

March 2022

# A Series of Unfortunate Events

## Explaining European Gas Prices in 2021

### The role of the traded gas hubs

#### Introduction

In 2020 and 2021, the European traded gas markets experienced two successive years of quite unexpected and extreme external factors which have had a pronounced effect on wholesale prices and the whole trading environment generally. This period saw, in the last week of May 2020, the lowest ever<sup>1</sup> Month Ahead traded prices<sup>2</sup> followed, in late 2021, by two successive highest ever Month Ahead prices.<sup>3</sup> At the time of writing this paper,<sup>4</sup> these remain the highest ever European wholesale gas prices. However, due to the current geopolitical situation commodity markets, and in particular the energy markets, are extremely volatile and these prices could be exceeded.

Not only were those prices extreme, but the protracted rally leading to the first highest price level in October 2021 was the longest ever seen and the historic volatility rates, as well as displaying some very sharp peaks and troughs, also recorded the highest ever level at the end of December, continuing to rise even higher into January.

There were also some interesting points to note regarding the traded volumes at the gas hubs, with a shift away from OTC trading towards more exchange trades, and disparate results from hub to hub, with some falling badly over the two year period, whilst others maintained or even improved their overall traded volumes.

This paper examines each of these factors to see how the traded wholesale gas markets reacted, or not, to external events such as the Covid-19 pandemic and the subsequent patchy economic recovery, some extreme weather events, changing LNG movements and, by no means least, the ever volatile geopolitical situation following the Russian invasion of Ukraine and the transit of gas through that country and/or via the NordStream 2 pipeline.

This paper therefore focuses on the actual trading aspects of the wholesale gas markets over the past two years, and in particular the role of trading activity in price dynamics in 2021, from the steady growth between March and August, and the extremely rapid growth from late August to the first peak in early October, with prices subsequently remaining high and volatile in Q4 and early 2022. It sits alongside

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<sup>1</sup> Using the Heren/ICIS closing Month Ahead daily prices data series from 1<sup>st</sup> January 2006.

<sup>2</sup> TTF Month Ahead closed at €3.54 on 28<sup>th</sup> May 2020; that same day NBP was the lowest priced hub, closing at €3.27/MWh.

<sup>3</sup> TTF Month Ahead closed at €116.78 on 5<sup>th</sup> October 2021; that same day NBP was the highest priced hub at €119.57/MWh; on 21<sup>st</sup> December 2021, Europe's highest ever gas prices were reached with TTF Month Ahead closing at €180.31 and the Czech VOB the highest of all, closing at €181.43/MWh.

<sup>4</sup> Mid-February 2021.

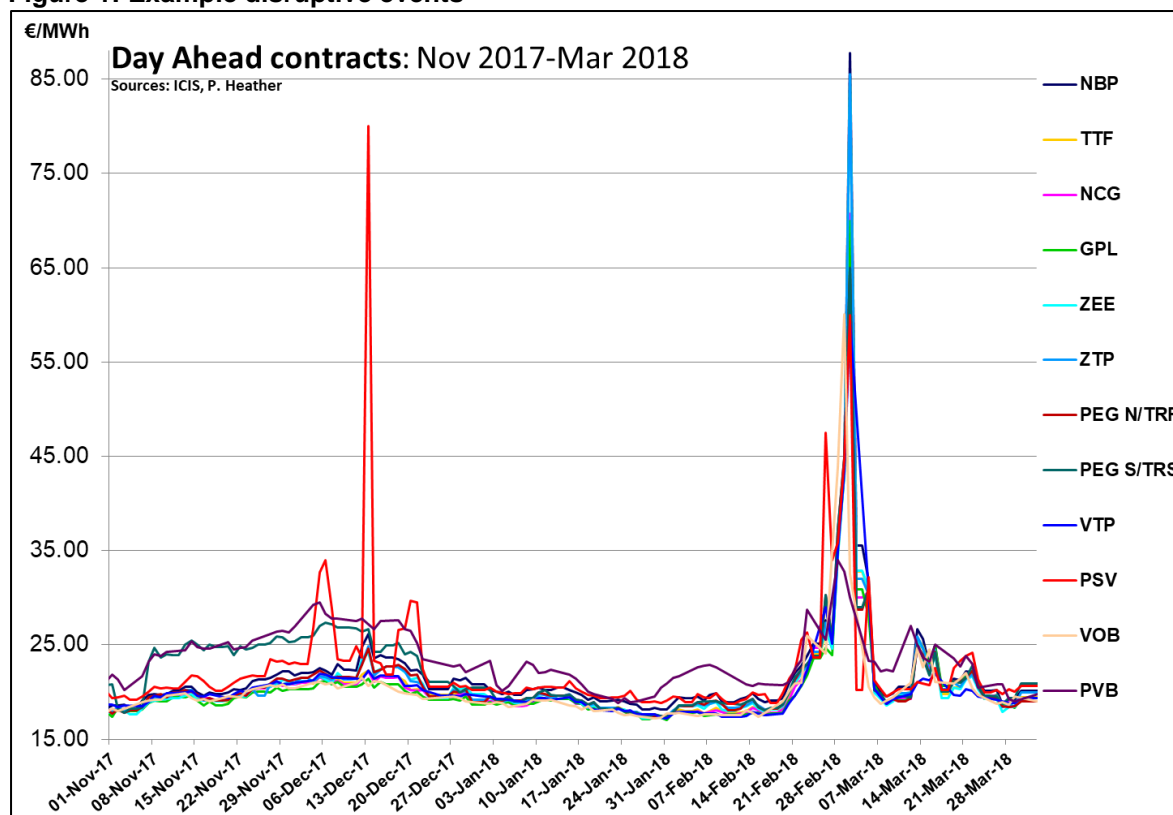
those written by my colleagues Jack Sharples<sup>5</sup> and Anouk Honoré<sup>6</sup> who discuss in their papers the possible physical supply, storage, and demand reasons behind the strong rise in prices.

## 1. Unprecedented price movements

Before exploring the possible reasons behind the 2021 price rally, it is worth placing it in the context of previous price movements in the wholesale gas markets. There have been a number of rallies and falls in the traded gas markets over the years since they were liberalised but they tended to be of a rather limited nature, over a relatively short period of time before price retracements<sup>7</sup> were observed. This is quite usual in traded commodity markets and even at times when there has been an important upward or downward move, over several months say, there have also been many retracements and adjustments along the way.

Some of the more violent price moves in the past were very different in nature: they tended to be short-lived and generally affected just one or a few hubs; they usually also affected just the Day Ahead price rather than the Month Ahead one. Two very good examples of these ‘disruptive events’ are shown in Figure 1 and show how violent the price reaction can be; the equivalent Month Ahead prices were barely affected.

**Figure 1: Example disruptive events**



Sources: ICIS; P. Heather

<sup>5</sup> Published December 2021 and available to download at: <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2021/12/Insight-108-Supply-Side-Factors-in-European-Gas-Prices.pdf>

<sup>6</sup> To be published March 2022; will be available to download at: <https://www.oxfordenergy.org/authors/anouk-honore/> ["A series of unfortunate events: Demand-side factors in the European gas price rally in 2021"]

<sup>7</sup> Typically, technical analysts look for about a 50 percent retracement from the peak or trough of a price move.

The first of the major disruptive events in the Figure relates to the explosion at the Baumgarten gas import and processing plant in Austria,<sup>8</sup> on 12<sup>th</sup> December 2017, followed by a serious fire which led to the total closure of the plant. Gas supplies in Austria were not immediately affected but gas flows through the TAG pipeline to Italy were stopped for about 12 hours. This obviously had an immediate impact on Italian gas supplies but, initially, it was the Month Ahead price that started to rally (by about €1/MWh), as traders did not know how badly affected the plant was or how long the supplies would be cut for. The Day Ahead price at this stage did not move as there was enough gas in the system and storage for immediate consumption. However, on the following day, the Day Ahead price rocketed from €23.69/MWh to €80/MWh, only to plummet back down to €23.34/MWh on the third day! This is quite typical of trader reaction in, especially, energy markets where there is a well-known adage of “buy the rumour, sell the fact”. This was a disruptive event which had a major price impact over a 24 hour period on just one traded gas hub.

