



July 2019

European traded gas hubs: a decade of change

1. Introduction

This OIES Insight provides a further update on the maturity and development of European traded gas hubs, following on from the comprehensive study undertaken in 2015¹ and the update published in 2017,² which looked at both the liquidity and pricing aspects of the hubs.

Those previous studies explained that the process of liberalisation is a long one and that to develop sufficient liquidity to become a successful benchmark hub would only be achieved by a very few hubs. Indeed, the British NBP and Dutch TTF both took over 10 years to reach that level and are still today the only two fully mature benchmark hubs in Europe. The East European countries have been taking much longer to liberalise and develop their traded gas markets, some not yet having even established a virtual hub, some 15 years after the EU Gas Directives.

The previous papers concluded that, although every EU member state will have, in time, its own gas hub into which and from which physical volumes of gas will be traded, the European Union's vision for a Single Energy Market in gas will not be realised for many years off, possibly until the mid-2020s; however, in the 2017 paper the conclusion was that it may never be fully realised.

This update paper will look in detail at the progress of all the European traded gas hubs in 2017 and 2018, to determine whether those previous conclusions are still valid; it will also look back over the past 10 years to see how the hubs have fared, whether there are any 'winners' or 'losers' and indeed, to see which countries are still to liberalise and which hubs to develop?

The present contribution complements the substantial research work undertaken in the last few years by the OIES, which has been following the development of European gas hubs since 2010. Previous publications by Patrick Heather for the OIES have documented the trading liquidity at the various hubs and have assessed their stages of development, using a compelling mix of both quantitative and subjective measures.

The five Key Elements are: market participants, traded products, traded volumes, tradability Index, churn rate; and the three Main Indicators are political will, cultural attitude, commercial acceptance.

This Insight highlights these criteria to offer an update on hub liquidity to the end of 2018.

¹ Heather (2015).

² Heather/Petrovitch (2017).

2. Liquidity analysis and the 5 Key Elements/3 Main Indicators

The liquidity metrics

There has been continued development of the European gas hubs since the publication of the last OIES research, which used data up to the end of 2016; this paper will bring the reader up to date with developments in 2017 and 2018.

The developing maturity of the Dutch TTF has continued apace and it has become by far the largest single traded gas hub in Europe, surpassing the British NBP during 2016. The 2017 Paper described it as the dominant European gas hub, not only in terms of total traded volumes but also in several of the other metrics that were analysed in that paper. Now it has become not only the €-denominated benchmark hub but also the leading European gas hub, and the main European benchmark or reference hub, as will be explained later in this paper.

The British hub managed to slightly increase its volumes in 2017 but then posted a sharp decline in 2018; however, it still recorded over 5 times greater volumes than the combined German hubs - NCG and Gaspool. Nearly all the other European hubs saw increases in traded volumes, with the exception of the Belgian ZEE and Czech VOB hubs.

This chapter will show the results of the 5 Key Elements, as far as they are available,³ the analysis of which helps to evaluate the path to liberalisation and market development of the traded gas hubs across Europe; it will also show the results of the 3 Main Indicators, as far as these can be assessed, to reveal the level of liberalisation and market development of those traded gas hubs.

The 5 Key Elements

The evaluation of the maturity of the selected hubs is based on evaluation of the following five key elements which will help in judging whether the criteria of depth, liquidity and transparency of these hubs are being met and to what degree. The five Key Elements are:

- a. Market participants: The number of active participants is an important indicator as to the development of that hub;
- b. Traded products: An important consideration when comparing traded markets, to determine whether they are used for balancing or for risk management and so can produce a benchmark hub;
- c. Traded volumes: This element is associated with market activity and development and is a clear sign of a hub's relative importance;
- d. Tradability index: ICIS assessment for determining liquidity. In itself it is not an indicator of depth, liquidity and transparency;
- e. Churn rates: The ratio of traded volume to actual physical throughput. The most important Key Element and a measure of a gas hub's commercial success.

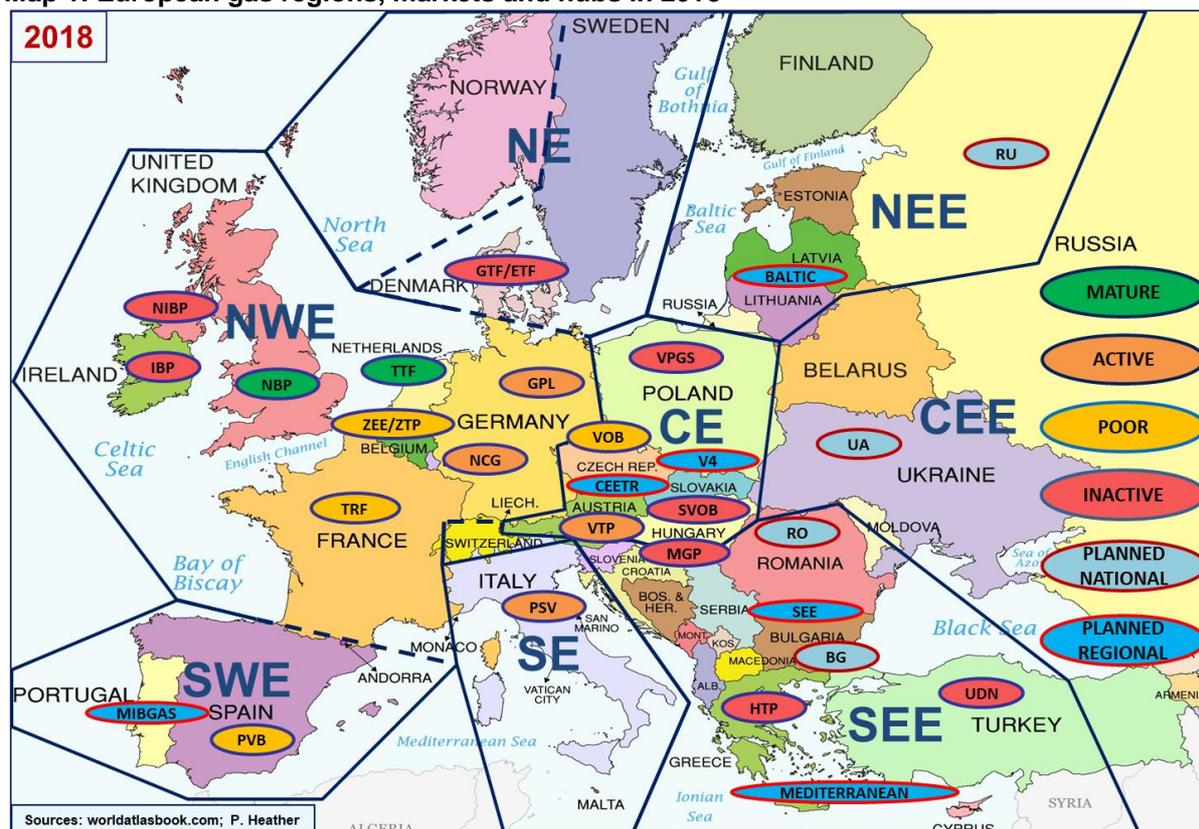
The detailed explanations as to the importance of the five Key Elements and the 3 Main Indicators and their impact on determining the level of hub maturity and development can be found in previous OIES papers, especially Heather (2015), Chapter 6. The detailed methodologies used in the tables to arrive at the 'rankings' of the hubs are described in the annex to that paper.

Map 1 shows the location of European hubs in 2018 and the various levels of gas hub development, using a colour code based on the results of the analysis in this Insight. The most developed part of

³ The 'Inactive' hubs shown in Map1 have not been fully analysed and included in the 5 Key Elements for lack of comprehensive data across all the Elements; however, such data as are available, are given in Chapter 3 of this paper.

Europe in terms of liberalised gas hubs is the north-west. This is also the part with the greatest disparity between the ‘mature’ and ‘illiquid’ hubs: Mature hubs are dark green; Active hubs orange; Poor hubs amber; and Illiquid hubs red. The colours used in Tables 1 to 6 are slightly different and will be explained with each Table.

Map 1: European gas regions, markets and hubs in 2018



The only changes in the last two years were the creation of a single traded zone in France (1st November 2018), the Trading Region France (TRF), and the creation of a hub in Greece (July 2019). As will be presented later in this Insight, there are due to be some further changes in 2019/20: there will be a single balancing zone between Denmark and Sweden from 1st April 2019; there will be a single gas transmission tariff zone between Finland, Estonia and Latvia from 1st January 2020, which could be the beginning of the long planned Baltic hub; and there could finally be an Irish IBP, should Brexit actually happen.

Key Element 1: Market participants

The number of companies trading at a gas hub is an important indicator as to the development of that market; it not only shows the willingness for traders to ‘get involved’ but also echoes how easy it is to participate. The important criteria are the number of independent participants and how many of them can be considered to be active: the more who regularly trade, the more liquidity there will be. If possible, the types of participants trading at a given hub should also be noted.

Only active traders should be considered because it is only they who will improve liquidity and competition to trade. They will usually create a ‘tighter’ bid/offer spread, and will reduce the chances of market manipulation. This will also generally mean that there will be greater depth to the market, and that there will be several buyers and sellers behind the posted bid and offer prices.

Following comments from several market participants that the results obtained in earlier papers were “too low” for some of the hubs, the methodology was changed from 2017 to assess the number of

traders regularly trading in the spot/prompt and Month contracts and those trading along the curve in the Quarters, Seasons and Years. Because the author places more emphasis on curve trading, which more fairly reflects the amount of hedging/risk management trading, the new methodology calculates a 'score' of one times the number of spot/prompt/Month traders, plus two times the number of curve traders.

In Table 1 mature hubs are shown in green; the active hubs, with developing depth, liquidity and transparency in amber; and the poor hubs, which cannot yet be considered as deep, transparent or liquid, in red.

Table 1: Market participants: 2015–2018

2018 HUB	OTC Active Traders*					
	Total Market		Hub Score [^]	S/P/M ^{**}	Q/S/Y ^{***}	Hub Score [^]
	2015	2016	2017	2018	2018	2018
TTF	45	>40	240	67	61	189
NBP	45	>40	185	55	48	151
NCG	>25	30	160	57	41	137
GPL			130	41	32	105
PSV	15	18	105	44	29	102
CEGH/VTP	15	15	100	35	24	83
TRF (PEG N up to 2017)	10	15	42	22	14	50
ZEE	15	15	35	19	14	47
ZTP			30	19	13	45
PVB	<10	<10	44	15	11	41
VOB	<10	<10	21	9	5	19

* The estimated number of traders who regularly trade – Note: different methodology from 2017;
** Spot / Prompt / Months contracts; *** Quarters / Seasons / Years contracts.
[^] Hub score calculated as (1xS/P/M) + (2xQ/S/Y)

Sources: 2015, 2016: from discussions with market participants and brokers.
2017: based on survey results from 3 traders (large companies) and 2 brokers;
2018: based on survey results from 4 traders (large companies) and 2 brokers.

The overall results from this new methodology⁴ are in line with those pre-2017, certainly as far as the 'top' hubs are concerned. In 2017/18, with respect to the number of active market participants, TTF records the highest score with the most traders in both categories. The Italian PSV has seen a marked increase in the number of traders, especially along the curve, enabling that hub to progress from being classified as 'active' to being 'mature'. The Austrian VTP also just qualified as mature in 2017 but fell back slightly in 2018. The other hubs have the same classification in 2018 as they had in 2015/16.

These results show that in 2018, on Key Element 1, TTF, NBP, the two German hubs and the PSV were mature; that the VTP, TRF and the Belgian hubs were active with developing depth,

⁴ Methodology (2017,2018):

S/P/M: Green: ≥ 60 ; Amber: < 60 ; Red: < 25

Q/S/Y: Green: ≥ 20 ; Amber: < 20 ; Red: < 10

Hub score: 1xSPM/2xQSY: Green: ≥ 100 ; Amber: < 100 ; Red: < 45 .

transparency and liquidity; and that the PVB and VOB cannot yet be considered as deep, transparent or liquid. However, it should be noted that the Spanish PVB did record a reasonable number of curve traders, which helped to bring its score to just under the 'active' category.

Key Element 2: Traded products

An important consideration when comparing traded markets and in evaluating their relative success is to look at the products available to trade (Table 2) and to note where along the traded curve the volumes are being effected. This is important as only risk management hubs are likely to become benchmark hubs providing market prices and only benchmark hubs are likely to be able to provide risk management products – a virtuous circle but one that can be seen in other commodities across the world: liquidity attracts liquidity which in turn makes a market successful, increases its churn rate and allows it to develop into a 'mature' market able to provide reference prices.

