TWh) - moving average 15 days



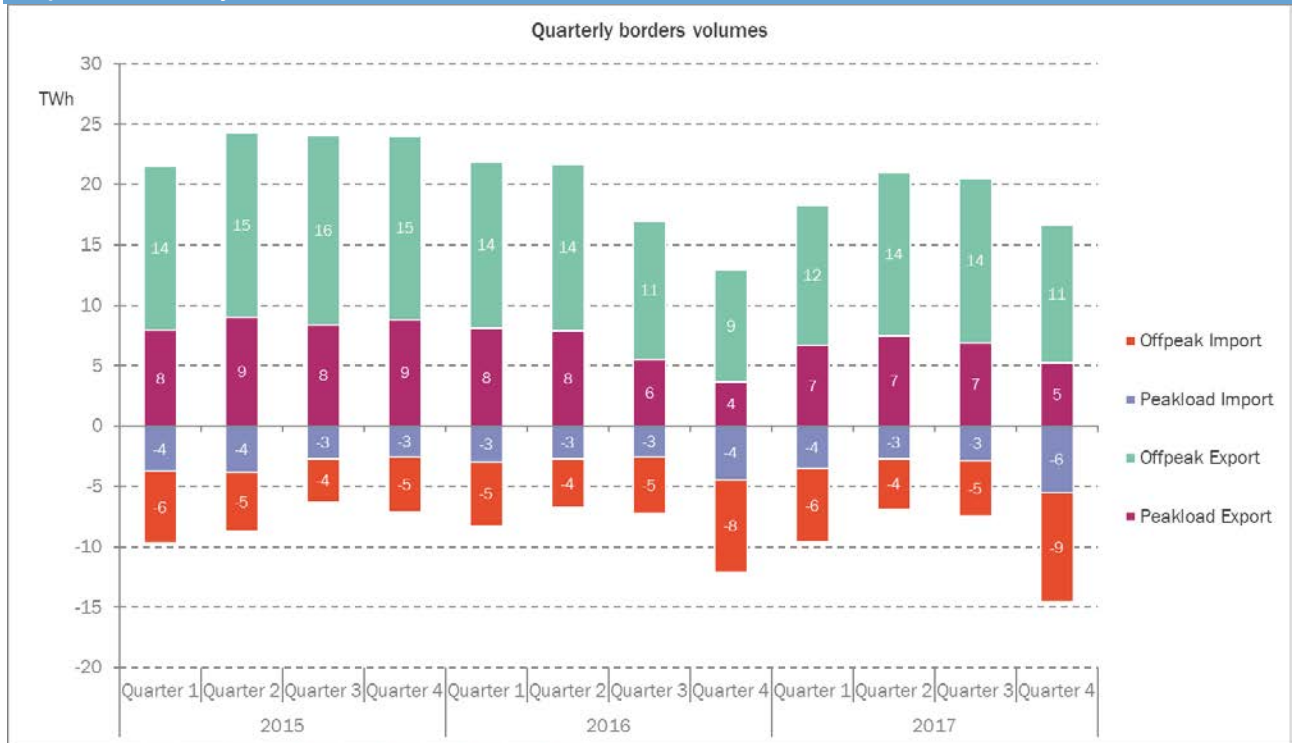
While total installed capacity of French production was stable in 2017, its composition however evolved. Fuel oil production capacity dropped 42%. This major drop was fully offset by the installation of new renewable production resources (+13.6%).

Despite the overall stability of installed capacity in France, total electricity production in 2017 was down for the second consecutive year, by 0.4% compared to 2016. French production therefore went from 531.3 TWh to 529.4 TWh. The drop in production was related to nuclear and hydraulic generation. It was only partially offset by greater use of thermal fossil production and renewables. Renewable energy production in fact increased by 12.8%, in line with the increase in renewable capacity.

Therefore, withdrawals/injections were balanced in particular by the drop in France's net exports compared to 2016 (-3.1%) in particular in the first and last quarters of 2017 (Graph 11). In these two quarters of 2017, imports increased significantly compared with the year 2015, a year during which the rate of nuclear availability was high, unlike in 2016. The use of interconnections overcame electricity system tightness, due to nuclear unavailability and the increase in consumption during this winter period. However, France maintained a positive balance of trade in 2017. It should also be noted that France was a net importer during the months of January and November 2017 with an import balance of 951 and 826 GWh respectively, which are two new records.



Graph 11: Quarterly volumes traded at borders



Source: RTE – Analysis: CRE

## 1.2 Building on the last months of 2016, very low nuclear production rate in 2017

The year 2017, building on the end of 2016, was marked by a fall in the nuclear availability rate, from 72.9% to 71.7% in 2017, to a historically low level. Nuclear availability picked up to meet the low part of the historical tunnel as from April 2017 but still remaining at the lowest levels. As from October, a new drop in availability brought rates to the low levels of the same period in 2016 (Graph 12). These episodes had significant impacts on physical tightness in the system with, in particular, a 1.3% drop in production by this sector compared to 2016, and a 9% drop compared to 2015, which drove wholesale electricity prices upward.

Concerns about nuclear availability in autumn 2016 began to dissipate with ASN's press conference of 5 December 2016, in which it stated that the restart of most of the reactors concerned by the carbon segregation issue could be envisaged. Announcements concerning the possible restart of the reactors concerned were made afterwards, with, in particular, ASN's statements of 12 January 2017<sup>7</sup> and 13 March 2017<sup>8</sup>.

Nuclear generation and actual and forecast availability were the subject of other announcements by ASN in the final months of 2017:

- 16 August 2017<sup>9</sup>: Start of ASN's public consultation on a draft decision governing the review of manufacturing records of the Creusot Forge plant. The end of the public consultation was set for 10 September 2017.
- 13 September 2017<sup>10</sup>: Placement of the Belleville-sur-Loire nuclear plant under enhanced surveillance by ASN "due to the safety deterioration it has observed since 2016 at this site, and the lack of significant improvements by EDF".
- 19 September 2017<sup>11</sup>: Following its public consultation, ASN made the restart of EDF's reactors shut down for refuelling and concerned by the irregularities of the Creusot Forge plant, dependent on the revision of those irregularities.

<sup>7</sup> <https://www.asn.fr/Informer/Actualites/Apres-controle-l-ASN-a-autorise-neuf-reacteurs-a-redemarrer>

<sup>8</sup> <https://www.asn.fr/Informer/Actualites/Anomalie-de-la-concentration-en-carbone-de-l-acier-redemarrage-des-reacteurs>

<sup>9</sup> <https://www.asn.fr/Informer/Actualites/Dossiers-de-fabrication-de-l-usine-Creusot-Forge>

<sup>10</sup> <https://www.asn.fr/Informer/Actualites/Centrale-nucleaire-de-Belleville-sous-surveillance-renforcee>

<sup>11</sup> <https://www.asn.fr/Informer/Actualites/Creusot-Forge-le-redemarrage-des-reacteurs-d-EDF-conditionne-a-la-remise-d-un-bilan-specifique>

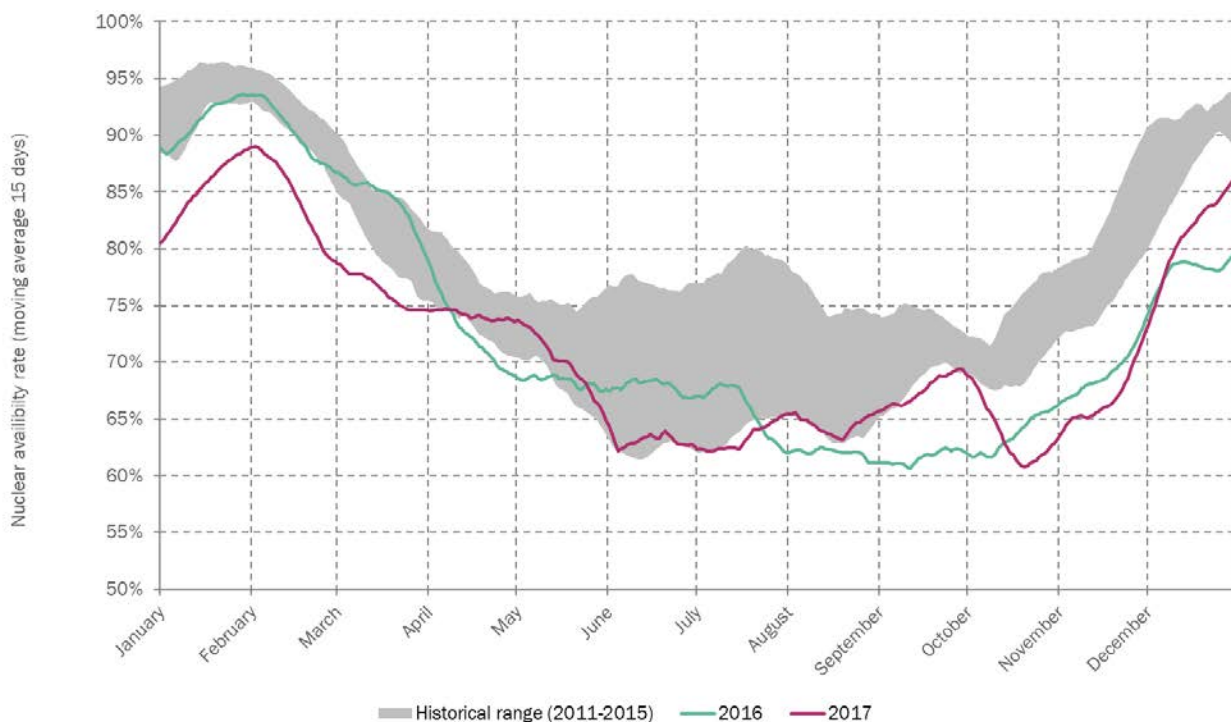




- 28 September 2017<sup>12</sup>: ASN requested the shutdown of four reactors at the Tricastin plant because of a risk of the dam breaking in the event of a major earthquake.
- 16 October 2017<sup>13</sup>: ASN stated that the heat sink piping system of 29 nuclear reactors, which cools the reactors in the event of any incident, has an earthquake resistance lower than the minimum thickness required.

This context fuelled electricity price volatility (see below).

Graph 12: Rate of French nuclear availability



Source: RTE – Analysis: CRE

### 1.3 Installed renewable energy capacity (excluding hydraulic) exceeding installed thermal fossil capacity for the first time and hydraulic production down in 2017

Installed capacity of renewable generation (excluding hydraulic) continued to grow reaching 23.2 GW and exceeding for the first time in 2017 installed thermal fossil capacity generation (Graph 13). In particular, wind and solar generation for several years, have had a high growth rate (Table 1). The long upward trend of renewable capacity and the long decline in thermal capacity (excluding nuclear) was therefore confirmed by this more important positioning of renewable capacity compared to fossil energy. However, in terms of production, renewable production (excluding hydraulic) were lower than thermal fossil production (excluding nuclear) in 2017 (Graph 14), against major use of fossil resources related to nuclear plant unavailability.

Table 1: Evolution of installed capacity of renewable sectors

|       | 2012  | 2013  | 2014  | 2015  | 2016 | 2017 | AAGR <sup>14</sup><br>2012/2017 |
|-------|-------|-------|-------|-------|------|------|---------------------------------|
| Wind  | +12 % | +8 %  | +12 % | +13 % | +14% | +16% | +13 %                           |
| Solar | +36 % | +27 % | +22 % | +17 % | +9%  | +13% | +21 %                           |

Source: RTE – Analysis: CRE

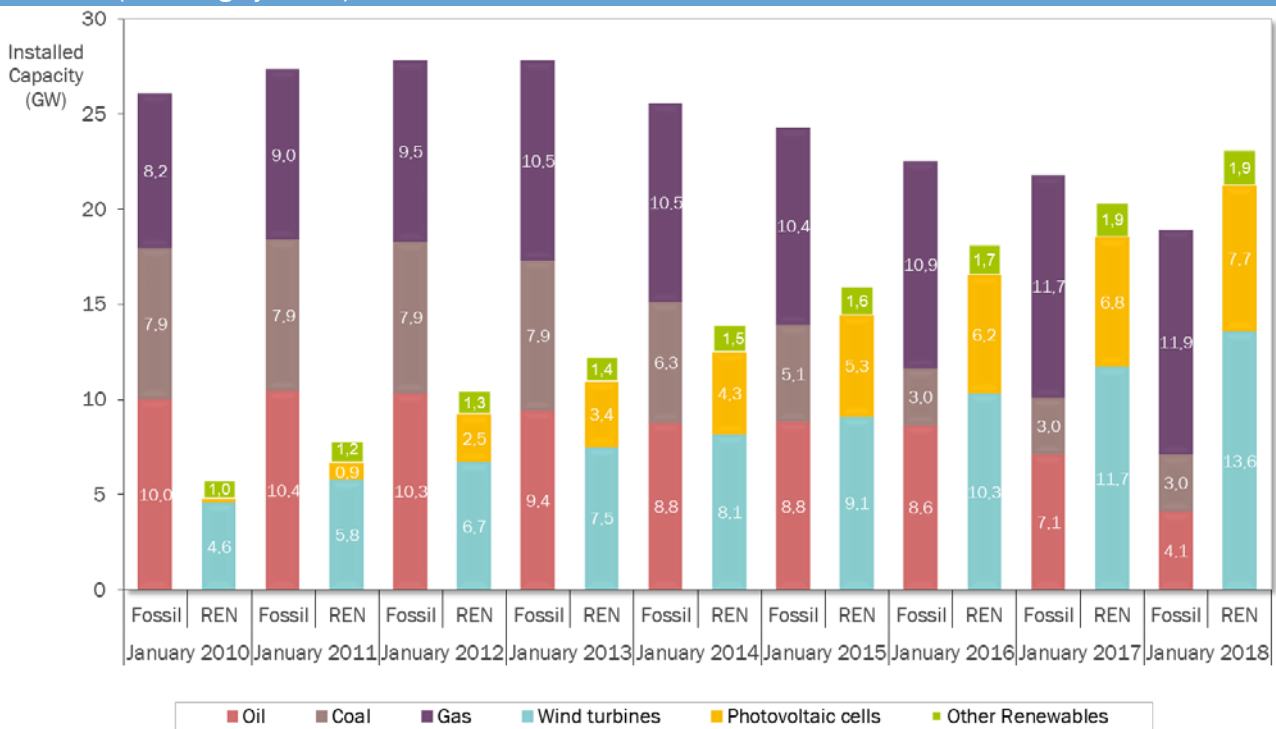
<sup>12</sup> <https://www.asn.fr/Informer/Actualites/Mise-a-l-arret-provisoire-de-la-centrale-nucleaire-du-Tricastin>

<sup>13</sup> <https://www.asn.fr/Informer/Actualites/Incident-de-niveau-2-pour-20-reacteurs-d-EDF>

<sup>14</sup> Average annual growth rate

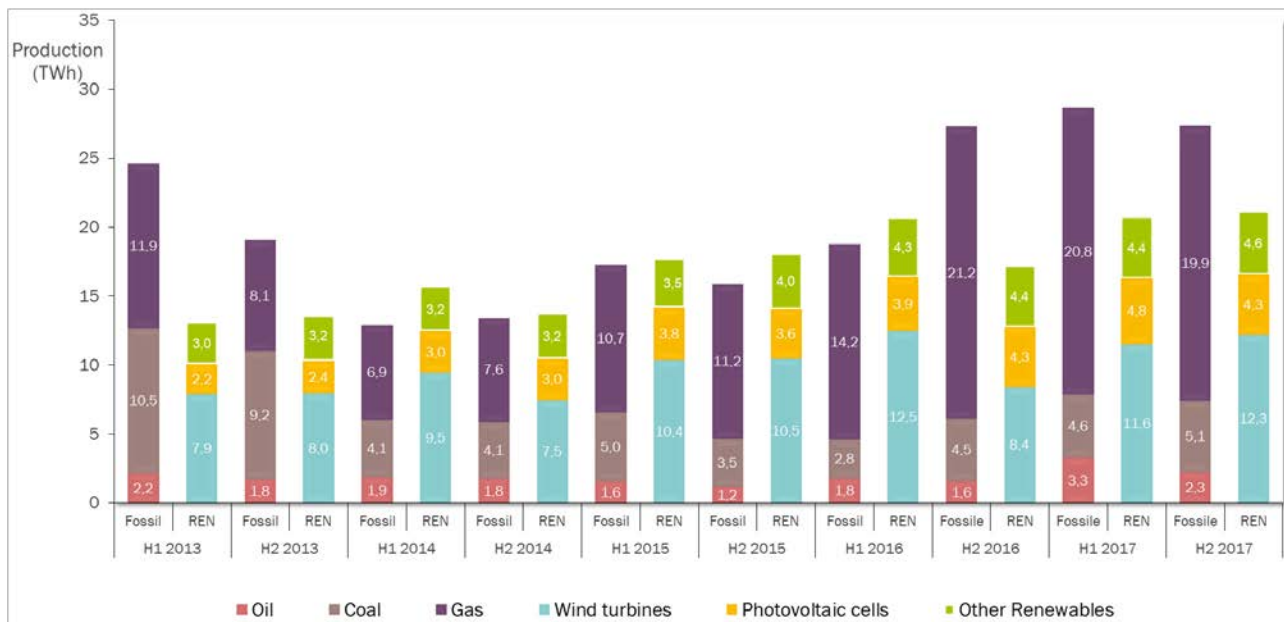


Graph 13: Comparison of installed capacity of thermal fossil resources (excluding nuclear) and renewable energy resources (excluding hydraulic)



Source: RTE – Analysis: CRE

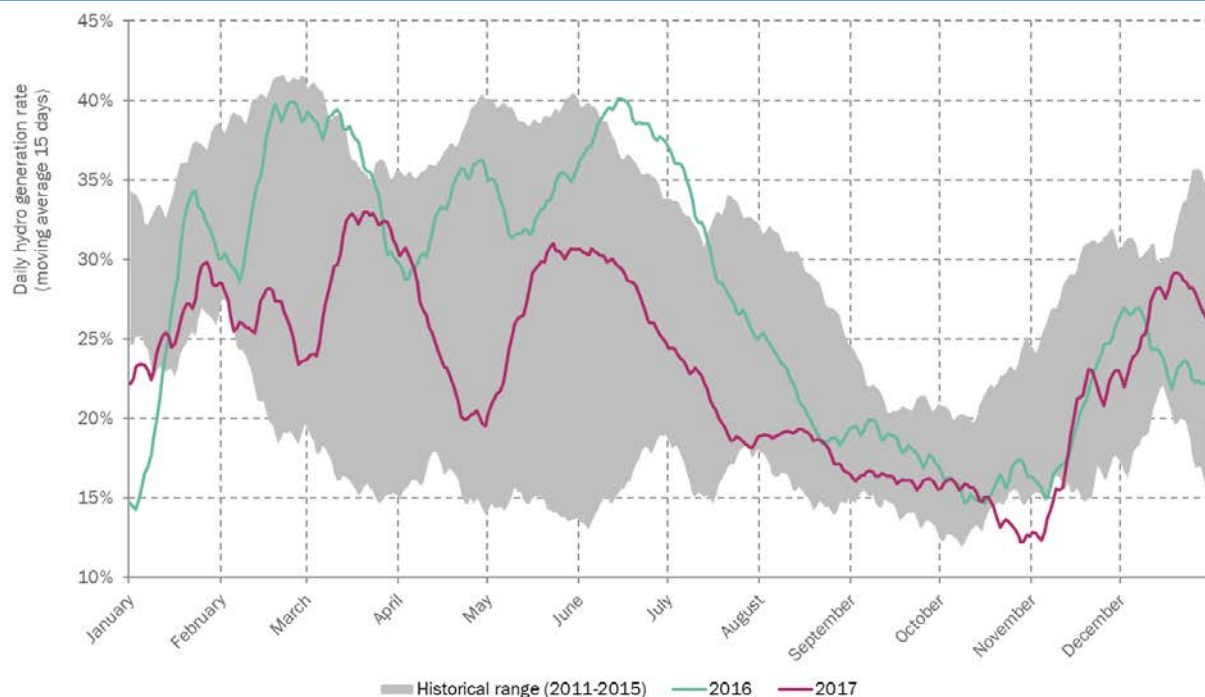
Graph 14: Comparison of six-month production of the thermal fossil (excluding nuclear) and renewable energy sectors (excluding hydraulic)



Source: RTE – Analysis: CRE

The average production rate of the hydraulic sector was down in 2017 (-16%) compared to 2016 in connection with the abovementioned rainfall deficit and episodes of drought (Graph 15). Therefore, hydraulic stocks throughout the year remained at values lower than those of 2016, even though they were inside the 2011-2015 historical tunnel for almost all of the year, with the exception of a short period in January and in autumn 2017. In total, hydraulic production in 2017 stood at 53.6 TWh, the lowest level recoded these last five years.

Graph 15: Rate of production of the hydraulic sector



Source: RTE – Analysis: CRE

#### 1.4 The year 2017 with record production of gas and coal sectors, used even more than in 2016

In 2017, despite the drop in installed thermal fossil capacity, in particular fuel oil, this sector’s production once again increased. Thermal production went from 45.9 TWh in 2016 to 54.4 TWh in 2017 (+18.5%), distributed across the three production resources, coal (+32.9%), gas (+15.9%) and fuel oil (+15.2%).

In terms of contribution to injections into the network, the gas sector was used the most. The production rate of this sector was an average 40% in 2017 with a use rate far above historical levels and a 5-point increase compared to 2016. The production profile of the gas sector during the year (Graph 17) shows heavy use during the first and fourth quarters, i.e. during the periods of low nuclear availability.

This gas production record is linked to the major increase in electricity prices (enabling positive profitability for producers despite relatively high gas prices (measured by the clean spark spread<sup>15</sup>). Gas plants had an excellent theoretical profitability and their production was sold. This phenomenon was heightened by low hydraulic production, which further increased the use of thermal resources.

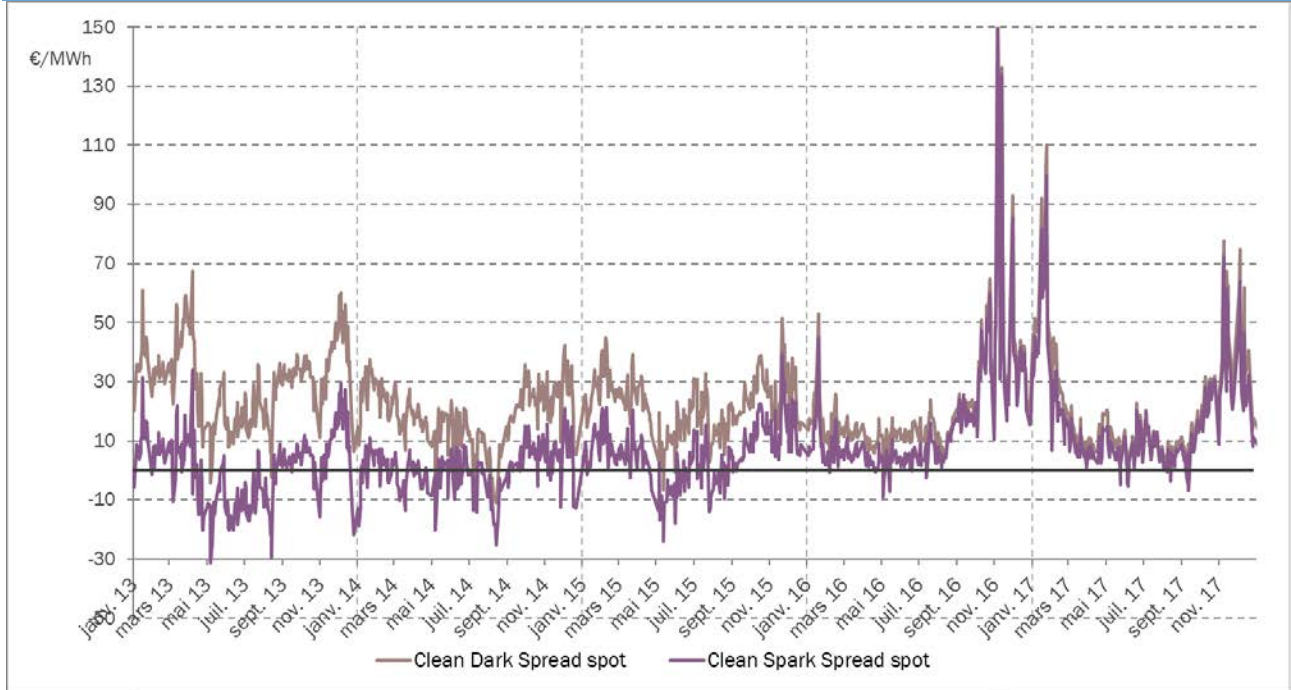
Similarly, the clean dark spread showed largely positive values throughout the year (Graph 16) and coal-fired power plants had a positive theoretical profitability in 2017. The production rate of the coal sector was an average 37% compared to 26% in 2016 (Graph 17). Production was however lower in volume than that of gas, totalling 9.7 TWh in 2017. The gas and coal production rates marked a very clear pickup in autumn 2017 against the fall in hydraulic production.

