

PatrickHeatherConsultancy

European experiences in gas market liberalisation and its impacts on the market

International Forum on Global Energy

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Patrick Heather

- In the commodity markets since 1981:
 - as broker, trader, manager
- Most of career in energy markets:
 - oil, oil products, gas and power
- Joined PowerGen in 1996: established gas trading capabilities
 - On several industry committees: inc. NBP'97 & standardised spark spd
 - Established Within-Day market by trading on-the-day flat gas at the NBP, the first ever such deal
 - Established Other trading firsts: IPE gas futures, 10yr flat gas NBP trade, standardised spark spread, NBP financial swap and others
 - In 2000, set-up PowerGen's electricity trading desk
- In 2002, recruited to BG Group as Trading Manager
 - Set-up their trading capability from scratch
 - Introduced the concept of 'portfolio optimisation' to a company that had been very much focused on operational issues

Patrick Heather

- Since 2004, Patrick has been an independent consultant
 - Advising and giving presentations to many organisations:
 - from the European Commission, regulators and governments, to the APX and ICE futures exchanges, to financial institutions and to various producer, mid-stream and end user companies
 - in Australia, Austria, Brazil, Britain, China, Estonia, France, Greece, Holland, India, Italy, Japan, Norway, the Philippines, Poland, Russia, Sweden and Turkey
 - Acting as Expert/Expert Witness:
 - Enron, Austrian utility, UK investment bank, Gas Supplier (SEE), Gas Marketer (NWE), Gas Marketer (SWE), Gas Supplier (NWE)
 - Lecturing at various seminars/universities/schools:
 - Florence School of Regulation, Warwick University, Bocconi School of Management, University of Tartu, Eurasia Energy Summer School
- Nov 06-Dec 09: Commercial Advisor to South Hook Gas
- Since 05: Senior Fellow of the Oxford Institute for Energy Studies

Patrick Heather Consultancy Limited

- An Energy Markets consultancy, specialising in the European utility sector, covering gas, electricity, emissions and coal and, in the energy forwards and futures markets.
- Advising on trading, risk-management and portfolio optimisation issues but also on providing marketing and business advice.
- Giving presentations on the utility/traded markets and related topics.
- Providing practical knowledge and experience in trading, managing trading operations, setting up trading desks, contract negotiation and Client representation.
- Providing Expert Opinion in gas contract litigation and other energy trading related cases.
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Oxford Institute for Energy Studies

Patrick Heather is a Senior Research Fellow at the OIES, focusing on the gas markets, in Britain, Continental Europe and Asia.

His published works are available on the Institute's website:

"The Evolution and Functioning of the Traded Gas Market in Britain"
<http://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG44-TheEvolutionandFunctioningOfTheTradedGasMarketInBritain-PatrickHeather-2010.pdf>

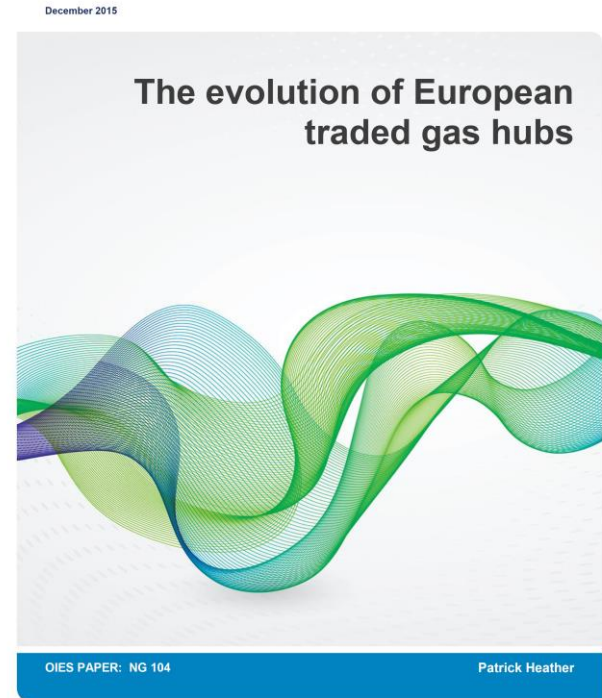
"Lessons from the February 2012 European gas 'crisis'"
<http://www.oxfordenergy.org/wpcms/wp-content/uploads/2012/04/Lessons-from-the-February-2012-gas-crisis.pdf>