Table 2: European gas hubs: traded products in 2018

2018	OTC	CLEARING	WD DA	BOW W/E W/DNW BOM	MA MONTHS	QUARTERS	SEASONS	YEARS (CAL + GAS)	EXCHANGE (% SHARE)	BALANCING TRADES	SPOT PROMPT	FUTURES MONTHS	FUTURES QUARTERS	FUTURES SEASONS	FUTURES YEARS	OPTIONS MONTHS
TTF	Y	Y	Y	Y	Y	Y	Y	Y	ICE 88 PGS 12 CME 0	N	Y	Y	Y	Y	Y	Y
NBP	Y	Y	Y	Y	Y	Y	Y	Y	ICE 99 PGS 0 CME 1	Y	Y	Y	Y	Y	Y	Y
NCG	Y	Y	Y	Y	Y	Y	Y	Y	PGS 99 ICE 1	N	Y	Y	Y	Y	Y	Y
GASPOOL	Y	Y	Y	Y	Y	Y	Y	Y	PGS 99 ICE 1	N	Y	Y	Y	Y	Y	N
PSV	Y	Y	Y	Y	Y	Y	Y	Y	GME 62 PGS 30 ICE 8	Y	Y	Y	Y	Y	Y	N
TRF	Y	Y	Y	Y	Y	Y	Y	Y	PGS 100	N	Y	Y	Y	Y	Y	N
VTP	Y	Y	Y	Y	Y	Y	Y	Y	PGS 100	N	Y	Y	Y	Y	Y	N
ZEE	Y	Y	Y	Y	Y	Y	Y	Y	PGS 100	Y	Y	Y	Y	Y	Y	N
ZTP	Y	Y	Y	Y	Y	Y	Y	Y	PGS 100	N	Y	Y	Y	Y	Y	N
PVB	Y	Y	Y	Y	Y	Y	Y	Y	MIB 100	N	Y	Y	Y	Y	Y	N
VOB	Y	Y	Y	Y	Y	Y	Y	Y	PGS 100	N	Y	Y	Y	Y	Y	N

***KEY:** GREEN: =>600TWh AMBER: <600tWh BLUE: <250TWh RED: <50TWh GREEN: =>500TWh AMBER: <500TWh BLUE= <100TWh RED: <30TWh

GREY: Hubs column based on OTC + Exchange 'score'/56; OTC column based on 'score'/28; Exchange column based on 'score'/28

No volumes ICE=ICE/Endex PGS=PEGAS CME=CME Europe MIB=MIBGAS Y=AVAILABLE N=NOT AVAILABLE

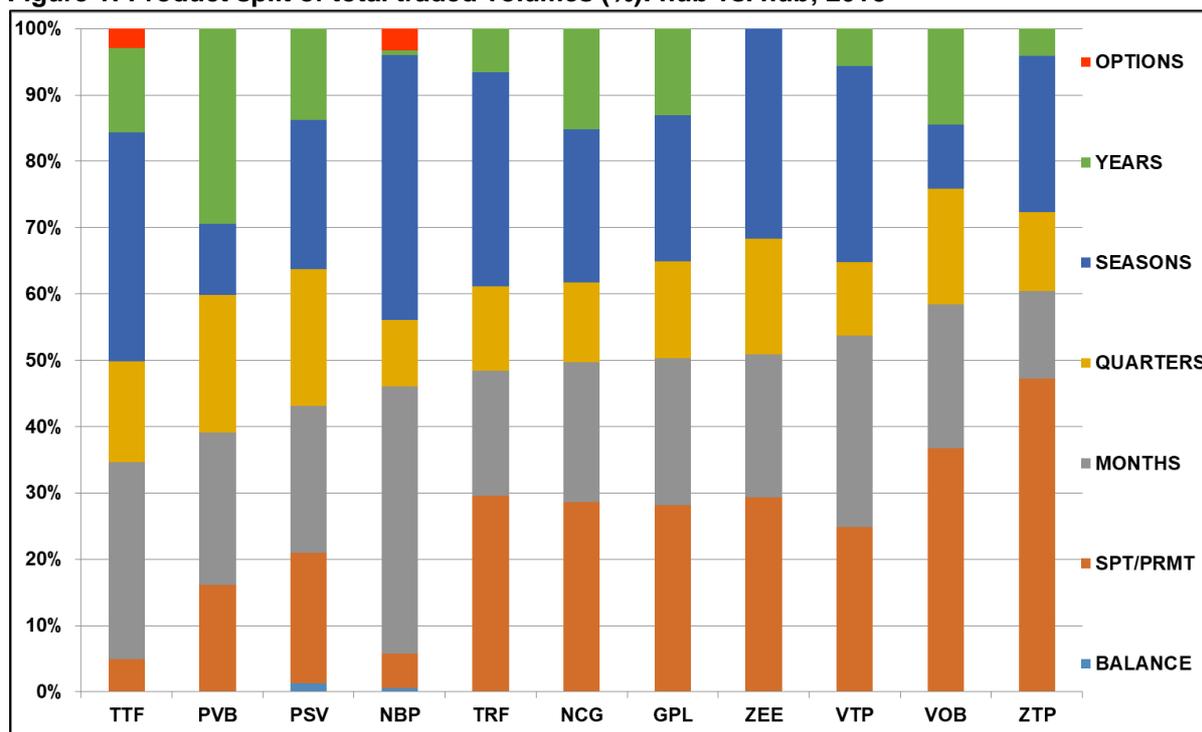
Sources: OTC: LEBA, ICIS, Exchange: ICE, ICE-Endex, PEGAS, CME, GME; MIBGAS; P. Heather

The traded products table shows the different types of products that are available to trade, in both the OTC and Exchange markets. The 'popularity' of the different products in each of the hubs is shown by four colour codes, according to absolute traded volumes (the methodology is listed in the 'Key' row near the bottom of the table). The table is divided between the OTC market to the left and the Exchange market to the right.

The relative hub versus hub detailed product splits for the total traded volumes are shown in Figure 1. This additional information will give a better understanding of what products along the curve are traded at each of the European hubs and how each of the hubs relates to the others. However, the splits are all percentages of each hub's total traded volume and not absolute volumes.

Although it is possible to trade all along the curve in the OTC market in each of the European gas hubs, in reality only the TTF and NBP trade in any quantity⁵ beyond the Month Ahead contract, although some of the other hubs are noticeably improving.⁶ When looking at the percentage splits, it is the TTF that has the highest percentage of the total trading being done in the Quarters, Seasons and Years (just over 65%, a little lower than in 2016).

Figure 1: Product split of total traded volumes (%): hub vs. hub; 2018



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

In absolute volumes, the German hubs follow (although in percentage terms they are both around 50% curve trading) but it is the emerging Spanish PVB which has risen to second in percentage terms of curve trading with 61% (albeit with relatively low absolute volumes), followed by the Italian PSV with 57% (in growing absolute volumes; see Table 3). In this metric, the British NBP has dropped back to fourth position with 54% curve trading, although in much higher absolute volumes.

The Belgian market is almost exclusively OTC with a small amount of spot Exchange trading. Overall, it still has reasonable liquidity despite traded volumes at ZEE falling sharply, partly offset by slowly rising volumes at ZTP. The spot/prompt and first month part of the curve accounts for 60% of the total traded volume at ZTP and 51% at ZEE; whilst the remaining 40/49% is in the near to mid curve, mainly traded in spreads against the NBP but with a limited amount of spreads against TTF and NCG.

The French TRF has improved its ranking since 2016, especially in 2018. Traded volumes have increased by 20% since 2016 and the percentage of curve trading has improved from 41% to 52%; there is still mixed liquidity along the curve, with most of the trading in the front Quarters and Seasons, less in the Years.

However, it must be noted that, although the percentages of spot/prompt may be quite high for both the Belgian and French hubs, their absolute traded volumes fall short of the PSV, German hubs, and far short of the British and Dutch hubs (as shown in Table 3).

⁵ In absolute volumes.

⁶ In percentage terms.

Finally, let us look at options traded products. These products are favoured by financial participants, especially banks and hedge funds and are usually only traded in mature markets that have good liquidity and transparency. Only NBP and TTF recorded Exchange options volumes (as well as a small quantity of OTC), although both are lower than in 2016. The NBP Exchange options accounted for 9.5% of its total Exchange volumes and the TTF 5.6% of the total Exchange traded volumes. However, adding the OTC volumes and then looking at the share of all traded volume, the NBP options accounted for 2.9% (down from 7.1% in 2016) and TTF for 3.3% (up from 1.7% in 2016).

With respect to the number of traded products it is clear from the tables that TTF and NBP have the greatest volume and TTF the greatest percentage of curve trading, both hubs having a reasonable percentage of options trading. The German hubs (especially NCG) are next in absolute volumes and also in the types of product traded. PSV has continued to improve significantly since 2016, consolidating its ranking of 5th highest traded volumes but also shows that significant volumes are being traded along the curve, mostly OTC. The French TRF has overtaken the combined Belgian hubs in total traded volumes and in the percentage split of curve trading. The Spanish PVB is showing definite signs of promise, especially in the split towards curve trading; however, as can be observed in Table 3, the total traded volumes are still relatively low.

These results show that in 2018, on Key Element 2, TTF and NBP were mature; that the German hubs, PSV, TRF, VTP and ZEE were active, with developing depth, transparency and liquidity; and that the ZTP, PVB and VOB cannot yet be considered as deep, transparent or liquid.

Key Element 3: Traded volumes

Traded volumes openly tell the tale of market activity; whatever the number of participants, whatever the types of product available, the volumes tell a very important story in the analysis of the development of a market, in this case the traded gas hubs. The traded volumes, compared to the overall size of the underlying market, determine the churn rate (see below), which is probably the most important factor in determining the success of a traded market. Generally speaking, markets with very high absolute traded volumes also have a large churn rate, have a large and varied range of participants and are usually free from price manipulation.

Table 3 shows the total traded volumes at each of the hubs in 2008, 2011, and 2016 and the progression from 2016 to 2018. In this table, mature hubs are shown in green; the active hubs, with developing depth, liquidity and transparency in amber; and the poor hubs, which cannot yet be considered as deep, transparent or liquid, in red.

Both TTF and NBP have by far the greatest traded volumes, and have done so throughout the decade; the big change over that period is that TTF overtook NBP in Q2-2016 (see Figure 2), with strong year-on-year increases since 2014. However, the greatest divergence between these two hubs occurred in 2018, with TTF increasing by 20% and NBP dropping by 28%.

The German hubs have been rather disappointing, having seen early growth from 2008 to 2014 but then easing back and remaining broadly the same over the past 3 years. The Italian PSV though has recorded progressive increases in traded volumes since 2014 and, in 2018, passed 1,000TWh, qualifying it as an 'active' hub in this metric and bringing it very close to the German GPL.

The French TRF saw a rise in activity in the 4th quarter of 2018, following the merger of PEG Nord and TRS; it remains to be seen whether this increase will continue in 2019. The Austrian VTP has seen a small but steady increase in its volumes over the past five years and appears to have successfully made the transition from a major physical trading point (Baumgarten/CEGH hub) to the virtual trading hub it is today.⁷

The really sorry account is that of the Belgian ZEE hub, which saw its peak in 2013 at 1,040TWh, falling year on year to just 460TWh in 2018. The virtual hub ZTP which started in late 2012 has

⁷ The locational CEGH hub was superseded by the virtual VTP hub in 2013.

helped sustain Belgian traded gas volumes but even then, despite a very strong growth to 150TWh in 2018, only made a Belgian total of 610TWh, ranking them joint 8th in the table.

The last two hubs in absolute volumes are the Spanish PVB and the Czech VOB. The PVB has grown solidly year on year since its inception in late 2015 (taking over from the previous AOC balancing mechanism), increasing its traded volumes from just 30TWh in 2016 to 100TWh in 2018, and no longer last in the table. In that position now is the VOB, which had seen very rapid growth from 35TWh in 2013 to 105TWh in 2016 but, since then eased back to just 80TWh in 2018.

Table 3: Total traded volumes: 2008–2018

2018	TOTAL TRADED VOLUMES* (TWh)						
HUB	2008	2011	2016	Δ% =>	2017	Δ% =>	2018
TTF	560	6295	22230	+6	23460	+20	28220
NBP	10620	18000	20045	+5	20970	-28	15105
NCG	360	880	2080	-17	1730	+2	1760
GPL		310	1110	+2	1130	+2	1150
PSV	160	185	885	+7	945	+12	1060
TRF	PEG N 185	PEG N 430	PEG N+TRS 650	-2	PEG N+TRS 640	+18	780
VTP	CEGH 165	CEGH 170	530	-	530	+23	650
ZEE	500	870	755	-32	510	-10	460
ZTP	n/a	n/a	25	+60	40	+275	150
PVB	n/a	n/a	30	+200	60	+67	100
VOB	n/a	n/a	105	-5	100	-20	80

*rounded to nearest 5TWh; not the same data sources in all years.