<sup>15</sup> The clean spark spread (CSS) and the clean dark spread (CDS) measure the theoretical profitability of a gas- or coal-fired power plant. The calculations presented are indicative, and do not take into account all plant costs, in particular fixed costs and start-up costs, and are therefore not the only indicators for the decision to start a unit.

CSS (€/MWh) =  $p_E - (\alpha p_C + \beta p_{CO_2})$ , where  $p_E$  is the day-ahead peak electricity price in France,  $p_C$  is the price of coal,  $p_{CO_2}$  the spot price of CO<sub>2</sub>,  $\alpha$  the average yield of a coal plant (35%) and  $\beta$  the emission factor of coal plants (0.96 tCO<sub>2</sub>/MWh). Calculations were done assuming a coal calorific value of 8.14 MWh/t.

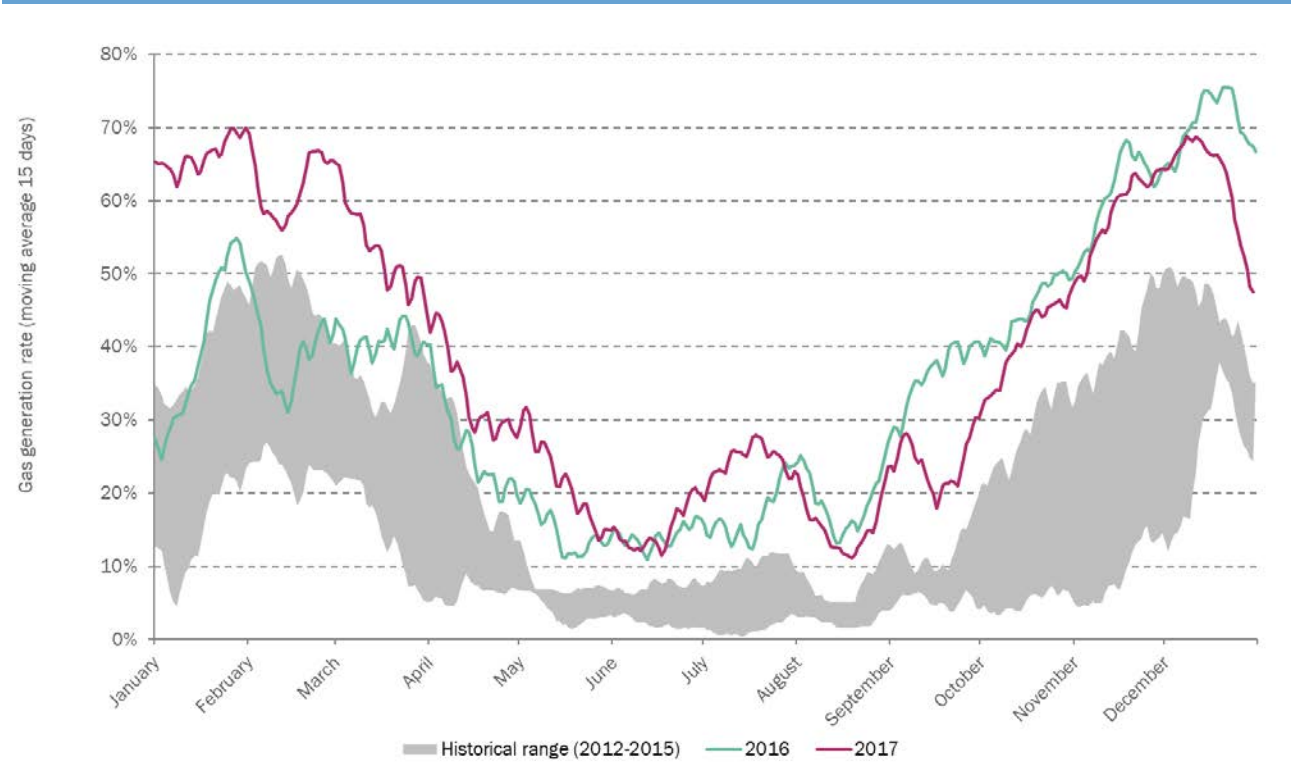
CSS (€/MWh) =  $p_E - (\gamma p_G + \delta p_{CO_2})$ , where  $p_E$  is the day-ahead peak electricity price in France,  $p_G$  is the price of gas,  $p_{CO_2}$  the spot price of CO<sub>2</sub>,  $\gamma$  the average yield of a gas plant (52%) and  $\delta$  the emission factor of gas plants (0.43 tCO<sub>2</sub>/MWh).

Graph 16: Peak spot clean dark spread and peak spot spark spread



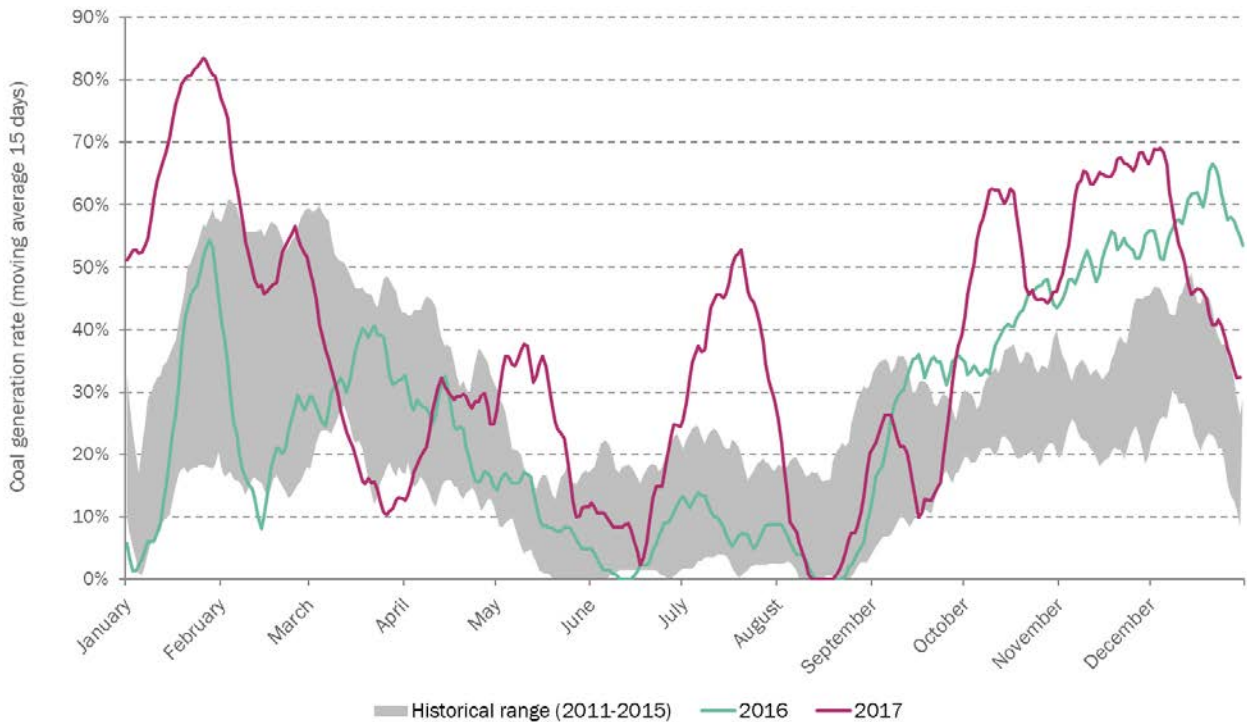
Source: ECX, Heren, Powernext, EPEX Spot - Analysis: CRE

Graph 17: Rate of production of the hydraulic sector



Source: RTE - Analysis: CRE

Graph 18: Rate of production of the coal sector



Source: RTE – Analysis: CRE

### 1.5 Nuclear sector marginal only 11% in 2017

A production sector is said to be marginal when the last unit of production used to meet demand belongs to that sector. That sector’s marginal production cost in theory determines the market price in EPEX SPOT’s day-ahead auction.

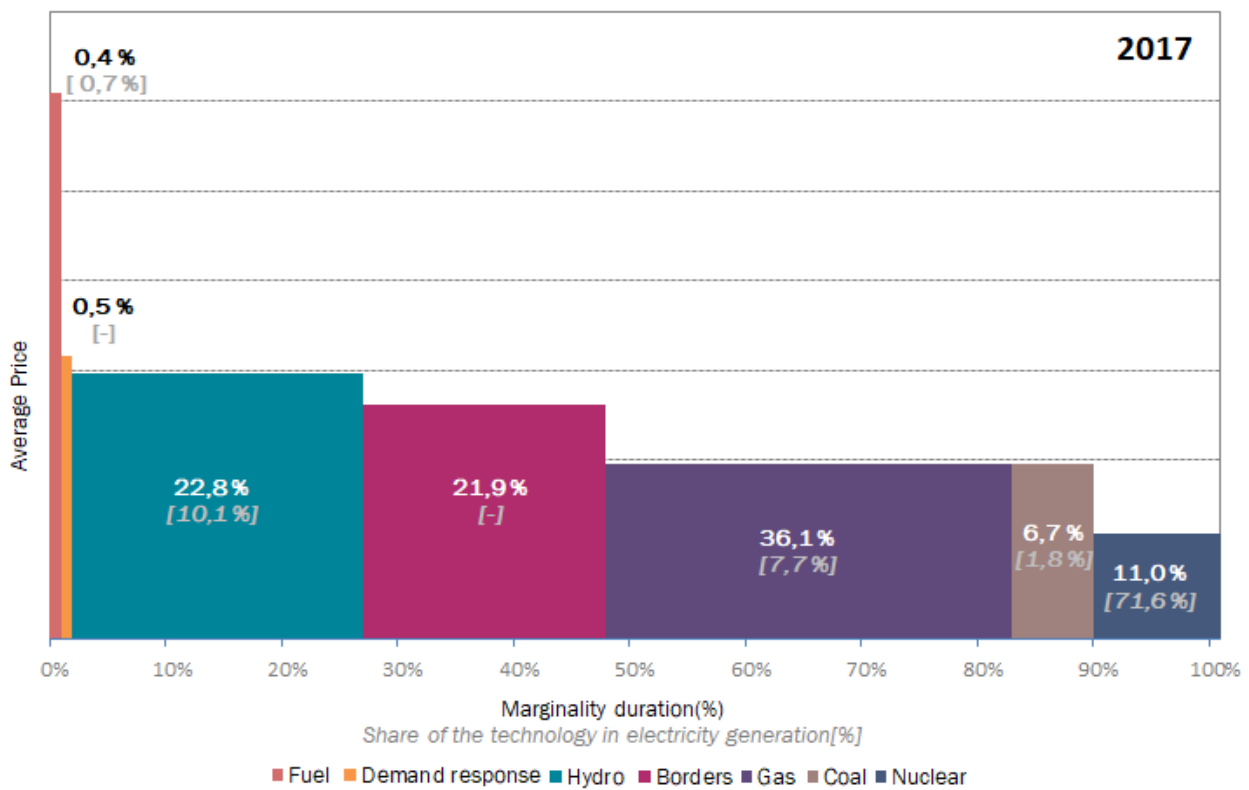
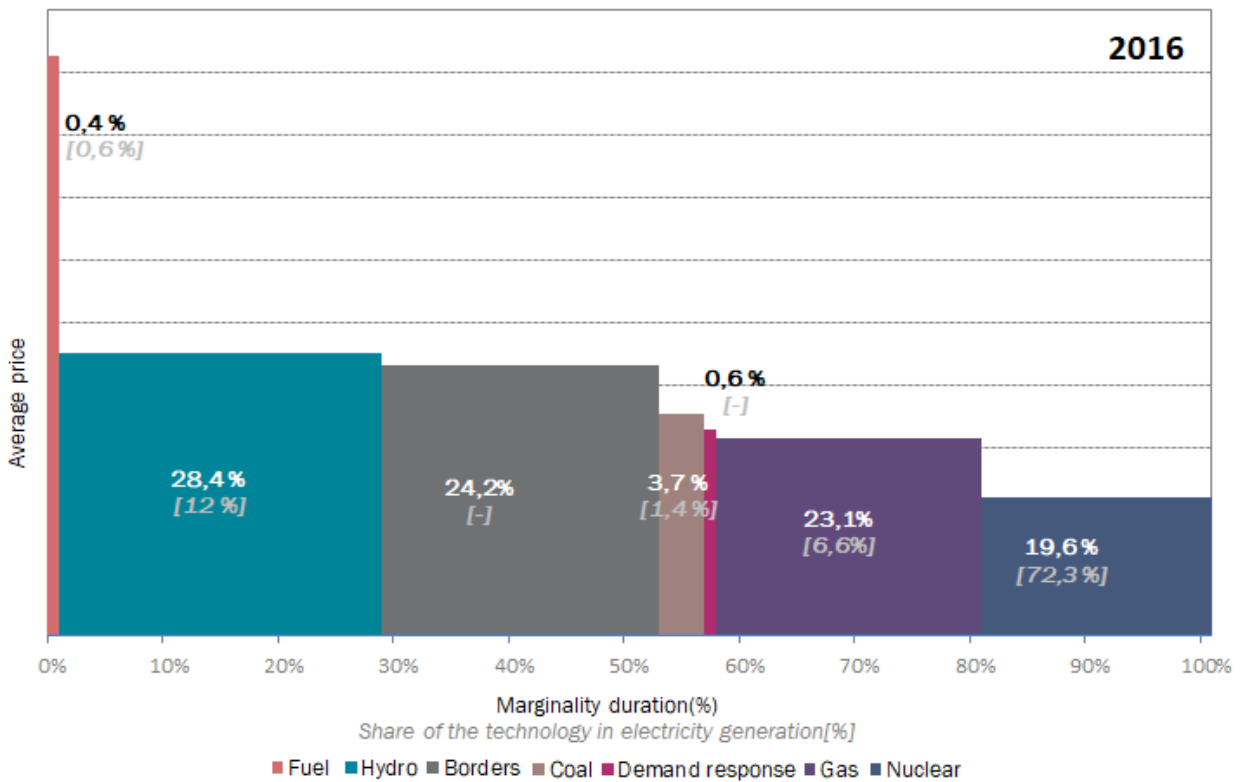
Against low unavailability, nuclear plants were marginal only 11% of the time in 2017 (Graph 19), i.e. at a frequency almost two times lower than that of the previous year (20%).

Similarly, low runoff led to a decline in marginality of the hydraulic sector (less than one-quarter of the time in 2017, a 5-point drop compared to 2016).

This drop was offset by greater use of gas plants, which were more often marginal: 36% of the time in 2017 compared to 23% in 2016. As a reminder, the gas sector was marginal only 16% of the time in 2015. Similarly, coal plants were more often present to determine the price, 7% of the time in 2017 (4% in 2016). Marginality of the coal sector however remained low, in line with installed capacity.

Lastly, it was estimated that border exchanges determined price formation 22% of the time, i.e. a slight drop compared to 2016 (24%).

Graph 19: Marginality of the different generation sectors in 2016 and 2017



Sources: EPEX SPOT, RTE, Producers





## 2. WHOLESALE ELECTRICITY PRICES UP SHARPLY AT THE START AND END OF THE YEAR

### 2.1 Spot prices high in Q1 and Q4 2017 with price peaks due to nuclear unavailability

The average baseload spot price for 2017 saw a major increase, standing at €44.99/MWh, i.e. a 23% increase compared to 2016. Intraday prices stood at an average €45.05/MWh in 2017 and followed the evolution of baseload spot prices. The price of the peak spot product also increased considerably (+17%) to reach €53.66/MWh.

The year 2017 started with a price peak, building on that of the end of the previous year, with spot prices regularly exceeding €100/MWh (Graph 20). Supply/demand tightness in France seen at the end of 2016 continued into Q1 2017, due in particular to a cold spell in the month of January, low hydraulic production and historically low nuclear availability levels.

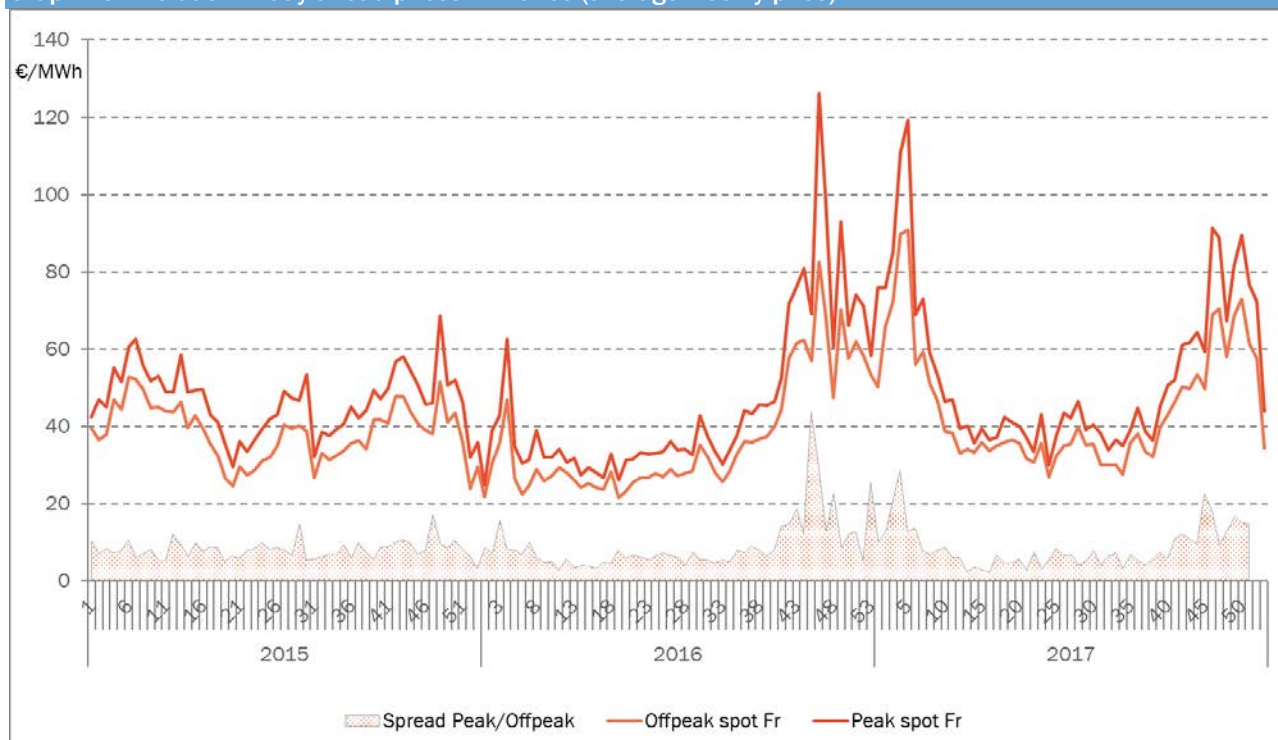
The periods during which there was less tightness in the system, i.e. during spring and summer, prices dropped with an average day-ahead level at €36.2/MWh. Nevertheless, compared with the year 2016 for the same period, this average price increased by roughly €5/MWh. This major increase is linked to low hydraulic production and greater use of thermal resources, which are more expensive. Early October saw a new fall in nuclear availability and a concomitant rise in prices. The average price at the end of 2017 was €59.3/MWh with periods of major volatility.

Table 2: Average day-ahead and intraday price

| Period | Average day-ahead price | Average Intraday price |
|--------|-------------------------|------------------------|
| 2015   | €38.56/MWh              | €38.76/MWh             |
| 2016   | €36.68/MWh              | €36.86/MWh             |
| 2017   | €44.98/MWh              | €45.05/MWh             |

Source: EPEX SPOT

Graph 20: Evolution in day-ahead prices in France (average weekly price)

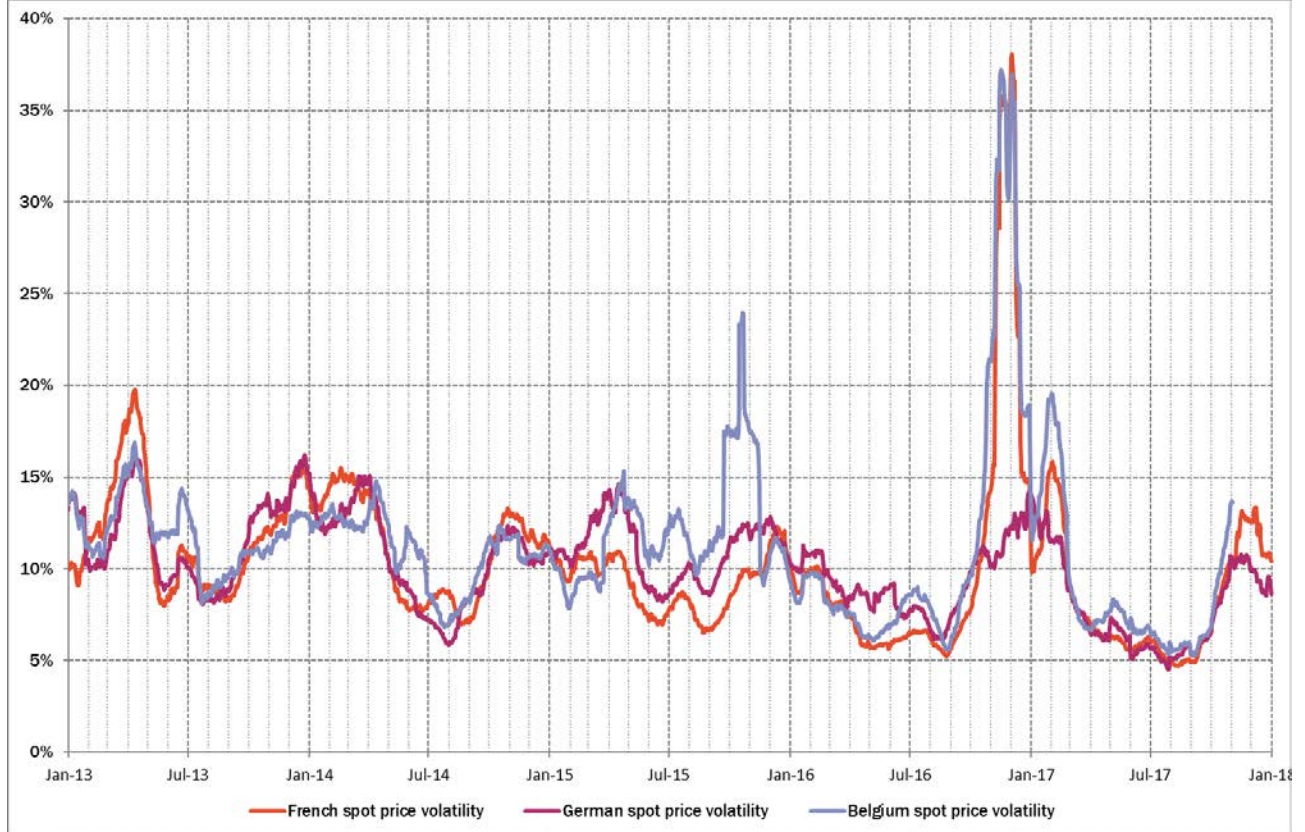


Source: EPEX SPOT

In the month of January, the EPEX SPOT auction saw a particular situation of tightness comparable to what happened in the month of November 2016. Low nuclear availability and low temperatures led to more than a week of high spot prices between 17 and 26 January 2017. In particular, between 24 and 26 January 2017, prices of the day-ahead baseload product were over €100/MWh and over €120/MWh for the peakload product. Major price pressures were also seen at the end of the year and the start of winter 2017/2018, i.e. on 8 and 9 November and 5 December 2017, with prices exceeding €100/MWh for the peakload product and at around €90/MWh for the baseload product. This type of market event is analysed specifically by CRE.