The second disruptive event shown in Figure 1 relates to the ‘Beast from the East’ seriously cold weather spell,<sup>9</sup> which lasted about a week at the end of February to the beginning of March 2018. This event also only affected the Day Ahead prices, and more so at the British NBP, the Belgian ZEE and ZTP, and the Dutch TTF hubs. The impact, although still important, was gradually less so at the German, French, Italian, and Austrian hubs, and noticeably less so again at the Czech hub. With this event, prices rose gradually over two days, reaching the peak on the third, and then slowly retracting over the next three days. However, by a week later, prices had returned to their pre-event levels. This event also had a major price impact, based on ‘fear of the worst’ effect, not really knowing how long the bad weather would last. This is a typical reaction to, especially natural, phenomena where traders know they will end but just not exactly when.

Both of the above disruptive events were in fact very different in cause, effect, and reaction to the sustained price rise seen in 2021; they led to extreme, but very short lived, volatile price spikes, where the greatest volatility was in the markets (hubs) that were directly affected by the event. The spikes followed anticipated trader reactions to ‘news items’ mostly of a physical nature but also sometimes geopolitical, although these do tend to have a longer effect.

**Figure 2: Brent crude prices January 2007 – December 2021**



Source: <https://www.hl.co.uk/shares/trading-commodities/brent-crude-oil>

<sup>8</sup> For more information, see: <https://www.gasconnect.at/en/incident-baumgarten/chronology>

<sup>9</sup> For more information, see: [https://en.wikipedia.org/wiki/2018\\_British\\_Isles\\_cold\\_wave](https://en.wikipedia.org/wiki/2018_British_Isles_cold_wave)

Finally, before analysing what did happen in the traded gas markets in 2020 and 2021 which, up to mid-February 2022 have given us the highest ever gas prices, it is worth putting them into perspective by considering the traded Brent crude oil market. There is a slight similarity between the gas and oil markets in that the Brent market experienced a sustained rally culminating in its highest ever price to date of \$147.50/bbl<sup>10</sup> (equivalent to €54.56/MWh)<sup>11</sup> on 11<sup>th</sup> July 2008; however, and contrary to the recent rally in gas prices, there followed a massive, almost linear, \$110 retracement over the following six months or so, as shown in Figure 2.

Therefore, the highest ever gas prices, set in Q4-2021, were two to over three times higher than the highest ever crude oil price, on a single trading day; this is still the case at time of writing,<sup>12</sup> with Brent trading around \$96/bbl and TTF gas around €75/MWh. The gas price rally in 2021 really was unprecedented, not only for the gas market, but for energy markets in general where nothing like this has happened before.

## 2. European gas market in 2021

Having seen how traded markets can react to disruptive events, but then usually settle back to their previous price levels, what happened during 2021 was completely different. To a large extent, the prolonged, steep rally was a combination of many different events and circumstances, all occurring either simultaneously or in rapid succession.

These events could be described as being a 'perfect storm', which developed during 2020 and 2021, with a number of physical supply, demand, and storage situations, which led to various stress factors globally. These have been analysed in detail in the two papers published by my colleagues, the main points of which are repeated in this section in order to try to explain the extraordinary price rise in 2021. They include *inter-alia* the effects of the Covid-19 pandemic on demand (both into and out of economic recession), a short spell of severe weather in Asia in January 2021, very high European storage levels at the start of Winter 2020-21, and what could be perceived as trader actions contrary to the emerging situation in Spring 2021.

The result, as shown in Figure 3, was an unprecedented 7-month sustained rise in wholesale gas prices by over €100/MWh from early March to early October 2021. Such long term gradual price moves would normally be associated with structural changes in the market, but this does not appear to be the case here. It is true that gas demand did start to recover as global economies started to grow again as the economic effects of the pandemic started to ease, although it was more apparent in Asia before it was in Europe but total estimated European consumption in 2021<sup>13</sup> at 480.2bcm was still a little lower than the pre-pandemic average.<sup>14</sup> The increased demand was not therefore enough to account for the higher prices.

Of a more structural nature maybe, was that domestic production had fallen by 13 percent compared to 2019, mainly due to the large reduction in output at the Dutch Groningen field, which will only produce very limited amounts of gas after the current gas year.<sup>15</sup> Pipeline imports in 2020 fell by 4 percent compared to 2019, due to an 18 percent fall in Russian supplies. This could now be perceived as a structural change to European supplies, given the current tense geopolitical situation between Russia

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<sup>10</sup> On 11<sup>th</sup> July 2008, ICE Brent Crude front month contract traded a low of €141.62, a high of €147.50, closing at €144.49.

<sup>11</sup> \$147.50  $\times$  1.69941 (conversion bbl to MWh) = \$86.79/MWh  $\times$  0.6286 (exchange rate on 11/7/08) = €54.56/MWh.

<sup>12</sup> Mid-February 2022.

<sup>13</sup> EU+UK, see: Sharples, Jack: OIES Energy Insight 108, pp.3-5; adjusted to include December 2021.

<sup>14</sup> The average European consumption for the three pre-pandemic years of 2017-19 was 483.2bcm.

<sup>15</sup> <https://www.reuters.com/business/energy/dutch-confirm-plan-end-gas-production-groningen-next-year-2021-09-24/>

<sup>16</sup> Although the Government did announce in early 2021 that it may be forced to extract a little more gas than originally planned in the current gas year to fulfil low calorific gas contracts with Germany. See: <https://www.bloomberg.com/news/articles/2022-01-07/dutch-groningen-gas-production-may-be-boosted-amid-higher-demand>



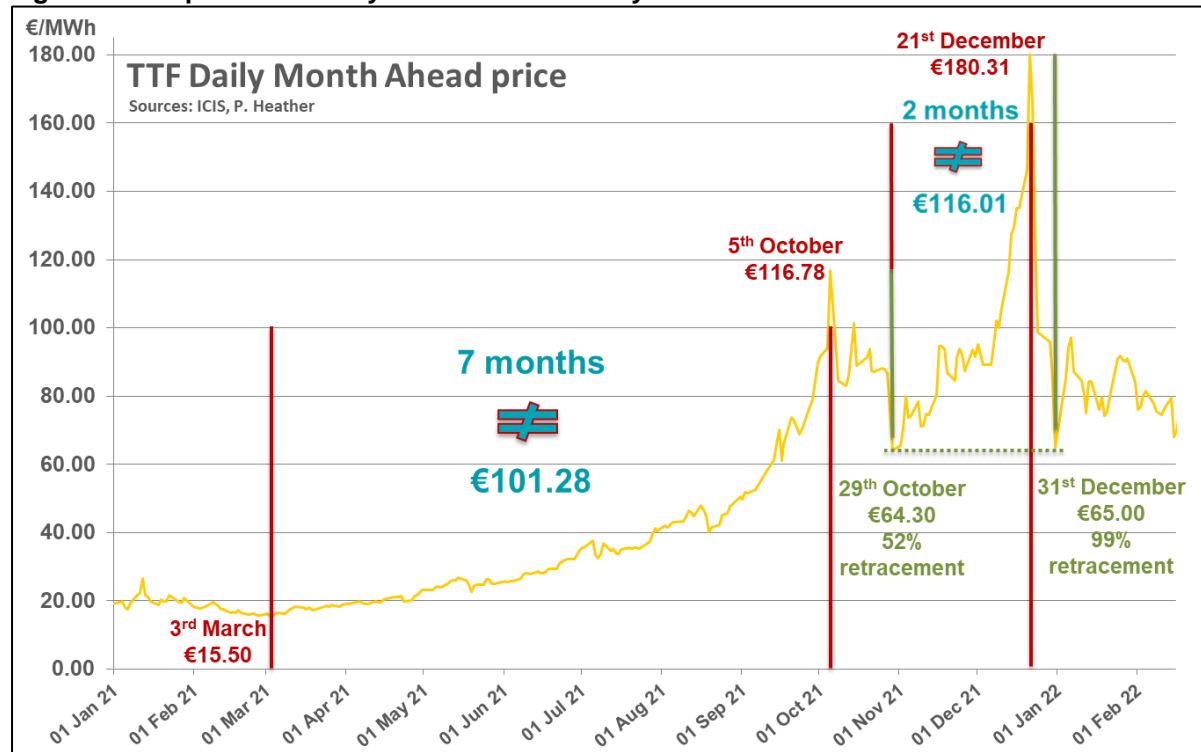


and the West and is seen as being of particular concern given the historically prominent role<sup>17</sup> that Russia has played in supplying Europe’s gas.