Sources: 2008: converted from bcm in IEA 2009 Natural Gas Review, p.30;

2011: LEBA, ICIS, ICE, ICE-Endex, EEX, Powernext, CEGH, GME; P. Heather.

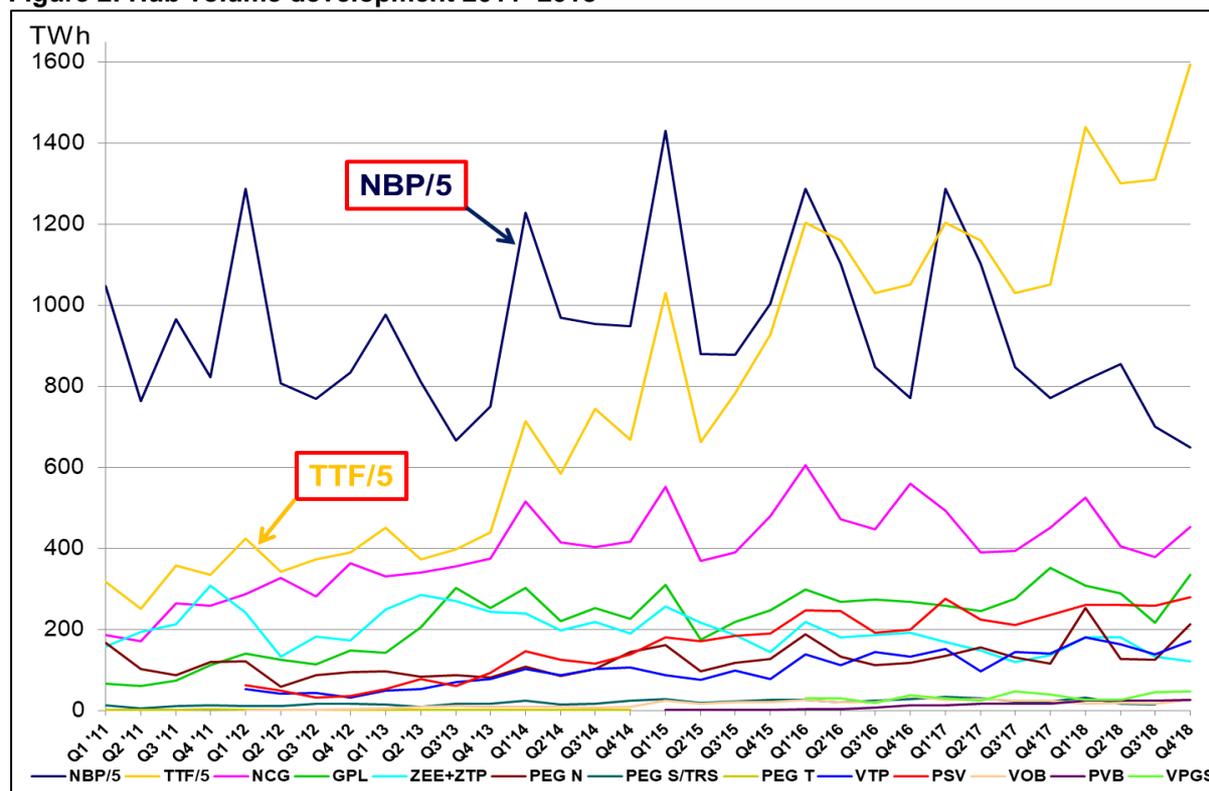
2016, 2017, 2018: LEBA, ICIS, ICE, ICE-Endex, PEGAS, CME, CEGH, GME; MIBGAS; P. Heather

The situation in 2018 is that TTF is now 1.9 times bigger than NBP but those two hubs together simply dwarf all the others in the amount of volume traded: out of a total of 49,515TWh traded across all the hubs, TTF and NBP together accounted for over 87%.

The progress in traded volumes of all the hubs from 2011 to 2018 is shown in Figure 2. Over the decade from 2008, all the hubs have grown with the sole exception of ZEE which is down 8%. The TTF has grown over 50 times, the German hubs together over 8 times, the PSV nearly 7 times, with the TRF (compared to PEG Nord) and VTP about 4 times. The hub with the least growth is the NBP, primarily because it was the only mature hub in 2008 with nearly 11,000TWh traded that year and because it has now lost much of its European benchmark status to the TTF.

These results show that in 2018, on Key Element 3, TTF and NBP were mature; that the German hubs and PSV were active, with developing depth, transparency and liquidity; and that all the other hubs cannot yet be considered as deep, transparent or liquid.

Figure 2: Hub volume development 2011–2018



Sources: OTC: LEBA; ICIS; Exchange: ICE, ICE-Exend, EEX; Powernext; PEGAS,CME, CEGH, GME; MIBGAS; P. Heather

Key Element 4: Tradability Index

The ICIS Tradability Index is not in itself an indication of a deep, liquid and transparent market but it can assist the analysis of the development of a traded hub, in conjunction with other metrics. This is because it only looks at the bid/offer spread without evaluating the depth of the market at the quoted prices; therefore, although it is good if a market has a tight bid/offer spread, this is less significant if only a small volume can be traded at the advertised price/s. However, it is included here to complement the other key elements that help to determine the depth, liquidity and transparency of the hubs in question.

For the Index⁸ to have any meaning, it is necessary to look firstly at the progression of the Index over time, then secondly at the actual numbers, as well as comparing it with the other metrics. In practice, a score of 18/20 or above indicates that the hub in question does have reasonable liquidity. A result of 14/20 or above indicates that, on this one metric, the hub in question shows potential and should then be analysed further by using the other metrics, and a result below 14/20 is not very meaningful.

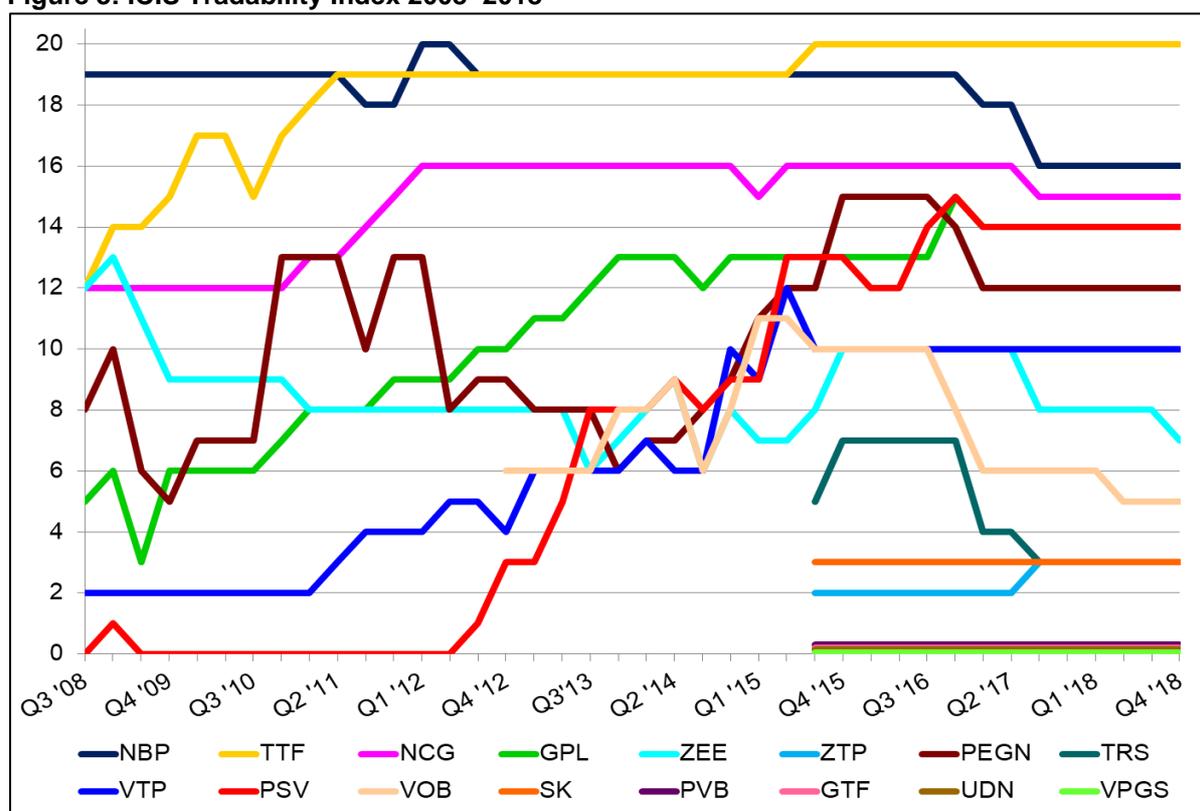
By looking at Figure 3, it can be seen that in 2008 NBP was the only mature hub, with all the other hubs at that time being categorised as poor. Over the ensuing decade NBP held that position until, from Q1-2017, it started to fall in line with that hub's lessening dominance in the European traded gas market. The TTF on the other hand continually improved its score following on from the Dutch government's 'Gas Roundabout' strategy,⁹ as it attracted ever increasing volumes and liquidity, from a 'poor' 12/20 in 2008, to reach the maximum 20/20 in Q3-2015 where it has remained since.

⁸ Methodology: Mature: ≥ 18 ; Active: < 18 ; Poor: < 14

⁹ For more detail, see: Heather (2012), pp.7-11.

Both the Belgian ZEE and German NCG hubs scored 12/20 in 2008, with the NCG slowly improving into the 'active' bracket in Q3-2011 and, despite reaching and remaining at 16/20 for most of the 5 year period from early 2012 to early 2017, it has eased back a little since Q3-2017. The ZEE hub on the other hand has fared less well, mainly due to its focus on physical imports rather than out and out trading and also because its trading has been intrinsically linked to NBP (often referred to as the "NBP across the Channel").¹⁰ Furthermore, there have been a number of cumbersome, primarily administrative, procedures that have inhibited trading at this hub unless absolutely necessary. Finally, the introduction of the ZTP virtual hub in October 2012 started to take volumes away from ZEE, which at the end of 2018 stood at just 7/20.

Figure 3: ICIS Tradability Index 2008–2018



Sources: ICIS European Gas Hub Reports; P. Heather

The French market has had a checkered journey, having a much lower score than its gas market would suggest. It has Europe's fourth largest gas consumption, a well-developed grid (in the north), was one of the first countries to set up virtual trading hubs and have an exchange promoting gas trading. However, it was also the country with initially 5 balancing zones (and traded markets), reducing to 3 in 2009, with PEG Nord as the main traded hub – and the only one analysed by ICIS for its Tradability Index, prior to the merger in 2015 of the 2 southern French hubs into the TRS. Although it has increased its score over the decade, the progress has been very volatile, going from 8/20 in 2008 to just 5/20 in Q4-2009, up to 13/20 in Q4-2010, back down to 6/20 in Q4-2013, up to a high of 15/20 in Q4-2015, only to ease off again to its current position at 12/20.

The remaining hubs that were trading in 2008 have all progressed very well from their low starting points. The CEGH/VTP was at 2/20 in 2008, rising gradually from early 2011 to reach a high of 12/20 in early 2015, only to ease back to the current position of just 10/20. The German GPL hub progressively improved from 5/20 in 2008 to a high of 15/20 in Q4-2016, easing back to 14/20 the

¹⁰ For more detail, see: Heather (2012), pp.12-13.

following quarter, where it has remained. Finally, the PSV is the hub that has recorded the strongest improvement of all the hubs. It stood at 0/20 in 2008, remaining there until Q2-2012, when it progressively increased to a high of 15/20 in Q4-2016, easing back to 14/20 the following quarter, where it has remained.

These results show that in 2018, on Key Element 4, only TTF is mature; that NBP, NCG, GPL and PSV are active hubs with developing depth, liquidity and transparency; and that all other hubs were poor hubs, and cannot be considered as deep, transparent or liquid.

Key Element 5: Churn rates

Probably the most important measure of a gas hub's commercial success is the churn ratio, which is the ratio of traded volume to actual physical throughput: a measure of the number of times a 'parcel' of gas is traded and re-traded between its initial sale by the producer and the final purchase by the consumer. The churn rates are an excellent measure of a hub's real liquidity and success and are a parameter used in most commodity and also financial markets.