These periods of price pressure occurred against a highly volatile French market in the first and last quarters of 2017. French market tightness mechanically drove bordering markets, in particular the Belgian market (Graph 21).

Graph 21: Volatility of day-ahead prices



Source: EPEX SPOT, Belpex - Analysis: CRE

## 2.2 Difference between spot prices and EDF's marginal costs down in 2017

With regard to the formation of the spot price, CRE specifically monitors differences existing between spot market prices and the marginal costs of EDF's generation facilities resulting from calculations of its daily optimisation models. On average, the price-cost difference during these periods in 2017 was 1.5%, i.e. a level lower than seen in 2016 which was 2.9% (5.3% in 2015) (see 2017-2016 and 2016-2015 Monitoring Reports). Ever since CRE has measured this indicator (2008), it has never exceeded 6.5%. The differences made public in the successive monitoring reports are presented in the following table.

Table 3: Evolution in price/EDF costs differences

| Year | Price/costs differences |
|------|-------------------------|
| 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%                    |

Without pre-empting additional checks, CRE considers that the average difference in 2017 does not reflect the exercise of market power.

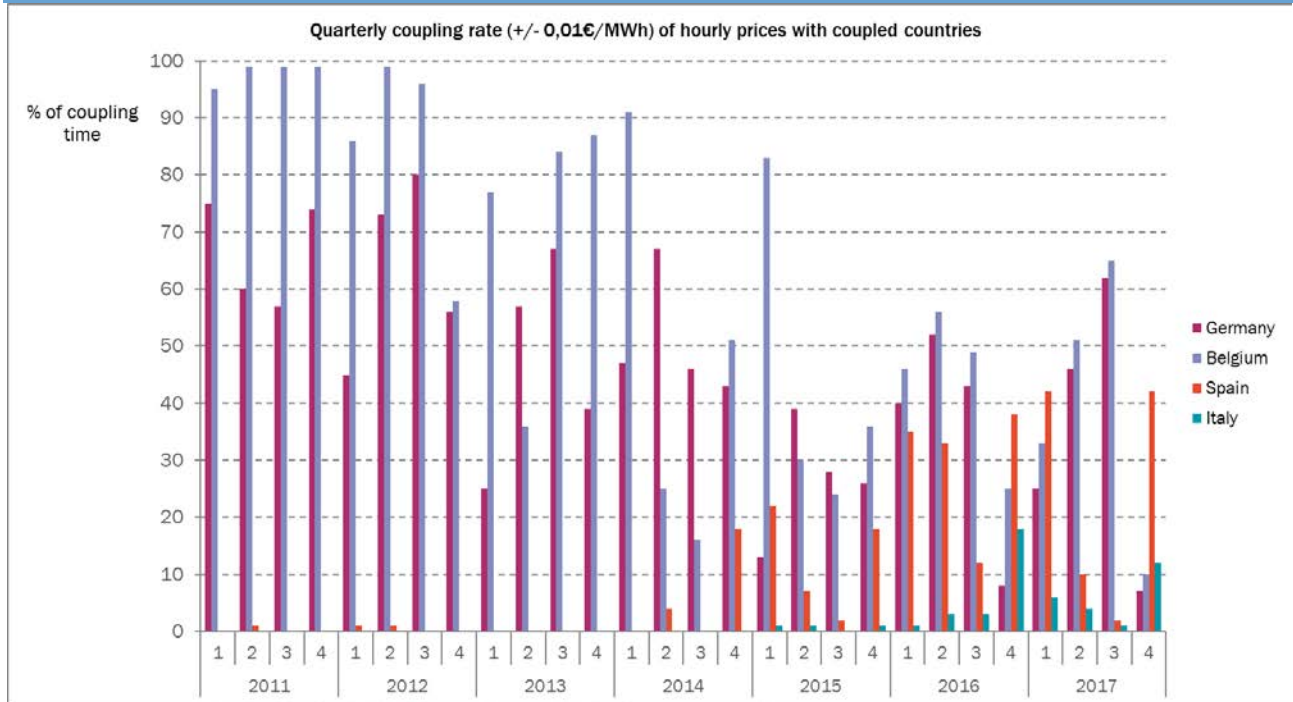
**2.3 Different coupling rates based on periods of French spot price volatility**

Spot price differentials increased in 2017 compared to the previous year at all borders, with the exception of the France/England border (Graph 27) and the France-Switzerland border (Graph 28), for which the differential in absolute price value dropped by €2.1/MWh and €20.2/MWh respectively. The greatest increases in absolute price differentials on average were recorded at the borders with Germany (Graph 23) and Spain (Graph 25) with an increase of over €3/MWh, followed by Italy (Graph 26) and Belgium (Graph 24), with an increase in absolute differences of €1.9/MWh and €1.6/MWh.

Movements in average spreads were particularly marked in Q1 and Q4 2017, in particular at the German, Belgian, Spanish and British borders. For the borders with Italy, England and Spain, there were major and constant differences in Q2 and Q3 2017. This situation was due to the large increase in average prices in France in 2017 (see 2.1).

Coupling rates reflected spreads with bordering countries which present the same dichotomy between the periods at the start and end of the year 2017 and the two middle quarters. Good coupling rates were seen compared to 2016 for Germany and Belgium during Q2 and Q3 2017 (with 46% and 62% for Germany and 51% and 62% for Belgium respectively). These rates are linked to low spreads with these countries during this period. Conversely, France had a very low coupling rate with Spain and Italy at around 5%. These rates are directly connected with the constant spreads with these countries. With regard to the first and last quarters of the year, coupling at the Spanish border increased considerably, reaching 42%. For Belgium, coupling fell in Q1 and Q4, particularly in Q4 2017, against high volatility in French prices as mentioned above.

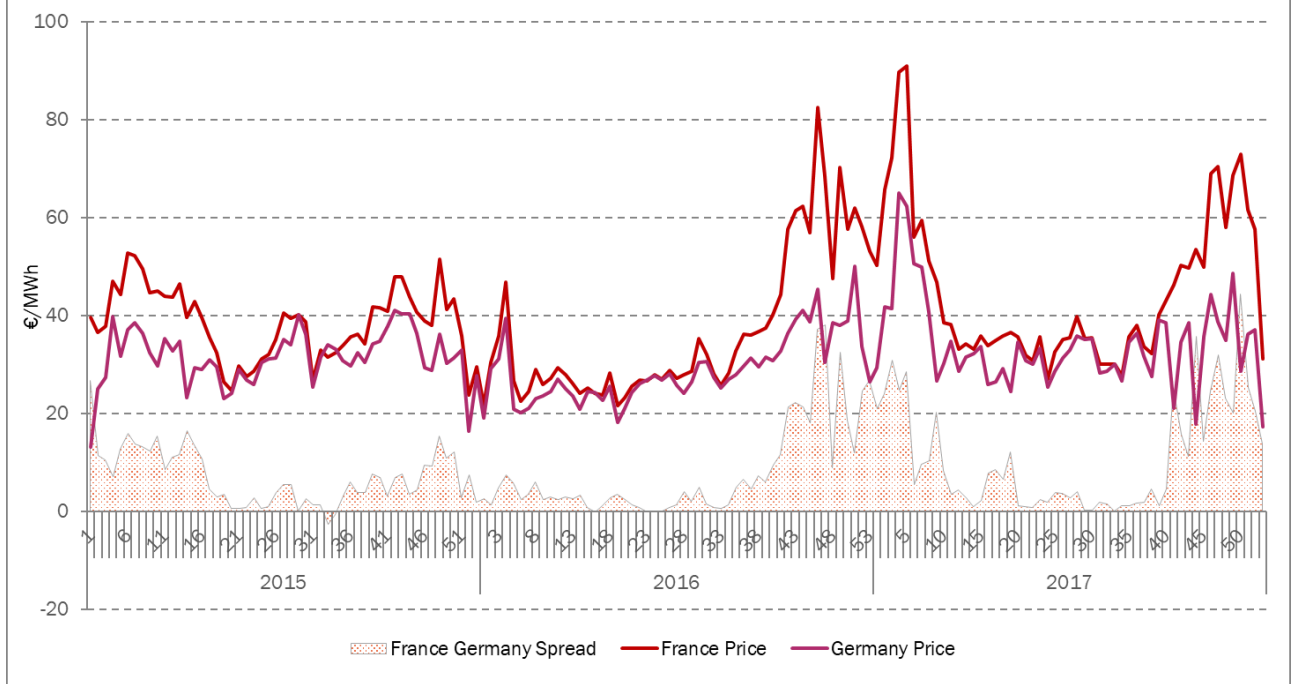
Graph 22: Quarterly coupling rate of hourly prices with coupled countries



Source: EPEX SPOT, Belpex, OMEL, IPEX

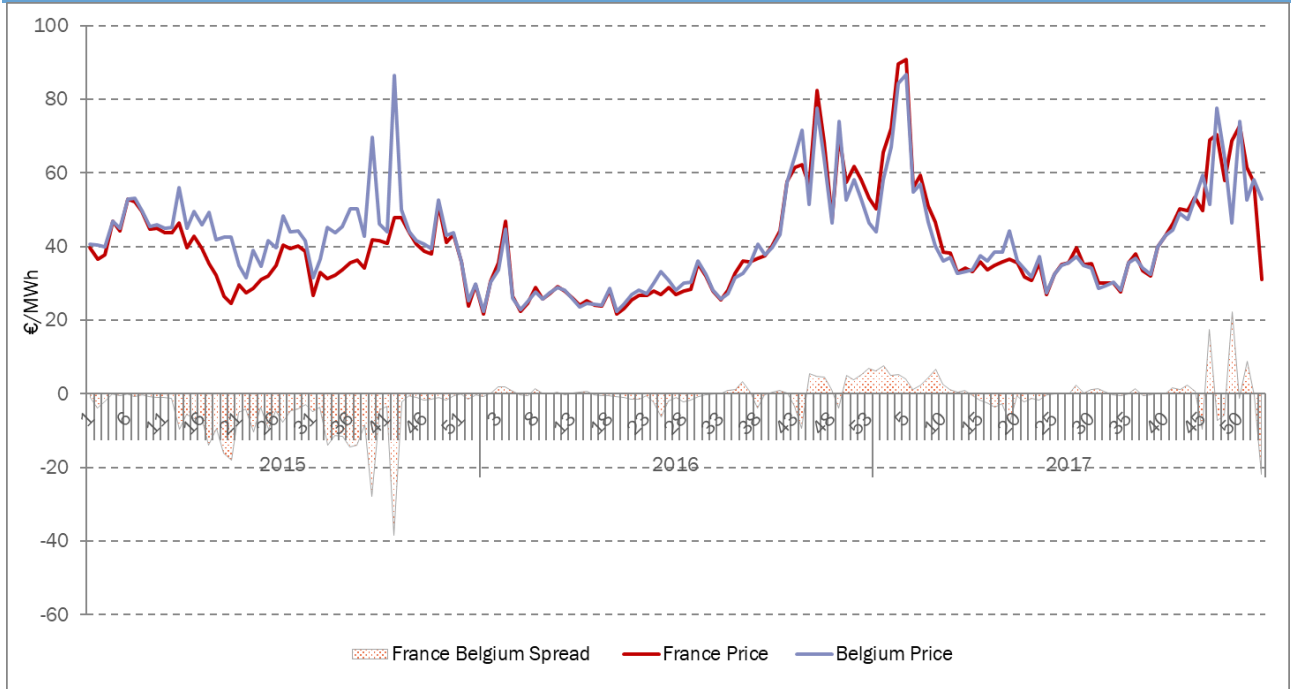


Graph 23: France and Germany spot price (weekly average)



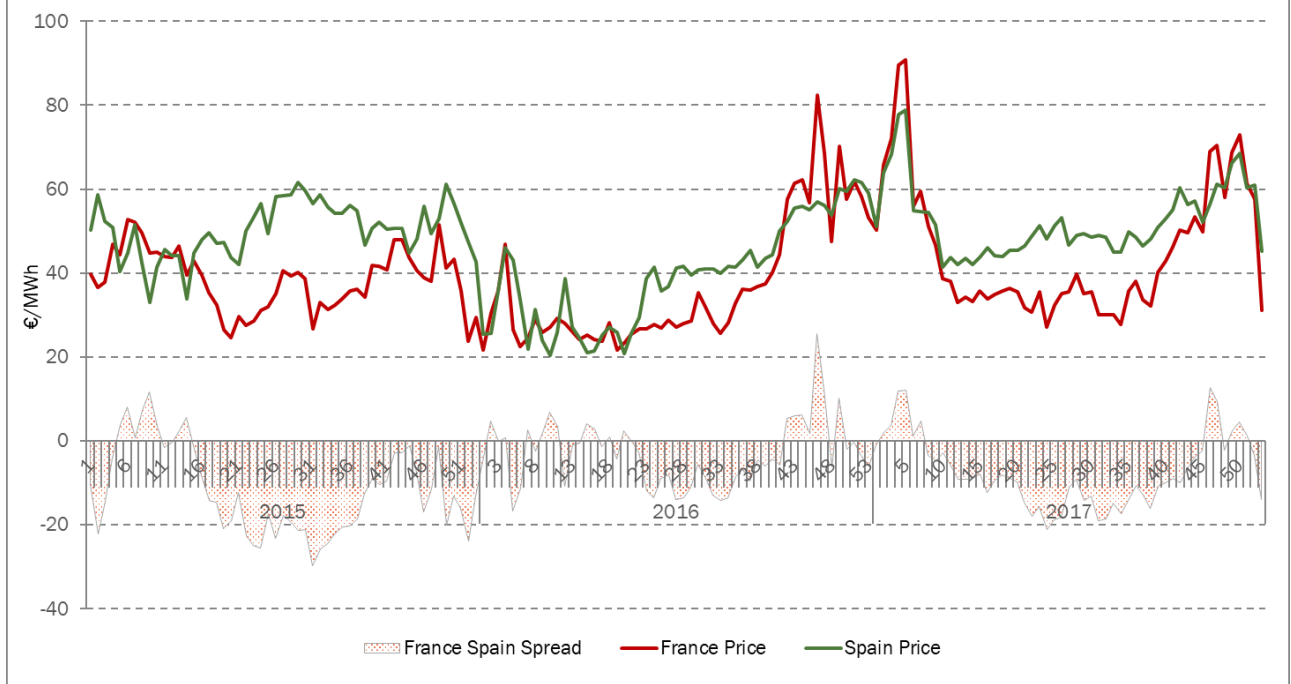
Source: EPEX SPOT

Graph 24: France and Belgium spot price (weekly average)



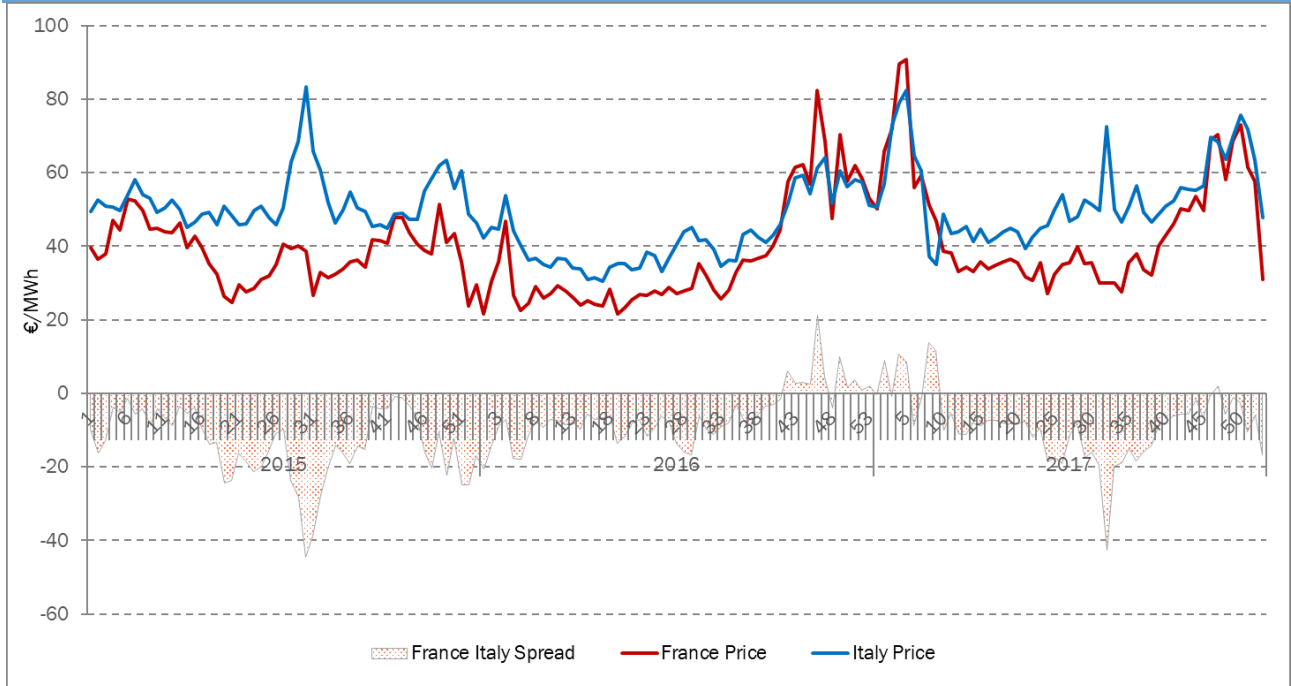
Source: EPEX SPOT, Belpex

Graph 25: France and Spain spot price (weekly average)



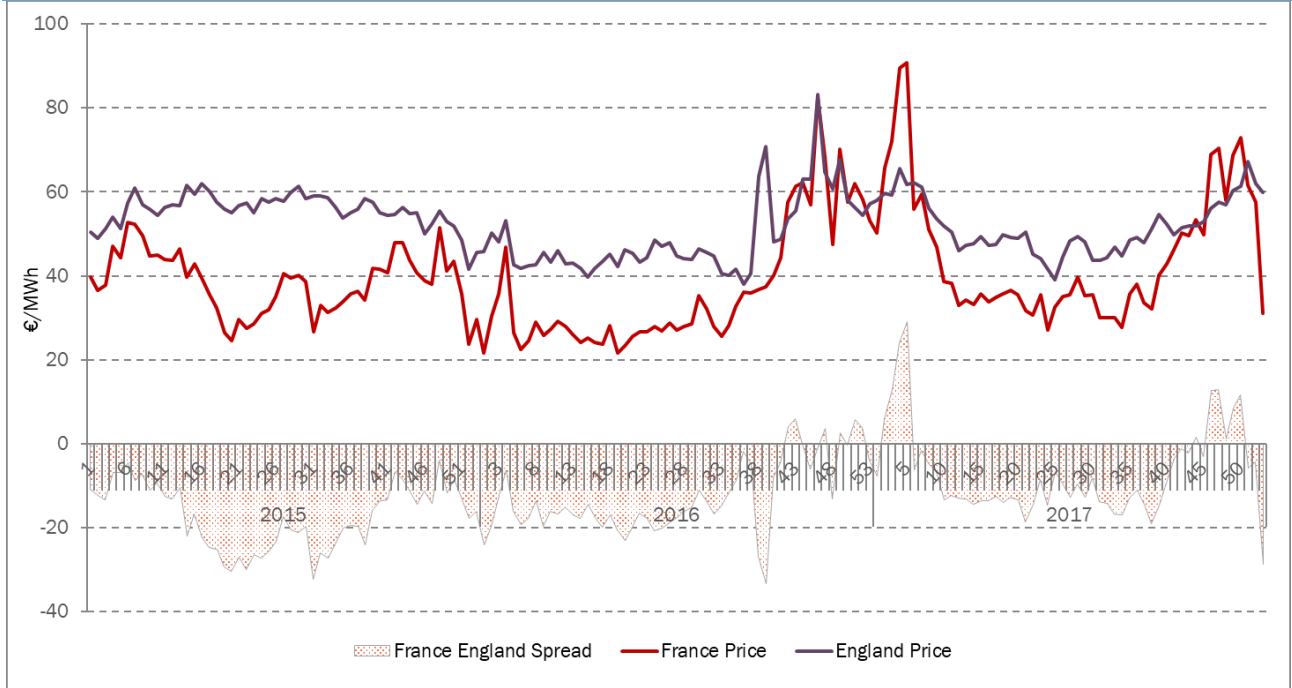
Source: EPEX SPOT, OMEL

Graph 26: France and Italy spot price (weekly average)



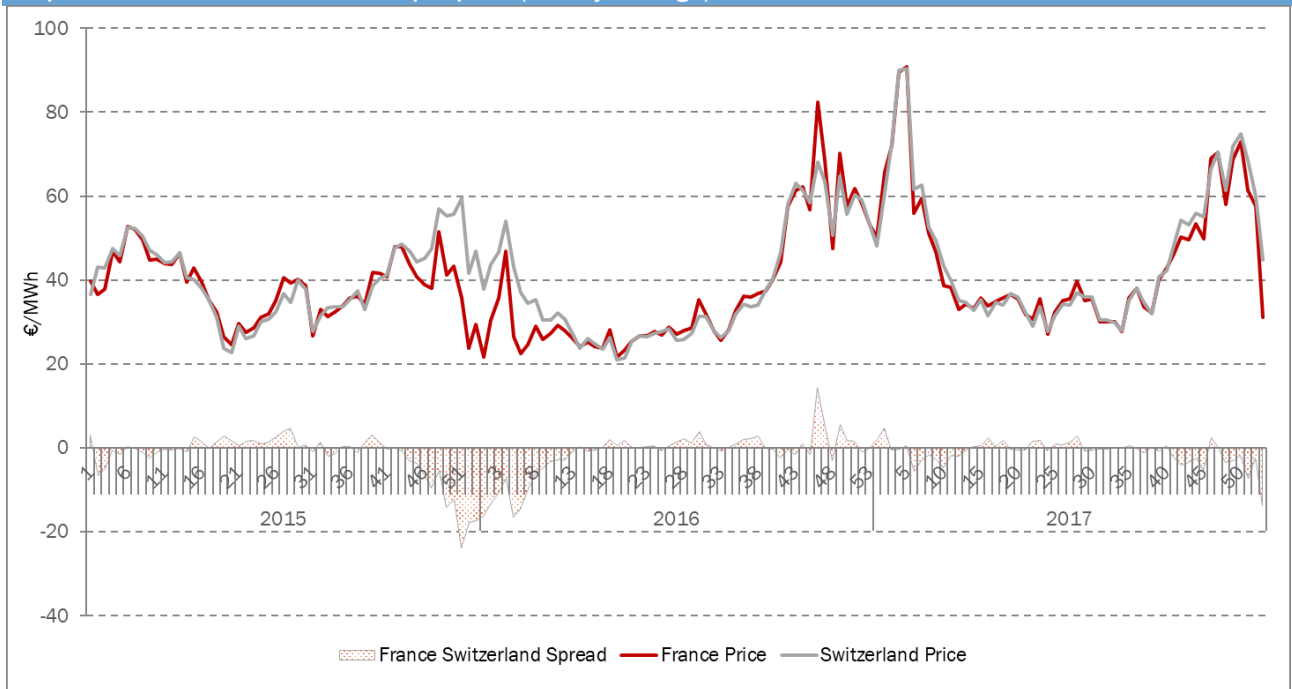
Source: EPEX SPOT, IPEX

Graph 27: France and England spot price (weekly average)



Source: EPEX SPOT, APX

Graph 28: France and Switzerland spot price (weekly average)

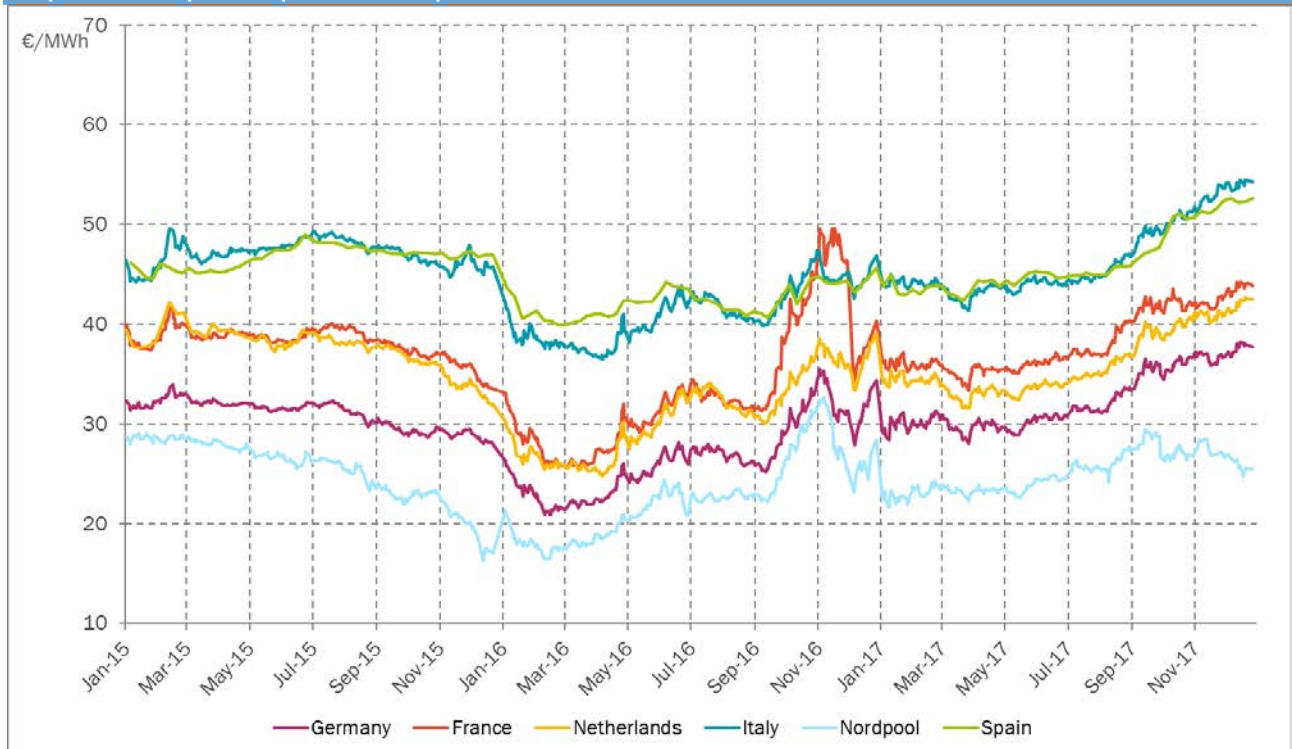


Source: EPEX SPOT

**2.4 Steady increase in wholesale futures prices in France and Europe in 2017**

The prices of futures products for delivery in Y+1 in Europe dropped slightly in Q1 2017, reaching its lowest around mid-March because of low gas and coal prices. This trend reversed as from that time (Graph 29). The prices of all Y+1 products in Europe followed a clear upward trend. This increase was steady during the three other quarters of 2017 due to the recovery in fuel prices as from spring. As from August 2017, different announcements concerning unavailability of nuclear generation resources in France (see 1.2) led to volatility in the French futures market.