"Continental European Gas Hubs: are they fit for purpose?"
<http://www.oxfordenergy.org/wpcms/wp-content/uploads/2012/06/NG-63.pdf>

"The evolution of European traded gas hubs"
<http://www.oxfordenergy.org/wpcms/wp-content/uploads/2015/12/NG-104.pdf>

"European traded gas hubs: an updated analysis on liquidity, maturity and barriers to market integration"
<https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/05/European-traded-gas-hubs-an-updated-analysis-on-liquidity-maturity-and-barriers-to-market-integration-OIES-Energy-Insight.pdf>

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Outline

Contractual structure of gas trading

- Transition from 'old' to 'new' world
- The catalyst for change in gas price formation
- The changing roles of players
- What is the situation today in Europe?

European gas hubs today

- Path to maturity and European gas regions
- How traded gas hubs help the gas markets evolve
- The 5 Key Elements
- The 3 Main Indicators

Summary and Conclusion

- The messages for emerging gas markets

Contractual structure of gas trading

Transition from 'old' to 'new' world

Privatisation vs. Liberalisation

Great Britain's **privatisation** of the public sector

Through Acts of Parliament

1982: Oil & Gas (Enterprise) Act:

1st restrictions on BGC; allowed TPA

1986: Gas Act (1986):

BGC becomes privatised - British Gas plc (BG)

1995: Gas Act (1995):

Set out timetable for full competition

1996: Network Code:

Set out rules & procedures for TPA and balancing

The process of transformation took 15 years; today the UK has a fully liberalised, established and successful traded gas market

Privatisation vs. Liberalisation

Continental Europe's **liberalisation** of energy markets

Through Directives and Energy Package

2000: First liberalisation directives for gas became law

2004: Second liberalisation directives for gas became law

2009: Third Energy Package became law:

Aim was to strengthen competition in the electricity and gas markets

Continental Europe is still going through the process of transformation; there is yet much to do, especially in Eastern Europe

Contractual structure of gas trading

The catalyst for change in gas price formation

Why move from Oil indexation to GOG pricing?

- **Oil indexation**

- is no longer relevant to market

- Logic for gas-on-gas **‘market pricing’** apparent

- But difficulty in knowing/deciding “how to get there?”

- Confusion still in certain countries regarding GOG

- Merits of LTCs vs. spot trading

- Difference between oil indexation and GOG pricing

However, if price formation moves away from oil indexation to GOG, there needs to be a reliable gas index on which to base contract pricing and to risk manage portfolios; this is provided by Benchmark hubs

Catalysts for change

Indigenous production:

Both Great Britain and the Netherlands had indigenous production which facilitated the development of traded markets in their countries

Multiple sources of supply:

Many sources of supply will reinforce security of demand and encourage competition

Gas 'bubbles':

A surplus of gas will encourage competition and the possible break up of old world monopolies

The 'right' political, cultural and commercial framework:

These are crucial to allowing the change to occur and to do so in a measured fashion

The aim is to have/create structured competition in a regulated framework

Catalysts for change

Judicial reviews/laws:

In particular, two German legal decisions which changed the gas sector:

- 2006 Federal Cartel Office banned LTCs between wholesalers and retailers
- 2010 Federal Court of Justice ruled that the price of gas to residential customers could not be based on Gasoil

Primarily a 'bottom up' approach:

Customers were demanding market pricing from ~2009

Dutch and Norwegian sellers prepared to change:

With the gas bubble in 2009-2011, GasTerra and Statoil were quick to offer their NWE customers market priced gas

The pricing structure of gas in (North West) Europe has significantly changed and has led to a rapid rise in traded volumes, especially at NBP and TTF

Contractual structure of gas trading

The changing roles of players

Gas Market in the Monopoly Era

THREE MAJOR GROUPS OF PLAYERS:

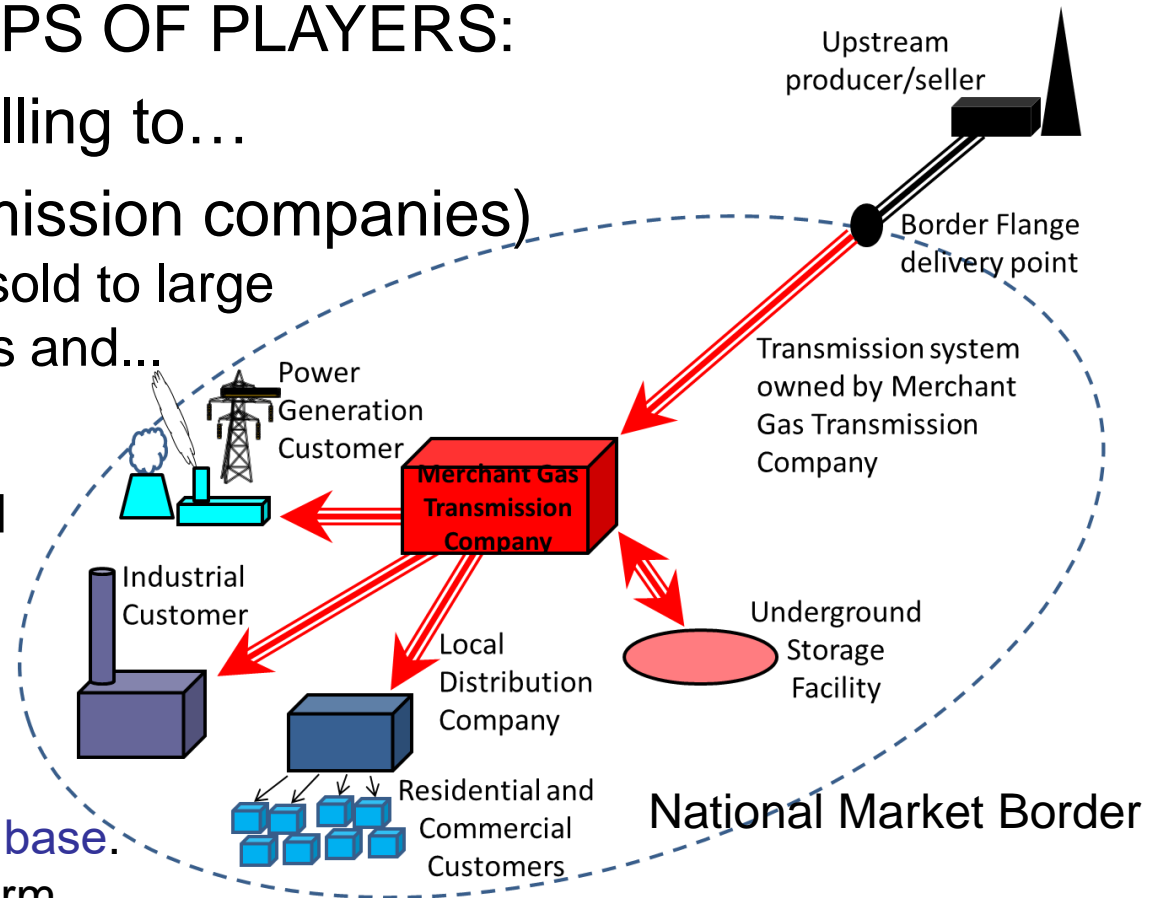
Producers/Exporters selling to...

MTCs (merchant transmission companies) which owned pipelines and sold to large industrials, power generators and...

LDCs (local distribution companies), which owned networks and sold to small customers

MTCs and LDCs had national or regional monopoly franchise areas with a 'captive' customer base.