Table 4: Churn rates: 2008–2018

2018	TRADED GAS HUBS CHURN RATES*				
HUB	2008	2011	2016	2017	2018
TTF	3.3	13.9	57.1	54.3	70.9
NBP	14.4	19.8	22.1	23.9	16.9
VTP	CEGH 2.4	CEGH 2.2	5.7	5.3	6.9
NCG	0.4	1.8	4.0	3.4	3.8
GPL		0.8	2.5	2.6	2.8
ZEE+ZTP	5.1	4.1	4.1	2.9	3.1
TRF	FRANCE 0.4	FRANCE 1.0	PEG N 1.7 TRS 0.6	PEG N 1.7 TRS 0.6	1.7
PSV	0.2	0.2	1.2	1.2	1.4
VOB	n/a	n/a	1.1	1.1	0.9
PVB	n/a	n/a	0.1	0.2	0.3

*Calculated on a **Net Market Churn** basis; not the same methodology in all years.

Sources: 2008: Heather (2010), Table 6, p.19; Komlev presentation 2011; calculated from BP and IEA; 2011, 2014: LEBA; ICE ; ICE-Endex ; EEX ; Powernext ; CEGH; GME; P. Heather
2015, 2016: LEBA, ICIS, ICE, ICE-Endex, PEGAS, CME, CEGH, GME; MIBGAS; P. Heather

Commodity markets are deemed to have reached maturity when the churn is in excess of 10. In this one metric all others are, necessarily, reflected: if there are many participants, trading many different products in large quantities, then the churn rate is likely to be high. The churn rate is used by traders as a 'snapshot' of a market's liquidity; some traders will not participate in markets with a churn of less than 10 and many financial players will only participate when the churn is above 12.

Table 4 shows the hubs' net¹¹ market churn rates from 2008 to 2018. TTF has continued to improve its score to 70.9 in 2018 from 13.9 in 2011 and just 3.3 in 2008; NBP remains in second place although in 2018 it has noticeably eased off to 16.9, which is still higher than the 14.4 in 2008. These two hubs are still the only ones to register a churn rate above 10.

The hub in third position and the only other one to register a churn above 5 is the Austrian VTP, at 6.9. All the other hubs register a very poor churn rate of under 5: ZEE has progressively eased back during the decade, from 5.1 in 2008 to just 3.1 in 2018, reflecting the sharp downturn in traded volumes.

The two German hubs have barely changed their position in the past 5 years since 2014, the NCG slightly lower and GPL slightly higher; however, they are both well above the position in 2008 when there was no 'churn', just 0.4 for the 2 hubs combined.

The French churn has fared worse than the German. Both countries had a 'no churn' result of 0.4 in 2008 but France, only reached 1.7 in 2018. PSV has had a similar trajectory over the decade, although there are signs from the other metrics that there is now growing liquidity in that market, despite the Italian churn in 2018 being just 1.4. VOB and PVB do not record a 'churn', as they are both under 1.

These results show that in 2018, on Key Element 5, TTF and NBP were mature; that VTP was an active hub with developing depth, liquidity and transparency; and that all other hubs were poor hubs, and cannot be considered as deep, transparent or liquid.

Summary of the 5 Key Elements in 2018

The results from each of the 5 Key Element tables have been recorded in a summary table (Table 5).

Table 5: Summary of the 5 Key Elements in 2018

2018	5 KEY ELEMENTS					
HUB	Active Market Participants*	Traded Products**	Traded Volumes	Tradability Index (Q4)	Churn Rate	Score /15***
TTF	189	50	28220	20	70.9	15
NBP	151	44	15105	16	16.9	14
NCG	137	23	1760	15	3.8	9
GPL	105	21	1150	14	2.8	9
PSV	102	20	1060	14	1.4	9
VTP	83	16	650	10	6.9	8
TRF	50	17	780	12	1.7	7
ZEE	47	16	460	7	3.1	7
ZTP	45	12	150	3		7
PVB	41	11	100	0	0.3	5
VOB	19	11	80	5	0.9	5

* Hub Score in the OTC Active Traders table.
** Score /56 derived from the OTC and Exchange product categories in the Traded Products Table.
*** Score based on each of the Key Elements scoring zero for Grey; 1 point for Red; 2 points for Amber; 3 points for Green.

Source: Calculated from previous tables

¹¹ See Heather (2015) for an explanation of the different methodologies used to calculate the churn.

A simple scoring methodology has been used to derive the final ordering of the hubs, to reflect their level of development: mature, active, poor and inactive as indicated in the map of the European gas regions, markets and hubs (Map 1). The points system is indicated at the bottom of the table and, adding up each of the constituent Key Elements will give a hub score out of 15. A hub is classified as being 'mature' if the score is 12-15; 'active' if the score is 8-11; 'poor' if the score is 5-7; and 'inactive' if the score is 1-4.

These results show that in 2018, taking all 5 key elements into account, the TTF and the NBP are the only hubs that can be considered as mature, deep, transparent and liquid. NCG, GPL, PSV and VTP are active hubs with developing depth, transparency and liquidity; all the other hubs cannot be considered as deep, transparent or liquid.

The 3 Main Indicators

There are 3 Main Indicators¹² that reveal the level of liberalisation and market development of traded gas hubs: the political will to create the necessary framework to get the process off the ground; the cultural attitudes to trading and change to want to succeed in a trading environment; and these in turn then dictate the level of commercial acceptance in order to see all the changes through that will allow the market to grow organically.

Table 6: EFET Hub scores categorised as mature, active, poor and inactive; 2014–2018

HUB	2014	2015	2016	2017	2018
NBP	20	20	20	20	20
TTF	19	19½	19½	19	19
NCG	15½	19	19	17½	17½
GPL	16	19	19	17	17
ZTP	16	17½	18	19	17
PEGs	16	16½	18½	17½	17
ZEE	17	17	17	16½	n/a
PSV	10½	15	15	16	16½
VTP	13	13	13½	16	16½
AOC/PVB	7	7	13½	16	15½
GTF	9	11	14	15½	14½
VOB	8	8½	9½	13	14
MGP	5	6½	9	12½	11½
VPGS	4½	5½	9½	10	9½
SK	3½	7	8	8½	9½
GR	4½	5½	5½	6½	8½
UDN	5½	5	4	5½	6
BG	1½	1	1½	1	4½
PT	n/a	n/a	n/a	n/a	4½
UA	n/a	n/a	n/a	3½	3½
RO	2½	1½	2	3	3

Source: 2018 EFET Review of Gas Hubs Assessments; P. Heather

¹² See Heather (2015) for a full description of the 3 Main Indicators. This Insight gives the summary update for 2018.

These 3 Main Indicators are the basis of creating successful traded gas markets out of the 'old world' monopolistic era. They are somewhat subjective but are essential to allowing a traded gas market to develop, but they do not in themselves guarantee that a market will succeed and become mature, as can be observed by comparing the results in Table 6 against those of the 5 Key Elements in Table 5.

The EFET Gas Hub Development Study is a good proxy for evaluating the three Main Indicators across all countries, including those that do not yet have an operational traded gas hub, as it assesses 5 regulatory conditions, 5 TSO conditions and 6 market conditions. The results of the 2018 Study are given in Table 6, enhanced by a four colour coding.¹³

The order of the hubs in the top half of the table is almost identical to that in Table 5, except that EFET did not distinguish between the three PEGs (prior to zone mergers), that the NBP and TTF rankings are reversed and that the French/Belgian and Italian/Austrian hubs are reversed: these reversals of order show that a good framework to trade does not always lead to high volumes and vice-versa. Indeed, EFET has now dropped its review of the ZEE hub following that hub's diminishing importance in European gas trading. The active category is rounded off with the VTP and PVB.

EFET gives the Danish GTF hub a relatively good mid-market score, placing it at the top of the poor category (even though there is relatively little trading¹⁴), just ahead of the Czech VOB, followed by the Hungarian MGP. Interestingly, the Polish VPGS just makes it as a poor hub with a score of 9½ (although there is reasonable trading,¹⁵ along with the Slovak SK.

Finally, the remaining 6 hubs studied have low to very low scores, classifying them as inactive; indeed, the two South East European hubs in Romania and Bulgaria are still at the planning stage, as is the Portuguese hub. The Greek hub officially started balancing operations in July 2018. EFET also analyses the Turkish UDN and the planned Ukrainian hub but, so far, has not studied the IBP (planned Irish hub).

3. How traded gas hubs help the gas markets evolve

There have been several political and regulatory efforts to help deliver efficient and competitive energy markets within Europe.¹⁶ The primary legislation was the '3rd Package' Directive of 13th July 2009 which provided for legally binding Network Codes in order to create a Single Energy Market in Gas. There followed the Gas Target Model (GTM), which detailed the suite of Codes necessary to achieve that vision.

The main and first Network Code to be published¹⁷ was that on Gas Balancing of Transmission Networks (BAL NC); this Code aims to create the harmonisation of balancing regimes in Europe, to facilitate gas trading across systems and to support the development of competition.¹⁸

The main aims of the Balancing Network Code are to facilitate trading within and between cross-border balancing zones, to enhance short-term market liquidity and to provide gas flexibility via market mechanisms; to incentivise network users to balance their portfolios and ensure that imbalance charges are cost-reflective (market-based balancing); and to enable network users and TSOs to use the same trading platforms to facilitate trade and balancing.

¹³ Methodology: Mature/Green: =>18; Active/Orange: <18; Poor/Amber: <15; Inactive/Red: <9.

¹⁴ A little less than 57TWh in 2018 – see Chapter 3 below.

¹⁵ There has been very little OTC trading but the TGE Exchange (POLPX) has been offering products at the Polish VPGS hub since 2013, both spot (WD and DA) and curve (Months, Quarters, Seasons and Years). The annual traded volumes (TWh) have increased from Spot: 0.425/Curve: 1.968 in 2013, to Spot: 117.212/Curve: 26.094 in 2018.

¹⁶ A description of the relevant legislation and regulations is given in Heather (2012), pp.22-25.

¹⁷ Commission Regulation (EU) No 312/2014 (BAL NC) was published on 26th March 2014.

¹⁸ Its main objective is the promotion of short-term markets and a market-based balancing regime via harmonised rules. It establishes rules for natural gas balancing, including network-related rules on nomination procedures, imbalance charges, settlement processes associated with daily imbalance charges and provisions on operational balancing.

It follows that in order to achieve these goals, the traded markets of each balancing zone within Europe need first and foremost to facilitate the physical daily balancing of the grid but, beyond that crucial primary need, that they also offer market participants the ability to optimise their portfolios ahead of delivery and, in just a few hubs, offer market participants the ability to hedge and risk manage their portfolios. It will only be the few mature hubs that can and will provide that facility.

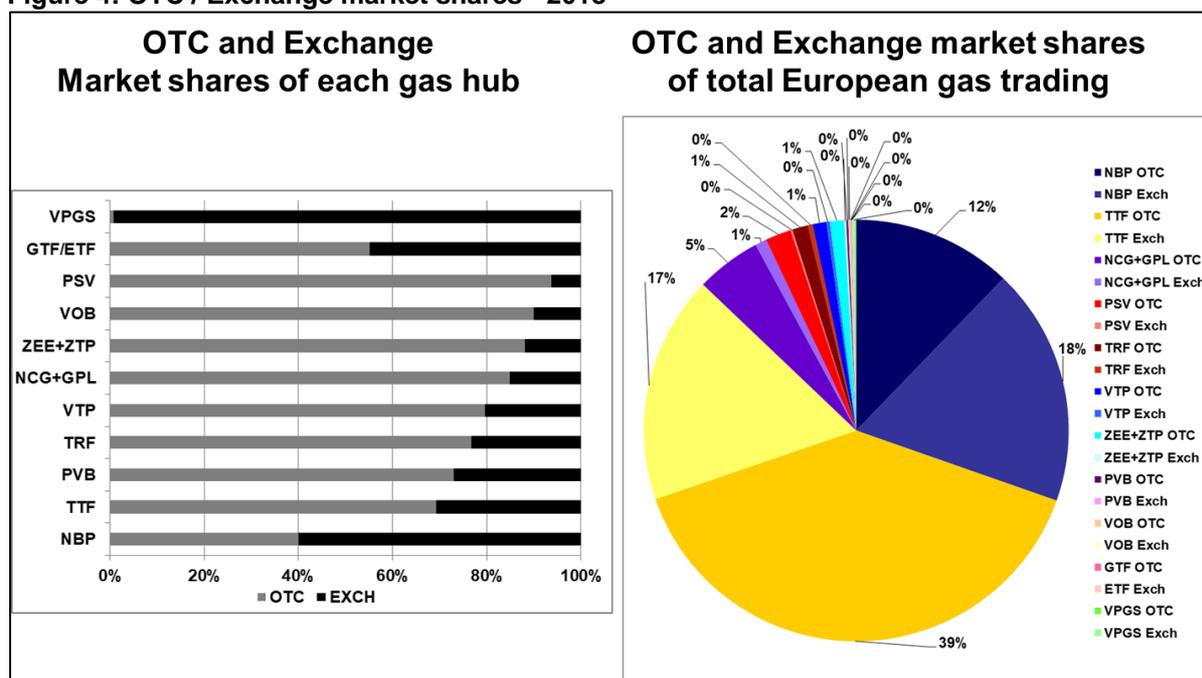
The traded markets are made up of two primary routes to market:¹⁹ via the Over-The-Counter (OTC) market and via Exchanges offering futures contracts. These two routes to market have different peculiarities, benefits, and drawbacks but are certainly complimentary and exist in all mature commodity markets.