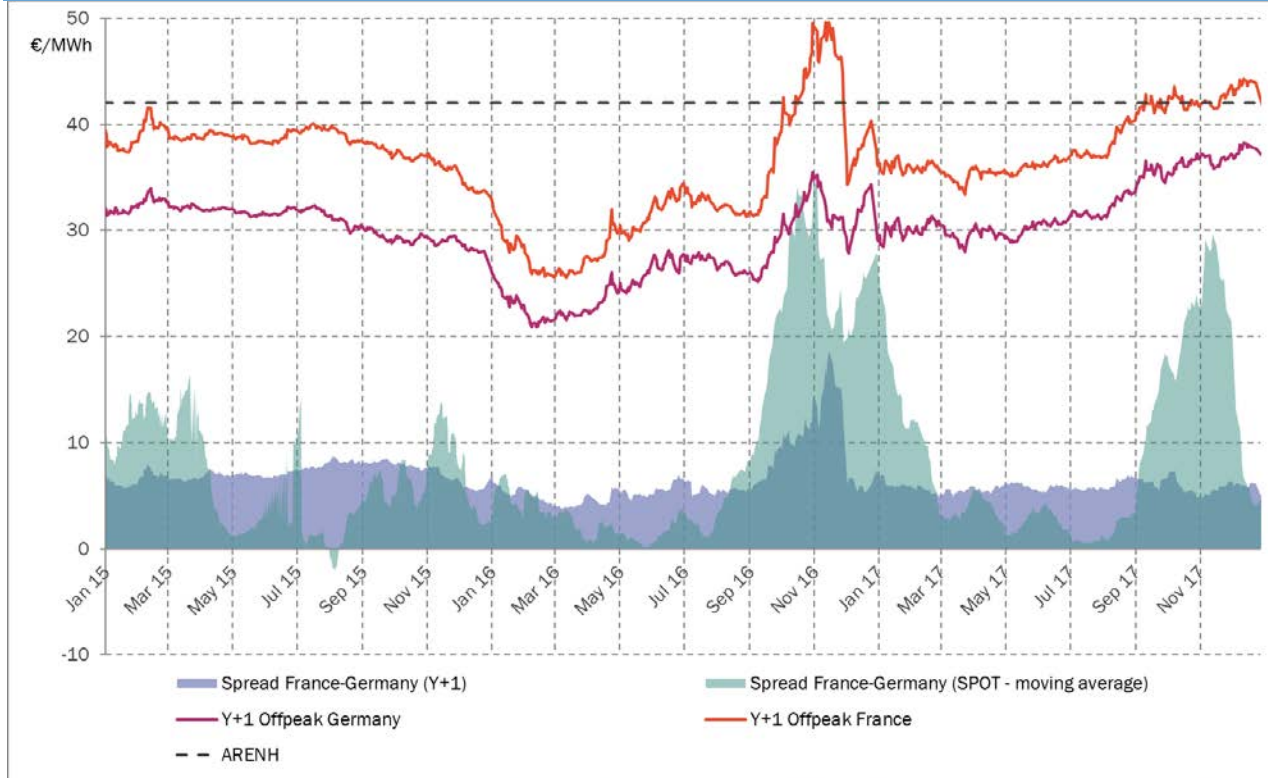
Graph 29 : Y+1 product prices in Europe



Source: EPD, ICE Exend, Heren

The price differential of futures products between Germany and France was down with a 5% drop in 2017 compared to 2016. Uncertainty about French nuclear unavailability in autumn 2016 dissipated at the end of 2016. The France/Germany spread narrowed at the end of 2017 returning to stable fluctuations around an average €5.9/MWh in 2017 (compared to an average €6.8/MWh in 2016).

Graph 30: Prices and differences between the French and German calendar products

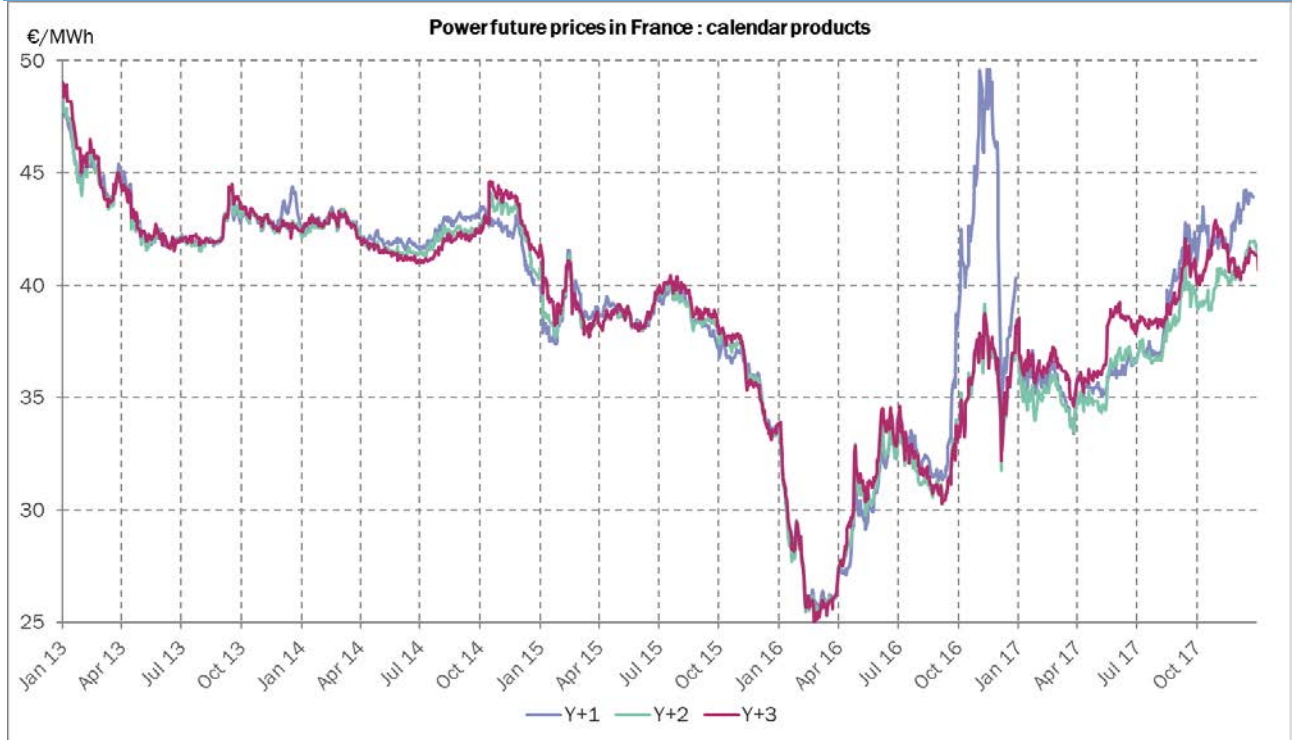


Source: EPEX SPOT, EEX

The prices of calendar products in France with one, two and three-year timeframes increased, particularly in H2 in the wake of commodities (gas, coal) and CO<sub>2</sub> prices. It can however be highlighted that the significant difference between the one-year timeframe and the two- and three-year timeframes, seen from the end of 2016 for the year 2017, narrowed in 2017 (for deliveries in 2018 and beyond), against reduced tightness related to uncertainty about nuclear availability. This evolution was tied to the announcements made in December 2016 and Q1 2017 about the restart of reactors concerned by the carbon segregation issue (see above). However, volatility and an increase in Y+1 calendar prices returned, in comparison with the Y+2 and Y+3 timeframes, at the end of 2017, once again in connection with announcements concerning nuclear generation (see 1.2).



Graph 31: Evolution of the prices of calendar products in France for the next three years



Source: EEX

Graph 32: Volatility of calendar product prices



Source: EPEX SPOT

Specifically concerning the extent of calendar product volatility, unlike in 2016, volatility of French and German Y+1 calendar prices were again very close in 2017, at around 10%, except for the renewed pressure mentioned above with a volatility peak in September 2017 at around 25% for France and Germany.

## 2.5 2017: three capacity auctions resulting in an upward trend in guaranteed capacity prices

In its decision of 8 November 2016, following a thorough one-year investigation, the European Commission authorised, in accordance with EU rules on State aids, the French capacity mechanism.

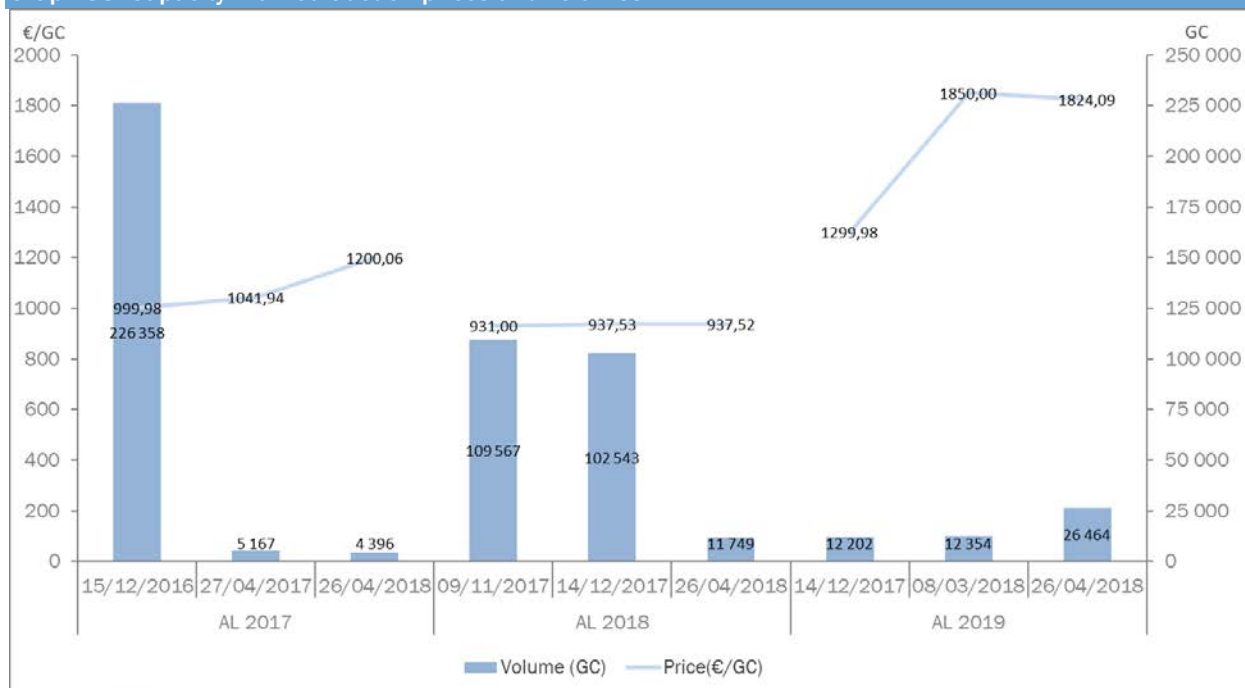
The operating principles of this market were reiterated in a previous report on the functioning of the wholesale markets (Section 3, page 45: 2.5 First capacity guarantee exchanges in 2016).

The first capacity guarantee auction took place in December 2016 only for delivery year (AL) 2017. Three other auctions took place on the EPEX SPOT market during 2017, and to date, two auctions have taken place in 2018 (8 March and 26 April).

|      | EPEX auction date | AL 17 | AL 18 | AL 19 | AL 20 | AL 21 | AL 22 |
|------|-------------------|-------|-------|-------|-------|-------|-------|
| 2016 | 15/12/2016        | X     |       |       |       |       |       |
|      | 27/04/2017        | X     |       |       |       |       |       |
| 2017 | 09/11/2017        |       | X     |       |       |       |       |
|      | 14/12/2017        |       | X     | X     |       |       |       |
| 2018 | 08/03/2018        |       |       | X     |       |       |       |
|      | 26/04/2018        | X     | X     | X     |       |       |       |
|      | 21/06/2018        |       |       | X     |       |       |       |
|      | 13/09/2018        |       |       | X     |       |       |       |
|      | 18/10/2018        |       |       | X     |       |       |       |
|      | 13/12/2018        |       |       | X     | X     | X     | X     |

While the first auction resulted in a guaranteed capacity (GC) price of almost €1,000 and those in 2017 (for delivery in 2018) of around €930/GC, the auctions that took place at the end of 2017 and in March and April 2018 (for delivery in 2019) resulted in a significant increase in guaranteed capacity prices (€1,850/GC for the auction of March 2018). These results occurred against a sharp decline in volumes traded compared to the first auction at the end of 2016 and those in November and December 2017 (Graph 33). The auctions analysed still correspond to the market launch phases, since, at a steady state of operation, a product will have at least 15<sup>16</sup> auctions spread across four years.

Graph 33: Capacity market: auction prices and volumes



\*The session of 26/04/2018 for the AL 2017 product was the first auction taking place after the delivery year with all the PP1 and PP2 days known (Peak Period: Days in the delivery period, used to calculate Mandatory Participants' obligation for a given Delivery Year)

Source: EPEX SPOT

<sup>16</sup> [https://www.rte-france.com/sites/default/files/2016\\_11\\_29\\_regles\\_mecanisme\\_de\\_capacite\\_1.pdf](https://www.rte-france.com/sites/default/files/2016_11_29_regles_mecanisme_de_capacite_1.pdf)



In any event, the evolution in the capacity price observed is examined carefully. In accordance with the provisions of Article L.131-2 of the Energy code, CRE monitors the guaranteed capacity market, for which the prohibitions and obligations specified in Articles 3, 4 and 5 of REMIT apply.

In Q1 2018, CRE undertook discussions with the main participants in the capacity auctions that took place. Seventeen requests for quantitative and qualitative information about participants' strategies were addressed.

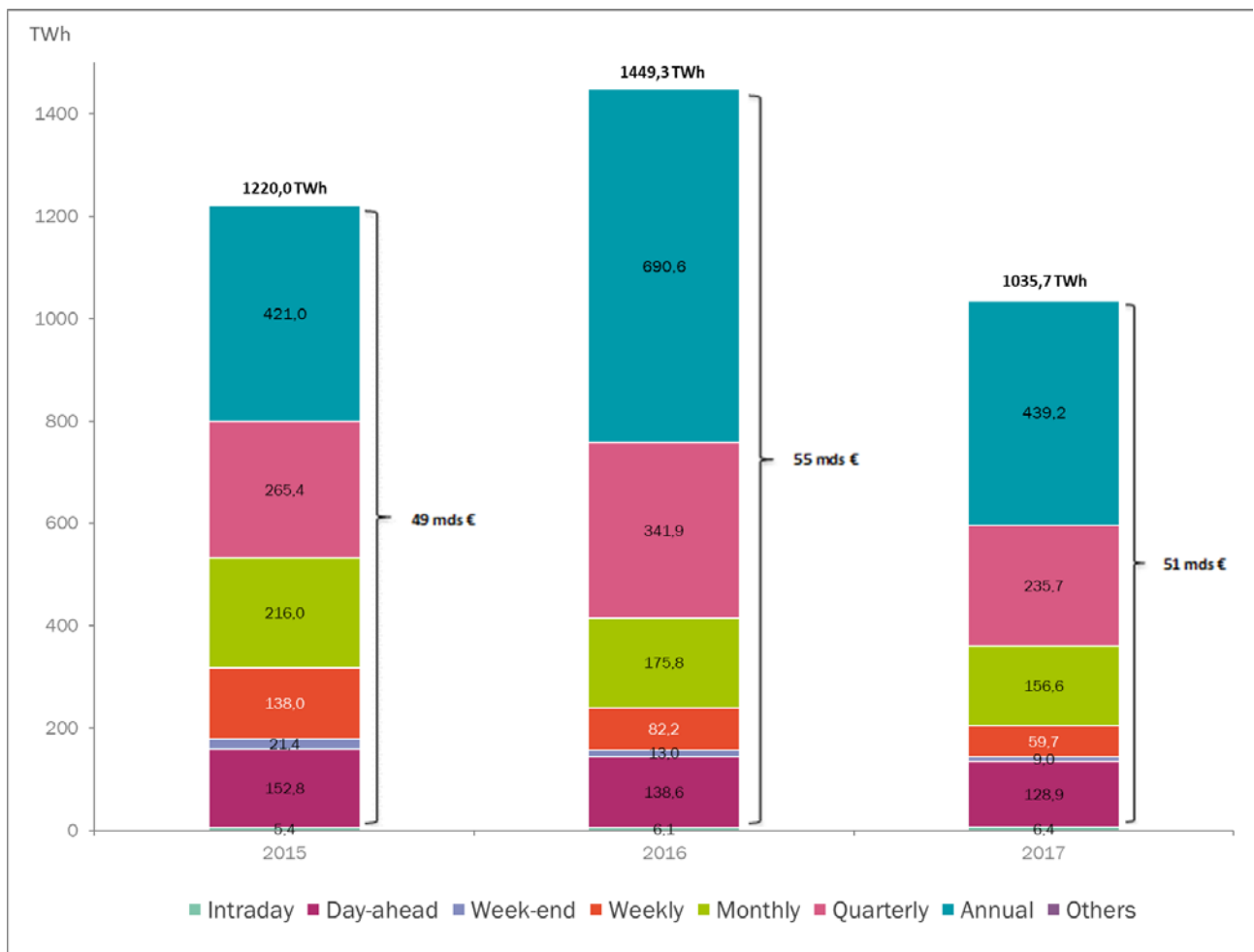
The precise answers provide details about individual bid strategies and the prices proposed. Most participants did not make any specific comments about the results of the auctions; some of them however expressed their concerns about the price increase observed.

CRE is continuing detailed analyses of the auction prices observed, and, in particular of the result of the comparison of the different supply and demand curves of the different market participants.

### 3. 38% DROP IN VOLUMES IN 2017 AGAINST MAJOR PRICE VARIATIONS

After four consecutive years of growth, volumes traded in the wholesale electricity markets saw a drop for the first time in 2017. This drop was seen for all tradable products with greater impacts in terms of volume for annual and quarterly products. Only intraday product volume increased slightly, but these volumes are marginal compared to the volumes traded in the wholesale electricity markets (Graph 34).

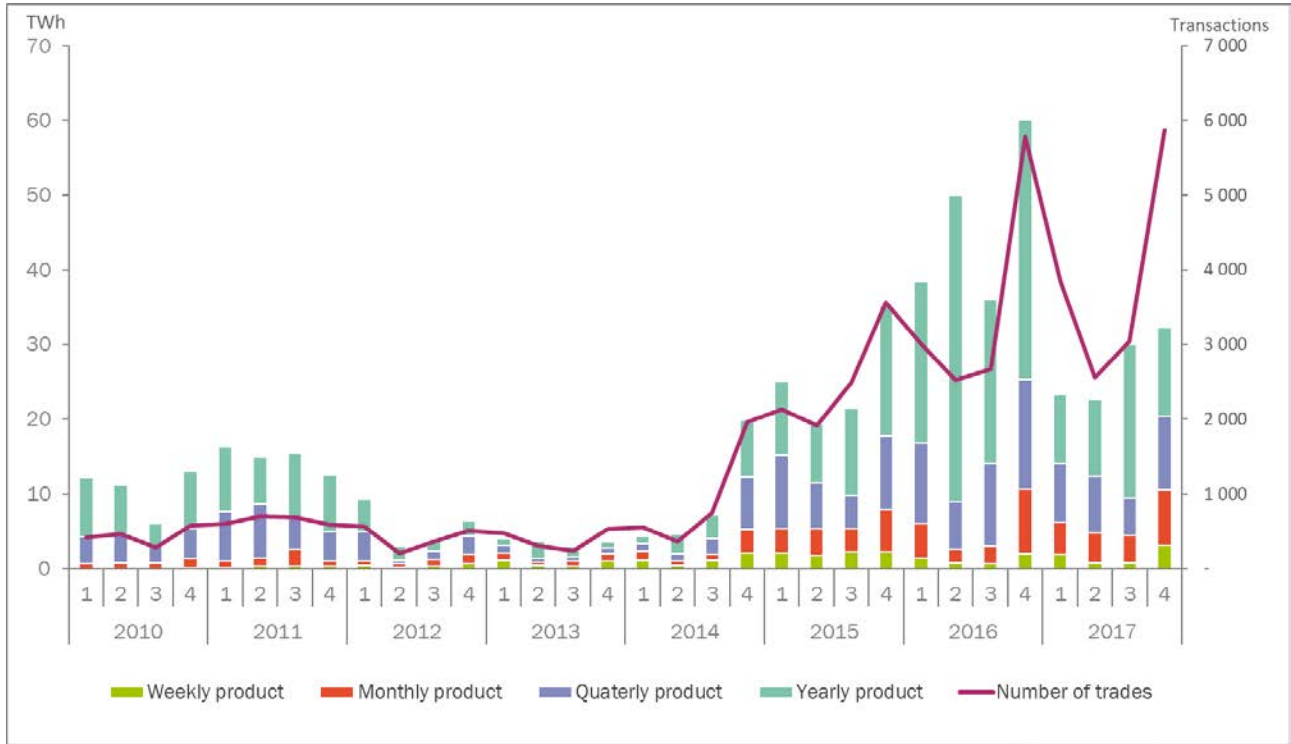
Graph 34: Volumes traded in the wholesale markets



Source: EPEX SPOT, EEX, Brokers

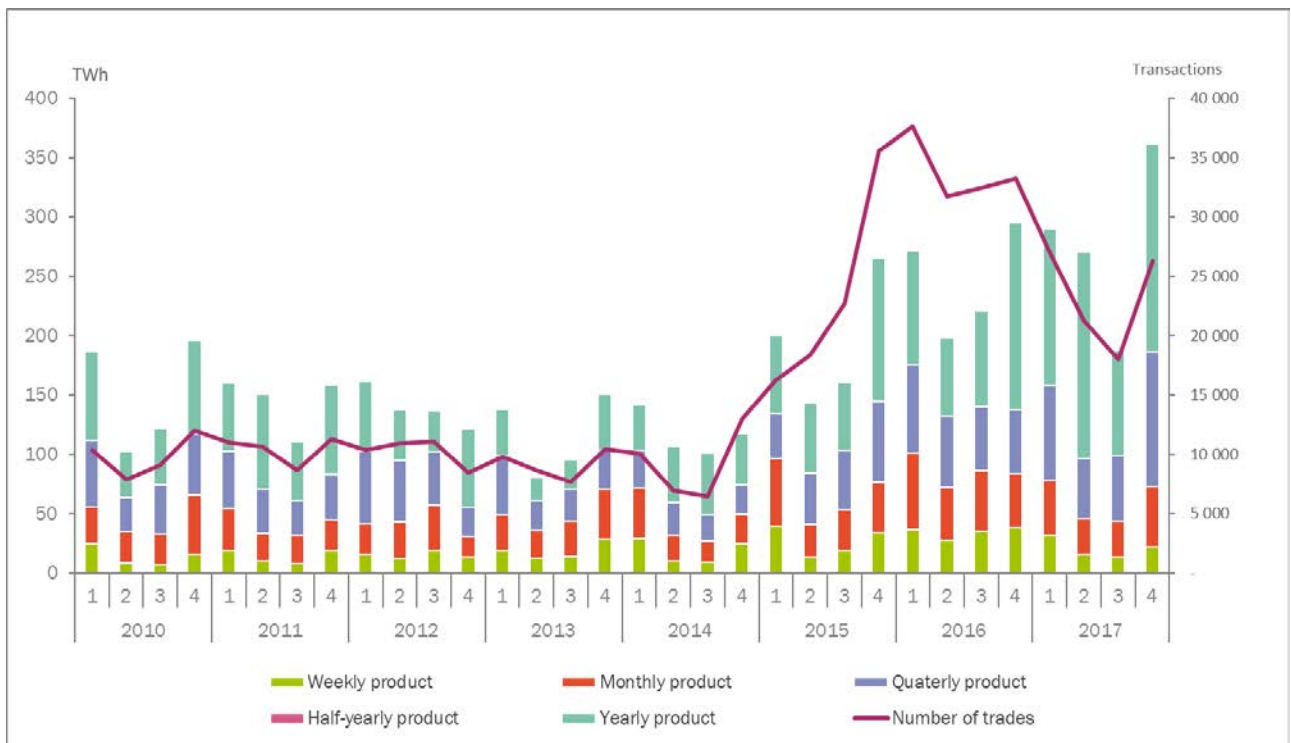


Graph 35: Volumes traded in the futures exchange



Source: EEX

Graph 36: Volumes traded in the intermediated futures market



Source: EEX, Brokers

**SECTION 4  
NATURAL GAS WHOLESALE MARKETS**

1. LOW STORAGE LEVELS IN 2017

1.1 Against stable consumption and low storage reservations, gas market marked by an increase in LNG supplies and exports

In 2017, the gas market saw growth in supply volumes and demand of 3.22% compared to 2016 (Graph 37).