The severe weather in Asia at the start of 2021 did have a marginal impact on European gas prices, but the effect was a limited price rise over a few days, to €26.46/MWh<sup>18</sup> and cannot alone account for the subsequent price rally later in 2021. What the cold weather spell in Asia did accentuate was the strong increase in demand for LNG imports in the region, and in particular from China, which not only diverted cargoes away from Europe but pushed up spot Asian prices too.

During 2019, the global LNG market was supply long and surplus cargoes were imported into Europe, where the liquid traded markets allowed for them to be easily monetised, and where the storage facilities could absorb the extra volumes. This resulted in record LNG imports of 104bcm. Although imports fell very slightly in 2020 and a little more in 2021, they were still an important 88.5bcm, thanks to a 52 percent increase in US imports<sup>19</sup> over 2019. At the start of 2022 there was an increasing amount of LNG imports into Europe and, on 26<sup>th</sup> January, European LNG send out hit the highest ever monthly total, at over 10.8bcm. Such higher LNG imports could make up for reduced pipeline supplies and even possibly help counteract the pricing impact of the geopolitical tensions.

**Figure 3: TTF prices: January 2021 – 15<sup>th</sup> February 2022**



Sources: ICIS; P. Heather

Turning to the situation with storage, there are signs that help explain why the already strengthening gas market from early March 2021, suddenly rallied strongly from late April, through to the first major peak in October. The purpose of storage has been to balance the European gas market and it has historically operated according to fairly set seasonal patterns, injecting ‘cheaper’ gas in the lower demand summer months, to be withdrawn during the ‘dearer’ higher demand winter months. These patterns can and have slightly changed over the years according to varying weather and pricing signals

<sup>17</sup> Since 2010, Russia has supplied between 30-46% of Europe’s demand; see: <https://www.statista.com/statistics/1021735/share-russian-gas-imports-eu/>

<sup>18</sup> On 12<sup>th</sup> January; 1<sup>st</sup> week average was €19/MWh; 2<sup>nd</sup> week, €22.27, 3<sup>rd</sup> week €20.14, 4<sup>th</sup> week €20.10; February €17.29.

<sup>19</sup> US LNG imports into Europe in 2019 were 16.6bcm and in 2021 they were 25.2bcm.

but generally the highest levels of stocks in any given Gas Year are in mid-October to mid-November, and the lowest levels in mid to late March or early April.

Both the 2019-20 and 2020-21 gas years started with very high stocks,<sup>20</sup> about 10 percent higher than each of the previous gas years. However, withdrawals in the 2019-20 gas year started late on 8<sup>th</sup> November from a peak of 101.1bcm, whereas in the 2020-21 gas year, they started early on 12<sup>th</sup> October from a peak of 99.7bcm. Conversely, the first injections in 2019-20 were on 3<sup>rd</sup> April from a low of 55.7bcm, whereas in 2020-21, they were on 22<sup>nd</sup> April from a low of 30.2bcm and, initially, they were very limited, not really kicking in until 9<sup>th</sup> May. Coincidentally, the 23<sup>rd</sup> April was the last trading day on which the TTF price was still below €20/MWh, and the 7<sup>th</sup> May the last day the price was still below €25/MWh, before the long steep sustained rise in wholesale gas prices throughout the summer months.

From having started the gas year in a strong position to be able to balance the market, gas stocks in the 2020-21 gas year finished on 30<sup>th</sup> September at just 77.4bcm, and by 1<sup>st</sup> January 2022, were just 56.1bcm, the lowest 1<sup>st</sup> January stock level in 6 years.

These figures show that the trading patterns were really quite different from Q4-20 onwards, and suggest that traders, having filled storage to very high levels with cheap gas during 2020, chose to withdraw it early for their needs rather than pay the gradually increasing gas prices. However, as those market prices continued to increase in Q2-21, at a time when they would normally be expected to ease back, traders again chose to withdraw, rather than start to inject as per the 'normal' cycle. The important point here is not so much trader behaviour up to that time, but that having depleted total stocks by over 70 percent, they needed to start reinjecting just as global gas prices continued to rapidly rise; they were left in a position of having to buy physical gas for their portfolios, and gas to place in storage, in a rising market, whilst at the same time performing hedging to manage their increasing price risks.

The vicious circle that the market seemed to have entered was to get progressively worse over the summer period, leading up to that first record peak price of €116.78/MWh on 5<sup>th</sup> October. The apparent contrary, or delayed, decisions made by European gas traders, seemingly hesitant in accepting the rapid growth in demand as global economies eased themselves out of the pandemic recession, along with the reluctance to start to replenish storage at what appeared to be 'too high' prices, were instrumental in forcing wholesale prices up during Q2 and Q3-2021. These reasons were further exacerbated by the gradually increasing tension with Russia, caused by the initial 'accusation' of not supplying western Europe with the extra quantities needed,<sup>21</sup> by the NordStream 2 pipeline certification process, and especially, towards the end of the year by concern over Russian militarisation near the Ukraine border.

Another factor significant to the almost exponential rise in the gas price during 2021 was the move away from OTC trading towards exchange trading.<sup>22</sup> As the wholesale price increased, this started to put a strain on contractual agreements between counterparties regarding their trading arrangements and, in particular, the limits regarding the financial exposure from open contracts between them. The usual payment terms for bilaterally traded gas, are to pay for the gas delivered up to 30 days after the month of actual physical delivery. As the wholesale price rises, this places greater risk on both the seller and the buyer of both non-payment and of non-delivery.

This is why there was a marked rise in trading at the exchanges which, through the clearing mechanism, offer guarantees on the financial performance of all futures contracts. However, in order to achieve this, both buyer and seller have to deposit with the clearing house an initial margin,<sup>23</sup> and further variation

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<sup>20</sup> See: Sharples, Jack: OIES Energy Insight 108, Figure 24, p.30; adjusted to include December 2021.

<sup>21</sup> See BBC News, 13<sup>th</sup> October 2021: "Russia denies weaponising energy amid Europe gas crisis":

<https://www.bbc.co.uk/news/world-europe-58896847>

<sup>22</sup> As described in the section below on trading.

<sup>23</sup> Historically, initial margin rates for energy contracts would be around 10% of contract value and the variation (or maintenance) margin would be around 10% of the additional price exposure. However, these rates will and have risen dramatically in times of volatile markets and could potentially even reach 100% (as for example the crude oil futures during the

margins if the direction of market prices goes against their net positions. This will continue each trading day for each position until it is closed out. Furthermore, when traded markets become more volatile, both the initial and variation margins are usually increased by the clearer in order to maintain the guarantee of financial performance.

The exchanges can be used for straightforward sales and purchases of physical gas, often in the spot contracts, or more often for risk management purposes by hedging forward physical sales and purchases by trading an equal and opposite quantity on the futures contracts. These types of trade have become the largest part of the overall trading at the most liquid hubs, especially at the TTF.