Mature OTC gas markets: their function

The OTC markets offer bilateral, often standardised, forward contracts and are in most European countries the favoured route in gas trading (see Figure 4). They can offer an open and transparent way to trade bilaterally (as opposed to non-transparent bilateral one-to-one negotiated contracts) that fosters trading, competition and, ultimately, the 'best' or 'right' price for gas at any given time. The more active of these markets tend to attract many participants of different types who then bring additional liquidity over and above the pure physical participants.

Liquid markets allow for the ability to physically adjust portfolio volumes over time and, importantly to hedge and financially risk manage gas portfolios.

Figure 4: OTC / Exchange market shares - 2018



Sources: LEBA, ICIS, ICE, ICE-Endex, PEGAS, CME, GME; MIBGAS, TGE; P. Heather

Mature gas markets can help provide Security of Supply and Security of Demand, both equally important in creating a successful ongoing marketplace for the pricing of short, medium or long-term contracts and for the buying and selling of, usually, marginal quantities of physical gas.

¹⁹ A full explanation of the Routes to Market can be found at Heather (2010), pp.24-27.

Most of all, mature, open, transparent and liquid markets provide secure Risk Management tools, used by both producers and consumers, as well as other market participants such as wholesalers, financial institutions and hedge funds.

Figure 4 (left hand bar chart) shows how prevalent the OTC markets are in most of the European gas markets although there are some notable exceptions. The British NBP has a majority of Exchange trading, which had historically been between 10-20% of the market's total traded volumes until the end of the 2000's. However, post financial crash and in line with the North American markets, there was a surge towards Exchange trading as this was perceived as being a less financially risky route to market, given that it is regulated and that the contracts are 'cleared' by a Clearing House and financially guaranteed. Today, the extent of exchange trading at the NBP has risen from ~30% in 2011 to ~60% in 2018. Similarly at the TTF, there has been a progressive rise of the proportion of exchange trading, from ~6% in 2011 to ~31% in 2018. Much of this increase at TTF has been due to non-physical players entering this market as it has progressively matured and now become not only the € denominated gas benchmark but *the* European gas benchmark.

The Spanish PVB and French TRF also have a reasonable amount of Exchange trading but for quite different reasons. France has had a pro-active gas exchange (Powernext) since the mid-2000's, offering a wide range of contracts including Nord/Sud spreads as part of a Market Coupling initiative.²⁰ It has also been offering traded spreads with TTF and ZEE and, over time, it was apparent that many French Shippers were hedging/risk managing their portfolios longer term at the TTF, then bringing their traded positions back to PEG Nord through primarily exchange traded spreads. Consequently, exchange trading at TRF (and previously at PEG Nord) has been above 20% for a number of years.

Spain is a newcomer as a 'proper' virtual traded hub, the PVB being in existence since only late 2015. However traded volumes have risen sharply from zero to 100TWh in just three years. From the start the Spanish exchange, MIBGAS, has been a part of this new market and the growth in trading. It originally only offered spot/prompt and a Month Ahead contract but, from Q4-2018, has also offered futures contracts down the curve. All contracts have proved successful with Spanish Shippers and the exchange now accounts for ~27% of all trading. The OTC/Exchange difference in the spot/curve split though is very interesting: OTC, curve trading accounts for 97% of the total whereas at the Exchange the split is fairly even with a 51% spot/49% curve split (bearing in mind that curve trading only occurred in Q4).

Finally, there are two anomalies in the Polish VPGS and Danish GTF/ETF. The Danish market is still relatively 'inactive' with a limited number of players and a total traded volume in 2018 of 57TWh. The gas market is actually two separate markets, with two virtual trading points, the Gas Transfer Facility (GTF) for OTC trading and the Exchange Transfer Facility (ETF) for Exchange trading and they each have about half the total market share (55% GTF/45% ETF).

The Polish VPGS is an anomaly because it is not reflective of a 'proper' liberalised market in the sense that the incumbent oil and gas company PGNiG is still very much the dominant force in gas trading and very little has changed since the analysis given in Heather (2015).²¹ Because PGNiG was forced by the government to deliver an ever-increasing proportion of its gas supplies on to the gas exchange, nearly all of the exchange trading effected is in essence just that: PGNiG supplies to its customers via the exchange! There is virtually no OTC trading in Poland, either in percentage terms or in absolute terms.²²

Figure 4 (right hand pie chart) shows the OTC and exchange market shares of total European gas trading for each hub. This clearly shows graphically the points mentioned above and that TTF has 56% of all trading, NBP 30%, with much smaller shares for the German hubs and PSV; all the other hubs just have slithers of colour showing.

²⁰ The Powernext market-coupling scheme was backed by the TSO, GRTgaz, but could not address the fundamental problem of insufficient physical capacity in the connection between the two zones. See Heather (2012), p.19.

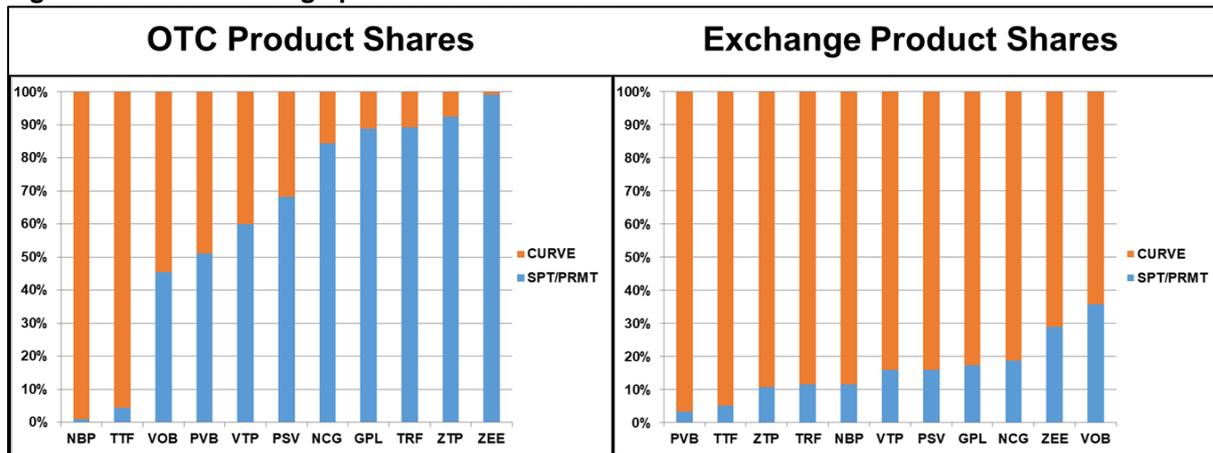
²¹ See full account in Heather (2015), pp.44-46.

²² See 'Emerging hubs' below for trading data.



Figure 5 shows the OTC / Exchange product shares for each of the hubs. What is very noticeable is that the product shares of OTC and Exchange trading are very different with curve trading dominating on Exchange trading and spot/prompt dominating on OTC trading, except for NBP and TTF. Interestingly, the product share split at TTF is almost the same whether trading is done OTC or through the Exchange, at about 95% curve and 5% spot/prompt.

Figure 5: OTC / Exchange product shares - 2018



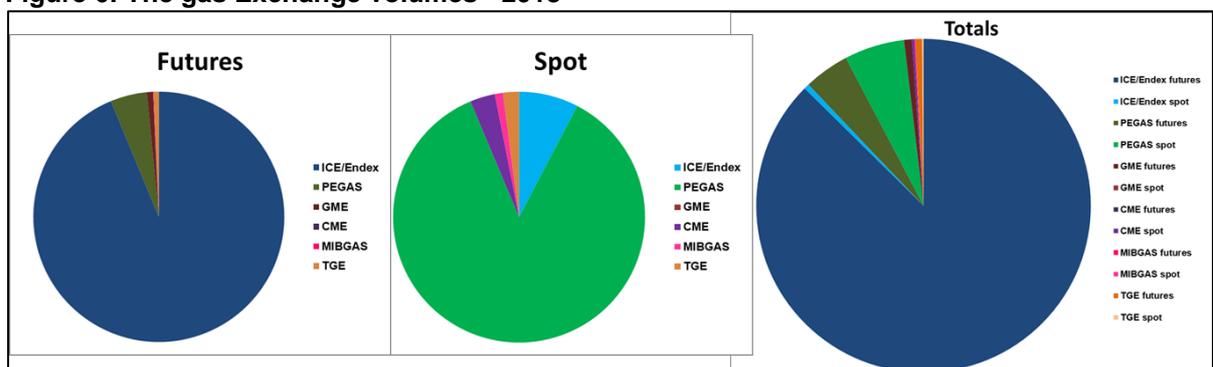
Sources: ICE, ICE-Endex, PEGAS, CME, GME; MIBGAS; P. Heather

Gas Exchanges: their role and function

As mentioned above, there was a sharp increase in Exchange trading post-financial crisis, especially in Anglo-Saxon countries from 2010 onwards, due to these markets being more financially secure than the OTC markets. Nevertheless, the Exchanges are complementary to the OTC market and offer an alternative route to market for market participants, having very different modes of trading, different cash flow implications and of course, a different risk profile.

Being regulated markets, Exchanges are obliged to make public the price and volume data which promotes price transparency and discovery and therefore, the ability to know the price of gas now for immediate delivery and in the future (up to six years ahead on ICE NBP and five years for ICE-Endex TTF). The data are publicly and easily accessible, either on the Exchanges' own websites or disseminated through price reporting agency screens.

Figure 6: The gas Exchange volumes - 2018



Sources: ICE, ICE-Endex, PEGAS, CME, GME; MIBGAS, TGE; P. Heather

Exchange trading allows for the ability to easily separate the price function from the physical supply function thereby providing a facility for managing price risk through a secure and regulated market, whilst keeping the physical flows separate.

As well as allowing for hedging and trading, the exchanges can also be a market place for the buying and selling of, usually, marginal quantities of physical gas and are in many countries the vehicle used for the balancing requirements of that hub.

However, the main role and function of gas Exchanges is that they are complementary to the OTC markets and assist in the development of traded gas hubs in a secure, regulated environment.

Figure 6 shows the various European gas Exchange volumes in 2018. The ICE/ICE-Endex dominates with 88% of the total Exchange volumes, with PEGAS accounting for 10% and the other Exchanges for just 2%. When looking at the shares for futures and spot contracts, ICE clearly dominates the futures (with 94% and PEGAS 5%) but PEGAS dominates the spot (with 86% and ICE 8%), which is a reflection of the product shares shown in Figure 5.

Emerging hubs: Recent and forthcoming market developments

Shown in Map 1 are 8 'inactive' hubs: the Polish VPGS,²³ the Hungarian MGP,²⁴ the Danish GTF/ETF,²⁵ the Slovak SVOB,²⁶ the Greek HTP²⁷ and the Turkish UDN,²⁸ plus the two Irish balancing hubs. These hubs have not been included in the analysis of the 5 Key Elements as it is mostly very difficult to get all the necessary data and/or the hubs themselves are too recent for there to be any data to be collected.

However, it is interesting to compare what data is available with those of the other European hubs. Table 7 shows the traded volumes for six of those hubs in the spot, prompt and curve contracts for both OTC and Exchange trading. As can be observed, there are great disparities between them as well as several cases of unavailable or inconsistent data.