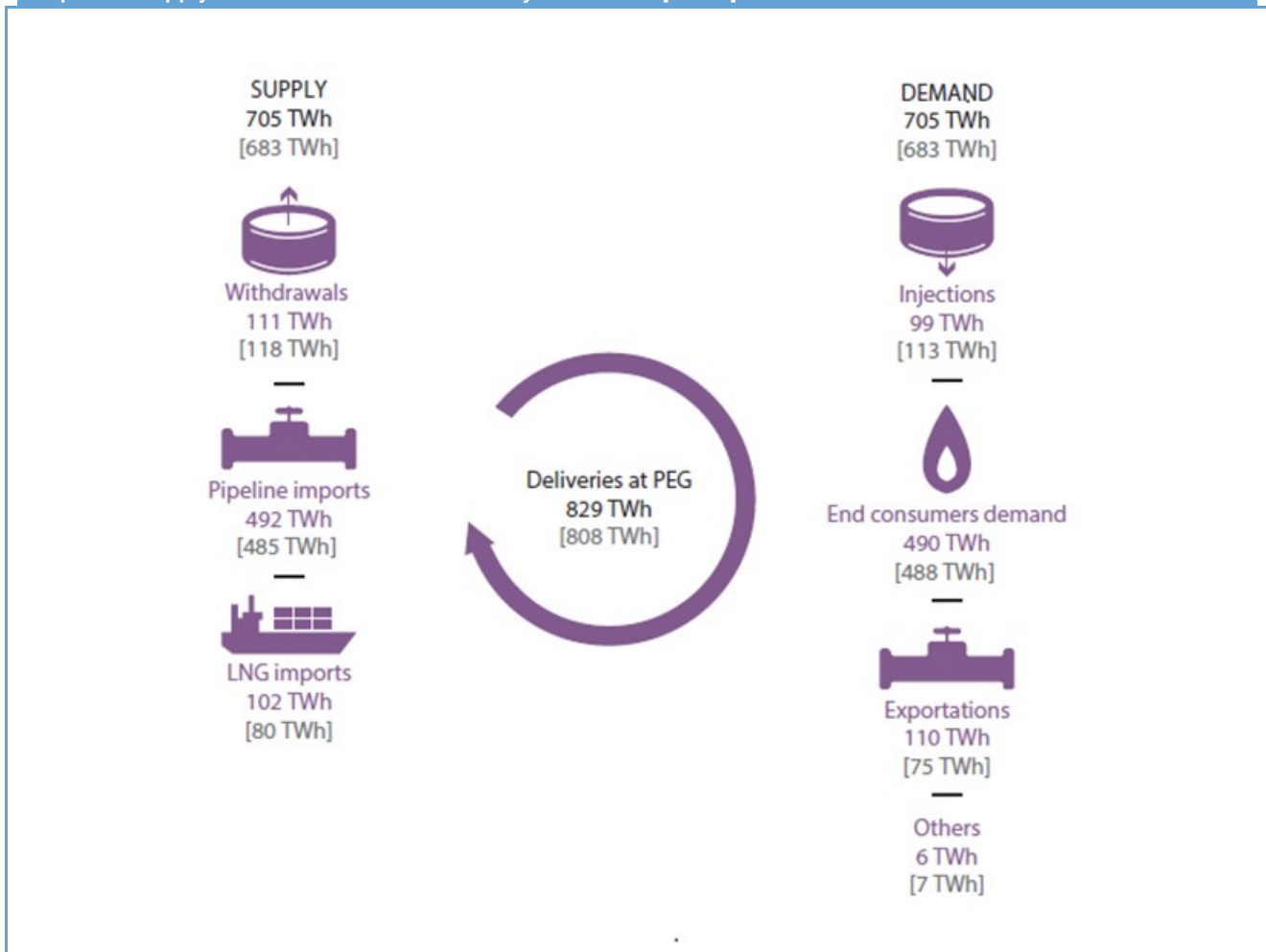
Against stable end customer consumption (+0.4%), the overall increase in demand was linked to a sharp increase in exports (+35 TWh, i.e. +46%).

Supply was marked by a major increase in LNG imports (+27% compared to 2016), stable overland imports (+0.4% compared to 2016) and less use of storage (-5.9% compared to 2016).

The south zone saw an episode of major tightness early 2017, linked to a cold spell in January combined with low LNG supply at Fos. This caused a price peak in the TRS as well as numerous bottlenecks in the GRTgaz network in the south-east.

Summer 2017 was marked by high LNG supplies, low storage injections and significant exports (+125%) particularly towards Spain.

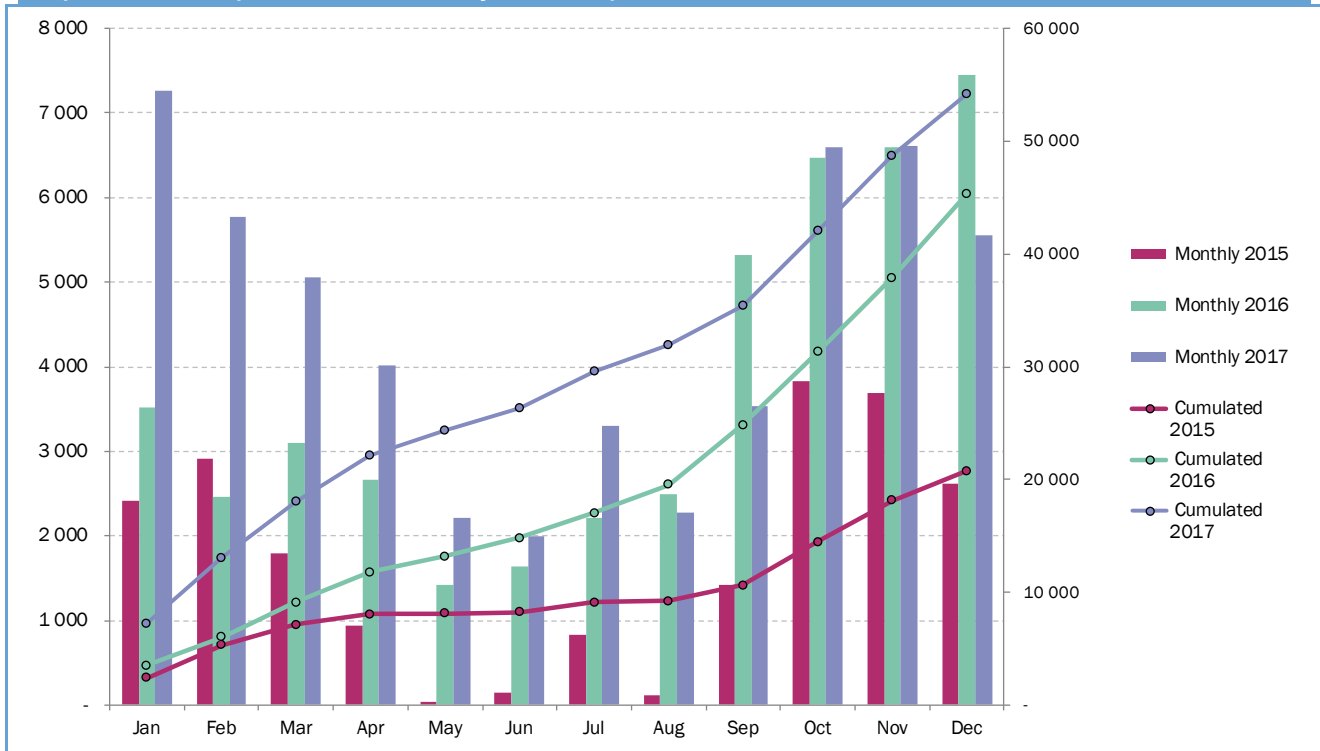
Graph 37: Supply and demand in the French system 2017 [2016]



Source: GRTgaz, Téréga – Analysis: CRE

Consumption of “highly modulated” sites (sites consuming a significant volume of gas, but with major fluctuations) reached 54 TWh in 2017, i.e. a 19% increase compared to 2016 (Graph 38). In H1 2017 in particular, low nuclear availability combined with relatively high electricity consumption led to increased use of gas-fired power plants (26 TWh, i.e. +78% compared to H1 2016).

Graph 38: Consumption of sites with major consumption variations



Source: GRTgaz, Téréga – Analysis: CRE

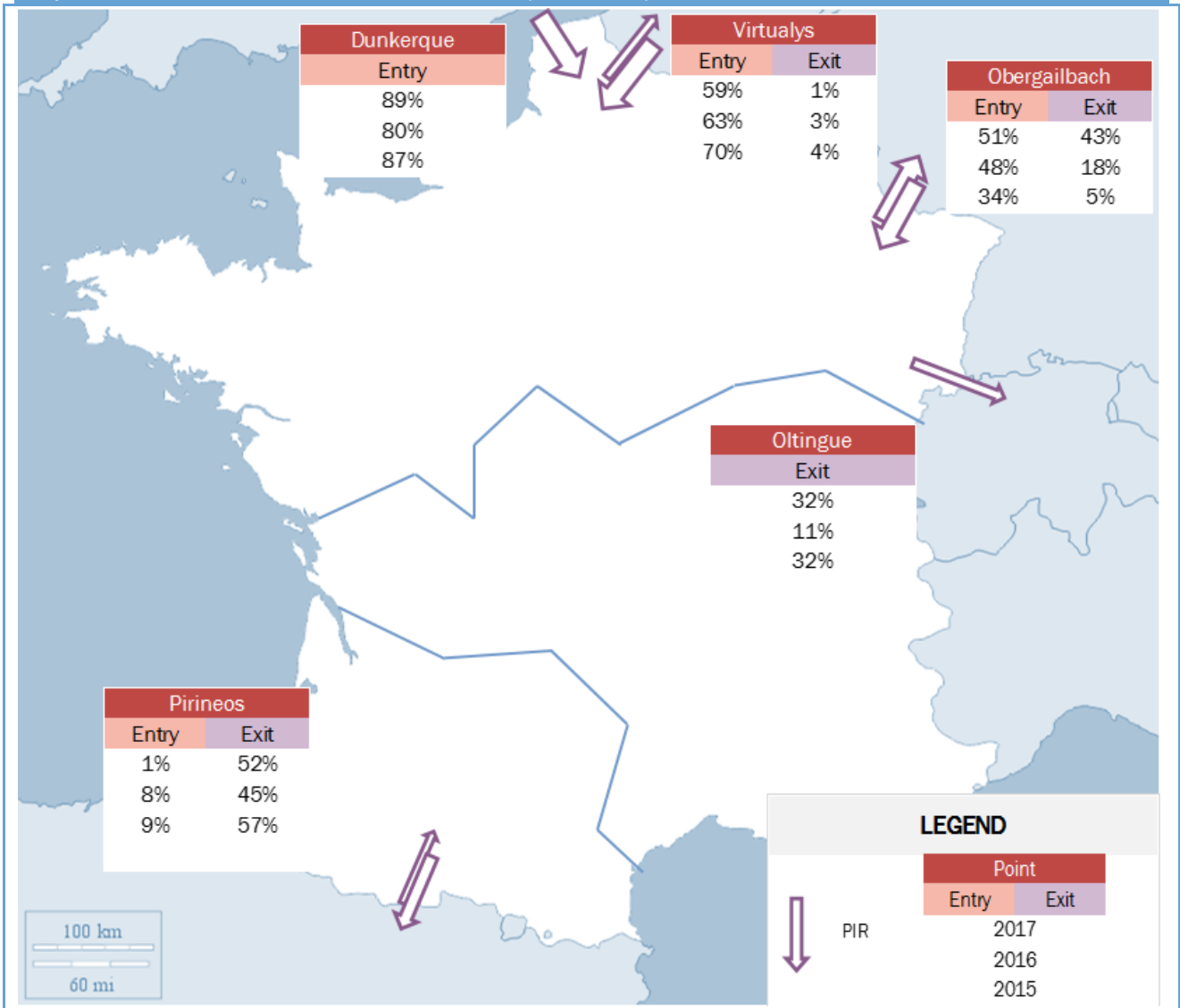
## 1.2 A 20 TWh increase in LNG supply

In 2017, 75% of the overall rise in imports (Graph 3) (+29 TWh, i.e. +5%) was due to the jump in LNG supply (+22 TWh) and the remaining 25% to the increase in overland imports (+7 TWh). The increase in overland imports was observed at Dunkirk (+16 TWh, i.e. +9%), coming from Norway. Imports from Obergailbach (gas coming mainly from Russia and passing through Germany) were in net decline. At the same time, exports to Switzerland via Oltingue, Spain via Pirineos and Germany via Obergailbach (backhaul flow) increased significantly. Imports from Belgium<sup>17</sup> dropped slightly.

The increase in LNG supply was more marked at the PEG Nord, where LNG imports jumped by 17 TWh, i.e. +90%, while the increase in LNG supply to the TRS stood at 5 TWh, i.e. +8.6%.

<sup>17</sup> The Taisnières H and Alveringhem network interconnection points (PIRs) became the Virtualys virtual interconnection point: a single point for the transmission of gas from/to Belgium as at 1 December 2017.

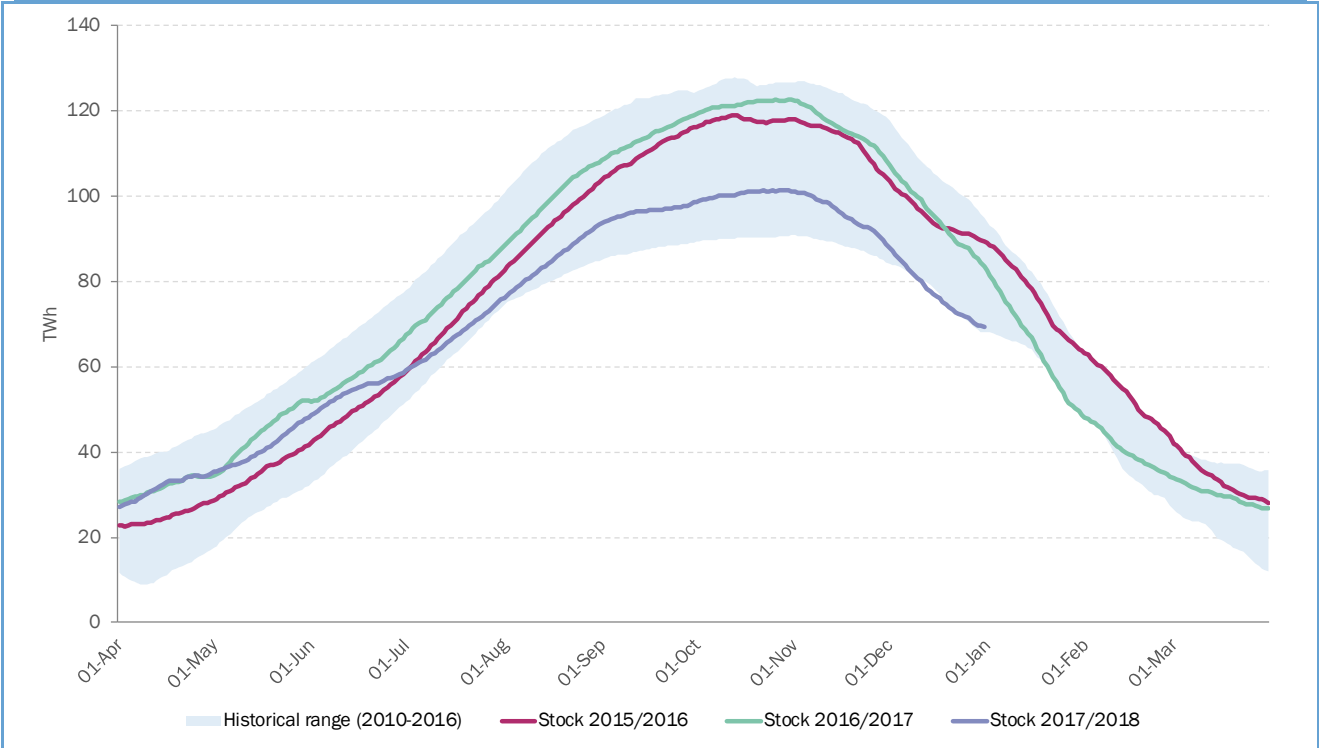
Graph 39: Rate of use of French interconnections (trade flows)



Source: GRTgaz, Téréga – Analysis: CRE

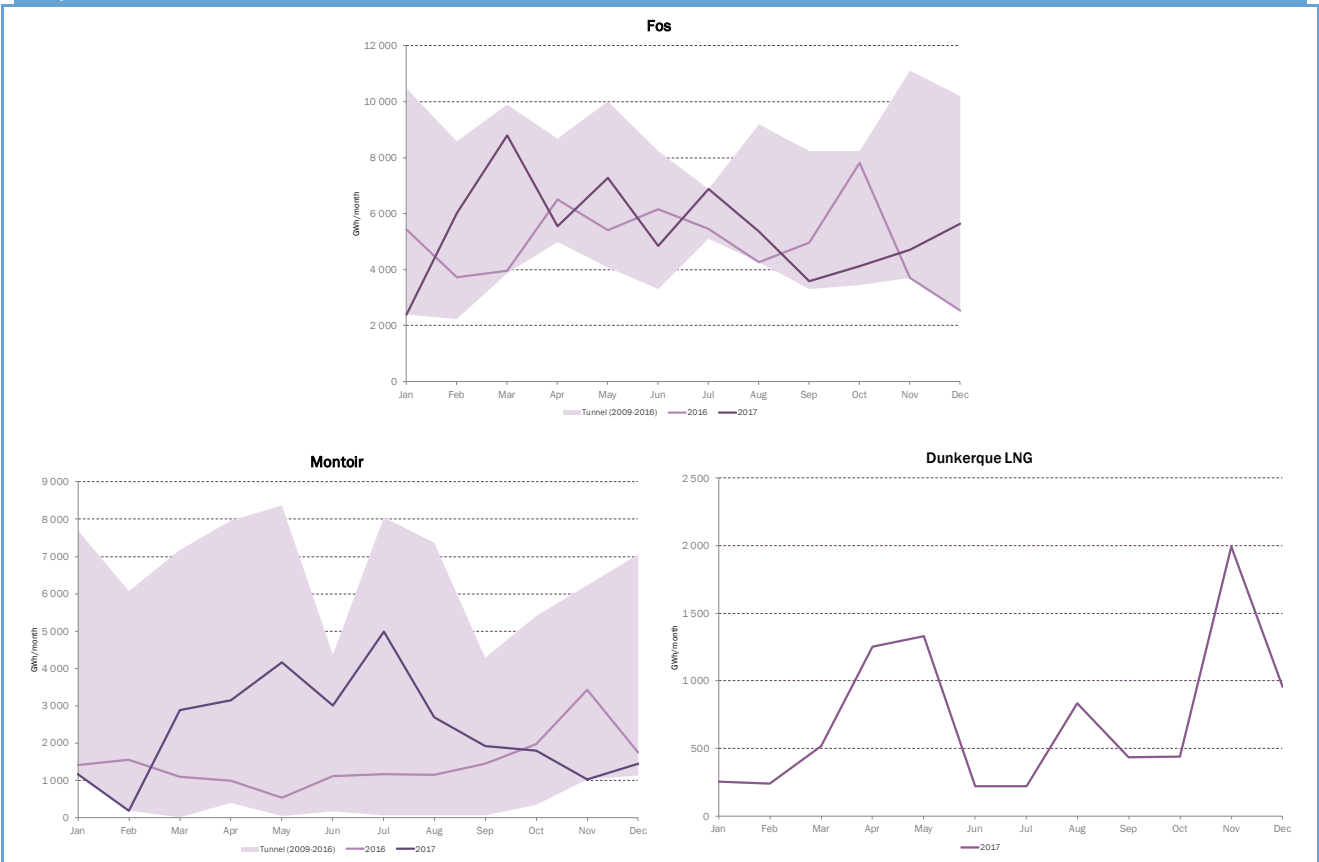
Against a cold 2016/2017 winter, storage was used heavily in Q1 2017, particularly in the month of January (Graph 40). Low storage capacity reservations led to little injections in summer 2017 and the storage level in July and August 2017 was close to the lowest part in the 2010-2016 tunnel. The storage level as at 1 November 2017 was close to 100 TWh, i.e. a 17.5% drop compared to 1 November 2016. Lastly, there were considerable withdrawals as from December 2017, which brought levels close to the lowest part of the 2010-2016 tunnel.

Graph 40: Storage levels in France



Source: Storengy, Téréga – Analysis: CRE

Graph 41 : LNG terminal send-out



Source: GRTGaz – Analysis: CRE

The TRS zone was disturbed by the episode of major tightness between January and February 2017, due to the significant drop in LNG send-out at Fos (Graph 41). In January 2017, this send-out was an average 77 GWh/d, which





represents about half of the average send-out for the 12 preceding months and the lowest monthly averages for the last four years. The drop in send-out was due to the reduction in LNG cargo arrivals because of problems with Algerian LNG trains during that period. In addition, gas demand was affected by low temperatures and heavy use of gas-fired power plants (see 1.4). Within this context, south-east bottlenecks emerged which GRTgaz addressed, in particular, by using on several occasions operational instruction notices for the salt cavern gas storages and the Fos terminal.

With regard to the north zone, send-out at the Montoir terminal increased significantly between the months of March and September 2017, tripling in comparison to the same period in 2016. In addition, the first commercial delivery at the Dunkirk terminal took place on 22 January 2017, following the send-out started in summer 2016 for testing purposes. Send-out at the Dunkirk terminal then accelerated as from Q4 2017.