However, at times of increased volatility in the markets and/or of significant and protracted price moves, using exchange trading for risk management purposes poses an even greater strain on the market participants, who have to decide whether they want to, or indeed can, actually pay the total margins required. It was reported on several occasions<sup>24</sup> that companies were struggling to pay their margins, or needed to borrow to increase their capital funding,<sup>25</sup> which in turn would result in having to pay interest and put even more financial pressure on their trading operations. If participants choose not to fund the additional margins, they would have to cover (buy back) in a rising market any short positions, which in itself would add to the upward price pressure. Finally, speculators, whether part of the large gas midstreamers, trading houses, or out and out financial speculators, will all exacerbate the volatility of the markets.

After the market reached that first record peak of €116.78/MWh on the 5<sup>th</sup> October 2021, there followed a three week 52 percent retracement down to €64.30/MWh. It is quite common to see retracements of around 50 percent in traded markets after sharp price movements, as traders reassess the underlying data or news item that caused the move in the first place, and speculators start to take their profits as the move slows down; there is often also a second wave of speculation in the contrary direction which helps the retracement to gain momentum, and often to overshoot what would be its natural equilibrium price at that time.

Of course, once those speculative positions have been closed out, traders look to the next move and from that point, any small news item or physical imbalance will trigger a fresh move, particularly in a volatile market; in the case of the gas market in Q4-21, the TTF price rebounded in a fairly erratic manner by about half of the fall from the peak of three weeks earlier, apparently stabilising for a week or so in a €10/MWh range<sup>26</sup> until the 6<sup>th</sup> December, when the next very sharp rally started.

Over the next two weeks the price climbed over €85/MWh to reach the second, and new all-time, high of €180.31/MWh on 21<sup>st</sup> December. This rally seemed to be triggered by headline news of extreme, record breaking low temperatures in north west Russia,<sup>27</sup> as well as the start of strike action on North Sea platforms;<sup>28</sup> however, in such a volatile market, this was more than enough to 'get the ball rolling' again.

It is equally possible that this second price rally and peak could have been provoked and exacerbated by traders trying to force the price higher ahead of the end of the calendar year, when a number of market participants would normally balance and close their portfolios before the Christmas and New

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Gulf War). Initial margins are paid when the opening trade is made; variation margins are applied at the close of business each trading day. Very occasionally, in very volatile markets, additional variation margins are called intra-day.

<sup>24</sup> Reuters, 4<sup>th</sup> October 2021: "Commodity traders face big margin calls as gas prices soar": <https://www.reuters.com/business/energy/exclusive-commodity-traders-face-big-margin-calls-gas-prices-soar-2021-10-04/> and: Financial Times, 13<sup>th</sup> October 2021: "Gunvor cuts LNG positions amid \$1bn of margin calls": <https://www.ft.com/content/545c16ce-f53a-48e3-bd30-c533c9563146/>

<sup>25</sup> Reuters, 11<sup>th</sup> January 2022: "Margin calls in spotlight amid Europe's energy market turmoil": <https://www.reuters.com/business/energy/margin-calls-spotlight-amid-europes-energy-market-turmoil-2022-01-11/>

<sup>26</sup> From €84.68/MWh on 22<sup>nd</sup> November, and €95.20/MWh on 1<sup>st</sup> December.

<sup>27</sup> See: <https://watchers.news/2021/12/06/st-petersburg-breaks-daily-temperature-record-december-2021/>

<sup>28</sup> See: <https://www.energyvoice.com/oilandgas/north-sea/370248/strike-action-by-hundreds-of-north-sea-workers-rock-solid-says-union/>

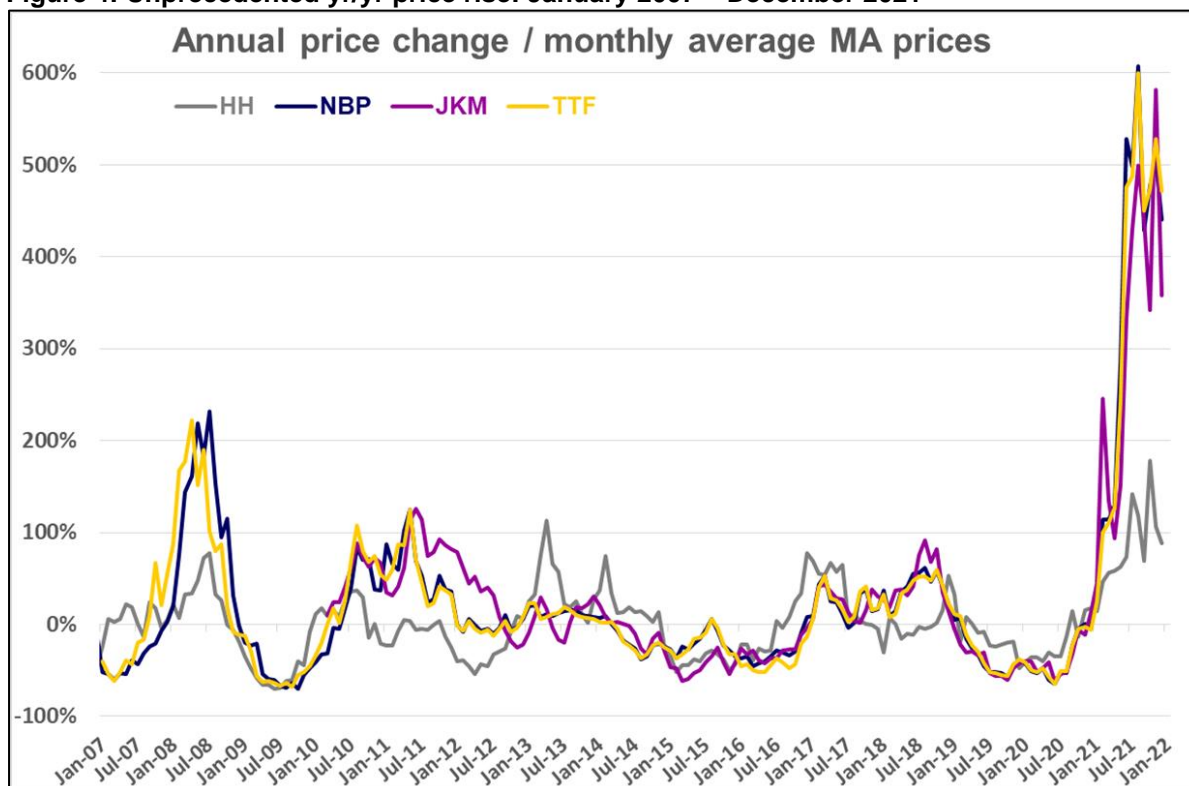
Year period; this is especially true at times of high volatility as market liquidity will tend to fall significantly over holidays when the markets are closed for much of the time.

However, as Figure 3 shows, prices then fell back even more sharply, to close on Christmas Eve at about the 6<sup>th</sup> December level. The market continued to ease further in the remaining trading days to the end of the year, to finish at €65.00/MWh, a near total retracement to where prices were on 29<sup>th</sup> October! The price moves of the gas market in Q4-21 could well be described as being a roller coaster of a ride, and anecdotal evidence suggests that many traders lost large amounts of money in the process.

To put the price moves in 2021 into perspective, the previous ‘largest’ price moves in the European traded gas market were on the British NBP, which fell €29.36/MWh over a whole year, between August 2008 and August 2009; the next largest move was the Dutch TTF, which fell €26.13/MWh between September 2018 and May 2020. Both of these large moves were falls in price and, although there were periods of high volatility in 2019, the actual way in which those market prices fell was not very erratic and simply reflected a gradual decline in overall value over a long period of time. The price move in 2021 was a prolonged steep rally and was up to that point by far the largest price move in the liberalised era.