Table 7: Selected Emerging hubs traded volumes - 2018

2018	EMERGING HUBS TRADED VOLUMES (TWh)						
HUB	OTC			EXCHANGE			TOTAL
	PRMT	CURVE	TOTAL	SPOT	CURVE	TOTAL	
VPGS	0.01	1.12	1.13	26.09	117.21	143.30	144.43
MGP	34.32	74.50	108.82	6.35	0.43	6.78	115.60
GTF/ETF	n/a	n/a	31.33	0.16	25.12	25.28	56.61
SVOB	1.03	2.96	3.99	no exchange trading			3.99
HTP	Nil	Nil	Nil	currently balancing only*			Est. <3
UDN	No available information			mostly daily balancing**			Est. <1

*the Greek TSO Desfa's balancing platform went live 1st July 2018.
 **the Turkish exchange EPIAŞ went live on 1st October 2018.

Source: ICIS, IENE, PEGAS, TGE, CEEGEX, HUDEX, company websites; P. Heather

The reasons for the disparity between OTC and Exchange trading at the VPGS were given in the previous chapter but are made even more apparent when the actual volumes are observed: just

²³ Virtual Point Gaz-System; PL; 2014.

²⁴ Magyar Gázkiegypont (Hungarian Gas Balancing Point); HU; 2010.

²⁵ Gas Transfer Facility / Exchange Transfer Facility; DK; 2004/2008.

²⁶ Slovenskom Virtuálnom Obchodnom Bode (Slovak Virtual Business Point); SK; 2016.

²⁷ Hellenic Trading Point; GR; 2018.

²⁸ Ulusal Dengeleme Noktası (National Balancing Point); TR; 2011.

1.13TWh traded OTC compared to a relatively important 144.43TWh traded on the TGE exchange, reflecting the PGNiG gas deliveries to its customers. The Hungarian MGP has been operational since 2010 and has had a slow but steady rise in activity over the years, resulting in a total traded volume in 2018 of just over 115TWh. This compares favourably with say the Czech VOB or Spanish PVB, except that there are fewer active trading participants and the range of traded products is less. On a positive note, the EFET assessment has improved from just 5/20 in 2014 to 12.5/20 in 2017, easing back to 11.5/20 in 2018. The MGP scored²⁹ well in several important criteria such as having a fully established Entry/Exit system with Title Transfer; efficient Cashout Rules with Imbalance Charges; Standardised Contracts with PRAs reporting Daily Prices; and an Exchange.³⁰ It needs to improve in a further 5 criteria (especially in Transparency and Consultation); and it scored zero in 5 more criteria.

The Danish GTF (OTC) market has been operational since 2004 yet the OTC it is still focused on the prompt and near to mid curve, mainly traded by Shippers adjusting or balancing their portfolios; there does not appear to be any or much trading from financial participants. Although EFET gave the Danish market a mid-table score of 14.5/20, it scored it zero in three important criteria: PRAs reporting a daily hub price; spot liquidity; and curve liquidity; and could improve in 4 criteria including Transparency. The ICIS Tradability Index scored the GTF at zero in Q4-2018.

The remaining hubs in Table 7 barely registered any trading; they all scored poorly in the EFET assessment³¹ and in the ICIS Tradability Index.³² A feasibility study is currently being undertaken in Greece by the Commodity Exchange³³ regarding the introduction of futures contracts at the HTP. There also appears to be a political will to see the country become a regional gas hub,³⁴ although that vision had been expressed as far back as 2012 and progress since then towards a liberalized traded gas market has been very slow indeed. The same can be said regarding Turkey becoming a regional gas hub, but this seems unlikely in the near term given the numerous structural, commercial and political barriers to be overcome.³⁵ On a positive note, the Turkish exchange EPIAŞ has finally started to offer a gas contract since the 1st October 2018, but initial results are poor with quite low volumes of mainly balancing gas traded.

The other two hubs shown in Map 1 are the NIBP³⁶ and the IBP,³⁷ the balancing hubs in Ireland. The north and the south are intrinsically linked to Great Britain for their gas supplies coming from the Moffat IP in Scotland and delivered through three undersea pipelines.³⁸ Northern Ireland does not have access to any other gas supplies, whilst the Irish Republic has its own production, supplying in 2018 some 43% of its consumption.³⁹ The pricing of gas in the Republic and the North has historically been closely linked to the British NBP and there was little incentive to follow the European Gas Directives. However, pressure from Brussels has meant that both countries have now adopted measures to comply with the EU Network Codes.

²⁹ Source: 2018 EFET Review of Gas Hubs Assessments.

³⁰ In fact there are two Exchanges, the Central East European Gas Exchange (CEEGEX) for spot/prompt trades (WD/DA): <https://ceegex.hu/en/>; and the Hungarian Derivatives Exchange (HUDEX) since January 2018 for futures contracts (3 Months/4 Quarters): <https://hudex.hu/en/>

³¹ SVOB – 9.5/20; HTP – 8.5/20; UDN – 6/20.

³² SVOB – 3/20; HTP – Not Assessed; UDN – zero/20.

³³ Hellenic Energy Exchange (HEEx): <https://www.europex.org/members/henex-hellenic-energy-exchange/>

³⁴ For more detail see Heather (2015), pp.50-55.

³⁵ Ditto.

³⁶ Northern Ireland Balancing Point; UK; 2015.

³⁷ Irish Balancing Point; IE; 2017.

³⁸ See map of the National Transmission System in Heather (2010), Appendix A.

³⁹ The Corrib field started production in December 2015 and although it has an estimated life of 20 years, peak production was reached in 2017 and it is now already in slow decline.

A recent report⁴⁰ by the Northern Ireland TSOs⁴¹ stated that:

“In Northern Ireland, the NI Network Codes have historically included market based balancing rules, under which Shippers are incentivised to manage their imbalance positions, and the NI TSOs take residual balancing action only where it is necessary to keep the system physically balanced. The net costs are met by all Shippers through a ‘disbursement account’ which is managed by the NI TSOs.

The changes to the NI Network Codes in 2015 for EU compliance introduced the Northern Irish Balancing Point (‘NIBP’ or ‘Trading Point’) for the first time. The NI BP is a notional location at which Shippers can trade gas with each other within the NI balancing zone. These arrangements have just completed their first year of use, and whilst there is some trade taking place, it is at minimal levels”.

Since this was published, there has not been any significant increase in trading activity and the NIBP is essentially only used for the purposes of balancing.

The Republic of Ireland introduced its own Irish Balancing Point in October 2017 and, after a slow start, it did pick up interest during the course of 2018, although in comparison with other European hubs, it is still in its teething stage.

A news report published by ICIS⁴² in April 2018 stated that:

“Liquidity on a new natural gas trading venue in the Republic of Ireland has climbed in April, ahead of the start of market-based balancing in May. After the first transaction was concluded on 5 October 2017, Irish participants have been using the electronic platform to balance physical positions on the Irish Balancing Point (IBP).

As balancing platform operator, EBI will be obliged to be publish a daily price for within-day transactions at the IBP [...] which would form the basis of imbalance charges. The current balancing regime, where GNI uses balancing contracts awarded to shippers through a tender, will remain in place as a backup.

EBI said that while their platform does provide scope for offering IBP-NBP basis contracts, they are assessing market interest in trading other products”.

The broker referenced above is Energy Broking Ireland and their website adds:

“Energy Broking Ireland (EBI) offers a local broking service [...] using an electronic trading platform with the option of voice broking. The service was launched in October 2017 and to date (September 2018) over 1,000 transactions have been executed on the platform. On a given day, anywhere from 5% to 20% of Ireland’s gas demand is traded through the platform.

Almost all the largest buyers and sellers of gas in Ireland trade on the EBI platform. Currently, the main products traded on the platform are Within-Day and Day-Ahead gas”.

However, neither ICIS nor EFET assess the IBP in their respective European hubs reports, not yet anyway. By all accounts, the IBP is successfully doing the job of providing efficient balancing tools, with the help of the broker platform. Remains to be seen whether this emerging hub might develop quickly if/when Brexit happens?

⁴⁰ Interim Measures Update Report, 20th December 2016: <http://www.mutual-energy.com/wp-content/uploads/downloads/2017/01/161220-Interim-Measures-Report-2016-for-Consultation.pdf>

⁴¹ There are four TSOs in Northern Ireland: Premier Transmission, Belfast Gas Transmission, West Transmission, and Gas Networks Ireland (UK).

⁴² ICIS, 27th April 2018: “Republic of Ireland gas market liquidity surges”: <https://www.icis.com/explore/resources/news/2018/04/27/10216648/republic-of-ireland-gas-market-liquidity-surges/?redirect=english>

As at the end of 2018, there are still a number of European Union Member States without an established gas hub, including Portugal, Sweden, Finland, Croatia, Slovenia, Romania and Bulgaria. All of these countries have a planned hub or another means of satisfying the EU Directives, although it might take several more years for them all to comply.

Portugal has not yet created its own virtual traded hub and does not have a traded gas market despite the efforts of the MibGas exchange in particular.⁴³ Frustratingly, the current situation is one where there is no virtual trading hub in Portugal (although there is a regulated 'virtual point') and there is no balancing zone with daily balancing (as required under the European Network Code). Although MibGas has been authorised and is set up and ready to take that role operationally, the TSO (REN) is balancing using Spanish balancing tariffs.⁴⁴ EFET has started to assess Portugal in its 2018 Review of Gas Hubs, giving the country a score of 4.5/20.

The much talked about creation of a single Iberian Market⁴⁵ Area has been extremely slow to develop, mainly due to a lack of political action, despite the apparent will expressed through the signing of Treaties and various press statements. A complication is that the Spanish government wants a high level, fully detailed, Inter-Governmental Agreement (IGA) with Portugal, in order to proceed to creating the new Iberian gas hub but the two regulators, CNMC and ERSE, both believe that progress could and probably will be made by them cooperating.⁴⁶

The Swedish gas market⁴⁷ is very small and fragmented; there is a physical gas pipeline connection with Denmark feeding the south-west of the country and another totally separate gasified zone around Stockholm which is supplied by LNG. Due to this specific gas structure, there are no Shippers and to gain access to the Swedish market a supplier needs to acquire transmission capacity on the Danish interconnector. There is no wholesale market and there is no gas trading in Sweden.

As from 1st April 2019 Denmark and Sweden merged their gas markets into one Joint Balancing Zone,⁴⁸ only the second such cross-border balancing zone in Europe.⁴⁹ In order to do this, the lower grid pressure in Sweden has needed to be gradually equalized with that of Denmark.

Finland has not been connected to any other EU gas grid and as such received a derogation allowed by the Natural Gas Market Directive. Following this, the natural gas market has not been opened in the manner specified in the Directives. This exemption is effective as long as Finland does not have a direct connection to the natural gas network of any other EU Member State and as long as it has only one main natural gas supplier.

This is about to finally change at the beginning of 2020 with the opening of the Balticconnector pipeline project.⁵⁰ Balticconnector is a bi-directional natural gas pipeline under construction between Ingå, Finland and Paldiski, Estonia that will enable the integration of the Finnish and Baltic systems with the EU's common gas market.

In February 2019 the TSOs of Finland, Latvia and Estonia⁵¹ signed an Inter TSO Compensation (ITC) agreement,⁵² which enables the functioning of a single gas transmission tariff zone for Finland, Estonia and Latvia from the beginning of 2020.

⁴³ Heather (2019), p.31.

⁴⁴ Heather (2019), p.6.

⁴⁵ For a full account of the Iberian gas market, see Heather (2019).

⁴⁶ Heather (2019), p.31.

⁴⁷ For more detail, see Heather (2015), p.41.

⁴⁸ Excluding the Stockholm gas grid.

⁴⁹ The other being the merged Belgian and Luxembourg Market Area.

⁵⁰ See <http://balticconnector.fi/en/the-project/>

⁵¹ Gasum Oy, AS Conexus Baltic Grid and Elering AS.

⁵² Gasum press release, 14th February 2019: "Finland, Estonia, Latvia Single Gas Transmission Tariff Zone – 1Jan2020": <https://www.gasum.com/en/About-gasum/for-the-media/News/2019/the-gas-tsos-of-finland-estonia-and-latvia-have-reached-a-new-voluntary-agreement-on-inter-tso-compensation-system/>

Croatia took ten years to reach full liberalization of its natural gas market in 2017, but there is no gas hub or exchange and the limited trading that does occur is through bilateral contracts. Similarly, its neighbour Slovenia does not have a gas hub or exchange and the wholesale market is made up of bilateral trades between suppliers and distributors.