CRE's deliberation of 26 October 2017 on the creation of a single gas market zone in France as at 1 November 2018, defined contractual mechanisms for easing these bottlenecks so as to ensure availability of firm capacity. This deliberation also enabled the early implementation of locational spread<sup>18</sup> as from winter 2017-2018 (Graph 42).

Therefore, in order to address bottlenecks in the south-east, GRTgaz used the locational spread product on several occasions in November and December 2017. These periods of tightness are analysed specifically as part of wholesale market monitoring.

Graph 42 : List of points potentially called on for locational spread interventions<sup>19</sup>



| Bottleneck            | Variant      | Downstream<br>(= purchase for GRTgaz)                                       | Upstream<br>(= sale for GRTgaz and TIGF)                     |
|-----------------------|--------------|---|--|
| North Bottleneck      | North 1      | 2DK + Montoir (+ North-East*) + North-West + North-Atlantic (+ North-South) | PIV + Obergailbach + Oltingue                                |
|                       | North 2      | Montoir + North-East + North-West + North-Atlantic (+ North-South)          | 2DK + PIV + Obergailbach + Oltingue                          |
| South-East Bottleneck | South-East 1 | Fos (+ South-East)*   | Jura + South-Atlantic + Lussagnet + Pirineos (+ North-South) |
|                       | South-East 2 | Fos + South-East + Jura   | South-Atlantic + Lussagnet + Pirineos (+ North-South)        |

\*: the South-East PITS and the North-East PITS straddle the South-East 1 and North 1 bottlenecks respectively. These PITS may be positioned upstream and downstream of the bottleneck according to the operational flexibility at each storage facility available on the day and agreed with Storengy.

<sup>18</sup> Locational products involve a gas purchase downstream of the bottleneck and a gas sale upstream.

<sup>19</sup> Winter Outlook 2017-2018, Publication of 24 October 2017 by GRTgaz and Téréga <http://www.grtgaz.com/fileadmin/clients/documents/en/Winter-Outlook-2017-2018-EN.pdf>

## 2. UPWARD TREND IN NATURAL GAS PRICES IN 2017

### 2.1 Spot prices in Europe marked by seasonal movement

In 2017, spot prices of the main gas hubs in Europe soared on average compared to 2016 (Graph 43). Prices at the TTF and the PEG Nord stood at an average €17.3/MWh and €17.5/MWh respectively compared to €13.9/MWh and €14.2/MWh in 2016. The upward trend in 2017 built on the second half of 2016. The price jump was very marked in Q1 2017 with an almost 30% growth for the PEG Nord and TTF compared to the previous quarter. Prices reached a high point in January 2017 during this month's cold spell (-1.6°C below average in France) with the TTF and PEG Nord at an average €19.9/MWh and €21.2/MWh respectively. Spot prices gradually went back down in summer 2017, to levels similar to those at the end of 2015, i.e. almost €15/MWh, in connection with little tightness in transmission infrastructure, large LNG imports and an easing of global gas prices (Graph 44). The PEG Nord price was among the lowest seen in continental Europe in summer 2017, below the price level of TTF and NCG.

The evolution in spot prices was marked by seasonal price movements as winter approached. The price rise accelerated in Q4 2017 with an almost 20% growth for the PEG Nord and 19% for the TTF compared to the previous quarter. This movement was marked by episodes of volatility, due to an increase in winter demand in Europe against occasional cold spells, high LNG demand in Asia and rather low storage levels.

The prices in the European gas hubs converged reflecting the lack of physical bottlenecks between the hubs concerned.

The price at NBP (gas exchange point of the United Kingdom) however was sometimes lower than at other European hubs, particularly in June and September 2017, due in particular to the closing of the Rough storage site in summer 2017.

Graph 43: Gas spot price in Europe



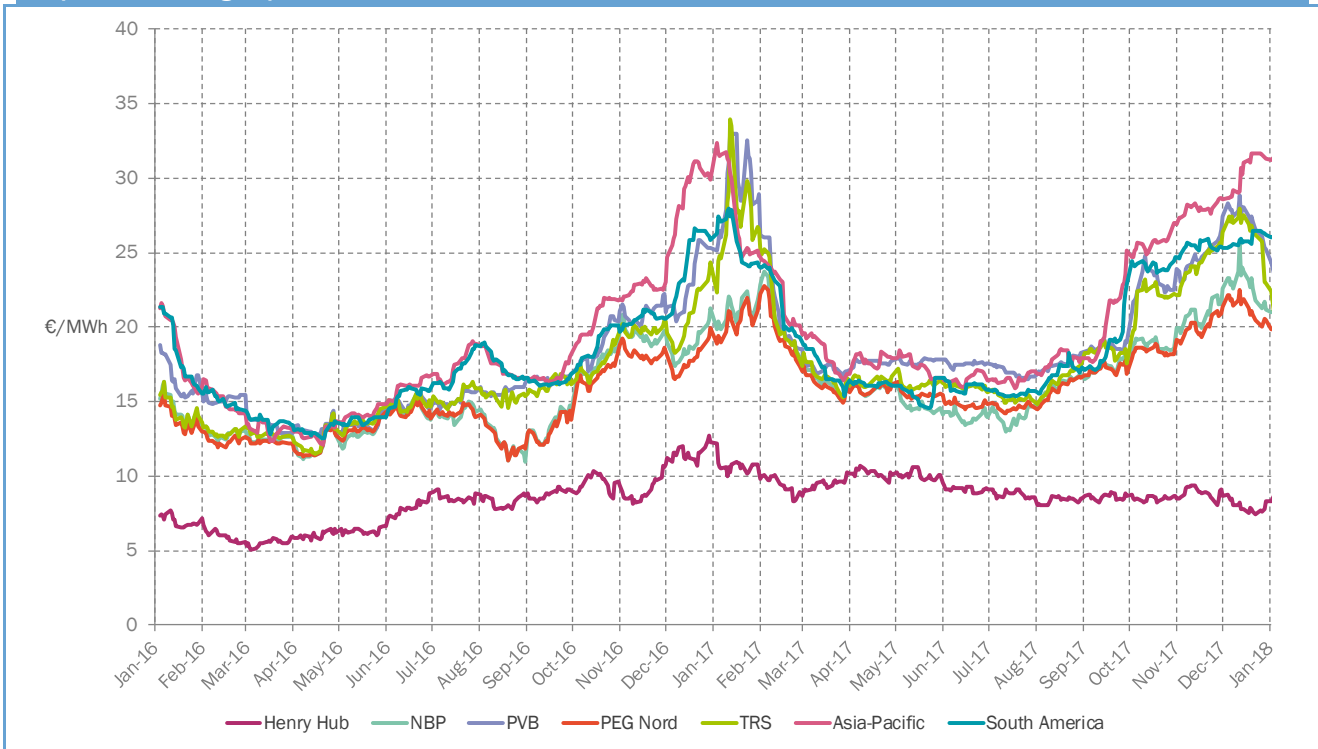
Source: ICIS Heren; Analysis: CRE

### 2.2 Price movements in Asia heavily impacting the TRS zone

Global prices were very seasonal, with very high price peaks in Q1 and Q4 2017 which then dropped drastically in summer (Graph 44). After reaching its lowest in spring 2016, an upward movement began, following that of commodities. This upward trend in international gas prices reflects the increase in international demand, coming from

Asia and southern Europe. In addition, prices in the Asian markets remained heavily influenced by oil because of the continuation of strong indexation of contracts for LNG supply to Asia to this commodity.

Graph 44: Global gas prices



Source: ICIS Heren; Analysis: CRE

The difference between Asian and European prices reflects LNG arbitrage between the demand coming from these two regions. The spread was very high particularly from Q4 2017. The Pacific Asia/NBP differential reached an average €7/MWh in Q4 2017.

TRS and PVB (Spanish gas exchange point), hubs for which a significant portion of supplies depends on LNG, were particularly sensitive to the jump in world prices in Q1 and Q4 2017, because of a very cold winter and a major drop in LNG flows to the south of Europe. The Pacific Asia/NBP differential reached an average €8/MWh in Q4 2017.

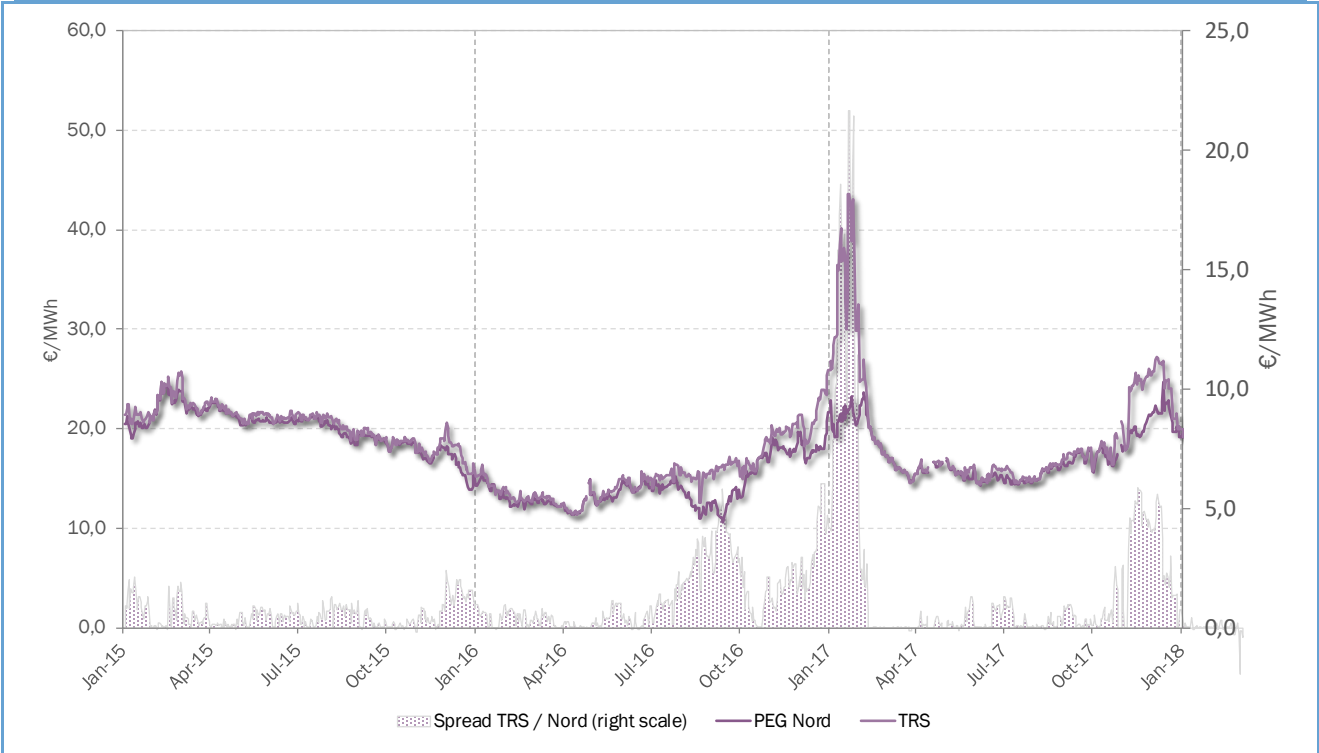
Lastly, the price of the Henry Hub (gas exchange point in the USA) reached an average €9.16/MWh in 2017, i.e. a 16% increase compared to 2016.

### 2.3 Major tightness in the TRS during winter periods particularly early 2017 in connection with low LNG imports

In Q1 2017, the spread between spot markets in France (TRS and PEG Nord) remained high, building on H2 2016, standing at an average €4.72/MWh (Graph 45) and peaked at over €21/MWh on 21 January 2017. Early 2017, particularly low temperatures associated with low LNG supplies at Fos (the terminal sent out an average 77 GWh/d in January, i.e. send-out two times lower than the average for 2016) and in Spain (tight LNG supply in the south in January 2017) exacerbated the increase in prices of the TRS zone which exceeded Asian and South American price levels. This price signal resulted in international arbitrage in favour of LNG deliveries to the south of France which returned, as from end of January 2017, to price levels similar to those of the PEG Nord. As for all unusual market episodes, the tightness seen at the start of the year in the south zone is examined attentively as part of CRE's wholesale market monitoring activities.

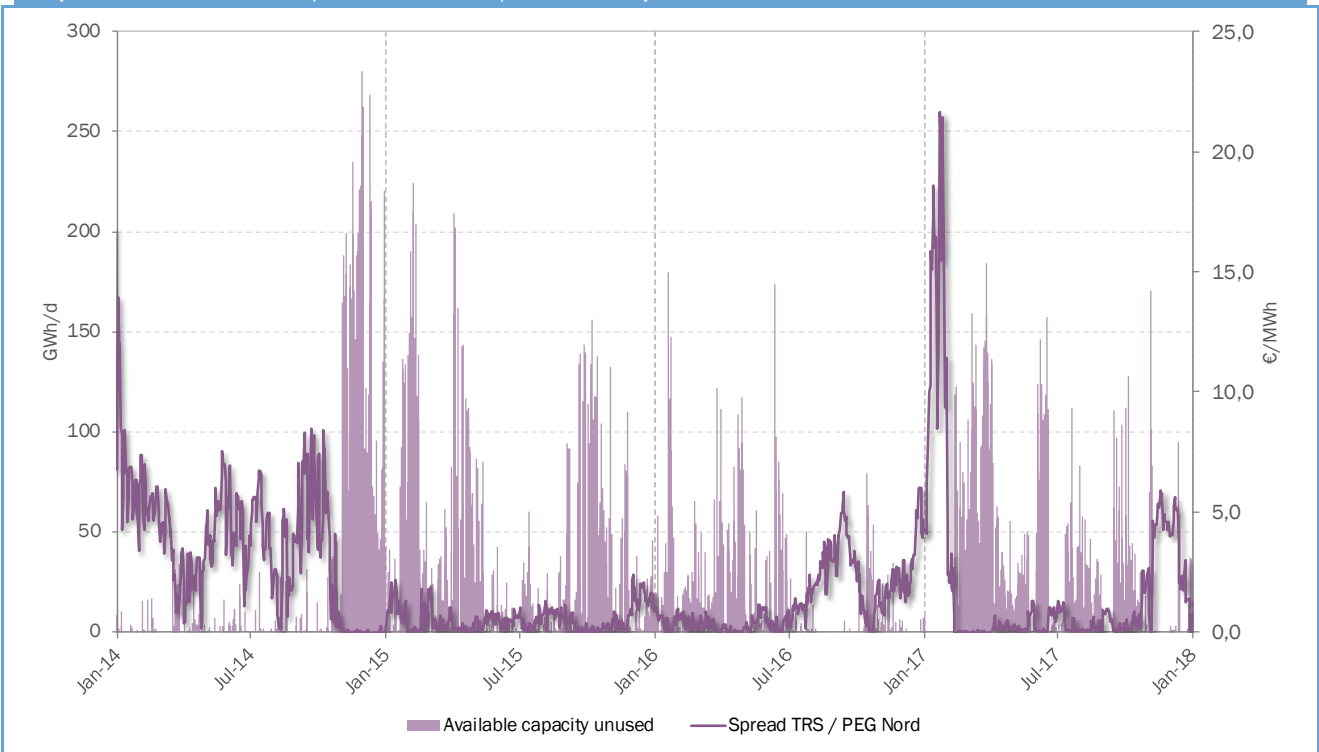
Following the price peak of January 2017, the TRS/PEG Nord spread dropped back to levels close to zero, due to rising send-out at the Fos terminal and high availability of the Nord/Sud link. The TRS/PEG Nord spread stood at an average €0.3/MWh in summer 2017. However, it soared as from Q4 2017, at an average €2.49/MWh. The price jump in the south zone was mainly related to LNG supplies at the Fos terminal and limited withdrawals, despite more than 90% utilisation of the Nord/Sud link for the period (Graph 46).

Graph 45: Evolution in the TRS/PEG Nord spread in the spot market



Source: ICIS Heren; Analysis: CRE

Graph 46: Use of the Nord/Sud link vs TRS/PEG Nord spread



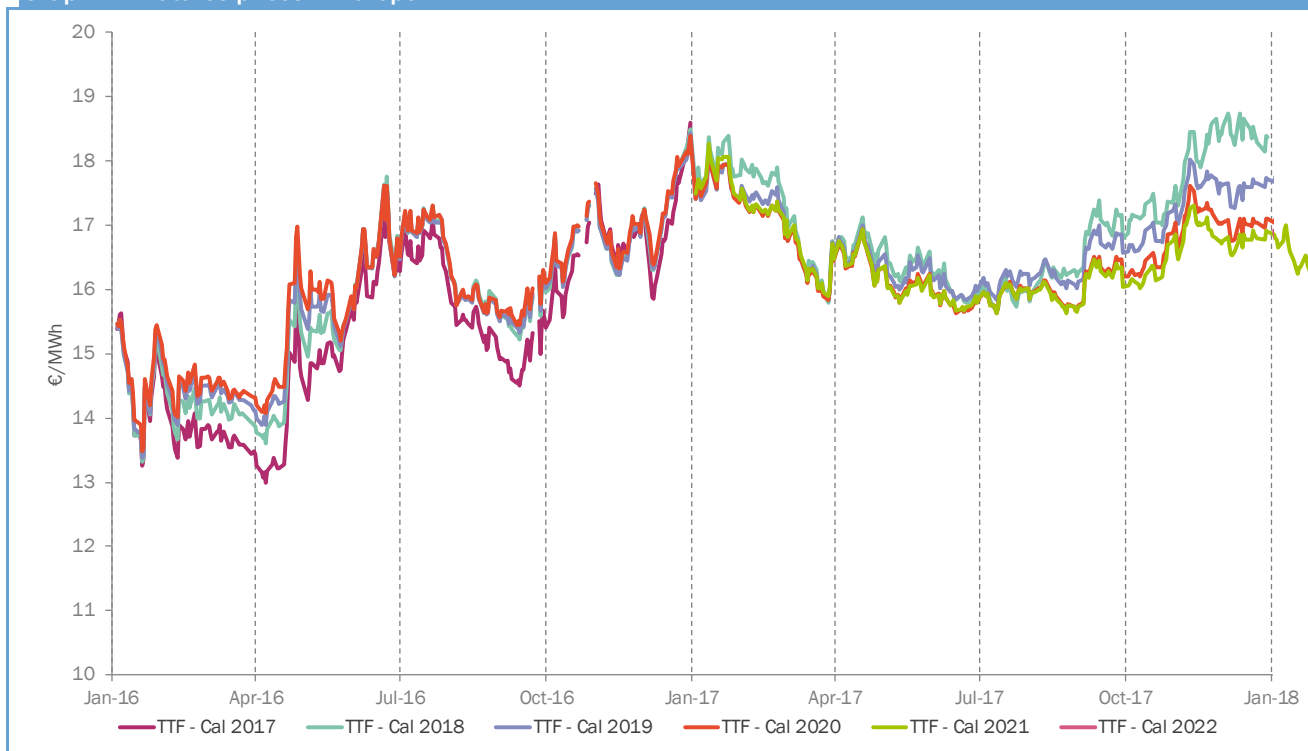
Source: ICIS Heren; Analysis: CRE

## 2.4 Futures prices following an upward trend in the wake of commodities in 2017

European futures prices followed an upward trend in 2017, against a general increase in commodity prices (Graph 47).

In 2017, the 2018 calendar product was an average €17/MWh, i.e. higher than the 2019 and 2020 products, which had an average price of €16.7/MWh and €16.5/MWh respectively. Futures prices increased (+4% increase for the +1 calendar product) throughout the year in the wake of commodities.

Graph 47: Futures prices in Europe



Source: ICIS Heren; Analysis: CRE

## 2.5 Little economic interest by market participants in booking storage capacity

Summer/winter spreads remained low compared to those recorded in 2016/2017, i.e. lower than €1.50/MWh on average. This spread peaked mid-July 2017, at almost €2.10/MWh, for a short period, before dropping to low levels (Graph 48).

Apart from any considerations relating to regulatory requirements concerning storage, market participants' economic interest in using underground storage to inject during summer and withdraw during winter was limited in this context.

In addition, in its deliberation of 10 March 2016<sup>20</sup>, CRE delivered a favourable opinion concerning the reform of the storage access system, based on the regulation of storage operators' income and auctioning of capacity.

To implement the commercialisation of storage, CRE, in its deliberation of 22 February 2018 (No. 2017-039)<sup>21</sup>, set the terms and conditions of capacity auctions in order to ensure full transparency in their organisation. The main goal of commercialisation was to sell all the capacity proposed. In those auctions, organised by Téréga and Storengy, all available storage capacity was able to be proposed to market participants. Almost all of this capacity was allocated; security of supply of natural gas for 2018-2019 is therefore ensured.

<sup>20</sup> Deliberation by the French Energy Regulatory Commission of 10 March 2016 rendering an opinion on the draft order amending the terms and conditions of third-party access to underground gas storage

<sup>21</sup> Deliberation by CRE of 22 February 2018 (No. 2018-039) deciding on the terms and conditions for storage capacity commercialisation within the framework of regulated access of third parties to underground natural gas storage in France

Graph 48: France winter/summer spread



Source: ICIS Heren; Analysis: CRE

### 3. DROP IN VOLUMES TRADED AT THE PEG NORD IN 2017

Wholesale gas trading in France is done within the framework of the organised Powernext market, over the counter, directly between parties or through brokers.

Trading in the French wholesale market is materialised at gas title transfer points (PEGs), virtual points where participants deliver gas to their counterparties according to their obligations. Following the merging of the PEG Sud and TIGF PEG, entered into effect on 1 April 2015<sup>22</sup>, the French market is currently organised into two marketplaces: the PEG Nord, attached to the North balancing zone, and the TRS, attached to GRTgaz's south and TIGF's balancing zones. The creation of a single gas market zone in France (Trading Region France – TRF), by merging the PEG Nord and TRS zones is scheduled for 1 November 2018.

The present report distinguishes between volumes traded in the intermediated markets and physical deliveries at the PEGs:

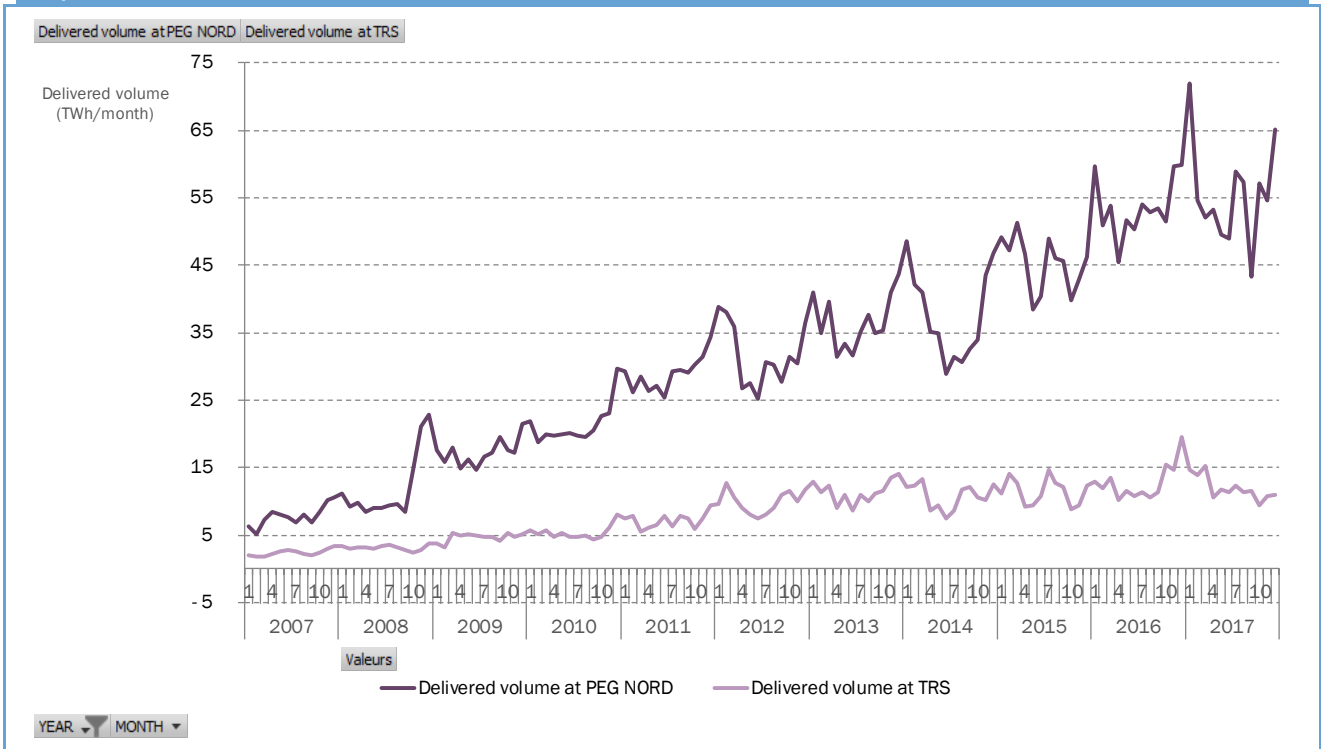
- intermediated markets include all of the contracts signed between the different participants through the exchange or brokers;
- deliveries at the PEGs cover net daily deliveries made between pairs of participants at the PEGs.