Figure 4 shows the year on year price change for four representative global gas contracts: the US Henry Hub, the Asian JKM, and the European NBP and TTF. The data used is actually smoothed out to a certain extent as it uses the monthly averages of the daily Month Ahead closing prices. However, even by doing this, it is clear to see the unprecedented year on year increases that occurred in all but the HH contract.

**Figure 4: Unprecedented yr/yr price rise: January 2007 – December 2021**



Sources: Argus; M. Fulwood; P. Heather

The United States has been mostly isolated from the global rise in prices as it is fully self-sufficient in gas and indeed has a surplus which is exported, primarily to Asia and Europe, as LNG. However, the additional global demand for





US LNG has prompted a smaller rise in the benchmark HH price, albeit still nearly three times dearer in October 2021 than it was a year earlier.

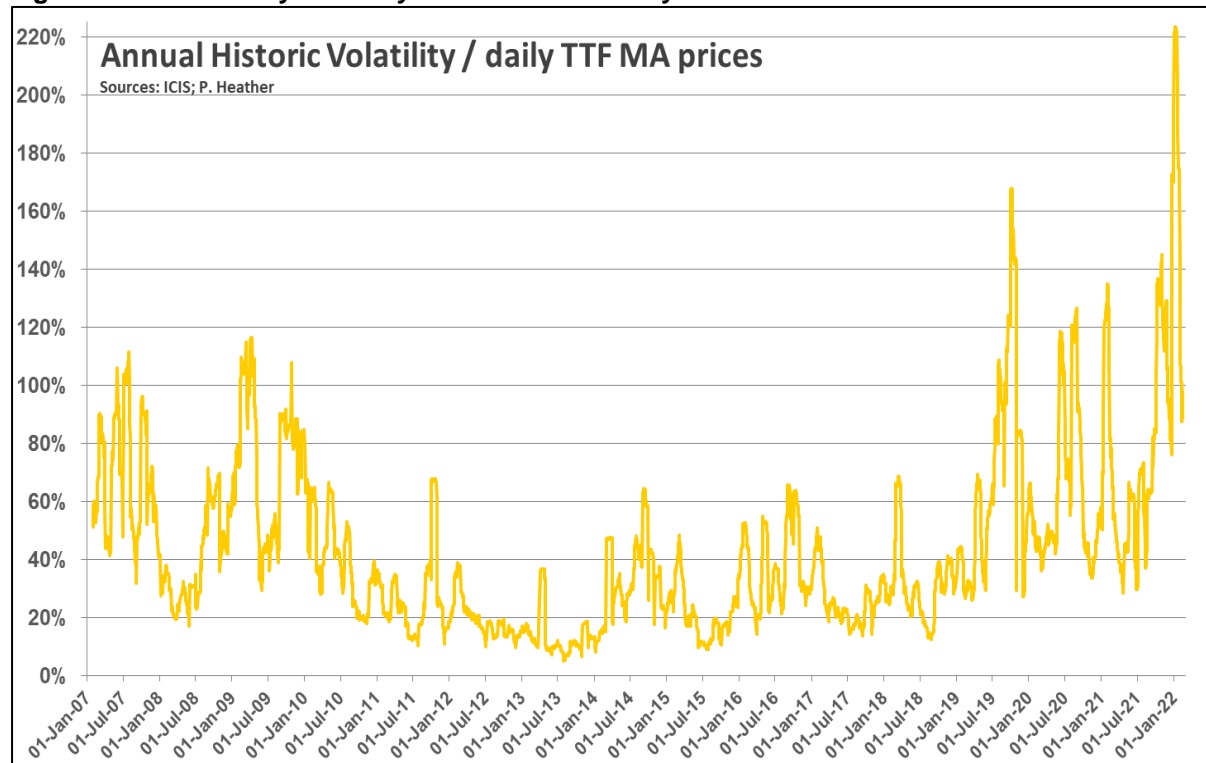
The steepest annual price changes were in the European and Asian prices, which increased about seven-fold in August and November 2021 respectively, compared to the same period in 2020. This is something that has never happened before and the previous large moves were leading up to the financial crisis, when crude hit its peak price in July 2008; at that point, gas prices in Europe had more than trebled in a year, whereas, in the US they had risen by slightly less than twice as much over July 2007.

There was a second noticeable peak in HH prices in Q1-2013, peaking in April of that year when prices were about twice as high as in April 2012. The main reason<sup>29</sup> for this peak was that the weather was abnormally cold, especially in March and April, meaning that total demand rose faster than total supply throughout Q1-2013, and this despite the ever increasing shale gas production, albeit at a slower pace compared to prior years. Finally, these conditions led to there being large storage withdrawals which brought stocks below their five-year average levels for the first time since August 2011.

However, these were relatively short rallies compared to the sustained rally in Asian and European gas prices during 2021 and it remains to be seen whether these extraordinary rises can be sustained in 2022?

Alongside the unprecedented rise in prices, there has also been an unprecedented rise in market volatility, as shown in Figure 5. This chart shows the annualised historic volatility<sup>30</sup> of the daily TTF Month Ahead closing prices over a fifteen year period from January 2007 up to 15<sup>th</sup> February 2022.

**Figure 5: TTF volatility: January 2007 – 15<sup>th</sup> February 2022**



Sources: ICIS; P. Heather

<sup>29</sup> See: <https://www.eia.gov/todayinenergy/detail.php?id=12191>

<sup>30</sup> For more information on how volatility is calculated, see: <https://www.investopedia.com/terms/v/volatility.asp>

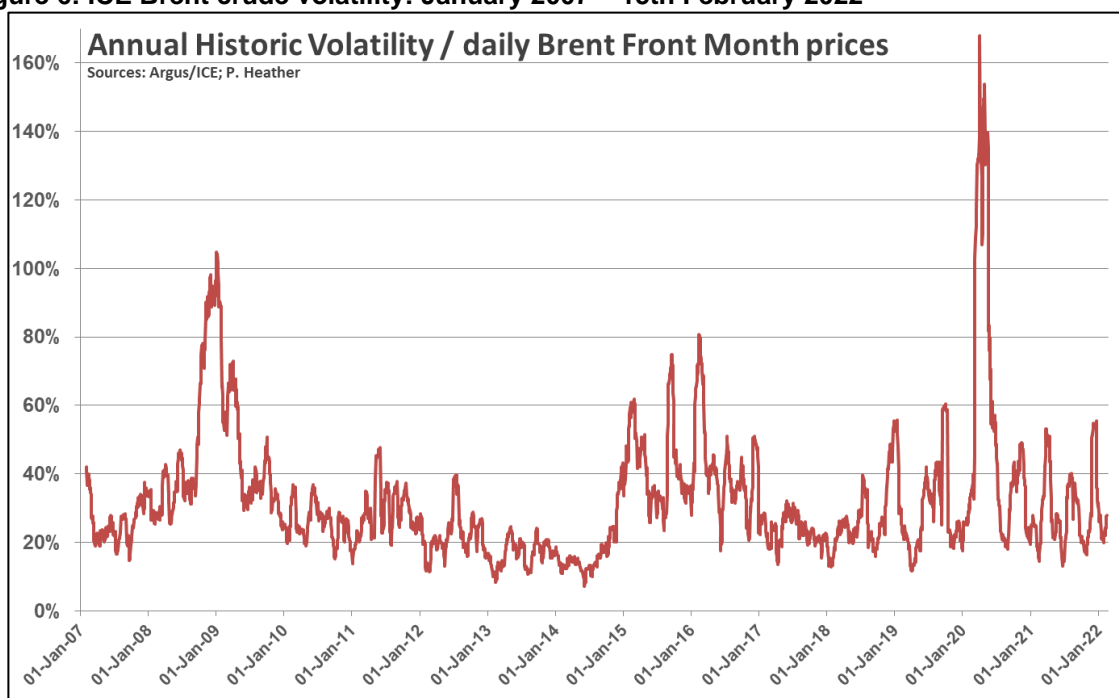
In 2007, TTF was still finding its feet and, although the volatility oscillated sharply between about 20 percent and 115 percent, it was generally at slightly lower lows and quite a bit lower highs than the neighbouring NBP, ZEE, NCG, GPL, and PEG Nord hubs. The financial crisis of 2008-09 also displayed high levels of volatility but then the market settled down, apart from a few short-lived spikes, so that from 1<sup>st</sup> January 2010 to 30<sup>th</sup> June 2019 the average volatility was 28 percent.