In south-east Europe, Romania and Bulgaria are very slowly moving towards liberalized gas markets, albeit with prolonged delays due in part to a lack of political will and continued political intervention. In Romania, regulated prices have been an important factor delaying the introduction of a liberalised, traded gas market. In fact after a small step in the right direction 2 years ago, the Romanian government decided to implement a new Decree at the end of 2018⁵³ imposing new levels of Regulated Selling Prices. This led to a formal notice from the EU in March 2019:

*“...for failing to correctly implement certain requirements of the gas directive and the security of gas supply regulation. The Commission found that the system of regulated wholesale prices newly introduced in the Romanian gas market goes against the EU legal requirements”.*⁵⁴

EFET gave Romania a score of 3/20 in its 2018 Review of Gas Hubs.

Bulgaria appears to be faring a little better and, according to a report by Deloitte,⁵⁵ “the Bulgarian Energy Regulator has taken significant steps towards the full liberalization of the natural gas market”. More recently, it was announced⁵⁶ that the Bulgarian Parliament has adopted amendments to the Energy Act “to ensure the implementation of the European directive establishing a network code on gas balancing of transmission networks”. A gas release programme will also be introduced to encourage a more competitive market. EFET gave Bulgaria a score of 4.5/20 in its 2018 Review of Gas Hubs.

4. Is the dominant position of the Dutch TTF under threat?

Groningen: Earth tremors and sharp decline in production

There have now been a number of earth tremors in the Groningen Province attributed to gas extraction of which nine had a magnitude of over 3.0 on the Richter scale since 2001;⁵⁷ the first occurred in 1986 and was largely ignored as a ‘one-off’ incident but the tremor in August 2012⁵⁸ triggered a public backlash and a subsequent shift in the Government’s attitude towards gas extraction, from which time it started to impose restrictions on production.

Further serious tremors in 2018⁵⁹ and 2019⁶⁰ have hardened the Government’s resolve to completely stop production in an accelerated time frame,⁶¹ initially by 2030 and now sooner, possibly by as soon as 2025.

Peak Groningen production of 53.9bcm was reached in 2013 but since then production has been subject to caps⁶² imposed by the Ministry of Economic Affairs and Climate Policy, who by 2018 had

⁵³ A government decree issued in late December forces domestic natural gas producers to sell their output mainly to suppliers at the regulated price of 68 lei (\$16/14 euro) per MWh until 2022, down from 90 lei previously.

⁵⁴ SeeNews.com, 7th March 2019: “EU Commission urges Romania to comply with gas supply regulation”:
<https://seenews.com/news/eu-commission-urges-romania-to-comply-with-gas-supply-regulation-645710>

⁵⁵ Deloitte report; “Natural Gas Trading Obligations” March 2018, slide 26:
<https://www2.deloitte.com/content/dam/Deloitte/ro/Documents/Natural%20gas%20trading%20obligations.pdf>

⁵⁶ Novonite.com, 28th June 2019: “Bulgarian Parliament Adopts on Amendments for Liberalisation of Natural Gas Market”:
<https://www.novonite.com/articles/198162/Bulgarian+Parliament+Adopts+on+Amendments+for+Liberalisation+of+Natural+Gas+Market>

⁵⁷ For an overview of the Groningen earth tremors, see: The Northern Times, 12th January 2018: “History of earthquakes in Groningen”: <https://northerntimes.nl/history-of-earthquakes-in-groningen/>

⁵⁸ 16th August 2012: a tremor of 3.6 magnitude on the Richter scale at Huizinge.

⁵⁹ 8th January 2018: a tremor of 3.4 magnitude on the Richter scale at Zeerijp.

⁶⁰ 22nd May 2019: a tremor of 3.4 magnitude on the Richter scale at Westerwijtwerd.

⁶¹ Platts, 22nd May 2019: “Groningen earthquake raises specter of accelerated Dutch gas phase-out”:
<https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/052219-dutch-gas-producing-groningen-region-hit-by-34-magnitude-earthquake>

declared⁶³ that the extraction level would be reduced to below 12bcm/year, no later than October 2022 and possibly even one year sooner. Depending on the impact of the measures, extraction after October 2022 was expected to decrease to at least 7.5bcm/year and possibly to substantially less than that. In subsequent years, it would gradually be reduced to zero.

It further stated that by 2022, all industrial [low calorific value] Groningen-gas users must have switched to [high cv] natural gas or to other sustainable sources of energy.

A new nitrogen installation is being built in Zuidbroek, costing €500M, to convert high cv natural gas into low cv natural gas and will be operational from October 2022.

In a subsequent statement in June 2018, the Ministry said that 12bcm/year can be reached by 2020 and now, following the January 2019 tremor, the Ministry has declared a lower 2018/19 quota of 19.4bcm and suggested that output could dip to as low as 4 bcm/year as soon as 2022.

It must be remembered that the 'small fields' production is also in natural decline from a peak of 27bcm in 2013, down to 24bcm in 2018 and a prediction of just 10bcm by 2030.

In 'off the record' comments received by the Author from three concerned parties during the summer of 2018, the situation was summarised as follows:

- *If there were another 'serious' earthquake at any time before 2021, the timetable for reducing production will almost certainly be accelerated; the target of zero Groningen production could be brought forward to the early 2020s.*
- *The reduction of, and eventual cessation of, Groningen production is now factored into Dutch economic planning as a certainty, despite many unknown extraneous factors regarding both the direct and indirect costs involved.*
- *The contractual commitments of producers and wholesalers of low-cv gas have largely been renegotiated, in a variety of ways (price, volume, time), to enable a smooth transition in the early to mid-2020s to a 100% high cv market.*

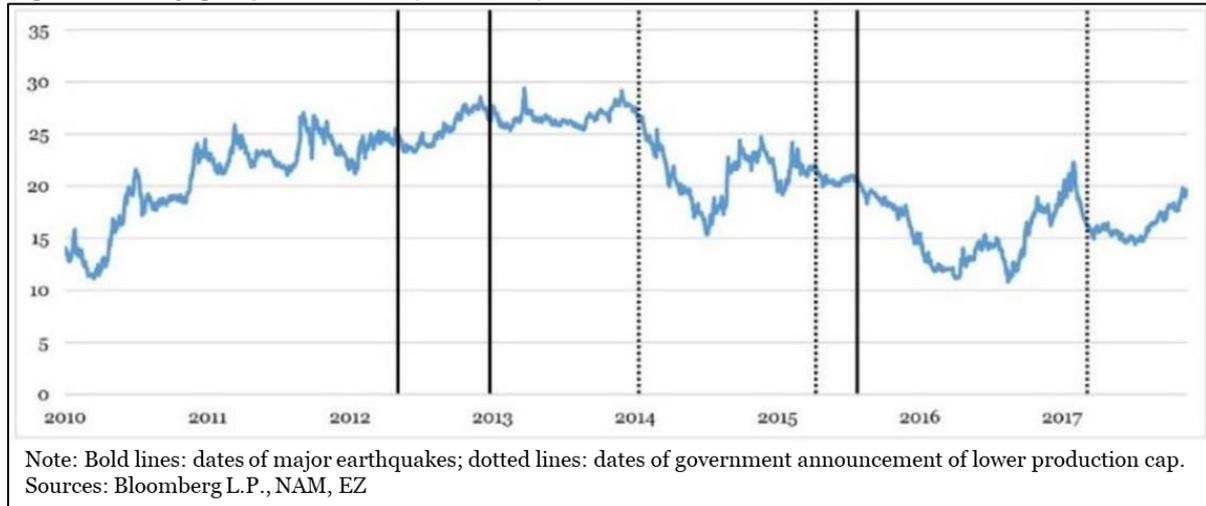
It is clear therefore that Groningen production will cease within 10 years and probably sooner than that, and that small fields production is in decline. The result will be that the Netherlands is about to end being a major European producer of gas. It had already started being a net importer⁶⁴ of high cv gas in 2014 and a net importer overall since 2018.

⁶² In January 2015 a cap of 40bcm was imposed; in December 2015, a cap of 27bcm; in June 2016, a cap of 24bcm; in April 2017, a cap of 21.6bcm; and in March 2018 future levels were set at: 2020/22: <12bcm; >2022: reduce to zero.

⁶³ Press Release, 29th March 2018: "Dutch Cabinet: termination of natural gas extraction in Groningen": <https://www.government.nl/ministries/ministry-of-economic-affairs-and-climate-policy/news/2018/03/29/dutch-cabinet-termination-of-natural-gas-extraction-in-groningen>

⁶⁴ Sybren de Jong presentation at Gas and LNG Supply Contracts Forum, Berlin, 19th June, 2019: "Developments in the Dutch gas market", slide 9.

Figure 7: Daily gas price at TTF (in €/MWh), 2010–2018



Source: CEER Policy Paper No 3,⁶⁵ June 2018, Figure 2.5, p. 20

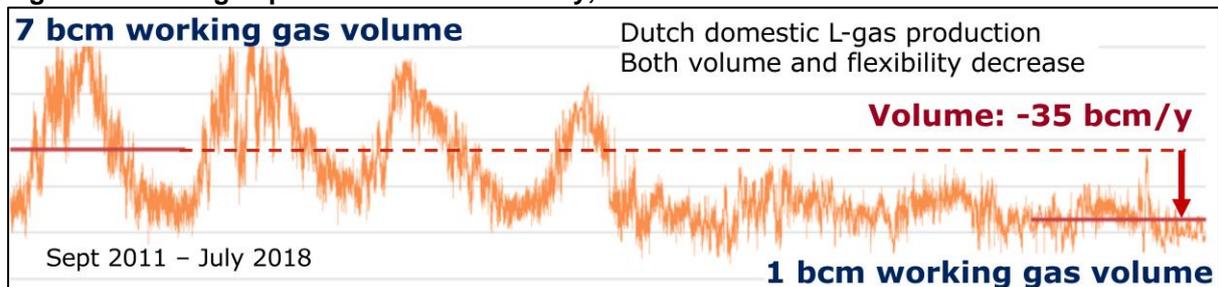
TTF: A European and global benchmark

The impressive growth of the TTF traded market can be observed in the statistical results shown in the 5 Key Elements and summarized in Table 5. Of particular note are the very high traded volumes (28,220TWh) and a net churn rate of 70.9. Is this dominant position of the TTF amongst European traded gas hubs threatened by the rapid decline in indigenous production?

Figure 7 shows that the recent tremors had no adverse effect on either the price or the volatility of TTF, as might have been expected; nor do the Dutch government announcements of reduced production rates appear to have had any effect. Indeed, and purely coincidentally, the price of TTF seems to have fallen after each event, as seen in Figure 7.

The analysis carried out by Sybren de Jong shows that despite a reduction in production volumes, coupled with a significant reduction in flexibility, TTF has maintained its status as a ‘Leader’ hub in north-west Europe. The production decrease is explained above and Figure 8 shows the extent of the reduction in flexibility, bearing in mind that the Groningen field has traditionally been considered as a major swing provider.