In 2017, deliveries at the PEG Nord and the TRS evolved differently. Building on the growth observed since 2005, deliveries at the PEG Nord were up 3.7% compared to 2016. However, deliveries to the TRS were down by more than 6% compared to 2016 (Graph 46). This reduction in the TRS is partly due to the increase in volumes exported to Spain.

<sup>22</sup> In compliance with CRE's deliberations of 19 July 2012 and of 13 December 2012



Graph 49: Deliveries to the PEG Nord and the TRS



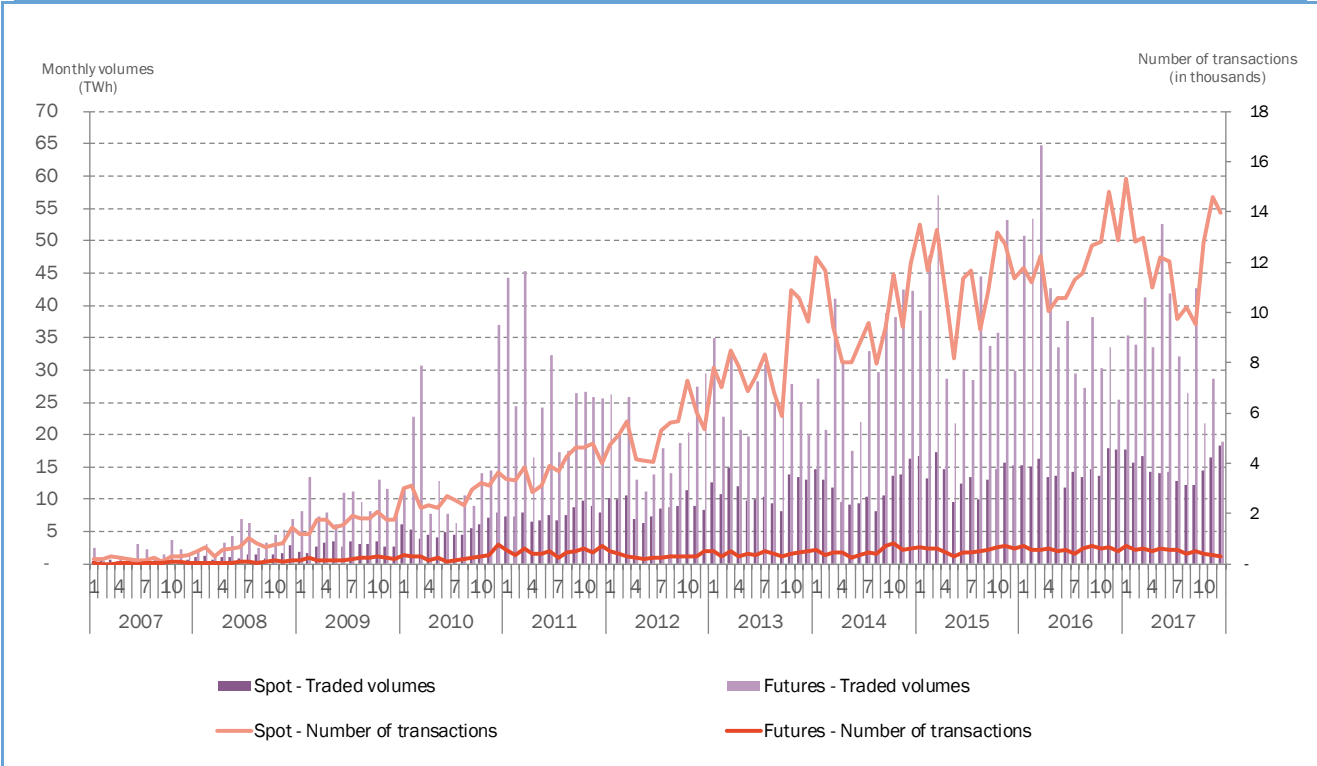
Source: ICIS Heren; Analysis: CRE

### 3.1 Low growth in spot trading and drop in futures product trading in 2017

Trading in the spot markets grew slightly in 2017, with overall volumes up 1.3% and the number of transactions up 3% compared to 2016 (Graph 50).

In the futures markets, volumes traded and the number of transactions dropped 12%, with major disparities between products. There was a major growth in the volume of annual products which almost doubled (+95%). At the same time, there was a drop in trading of seasonal products (-20%) and monthly products (-14%) compared to 2016 (Graph 52). This drop was mainly due to low storage capacity reservations for the 2017/2018 storage year.

Graph 50: Evolution in volumes traded and the number of transactions in the French intermediated market

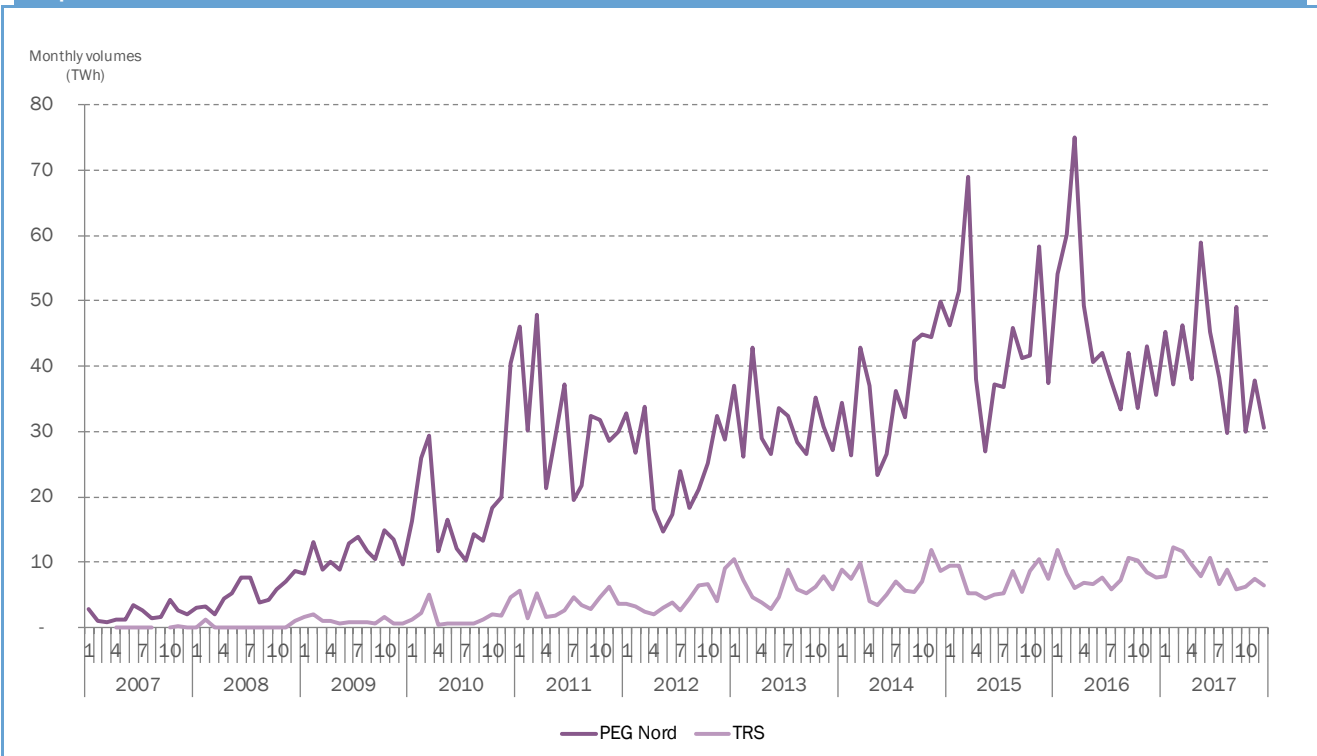


Source: ICIS Heren; Analysis: CRE

Volumes traded in the intermediated market in 2017 dropped significantly compared to 2016, (-55 TWh, i.e. - 8%) (Graph 51). Volumes traded at the PEG Nord fell by 11% (i.e. -60 TWh) compared to the previous year.

In addition, volumes traded at the TRS in 2017 increased by 4% (i.e. +4 TWh) compared to 2016, against an improvement in liquidity at the TRS following the merging of the south zone hubs (TIGF and PEG Sud) in April 2015.

Graph 51: Volumes traded at each PEG in the intermediated market

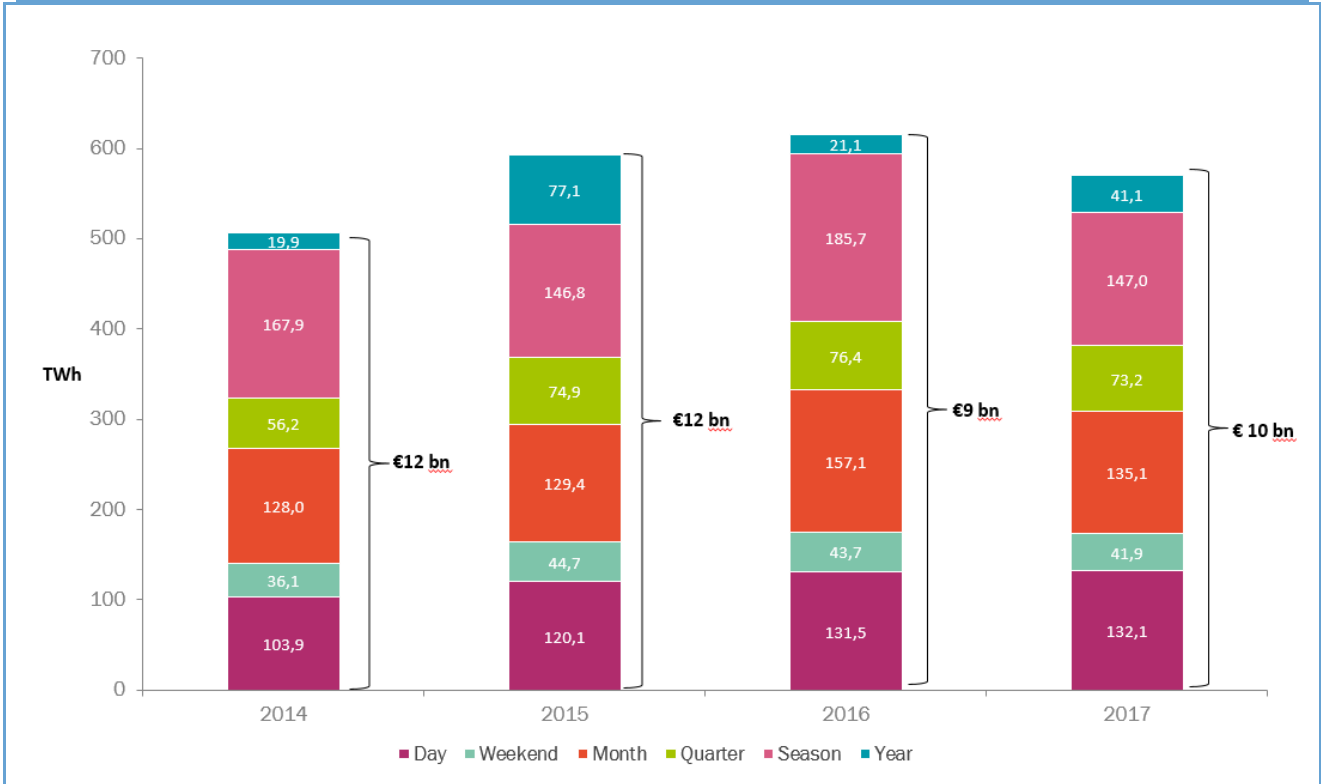


Source: ICIS Heren; Analysis: CRE



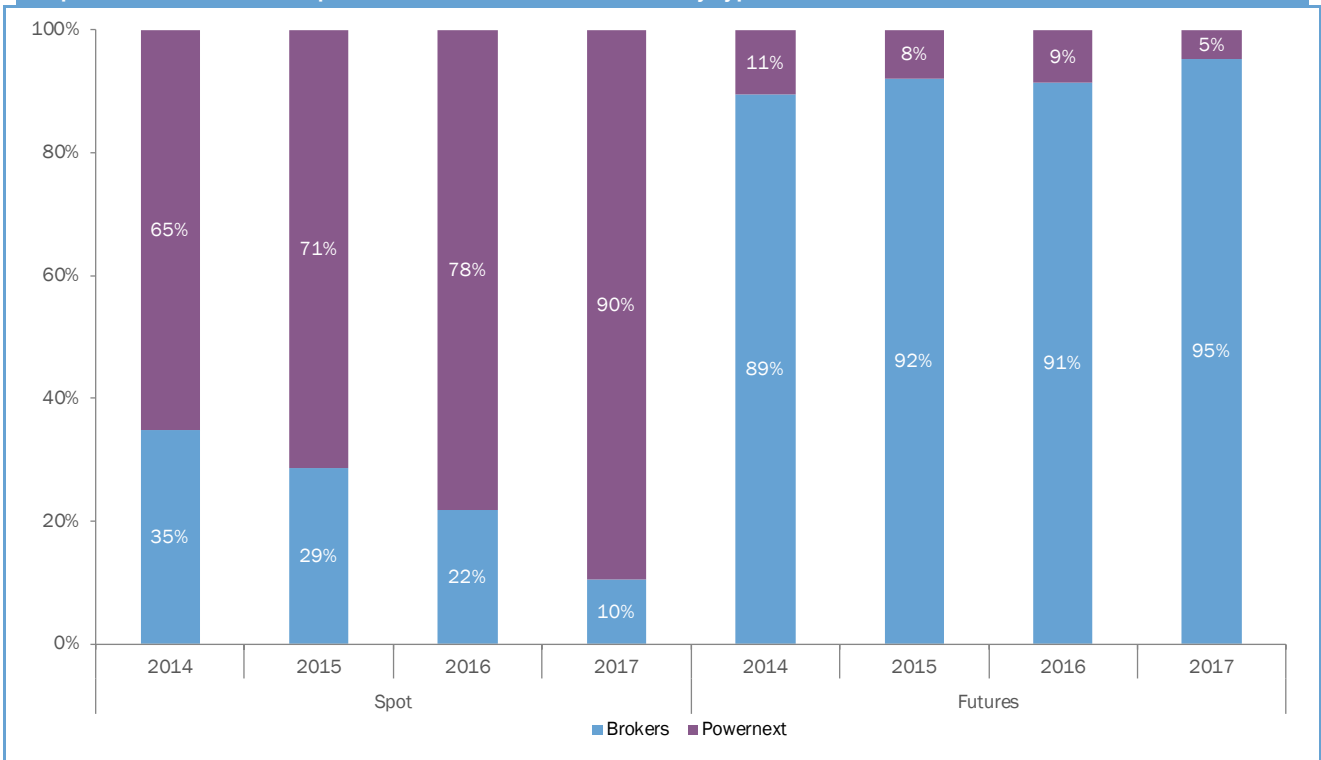
Because of the upward trend in gas prices in the wholesale markets in 2017, the value of trading increased almost 10% compared to 2016 despite a drop in the volume traded (Graph 52). This increase in value was particularly marked in January 2017, with a 38% increase in volume compared to January 2016, which represents 22% of trading in H1 2017.

Graph 52: Volumes traded for each product in the intermediated market



Source: ICIS Heren; Analysis: CRE

Graph 53: Breakdown of spot and futures volumes traded by type of market in France



Source: Powernext, brokers; Analysis: CRE

The market share of volumes traded via the Powernext exchange in the spot market in 2017 saw a slight 2-point increase compared to 2016, reaching 90% (Graph 53).

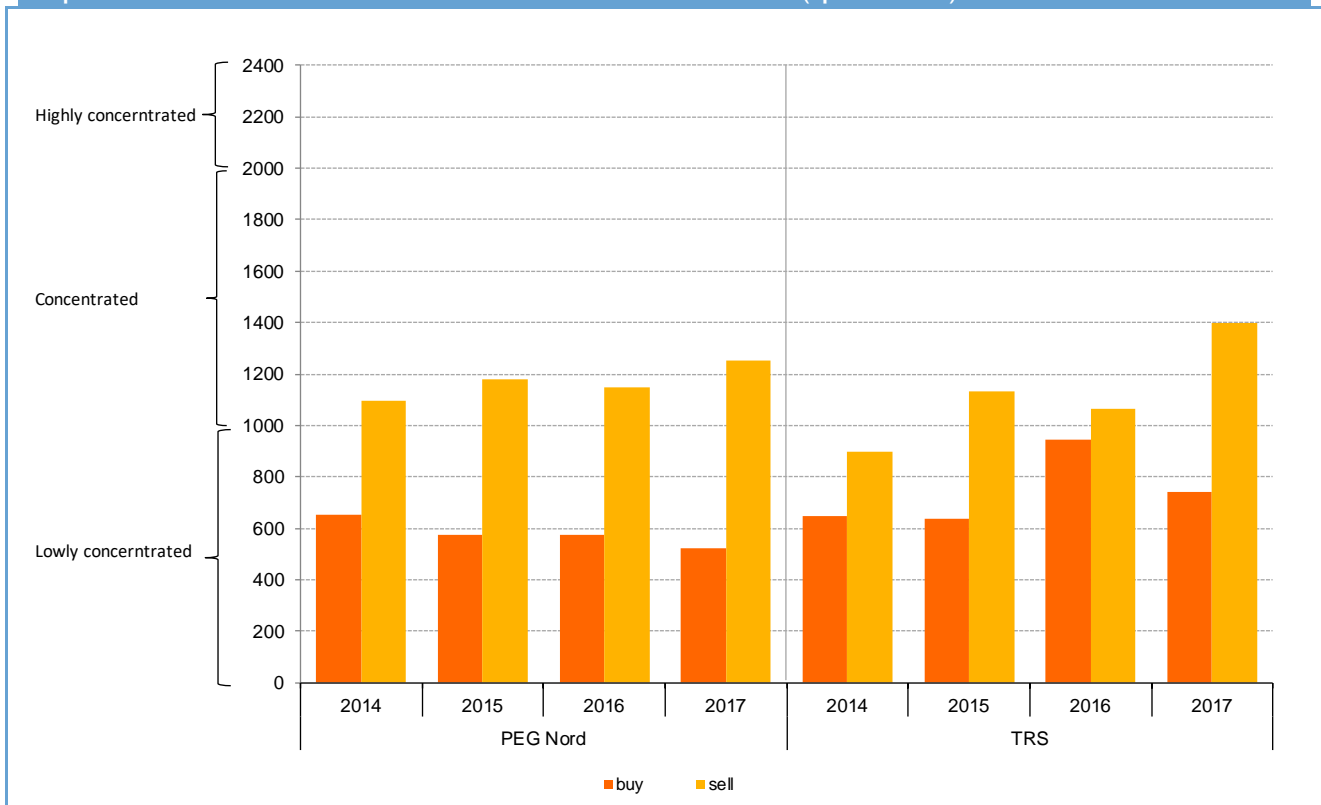
Conversely in the futures market, the market share of volumes traded via the Powernext exchange in 2017 dropped slightly. The Powernext exchange now only represents 5% of volumes traded, i.e. a 4-point drop compared to 2016. The drop in the Powernext market exchange is partly due to the drop in seasonal product trading in the exchange because of low storage reservations.

### 3.2 Slight drop in competition indices in 2017

The Herfindahl-Hirschman (HHI) index measures the level of market concentration and is an indicator of its liquidity and development.

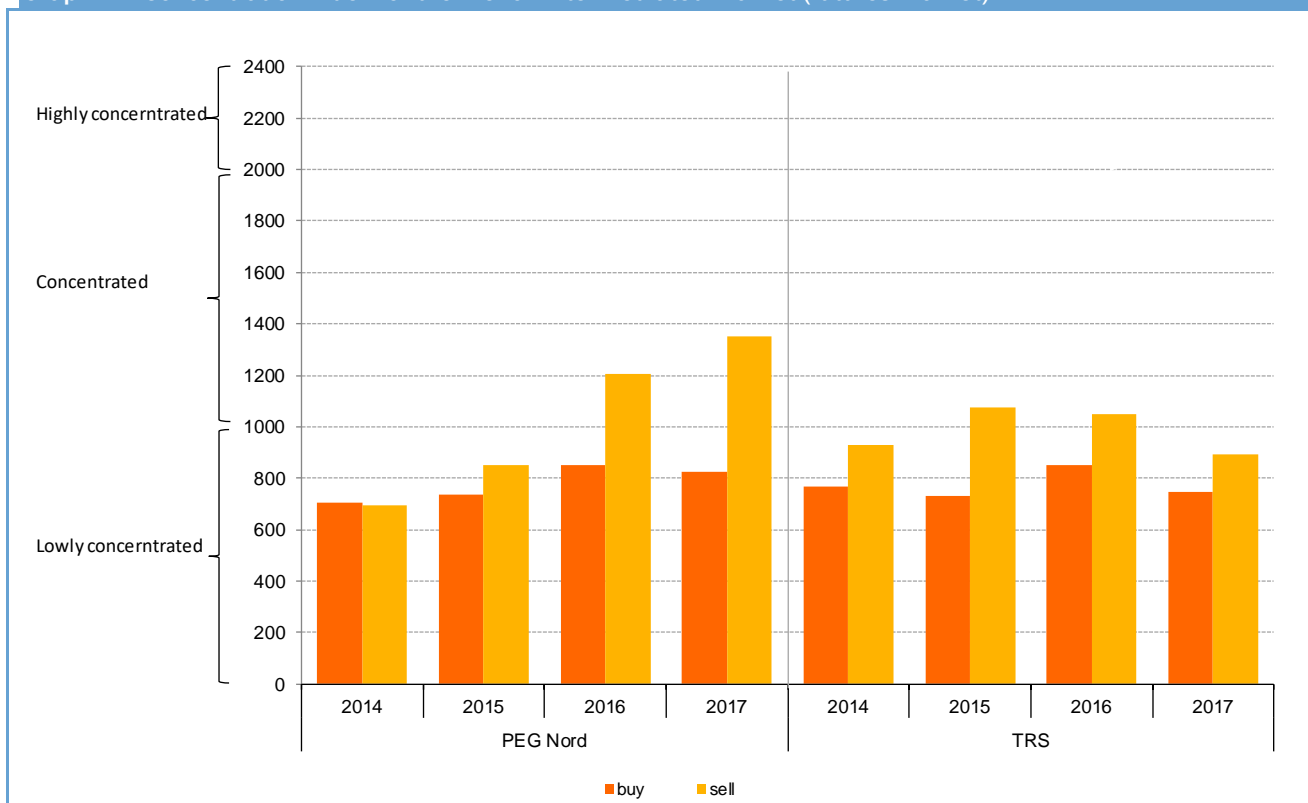
The HHI indices of wholesale gas markets in France (Graph 54 and Graph 55) are characteristic of a moderately concentrated market as regards sales and with little concentration as regards purchases. The concentration levels were similar in the spot segment and the futures market for the Nord and Sud marketplaces from 2014 to 2017.

Graph 54: Concentration index for the French intermediated market (spot market)



Source: Powernext, brokers; Analysis: CRE

Graph 55: Concentration index for the French intermediated market (futures market)



Source: Powernext, brokers; Analysis: CRE

The number of participants present in the French market (PEG) and at network interconnection points (PIRs) increased slightly in 2017 (Table 5). The number of shippers present at the transport/storage interface points (PITS) and the transport/distribution interface points (PITDs) remained stable between 2016 and 2017.