From July 2019, the volatility started to increase whilst also getting more erratic, which led to the first major spike in gas volatility on 7<sup>th</sup> October 2019 of 167.64 percent. This was the result of trader uncertainty coming into the new Gas Year and the Winter season: despite there being the highest storage levels over a six year period,<sup>31</sup> gas demand was gradually rising amid fears of bad winter weather, and also partly reflecting a rise in LTC oil indexed prices,<sup>32</sup> following the sharp rebound in crude oil prices in Q1-2019 from a \$30/bbl fall in Q4-2018, which led to a jump in the TTF Month Ahead price on 1<sup>st</sup> October 2019 by over €5/MWh. Over the 15 year period from January 2007 to December 2021, TTF gas had an average volatility of 44.03 percent, and the 13 year period to pre-pandemic December 2019, the average volatility was 38.20 percent.

With the market trading in very erratic moves, with both many sharp troughs and many peaks, the average volatility in the period from 1<sup>st</sup> July 2019 to 20<sup>th</sup> June 2021 jumped to 71.23 percent, and the average volatility increased even more from 21<sup>st</sup> June 2021 to 15<sup>th</sup> February 2022, reaching 103.87 percent. This period contained the second major spike in volatility on 7<sup>th</sup> January 2022 of 223.57 percent.

These are truly incredible and unprecedented levels of volatility and, as with the outright traded prices, are much higher than those of Brent crude oil: over the 15 year period from January 2007 to December 2021, Brent crude had an average volatility of 32.37 percent and an all-time, very sharp and short-lived, high of 168.06 percent on 2<sup>nd</sup> April 2020, following the sharp doubling of prices after the dramatic €50/bbl fall in Q1-20. The volatility over the 13 year period up to December 2019 was 30.50 percent.

**Figure 6: ICE Brent crude volatility: January 2007 – 15th February 2022**



Sources: Argus/ICE; P. Heather

<sup>31</sup> On 1<sup>st</sup> October 2019 European stocks were at 99.4bcm, the highest 1<sup>st</sup> October level out of Gas Years 2016 to 2021.

<sup>32</sup> The oil indexation formulae in the traditional European long term gas contracts had a 6-9 month lag in the oil prices used.

Therefore, the first major gas volatility spike was very similar to the highest ever Brent spike, both at about 168 percent; however, the second major gas volatility spike in January 2022 was about a third higher still. As with the outright prices, the gas market has reached unprecedented levels compared to oil, but also to commodity markets in general where nothing quite like this has happened before.

Typically,<sup>33</sup> the currency markets (of the leading, stable, 'reserve' currencies) have a volatility level below 10 percent. The bond markets also typically have some of the lowest volatility rates, closely followed by the equity markets, each averaging about 12-16 percent historical volatility over time. Of course there will be differences depending on whether the market in question is based in a larger economy or a poorer and/or less stable one. Finally, there is the commodities sector, which is often split between 'soft' commodities,<sup>34</sup> energy commodities, metals, and finally gold, which is a hybrid metal/reserve asset. Typical historical volatilities in the commodities asset class have varied widely over the past 40-50 years; gold has had a range of 4 to 40 percent, metals a range of 10 to over 100 percent, soft commodities have varied widely from corn (12 to 48 percent) and soybeans (10 to 75 percent) to sugar (10 to 100 percent). Energy has typically been the most volatile, with crude oil and natural gas about the same until the more recent past where, even setting aside the extreme peaks, gas has been more volatile.

Volatility is in effect a measure of market uncertainty and this has been abundant in the gas market since 2020, and especially throughout 2021, as already explained. The uncertainty was due to a combination of the deep global economic recession due to the Covid-19 pandemic, and subsequent gradual rebound in 2021, the faster than anticipated decline in European gas production, and resultant loss of swing, the loss of global LNG supply due to outages, political issues and delays to new projects, and for Europe, less US LNG exports than expected due to shut-ins and the rapid increase in Asian demand. Added to these, there have been recurring bouts of bad weather, both in winter 2020/21 and at the start of the 2021/22 winter, with European storage levels being depleted faster than normal, resulting in stocks falling below 50 percent in the middle of January 2022. Finally, the traded gas markets became increasingly volatile because of escalating geopolitical tensions over NordStream 2 and Ukraine.

The recent very high prices in gas and the ensuing very high levels of historical volatility are really in a different league, making gas the most volatile commodity by far. The question is whether these levels are simply a short-lived aberration, or are a new normal?

Despite the historically high gas prices, its use in power generation was not greatly affected; indeed, there was actually a strong growth in gas powered generation in 2021,<sup>35</sup> primarily in the first half of the year and again in November and December. With such high gas prices, there should have been some switching to coal but in fact, this was relatively limited. The principle reason for this is that the rise in carbon pricing meant that the clean spark spreads remained more profitable than the clean dark spreads<sup>36</sup> until late July in the Netherlands and until early September in the UK.<sup>37</sup>

Furthermore, the correlation between European gas and electricity prices rose to a record high for 2021, according to a calculation done by Greg Molnár of the IEA.<sup>38</sup> Figure 7 shows the results of the correlation between the Month Ahead contract at TTF, Europe's most traded gas market, and the Month

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<sup>33</sup> The volatilities information is from: <https://www.thebalance.com/why-commodities-are-volatile-assets-4126754>

<sup>34</sup> Soft commodities are agricultural products that may be grown, or livestock that may be bred and reared.

<sup>35</sup> Honoré, A (yet to be published), Chapter 3.3: "After a -2.6% decline in 2020, electricity generated from gas was up by +6.3% in 2021, and even +3.6% above its 2019 level"

<sup>36</sup> Honoré, A (2022 yet to be published), marked as Figure: "Relative gas vs coal power plants profitability".

<sup>37</sup> This was because the UK had a higher carbon price traded on the UKETS compared to that on the EUETS.