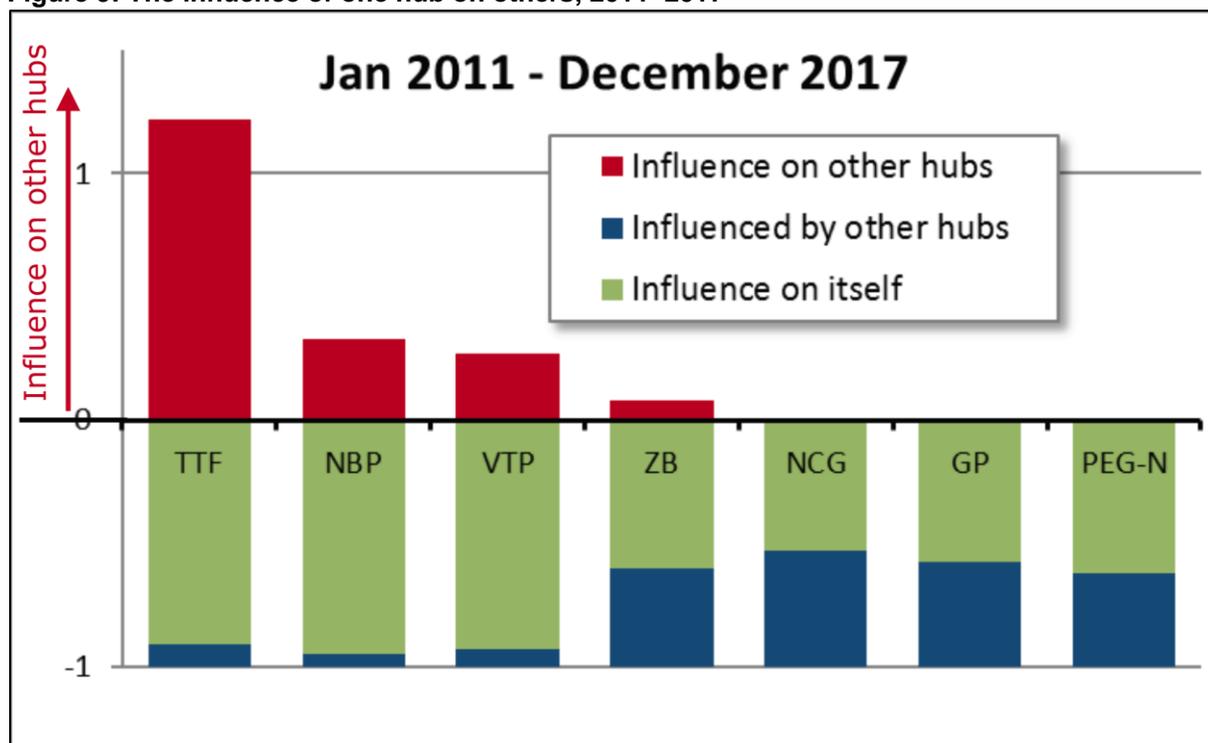
Figure 8: Groningen production and flexibility, 2011–2018



Source: Sybren de Jong presentation, Berlin, 19th June, 2019: “Developments in the Dutch gas market”, slide 11

⁶⁵ CEER Policy Paper No 3, June 2018: “Gas production and earthquakes in Groningen; reflection on economic and social consequences”: <https://www.rug.nl/feb/news/2018/180605-gas-production-and-earthquakes.pdf>

Figure 9: The influence of one hub on others, 2011–2017



Source: Sybren de Jong presentation, Berlin, 19th June, 2019: “Developments in the Dutch gas market”, slide 20

Figure 9 shows the relative influence that 7 north-west European gas hubs have on each other from the results of Sybren de Jong’s ‘Starlings’ theory.⁶⁶ This clearly shows that TTF is the hub that has the strongest influence on other hubs.

As indigenous production declines across Europe, the price of gas is likely to be more volatile and subject to global trends. However, a fully transparent and highly liquid market, offering many diverse traded products, can help smooth any price movements and assist traders to manage their risk. TTF currently provides that market-place.

The lack of seasonal swing from Groningen and the loss of large storage facilities (such as the UK Rough, German Krummhorn and Kalle, French Gournay sur Aronde and the announced closure of Grijpskerk in the Netherlands) could have a negative impact on both volatility and prices. However, so far in the past 4 years there has been no real or lasting impact. These past few years have shown that north-west Europe has coped even during severe weather periods.

The question remains as to whether TTF can continue to be the benchmark gas hub in Europe and the above analysis shows that the already large reduction in production has had no effect on TTF’s position as a benchmark hub or on TTF’s position as a leading, benchmark hub.

The fact is that TTF is now by far the largest traded hub in Europe; has become the € benchmark hub for NWE gas supplies and, along with NBP, it is being widely used for hedging and risk management of gas portfolios. TTF is also a Leader hub in terms of pricing and there is a strong political will in the Netherlands to keep TTF’s dominance, and maybe more so now that physical volumes will decline.

⁶⁶ For an explanation of the Starlings theory, see Heather (2015), pp.64-66.

Table 8: Global Benchmark churn rates, 2018

Representative churn rates 2018 (trading/consumption)		
Country	Hub	Churn
United States	HH	53.9
Netherlands	TTF	70.9
Britain	NBP	16.9
FR-DE-AT-CZ-Benelux	TTF	16.7
UK-IE	NBP	15.9
Austria	VTP	6.9
Germany	NCG+GPL	3.3
Belgium	ZEE+ZTP	3.1
Rest of Europe	FR,IT,CZ,ES	0.3-1.7
Asia	No hubs yet but increasing spot trading	
CN-JP-KR-TW	JKM	0.2

Sources: JODI, Platts, LEBA, ICIS, ICE, ICE-Endex, PEGAS, CME, GME; MIBGAS; T.Bros, P.Heather

Not only is TTF firmly placed as a European benchmark hub using the EU's net churn methodology of comparing total traded volumes to the underlying hub's physical consumption; but if we now look at the area of risk management coverage of TTF and other hubs, we can compare them on a global level. This task was undertaken by the Author and an OIES colleague Thierry Bros and published in the Quarterly Gas Review 5.⁶⁷

The purpose of that analysis was to see what would be the relative churn rates of the current most favoured traded gas hubs in the three main global gas regions, North America, Europe, and Asia. In this Insight Table 8 shows the results including for comparison the other European hubs. This analysis was based on the Author's research on the development of the European hubs but needed to be slightly amended to take account of different criteria.

In North America the Henry Hub (HH) is the most traded of the 33 Market Centers and, although there are at least 4 other US and Canadian hubs that do have large traded volumes,⁶⁸ it is the HH that is considered to be the Benchmark. In Europe, the Dutch TTF is the benchmark for France, Germany, Austria, Czech Republic and Benelux;⁶⁹ the British NBP is the benchmark for the UK and the Republic of Ireland.⁷⁰

⁶⁷ Bros (2019), pp.9-11.

⁶⁸ In particular, Waha Texas Hub and Dominion Hub in the US; AECO-C Hub and Dawn Market Center in Canada.

⁶⁹ It is also used as a reference price in a limited number of Italian and Spanish contracts and for some LNG deliveries into NWE.

⁷⁰ It is also used as a reference price for many LNG deliveries into Britain.

Asia does not have a traded gas hub as such but the Platts JKM⁷¹ prices⁷² are being used for the pricing of some LNG contracts in the region and for risk management. The traded volumes have grown exponentially over the last 3 years⁷³ and the number of market participants in 2018 stood at 40-45. The Asian JKM is still in its infancy and despite the rapid growth of traded volumes, when set against the very large physical underlying volumes in China, Japan, Korea and Taiwan, the 'churn' in 2018 was just 0.2, meaning it is classified as illiquid.

However, the HH, TTF and NBP are successful, mature, benchmark hubs and, when analysed according to the Author's global benchmark methodology,⁷⁴ the HH is classified as a very liquid benchmark hub, whilst the TTF and NBP are classified as liquid benchmark hubs.

6. Conclusion

The last decade has seen clear progress in the development of the European traded gas hubs although with some very different results across Europe in terms of speed of development and the level of development.

In 2008, only 9 European countries⁷⁵ had a traded gas hub and the only mature gas hub was the NBP which had by then been trading for over 10 years. It had a large number of market participants,⁷⁶ including financial players and was being used for balancing, hedging and risk management purposes, and for speculation. Those participants were from Britain but also from Continental Europe as there was not yet a hub liquid enough on the Continent to use for risk management. Traded products ranged from balancing and spot/prompt to the far curve, more than at any other hub at that time and the total traded volumes that year accounted for c.85%⁷⁷ of all European gas trading. This resulted in the NBP having a churn rate of 14.4, placing it comfortably in the mature category.

The Belgian ZEE hub had more active traders and a higher churn rate than the Dutch TTF,⁷⁸ although the TTF had in that year just overtaken ZEE in the total traded volumes. France still had 5 separate hubs⁷⁹ although the Powernext Exchange was working hard at developing traded interest which resulted in good volume growth. Germany did not yet have the current NCG and GPL hubs but instead, prior to 2009, had 19 trading zones of which the EGT⁸⁰ and BEB⁸¹ networks were the main trading locations and which together had a total traded volume of 360TWh in 2008. The Italian and Austrian hubs had some data available and were of a similar size regarding their traded volumes at around 180-185TWh. However, the Spanish and Danish markets had very little available data and were not analysed by this Author at the time.

During the ensuing decade, new trading hubs were gradually formed as Member States started to follow the EU Energy Directives and, in particular, the Network Codes (NCs). However, as indicated in Chapter 3, there are still 7 countries without a traded gas hub. Although they are all working towards implementation of the NCs this could still take some time.

⁷¹ Platts JKM™ (Japan Korea Marker) LNG Price Assessment.

⁷² Platts uses a Market-on-Close (MOC) methodology; for more information on the the Platts JKM and the methodology, see: <https://www.spglobal.com/platts/en/our-methodology/price-assessments/natural-gas/jkmt-japan-korea-marker-gas-price-assessments>

⁷³ Although Platts started calculating the JKM Index in 2012 it did not really start to trade until winter 2015/16. JKM posted trade volumes of: 2016 12,717 lots; 2017 50,236 lots; 2018 180,149 lots; Q1-19 over 90,000 lots.

⁷⁴ A churn rate below 10 = Illiquid (red); 10<15 = Mature (amber); 15<50 = Liquid (light green); =>50 = Very Liquid (dark green).

⁷⁵ By date of inception: Britain, Belgium, Netherlands, Italy, France, Spain, Denmark, Austria, and Germany.

⁷⁶ About 100 total / 25 active.

⁷⁷ 10620TWh vs. a total 12550TWh.

⁷⁸ About 60 total / 10 active ZEE vs. 40 total / 8 active TTF; 560TWh TTF vs. 500TWh ZEE.

⁷⁹ Until the merger in 2009 of PEGs Nord, Ouest, Est to form PEG Nord.

⁸⁰ E.ON Gastransport which became NCG in 2009.

⁸¹ BEB which became GPL in 2009.

When comparing the situation in 2008 with 2018, the two most significant changes have been the changes in fortune for the NBP and TTF hubs. NBP finally lost first place to TTF during 2016, when the Dutch hub overtook it in total traded volumes and has continued to grow in the two years since. TTF is now by far the largest traded gas hub in Europe, accounting for 57% of the total European traded gas volumes. Interestingly, NBP accounted for 30.5% so that, when taken together, the TTF and NBP accounted for 87% which is very similar to the situation in 2008.⁸²

The other hubs have had varying success, with ZEE having fallen back by 57% from its peak in 2013 and despite the Belgian ZTP virtual hub helping to sustain volumes, it has not been enough to stop that country's traded gas market falling to 8th/9th place in the rankings, whereas ZEE alone was ranked 5th in 2015. Conversely, the Italian PSV has seen very strong growth with its traded volumes increasing 6 times since 2012 and it is now ranked 5th.

Another disappointment has been the French traded gas market which has shown very slow progress despite the promising early signs. The volumes have improved over the decade but at a lesser rate than other hubs so that, from being ranked 5th in 2008, it fell back to just 7th by 2015 and has remained in that position since, with an equally disappointing churn rate of just 1.7.

The two German hubs should have delivered more, considering the size of the underlying physical gas market but the market is historically based on short term trading alongside long term contracts and this has remained the case. Although both NCG and GPL have seen an increase in curve trading, most of the hedging and risk management is effected at the TTF. The proposed merger of the two hubs should finally materialise by 2022 but it remains to be seen whether that action alone will help foster trading in Germany.

A hub worth following is the Spanish PVB which has had a very positive start since its inception in late 2015. After just three full years of trading, volumes went from just 30TWh in 2016 to 100TWh in 2018. Positive signs are that there is a good mix of trading all along the curve from spot/prompt to 3 years forward and the Exchange has been very proactive in developing the market. There also appears to be a strong political will to see that market develop further.

The types of products traded vary widely from hub to hub, continuing the divergence between those hubs being used for balancing activities and those for risk management activities. All hubs are balancing hubs but only two can be classified as mature risk management hubs: TTF and NBP. There are four active hubs: NCG, GPL, PSV, VTP; five poor hubs: TRF, ZEE, ZTP, PVB, VOB.

In conclusion, a decade of change has resulted in a 'wider' European gas market with more countries now implementing the Directives and much more gas trading overall. The rankings have changed, particularly mid-table, but the top two hubs in 2008 are the top two in 2018 but with their positions reversed; together they accounted for 89% of total traded volumes in 2008 and for 87% in 2018.

The NBP is the £ benchmark for gas in the British Isles and some LNG supplies; TTF has become the € benchmark hub for north west European gas supplies. Both are being widely used for risk management. Despite the fall in Groningen production there is no evidence that this will affect TTF's dominant position as the European benchmark hub.

On a global scale, TTF and NBP are benchmark hubs for their regions.

The final overall conclusion to this Insight is that, after nearly 20 years, most EU Member States do now have a gas hub and it is hoped that the remaining 7 countries will abide by the Directives within the next 2-5 years. It is possible that by 2025 Europe may finally have a single gas market, of sorts.

⁸² Taken together, NBP and TTF in 2008 accounted for 89% of the total European traded gas volumes.

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