Table 5: Number of participants active in the French market

|      | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|------|------|------|------|------|------|------|
| PEG  | 68   | 75   | 87   | 92   | 88   | 93   |
| PIR  | 46   | 46   | 52   | 56   | 51   | 54   |
| PITD | 28   | 26   | 33   | 33   | 35   | 35   |
| PITS | 38   | 27   | 39   | 38   | 41   | 42   |

With regard to LNG terminals, the number of participants was stable for Montoir and Fos Tonkin, while the number of shippers active at Fos Cavaou doubled in 2017. The Dunkirk terminal entered into commercial use in the first half of 2017 and two shippers sent out volumes from this terminal in 2017 (Table 6).

Table 6: Number of active participants that imported volumes via the LNG terminals

|            | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|------------|------|------|------|------|------|------|
| Montoir    | 2    | 1    | 1    | 2    | 2    | 2    |
| Fos Tonkin | 2    | 1    | 1    | 1    | 1    | 1    |
| Fos Cavaou | 3    | 2    | 2    | 2    | 2    | 4    |
| Dunkerque  | na   | na   | na   | na   | na   | 2    |

## KEY FIGURES

### 1. ELECTRICITY MARKET

Table 7: Installed production capacity in France

|  | Annual variation<br>2016/2017     |              |              |                     |             |
|--|-----------------------------------|--------------|--------------|---------------------|-------------|
|  | End 2015                          | End 2016     | End 2017     | As a<br>pourcentage | As a value  |
|  | <b>Generating facilities (GW)</b> | <b>129,3</b> | <b>130,8</b> | <b>130,8</b>        | <b>0,0%</b> |
| <b>Nuclear</b>                         | <b>63,1</b>                       | <b>63,1</b>  | <b>63,1</b>  | <b>0,0%</b>         | <b>0,0</b>  |
| <b>Hydraulic</b>                       | <b>25,4</b>                       | <b>25,5</b>  | <b>25,5</b>  | <b>0,0%</b>         | <b>0,0</b>  |
| <b>Fossil-fired</b>                    | <b>22,6</b>                       | <b>21,8</b>  | <b>18,9</b>  | <b>-13,1%</b>       | <b>-2,9</b> |
| Coal                                   | 3,0                               | 3,0          | 3,0          | 0,0%                | 0,0         |
| Fuel oil                               | 8,6                               | 7,1          | 4,1          | -42,3%              | -3,0        |
| Gas                                    | 10,9                              | 11,7         | 11,9         | 1,3%                | 0,2         |
| <b>Renewable (excluding hydraulic)</b> | <b>18,2</b>                       | <b>20,4</b>  | <b>23,2</b>  | <b>13,6%</b>        | <b>2,8</b>  |
| Wind                                   | 10,3                              | 11,7         | 13,6         | 15,9%               | 1,9         |
| Solar                                  | 6,2                               | 6,8          | 7,7          | 12,6%               | 0,9         |
| Renewable thermal                      | 1,7                               | 1,9          | 1,9          | 2,6%                | 0,0         |

Source: RTE

Table 8: Production of the different technology sectors in France

|  | Annual variation<br>2016/2017 |              |              |                     |              |
|--|-------------------------------|--------------|--------------|---------------------|--------------|
|  | 2015                          | 2016         | 2017         | As a<br>pourcentage | As a value   |
|  | <b>Production (TWh)</b>       | <b>545,1</b> | <b>531,3</b> | <b>529,4</b>        | <b>-0,4%</b> |
| <b>Nuclear</b>                         | <b>416,8</b>                  | <b>384,0</b> | <b>379,1</b> | <b>-1,3%</b>        | <b>-4,9</b>  |
| <b>Hydraulic</b>                       | <b>58,7</b>                   | <b>63,9</b>  | <b>53,6</b>  | <b>-16,1%</b>       | <b>-10,3</b> |
| <b>Fossil-fired</b>                    | <b>33,2</b>                   | <b>45,9</b>  | <b>54,4</b>  | <b>18,5%</b>        | <b>8,5</b>   |
| Coal                                   | 8,5                           | 7,3          | 9,7          | 32,9%               | 2,4          |
| Gas                                    | 21,9                          | 35,3         | 40,9         | 15,9%               | 5,6          |
| Fuel oil                               | 2,8                           | 3,3          | 3,8          | 15,2%               | 0,5          |
| <b>Renewable (excluding hydraulic)</b> | <b>36,4</b>                   | <b>37,5</b>  | <b>42,3</b>  | <b>12,8%</b>        | <b>4,8</b>   |
| Wind                                   | 21,1                          | 20,7         | 24,0         | 15,9%               | 3,3          |
| Solar                                  | 7,4                           | 8,3          | 9,2          | 10,8%               | 0,9          |
| Renewable thermal                      | 7,9                           | 8,5          | 9,1          | 7,1%                | 0,6          |
| <b>Consumption (TWh)</b>               | <b>443,0</b>                  | <b>483,0</b> | <b>482,0</b> | <b>-0,2%</b>        | <b>-1,0</b>  |

Source: RTE

Table 9: Imports and exports in France

|                           | Annual variation<br>2016/2017 |             |             |                     |             |
|---------------------------|-------------------------------|-------------|-------------|---------------------|-------------|
|                           | 2015                          | 2016        | 2017        | As a<br>pourcentage | As a value  |
| <b>Imports</b>            | <b>31,8</b>                   | <b>34,4</b> | <b>38,5</b> | <b>11,9%</b>        | <b>4,1</b>  |
| Peak imports (TWh)        | 12,9                          | 12,7        | 14,6        | 15,0%               | 1,9         |
| Off-peak imports (TWh)    | 18,9                          | 21,7        | 23,9        | 10,1%               | 2,2         |
| <b>Exports</b>            | <b>93,8</b>                   | <b>73,5</b> | <b>76,4</b> | <b>3,9%</b>         | <b>2,9</b>  |
| Peak exports (TWh)        | 34,1                          | 25,1        | 26,3        | 4,8%                | 1,2         |
| Off-peak exports (TWh)    | 59,7                          | 48,4        | 50,1        | 3,5%                | 1,7         |
| <b>Net export balance</b> | <b>62,0</b>                   | <b>39,1</b> | <b>37,9</b> | <b>-3,1%</b>        | <b>-1,2</b> |

Source: RTE

Table 10: Balance at borders

|                                   | Annual variation<br>2016 / 2017 |             |             |                     |             |
|-----------------------------------|---------------------------------|-------------|-------------|---------------------|-------------|
|                                   | 2015                            | 2016        | 2017        | As a<br>pourcentage | As a value  |
| <b>Balance at borders, in TWh</b> |                                 |             |             |                     |             |
| CWE zone                          | 6,7                             | -5,4        | -10,9       | 104,0%              | -5,6        |
| Spain                             | 7,4                             | 7,8         | 12,5        | 59,7%               | 4,7         |
| United Kingdom                    | 14,1                            | 10,0        | 8,0         | -20,7%              | -2,1        |
| Italy                             | 19,7                            | 16,5        | 18,2        | 9,8%                | 1,6         |
| Switzerland                       | 14                              | 10,1        | 10,3        | 1,7%                | 0,2         |
| <b>Total</b>                      | <b>61,9</b>                     | <b>39,1</b> | <b>38,0</b> | <b>-3,0%</b>        | <b>-1,1</b> |

Source: RTE

Table 11: Clean dark spread, clean spark spread and coal

|                                 | Annual variation<br>2016 / 2017 |      |      |                     |            |
|---------------------------------|---------------------------------|------|------|---------------------|------------|
|                                 | 2015                            | 2016 | 2017 | As a<br>pourcentage | As a value |
| <b>Y+1 maturity</b>             |                                 |      |      |                     |            |
| Coal (€/t)                      | 49,5                            | 48,3 | 65,1 | 34,8%               | 16,8       |
| Peak clean dark spread (€/MWh)  | 21,2                            | 21,4 | 24,0 | 11,9%               | 2,6        |
| Peak clean spark spread (€/MWh) | 4,7                             | 15,8 | 19,5 | 23,5%               | 3,7        |

Source: ICE, EPEX SPOT, EEX



Table 12: Injections and withdrawals in the French electricity system

|   | Annual variation<br>2016 / 2017 |      |      |                     |            |
|---|---------------------------------|------|------|---------------------|------------|
|   | 2015                            | 2016 | 2017 | As a<br>pourcentage | As a value |
|   | <b>Injections, in TWh</b>       |      |      |                     |            |
| Production, excluding ARENH and VPP, in TWh | 529                             | 531  | 447  | -15,8%              | -83,7      |
| ARENH, in TWh                               | 16                              | 0    | 82   | -                   | 82,1       |
| Imports, in TWh                             | 32                              | 33   | 36   | 9,7%                | 3,2        |
| <b>Withdrawals, in TWh</b>                  |                                 |      |      |                     |            |
| End customer consumption, en TWh            | 442                             | 447  | 446  | -0,2%               | -0,7       |
| Pumping, in TWh                             | 6,8                             | 7    | 7    | 1,9%                | 0,1        |
| Exports, in TWh                             | 96                              | 74   | 74,2 | 0,3%                | 0,2        |
| Losses in TWh                               | 33                              | 36   | 36   | -0,8%               | -0,3       |

Source: RTE

Table 13: Participants in the French electricity market

|   | Annual variation<br>2016/2017 |            |            |                     |            |
|---|-------------------------------|------------|------------|---------------------|------------|
|   | 2015                          | 2016       | 2017       | As a<br>pourcentage | As a value |
|   | <b>Balancing responsible</b>  | <b>193</b> | <b>197</b> | <b>233</b>          | <b>18%</b> |
| Active in electricity generation              | 23                            | 26         | 28         | 7,7%                | 2          |
| Holder of volumes purchased at VPP            | 10                            | 0          | 0          | -                   | 0          |
| Holder of rights of regulated access to ARENH | 20                            | 0          | 18         | -                   | 18         |
| Final customers provider                      | 26                            | 32         | 35         | 9,4%                | 3          |
| Active on imports/exports                     | 103                           | 77         | 55         | -28,6%              | -22        |
| Active on bloc exchange                       | 113                           | 103        | 108        | 4,9%                | 5          |
| Active on Exchange                            | 105                           | 96         | 100        | 4,2%                | 4          |

Source: RTE, EPEX SPOT, Brokers

Table 14: Spot and futures prices in the French electricity market

|  | Annual variation<br>2016 / 2017 |       |       |                     |            |
|--|---------------------------------|-------|-------|---------------------|------------|
|  | 2015                            | 2016  | 2017  | As a<br>pourcentage | As a value |
| <b>Spot market prices</b>                          |                                 |       |       |                     |            |
| Intraday price France, in €/MWh                    | 38,77                           | 36,87 | 45,05 | 22,0%               | 8,2        |
| Day-Ahead price France Baseload, in €/MWh          | 38,5                            | 36,67 | 44,99 | 23,0%               | 8,3        |
| Day-Ahead price France Peakload, in €/MWh          | 46,63                           | 45,69 | 53,66 | 17,0%               | 8,0        |
| France-Germany Day-ahead Baseload spread, in €/MWh | 6,88                            | 7,59  | 10,68 | 41,0%               | 3,1        |
| France-Germany Day-ahead peakload spread, in €/MWh | 9,27                            | 10,32 | 10,94 | 6,0%                | 0,6        |
| Day-Ahead France-Germany convergence rate          | 27,0%                           | 36,0% | 35,0% | -2,0%               | -0,01      |
| <b>Forward market prices</b>                       |                                 |       |       |                     |            |
| M+1 price France, in €/MWh                         | 36,92                           | 41,23 | 45,21 | 10,0%               | 4,0        |
| M+1 France-Germany Spread , in €/MWh               | 5,95                            | 11,88 | 9,42  | -21,0%              | -2,5       |
| Q+1 price France, in €/MWh                         | 37,11                           | 39,55 | 42,5  | 7,0%                | 3,0        |
| Spread Q+1 France-Germany, en €/MWh                | 6,15                            | 10,51 | 7,04  | -33,0%              | -3,5       |
| Y+1 price France, in €/MWh                         | 38,14                           | 33,38 | 38,29 | 15,0%               | 4,9        |
| Spread Y+1 France-Germany, en €/MWh                | 7,18                            | 6,79  | 5,87  | -14,0%              | -0,9       |
| <b>Y+1 Peakload/Baseload ratio</b>                 |                                 |       |       |                     |            |
| France   | 1,23                            | 1,33  | 1,31  | -1,5%               | -0,02      |
| Germany  | 1,26                            | 1,26  | 1,25  | -0,8%               | -0,01      |

Source: EPEX SPOT, EEX

Table 15: Spot and futures volumes in the French electricity market

|   | Annual variation<br>2016 / 2017 |              |              |                     |             |
|---|---------------------------------|--------------|--------------|---------------------|-------------|
|   | 2015                            | 2016         | 2017         | As a<br>pourcentage | As a value  |
| <b>NEB</b>  |                                 |              |              |                     |             |
| NEB Volumes, in TWh                               | 503,1                           | 549,6        | 414,5        | -24,6%              | -135,1      |
| NEB/French consumption ratio                      | 1,1                             | 1,3          | 0,9          | -                   | -0,3        |
| <b>Spot market in TWh</b>                         | <b>158,2</b>                    | <b>144,8</b> | <b>135,8</b> | <b>0,7</b>          | <b>-9,0</b> |
| Volumes in the EPEX SPOT intraday market, in TWh  | 5,4                             | 6,1          | 6,5          | 6,6%                | 0,4         |
| Portion of Intraday cross-border Fr-Ger volumes   | 62%                             | 65%          | 69%          | -                   | 0,0         |
| Volumes in the EPEX SPOT Day-Ahead market, in TWh | 106,4                           | 110,7        | 105,7        | -4,5%               | -5,0        |
| Volumes in the Broker Day-Ahead market, in TWh    | 46,4                            | 28,0         | 23,7         | -15,5%              | -4,3        |
| <b>Forward market</b>                             |                                 |              |              |                     |             |
| Volumes, in TWh                                   | 1068,7                          | 1309,3       | 902,8        | -31,0%              | -406,5      |
| Broker market share                               | 91%                             | 86%          | 86%          | -                   | 0,0         |
| EEX market share                                  | 9%                              | 14%          | 14%          | -                   | 0,0         |
| Number of transactions                            | 112835                          | 102516       | 83379        | -18,7%              | -19137,0    |
| Broker market share                               | 92%                             | 87%          | 83%          | -                   | 0,0         |
| EEX market share                                  | 8%                              | 13%          | 17%          | -                   | 0,0         |
| <b>Y+1 product</b>                                |                                 |              |              |                     |             |
| Volumes, in TWh                                   | 282,8                           | 496,1        | 338,7        | -31,7%              | -157,4      |
| Number of transactions                            | 6219                            | 11686        | 8528         | -27,0%              | -3158,0     |
| <b>Q+1 product</b>                                |                                 |              |              |                     |             |
| Volumes, in TWh                                   | 120,1                           | 125,9        | 121,8        | -3,3%               | -4,1        |
| Number of transactions                            | 8113                            | 9655         | 10155        | 5,2%                | 500,0       |
| <b>M+1 product</b>                                |                                 |              |              |                     |             |
| Volumes, in TWh                                   | 158,7                           | 119,5        | 108,9        | -8,8%               | -10,6       |
| Number of transactions                            | 23951                           | 20260        | 21176        | 4,5%                | 916,0       |

Source: EPEX SPOT, EEX, Brokers

Table 16: Concentration indices (HHI) of the different segments of the wholesale electricity market in France

|                          | HHI - Market Concentration |      |              |      |
|--------------------------|----------------------------|------|--------------|------|
|                          | 2015                       |      | 2016         |      |
|                          | EDF included               |      | EDF included |      |
| <b>Deliveries</b>        |                            |      |              |      |
| OTC - block purchases    | 496                        | 1107 | 379          | 810  |
| OTC - bloc sales         | 657                        | 1079 | 575          | 632  |
| EPEX - purchases         | 592                        | 599  | 513          | 870  |
| EPEX - sales             | 320                        | 3346 | 395          | 2401 |
| <b>Injections</b>        |                            |      |              |      |
| Generation               | 3587                       | 7085 | 3466         | 7068 |
| ARENH                    | 0                          |      | 2014         |      |
| Imports                  | 731                        | 740  | 1415         | 1146 |
| <b>Withdrawals</b>       |                            |      |              |      |
| End-consumer consumption | 1795                       | 5334 | 1835         | 5012 |
| Grid losses              | 1643                       | 1535 | 1583         | 1545 |
| Exports                  | 566                        | 1603 | 1453         | 2207 |

Sources: RTE, EPEX SPOT, Brokers

## 2. GAS MARKET

**Table 17: Fundamentals of the gas market in France**

| Market fundamentals                                   | Yearly values |      |      | Yearly variation<br>2017 / 2016 |          |
|---|---------------|------|------|---------------------------------|----------|
|   | 2015          | 2016 | 2017 | In percentage                   | In value |
| <b>Entry and exit flows</b>                           |               |      |      |                                 |          |
| Supply (TWh)  | 648           | 683  | 705  | 3%                              | 23       |
| Storages withdrawals                                  | 120           | 118  | 111  | -6%                             | -7       |
| Imports   | 528           | 565  | 595  | 5%                              | 30       |
| <i>Pipeline</i>                                       | 463           | 485  | 492  | 1%                              | 7        |
| <i>LNG</i>  | 65            | 80   | 102  | 29%                             | 23       |
| Production  | 0             | 0    | 0    | -18%                            | 0        |
| Demand (TWh)  | 648           | 683  | 705  | 3%                              | 23       |
| Storages injections                                   | 115           | 113  | 99   | -13%                            | -14      |
| End consumers demand                                  | 448           | 488  | 490  | 0%                              | 2        |
| <i>Distribution consumers</i>                         | 289           | 304  | 297  | -2%                             | -7       |
| <i>Consumers connected to the transmission system</i> | 160           | 184  | 193  | 5%                              | 9        |
| Exports   | 80            | 75   | 110  | 47%                             | 35       |
| Other   | 5             | 7    | 6    | -2%                             | 0        |
| Deliveries at PEGs (TWh)                              | 681           | 797  | 813  | 2%                              | 16       |
| PEG Nord  | 543           | 643  | 669  | 4%                              | 26       |
| TRS   | 138           | 154  | 144  | -6%                             | -10      |
| <b>Infrastructure figures</b>                         |               |      |      |                                 |          |
| North-to-south link                                   | 90%           | 95%  | 91%  |                                 | -4%      |
| Availability of North-to-south link                   | 83%           | 81%  | 84%  |                                 | 3%       |
| Utilization de Dunkerque (UK -> France)               | 88%           | 80%  | 89%  |                                 |          |
| Utilization of Virtualys* interconnection (Entry)     | 69%           | 63%  | 59%  |                                 | -4%      |
| Utilization of Pirineos interconnection (Exit)        | 57%           | 45%  | 52%  |                                 | 8%       |
| Stock levels (TWh as at the end of the Quarter)       | 74            | 96   | 83   | -13%                            | -13      |
| Avg. Net variation of French stocks (GWh/j)           | 22            | -11  | -8   | -28%                            | 3        |
| Avg. LNG terminals senf-out (GWh/j)                   | 179           | 214  | 280  | 31%                             | 66       |
| Avg. Exports from France to Spain (GWh/j)             | 102           | 120  | 114  | -5%                             | -6       |

\*Use of the Taisnières H PIR before 1 December 2017

Source: GRTgaz, Téréga – Analysis: CRE

**Table 18: Gas prices in France**

| Prices                                  | Yearly values |      |      | Yearly variation<br>2017 / 2016 |          |
|---|---------------|------|------|---------------------------------|----------|
|   | 2015          | 2016 | 2017 | In percentage                   | In value |
| <b>Spot prices (€/MWh)</b>              |               |      |      |                                 |          |
| PEG Nord day-ahead (avg.)               | 20,1          | 14,3 | 17,5 | 23%                             | 3,2      |
| TRS day-ahead (avg.)                    | 21,6          | 15,6 | 19,5 | 25%                             | 3,9      |
| Day-ahead PEG Nord/Sud spread (avg.)    | 0,5           | 1,3  | 2,0  | 51%                             | 0,7      |
| Day-ahead PEG Nord/TTF Spread (avg.)    | 0,3           | 0,3  | 0,2  | -32%                            | -0,1     |
| <b>Forward prices (€/MWh)</b>           |               |      |      |                                 |          |
| PEG Nord M+1 (avg.)                     | 19,9          | 14,2 | 17,4 | 23%                             | 3,2      |
| TRS M+1 (avg.)                          | 20,5          | 15,4 | 19,6 | 27%                             | 4,2      |
| PEG Nord Y+1 (avg.)                     | 20,4          | 15,6 | 17,3 | 11%                             | 1,7      |
| M+1 PEG Nord/Sud spread (avg.)          | 0,6           | 1,2  | 2,2  | 78%                             | 1,0      |
| M+1 PEG Nord/TTF spread (avg.)          | 0,3           | 0,2  | 0,3  | 20%                             | 0,0      |
| Summer-ahead/Winter-ahead spread (avg.) | 1,5           | 1,9  | 1,4  | -26%                            | -0,5     |

Source: Powernext, Heren – Analysis: CRE

Table 19: Gas trading in France

| Trading activity  | Yearly values |         |         | Yearly variation<br>2017 / 2016 |          |
|---|---------------|---------|---------|---------------------------------|----------|
|   | 2015          | 2016    | 2017    | In percentage                   | In value |
| <b>Wholesale markets activity in France</b>                       |               |         |         |                                 |          |
| Natural gas exchanged at PEG* (TWh)                               | 565           | 634     | 609     | -4%                             | -25      |
| % of national consumption   | 126%          | 130%    | 124%    |                                 | -6%      |
| <b>Trading volumes in the French intermediated markets</b>        |               |         |         |                                 |          |
| Spot market (TWh)   | 177           | 188     | 185     | -1%                             | -3       |
| Intraday  | 18            | 27      | 28      | 5%                              | 1,5      |
| Day Ahead   | 102           | 105     | 106     | 1%                              | 0,8      |
| Exchange (DA, WD, WE, other spot)                                 | 119           | 139     | 161     | 16%                             | 22,3     |
| Brokers (DA, WD, WE, other spot)                                  | 59            | 49      | 24      | -51%                            | -24,9    |
| Forwards market (TWh)   | 438           | 455     | 402     | -12%                            | -53      |
| M+1   | 107           | 128     | 115     | -10%                            | -13,0    |
| Q+1   | 51            | 44      | 47      | 9%                              | 3,8      |
| S+1   | 78            | 75      | 78      | 5%                              | 3,9      |
| Y+1   | 46            | 7       | 26      | 283%                            | 19,4     |
| Exchange (all maturities)   | 45            | 54      | 25      | -54%                            | -29,0    |
| Brokers (all maturities)  | 393           | 401     | 377     | -6%                             | -24,3    |
| <b>Number of transactions in the French intermediated markets</b> |               |         |         |                                 |          |
| Spot market   | 138 322       | 142 806 | 147 439 | 3%                              | 4633     |
| Intraday  | 24 540        | 29 483  | 30 003  | 2%                              | 520      |
| Day Ahead   | 92 219        | 92 596  | 95 583  | 3%                              | 2987     |
| Exchange (DA, WD, WE, other spot)                                 | 112 872       | 122 942 | 139 013 | 13%                             | 16071    |
| Brokers (DA, WD, WE, other spot)                                  | 25 450        | 19 864  | 8 426   | -58%                            | -11438   |
| Forwards market   | 6 046         | 6 623   | 5 956   | -10%                            | -667     |
| M+1   | 3 303         | 3 800   | 3 584   | -6%                             | -216     |
| Q+1   | 571           | 531     | 573     | 8%                              | 42       |
| S+1   | 531           | 475     | 419     | -12%                            | -56      |
| Y+1   | 242           | 57      | 126     | 121%                            | 69       |
| Exchange (all forward maturities)                                 | 1 550         | 1 700   | 1 097   | -35%                            | -603     |
| Brokers (all forward maturities)                                  | 4 496         | 4 923   | 4 859   | -1%                             | -64      |
| <b>Concentration of the natural gas market in France</b>          |               |         |         |                                 |          |
| Numbers of shippers active in the market                          | 110           | 103     | 110     | 7%                              | 7        |
| Active in Powernext Gas Spot                                      | 54            | 59      | 62      | 5%                              | 3        |
| Active in Powernext Gas Futures                                   | 40            | 47      | 46      | -2%                             | -1       |

\*Deliveries resulting from trading in the intermediated markets in France

Source: GRTgaz, Téréga, Powernext, brokers – Analyse: CRE

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