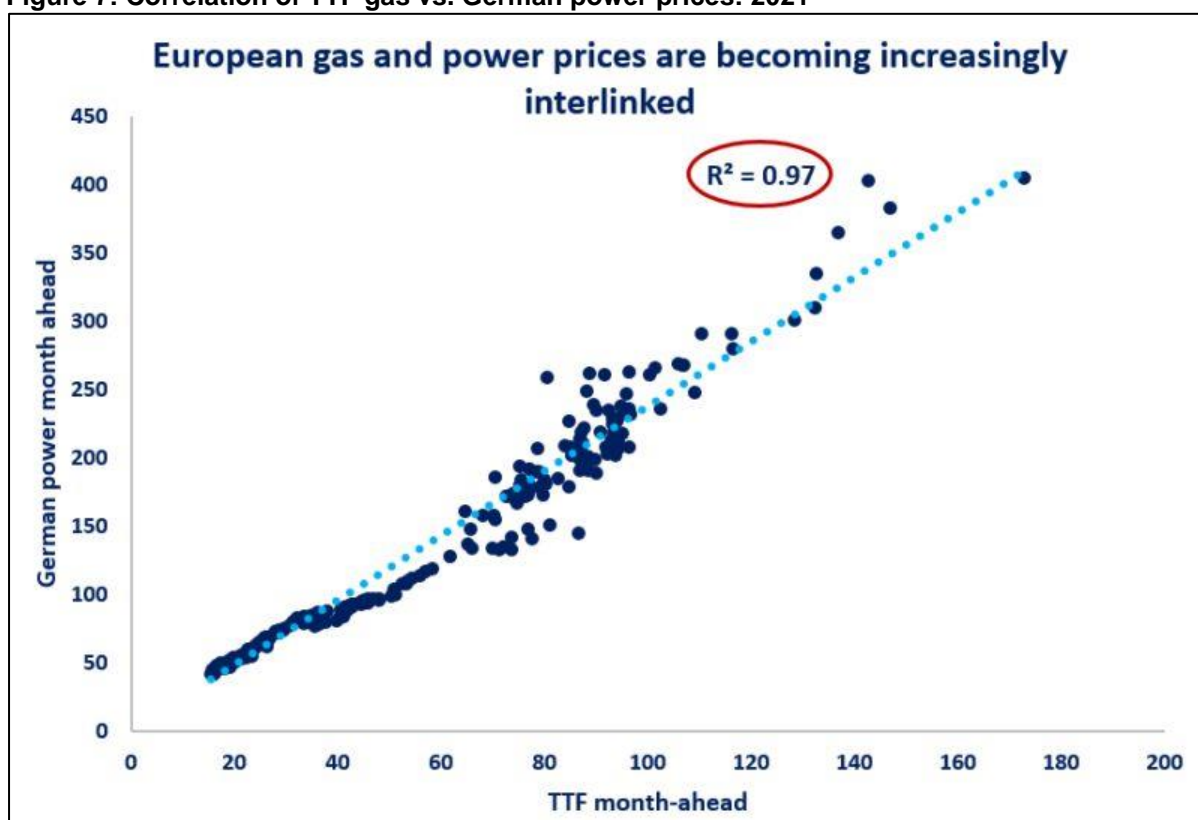
<sup>38</sup> See the article on LinkedIn at:

[https://www.linkedin.com/search/results/content/?keywords=greg%20moln%C3%A1r%20gas%20and%20power%20correlation&position=0&searchId=f295f869-8893-46c9-aac6-bc02a509718f&sid=rz&update=urn%3Ain%3Aactivity%3A6897086281977802752%2CBLNED\\_SEARCH\\_FEED%2CEMPTY%2CDEFAULT%2Cfalse](https://www.linkedin.com/search/results/content/?keywords=greg%20moln%C3%A1r%20gas%20and%20power%20correlation&position=0&searchId=f295f869-8893-46c9-aac6-bc02a509718f&sid=rz&update=urn%3Ain%3Aactivity%3A6897086281977802752%2CBLNED_SEARCH_FEED%2CEMPTY%2CDEFAULT%2Cfalse)

Ahead contract on German power, Europe's most traded power market. For the calendar year 2021 the correlation is a very strong 0.97, compared to 0.57 in 2020 and just 0.3 in 2019.

The LinkedIn article goes on to say that as “gas prices [have surged] to record levels, gas-fired power plants are now the marginal price-setter for electricity prices in almost all European power markets, which explains the strong inter-influence between gas and electricity prices”

**Figure 7: Correlation of TTF gas vs. German power prices: 2021**



Source: Greg Molnár, IEA (LinkedIn feed 9/2/2022)

Given the strong commitment made by many nations, and the EU's own 'Fit for 55' initiative to combat climate change, it can be supposed that there will be a decline in coal, lignite and fuel oil from the generation mix, to be temporarily replaced by gas until renewables can grow sufficiently to fill the gap. If this is the case, then during this intermediate period, it can also be supposed that the correlation between gas and power will continue to remain strong.

### 3. Review of the traded volumes in 2021

Despite the impact of the pandemic affecting both the supply of and the demand for gas during 2020, and the turbulent traded markets of 2021, the European gas market has remained resilient, with the total traded volumes increasing about<sup>39</sup> 4 percent to about 66,800TWh.<sup>40</sup> This rise is thanks to the continued year on year increases seen at Europe's leading Benchmark hub, the Dutch TTF, which recorded rises of over 12,200TWh in 2019, 6,300TWh in 2020, and 6,700TWh in 2021,<sup>41</sup> accounting in 2021 for just shy of 80 percent of all European gas trading.

<sup>39</sup> Not all the 2021 data have been computed yet, especially from the smaller hubs.

<sup>40</sup> Whilst it is usual in Europe to refer to physical gas volumes in billion cubic metres, it is usual to refer to the traded volumes in Terawatt hours and traded prices in Euros per Terawatt hour; 66,800TWh is approximately 6,302bcm.

<sup>41</sup> Total TTF traded volumes in 2018: 28,221TWh; 2019: 40,388TWh; 2020: 46,687TWh; and 2021: 53,428TWh.



Table 1 shows the total traded volumes in 2021 for the seven most traded hubs in Europe,<sup>42</sup> as well as the splits between exchange spot and futures contracts, and the total OTC contracts, it has been ordered by descending total volumes. This clearly shows how TTF is the dominant hub, pulling away from the 'pack' below, and is now eight times larger than the second place NBP and over 17 times larger than the third place combined German hubs!

**Table 1: Hubs' traded volumes Jan-Oct 2021**

HUB TOTAL TRADED VOLUMES (TWh): 2021				
HUB	TOTAL VOLUMES	EXCHANGE TRADING		OTC TRADING
		SPOT VOLUMES	FUTURES VOLUMES	SPOT & CURVE
TTF	53428	763.77	36151.51	16512.34
NBP	6641	92.70	4590.84	1957.43
NCG+THE+GPL	3108	553.89	117.01	117.01
PSV	1148	89.49	54.73	1004.26
VTP	916	129.10	100.99	686.19
TRF	854	199.52	34.85	619.18
ZEE+ZTP	289	138.60	1.76	149.07

Sources: OTC: LEBA, ICIS; Exchange: ICE, ICE-Endex, PEGAS, CME; P. Heather

It remains clear to see that the TTF is way ahead of all the other European traded gas hubs, including the NBP which is still holding on to second place with total volumes over double those of the German hubs combined. TTF is continuing to attract risk management trading, as well as speculative trading, and is by far the most liquid gas hub. Although as with all gas hubs TTF is used for balancing and physical portfolio adjustments ahead of maturity,<sup>43</sup> it is primarily used for forward hedging, portfolio positioning and for speculation. Furthermore, it is by far (with NBP) the hub with the largest share of futures trading, at 68 percent of total trades in 2021. This indicates that there is an overwhelming amount of pure financial trading, rather than purely physical reasons, and that aggregators, financial institutions and speculators are trading at this hub more than at any of the others.

Table 2 gives additional information of the percentage changes in each of those contract categories for 2021 compared to 2019, and compared to 2020; it has been ordered by descending percentage changes between 2019 and 2021. Of these main established north west European hubs, it was the British NBP and the Belgian ZEE and ZTP hubs that fared the worst, each falling nearly 47 percent and 49 percent respectively, compared to the pre-pandemic 2019 year, and falling a further 34 percent and 38 percent respectively compared to 2020. The remaining four countries' hubs each increased their total traded volumes from 2018 to 2019, but only the Austrian VTP and the Italian PSV increased further in 2020. The German hubs combined and the French TRF started to fall in 2020, and this persisted in 2021, along with relatively small falls at the VTP and PSV.

What is clear from the category splits is that OTC trading has suffered across the board, even at TTF. There are several possible reasons for this but the main one is that OTC trades are bilateral contracts where the counterparties have both performance and financial risk with each other. Exchange trading

<sup>42</sup> Dutch TTF; British NBP; German NCG, THE, and GPL; Italian PSV; Austrian VTP; French TRF; and Belgian ZEE and ZTP.

<sup>43</sup> The spot exchange volumes alone are 2½ times the total Belgian volumes, and not far short of the total French volumes.

on the other hand offers financial guarantees through the clearing mechanism and would therefore have been considered as a 'safer' route to market, both during the pandemic related market uncertainty in 2019, and especially in 2021 as the prices started to rise rapidly.

However, this in itself would have had a knock on effect where, in such an environment, margin calls indirectly led to short covering, potentially pushing prices higher still, as discussed earlier in this paper.

**Table 2: Hubs' traded volumes changes Jan-Oct 2021 vs 2019 and 2020**

CHANGES BASED ON HUB TOTAL TRADED VOLUMES: 2019 / 2020 / 2021								
HUB	CHANGE ON TOTAL VOLUMES		CHANGE ON EXCHANGE VOLUMES				CHANGE ON OTC VOLUMES	
			SPOT VOLUMES		FUTURES VOLUMES		CURVE VOLUMES	
	Δ 2019 / 2021	Δ 2020 / 2021	Δ 2019 / 2021	Δ 2020 / 2021	Δ 2019 / 2021	Δ 2020 / 2021	Δ 2019 / 2021	Δ 2020 / 2021
TTF	32.25% ↑	14.44%	24.08%	28.38%	122.05%	47.37%	-29.74%	-23.42%
VTP	5.06% ↑	-9.30%	27.28%	42.24%	61.94%	29.92%	-23.35%	-18.48%
TRF	-11.82% ↓	-3.93%	47.47%	27.39%	39.79%	31.98%	-23.35%	-12.23%
NCG+THE+GPL	-13.23% ↓	-6.21%	20.30%	33.98%	38.34%	77.68%	-19.75%	-14.02%
PSV	-20.38% ↓	-20.65%	30.46%	16.55%	185.92%	102.75%	-25.87%	-25.25%
NBP	-46.80% ↓	-34.00%	1.94%	5.02%	-41.18%	-36.60%	-57.32%	-28.38%
ZEE+ZTP	-48.99% ↓	-38.19%	54.16%	39.08%	-24.33%	-2.49%	-68.62%	-59.36%

Sources: OTC: LEBA, ICIS; Exchange: ICE, ICE-Endex, PEGAS, CME; P. Heather

Table 2 shows how there were some very high increases in futures volumes at several of the hubs but especially at TTF and PSV, and over the two year period at the VTP also. The NBP and Belgian hubs had a fall in futures volumes but did record rises in their spot volumes.

The important conclusion from this section on trading results is that there has been a swing over the past two years from the OTC market to the exchange contracts. Additionally, the British NBP and Belgian hubs have continued to fall rapidly, the Austrian VTP has held its position well having overtaken the French TRF in 2020, which itself fell back for the second year from its peak,<sup>44</sup> the PSV had its first dip in volumes in 2021 following a continuous annual rise since at least 2008,<sup>45</sup> the combined German hubs also slipped back for the second year from a peak in 2018,<sup>46</sup> and the Dutch TTF has continued to forge ahead as the dominant benchmark hub.

## Summary and conclusion

The aim of this paper has been to analyse the role of trading activity in the gas markets over the past two years, and especially over the course of 2021 as prices grew steadily between March and August, followed by the extremely rapid growth from late August to the first peak in early October, and the very volatile trading during Q4-21 which resulted in the second, unprecedented peak.

There have been some extreme price moves in the past, which tended to be quite short-lived, generally affected just one or a few hubs, and were on the Day Ahead more than the Month Ahead contracts. What happened during 2021 was very different. There was a long protracted price rise in all contracts along the curve, culminating in the highest ever gas prices, which were over three times greater than

<sup>44</sup> The total TRF traded volumes were 968TWh in 2019.

<sup>45</sup> The author does not have annual data prior to that date; in 2008, total traded volumes at PSV were 160TWh.

<sup>46</sup> The combined total traded volumes of GPL and NCG were 3582TWh in 2018.

the highest ever crude oil price. To a large extent this was caused by a combination of many factors occurring either at the same time or in rapid succession, and described as a 'perfect storm', which developed during 2020 and 2021.

The result was an unprecedented 7-month sustained rise in wholesale gas prices of over €100/MWh from early March to early October 2021, resulting in a record peak of €116.78/MWh. After a 50 percent retracement and some price consolidation, a second massive rally over just two weeks took the price to another all-time, high of €180.31/MWh on 21st December.

There were several physical reasons for the rally but they do not alone account for the higher prices. They include an increase in consumption as economies crept out of the pandemic-induced recession, a fall in European domestic production, mainly due to the large reduction at the Dutch Groningen field, a fall in pipeline imports, especially from Russia, and severe weather conditions in Asia at the start of 2021, which did have a marginal impact on European gas prices.

Movements in storage stocks also had an impact. 2020-21 gas stocks started strong but finished on just 77.4bcm. Stocks on 1st January 2022 were 56.1bcm, the lowest 1<sup>st</sup> January stock level in 6 years. Trading patterns from Q4-20 onwards were quite different from previous years. Traders, having filled storage to very high levels with cheap gas during 2020, seem to have chosen to withdraw it early for their late winter needs rather than pay the gradually increasing gas prices. When the usual reinjection cycle would normally start, global gas prices continued to rapidly rise and traders had to buy gas for their portfolios, and to place in storage, in a rising market, whilst hedging to manage their price risks. The situation was exacerbated by accusations that Russia had not supplied western Europe with the extra quantities needed.

As market prices were increasing, there was a clear move away from OTC trading (which had already started during 2020) towards exchange trading, at all the European hubs, though at different rates. The need to increase financial performance guarantees when the direction of market prices went against net positions led to reports that companies were struggling to pay their margins, or needed to borrow to increase their capital funding.

It is possible that the second price rally and peak in December could have been provoked and exacerbated by traders trying to force the price higher for speculative reasons, ahead of the end of the calendar year. There was also an unprecedented rise in the year on year price change and market volatility. The steepest annual price changes were in European and Asian prices, which increased about seven-fold in August and November 2021, compared to the same periods in 2020.

With the market trading in very erratic moves, average volatility from 1st July 2019 to 20th June 2021 jumped to 71.23 percent, and reached 103.87 percent from 21st June 2021 to 15th February 2022. The second major spike in volatility of 223.57 percent occurred on 7th January 2022. These truly incredible and unprecedented levels of volatility, as well as outright traded prices, are much higher than those of Brent crude oil.

Volatility is in effect a measure of market uncertainty which has been abundant in the gas market since 2020, and especially throughout 2021. The uncertainty was due to the deep global economic recession due to the Covid-19 pandemic, subsequent gradual rebound in 2021, the faster than anticipated decline in European gas production, and resultant loss of swing, the loss of global LNG supply due to outages, political issues and delays to new projects, and for Europe, less US LNG exports than expected due to shut-ins and the rapid increase in Asian demand. Added to these, there have been recurring bouts of bad weather, in winter 2020/21 and at the start of the 2021/22 winter, with European storage levels depleted faster than normal, and falling below 50 percent in the middle of January 2022.

There has also been increasing tension between the West and Russia over the lower pipeline imports compared with 2018-19, the delay in the certification and permitting of the new NordStream 2 pipeline, and especially, the escalating geopolitical tensions over Ukraine. Geopolitical situations can cause the greatest uncertainty and therefore greater price moves.

The final conclusion is that 2021 turned out to be the most turbulent year ever in the history of the liberalised traded gas markets: unprecedented price levels after one of the longest sustained rallies and two sharp retracements, unprecedented six fold year on year price rises, unprecedented high levels of volatility making natural gas the most volatile commodity by far and, possibly, some of the greatest trader uncertainty. The geopolitical Russian situation, confusion over climate targets and how to achieve them, with or without natural gas in the mix, are increasing uncertainty.

It is still very unclear whether we are in a new price era, due to this series of unfortunate events over the past two years, and due to the continuing geo-political tensions. The real question is whether these levels of price and volatility are simply a short-lived aberration, or are a new normal?