They purchased/sold on long term contracts which allowed them to pass through price risk



This was a very stable, very profitable, very successful set of business models; risks were low (except for some groups of consumers who did not recognise the risks which had been allocated to them) and as a result there was massive expansion of European gas demand

Hub-Based Gas Market

FOUR MAJOR GROUPS OF PLAYERS:

Producers/Exporters:

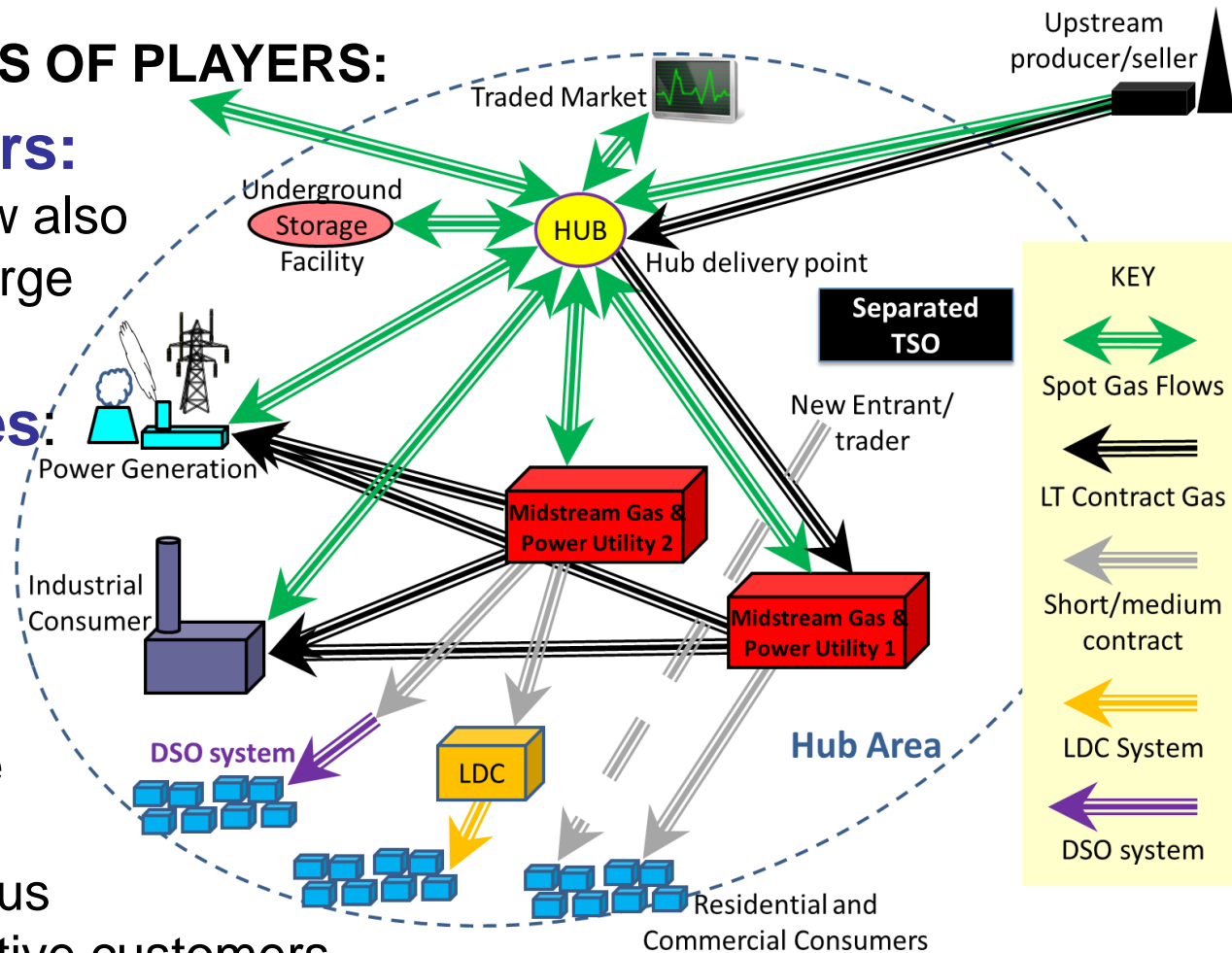
largely the same but now also able to sell directly (to large customers)

Network Companies:

“new kids on the block” unbundled from MTCs and LDCs, low risk/regulated rate of return

LDCs largely the same (without their networks)

not (yet) subject to serious competition for their captive customers

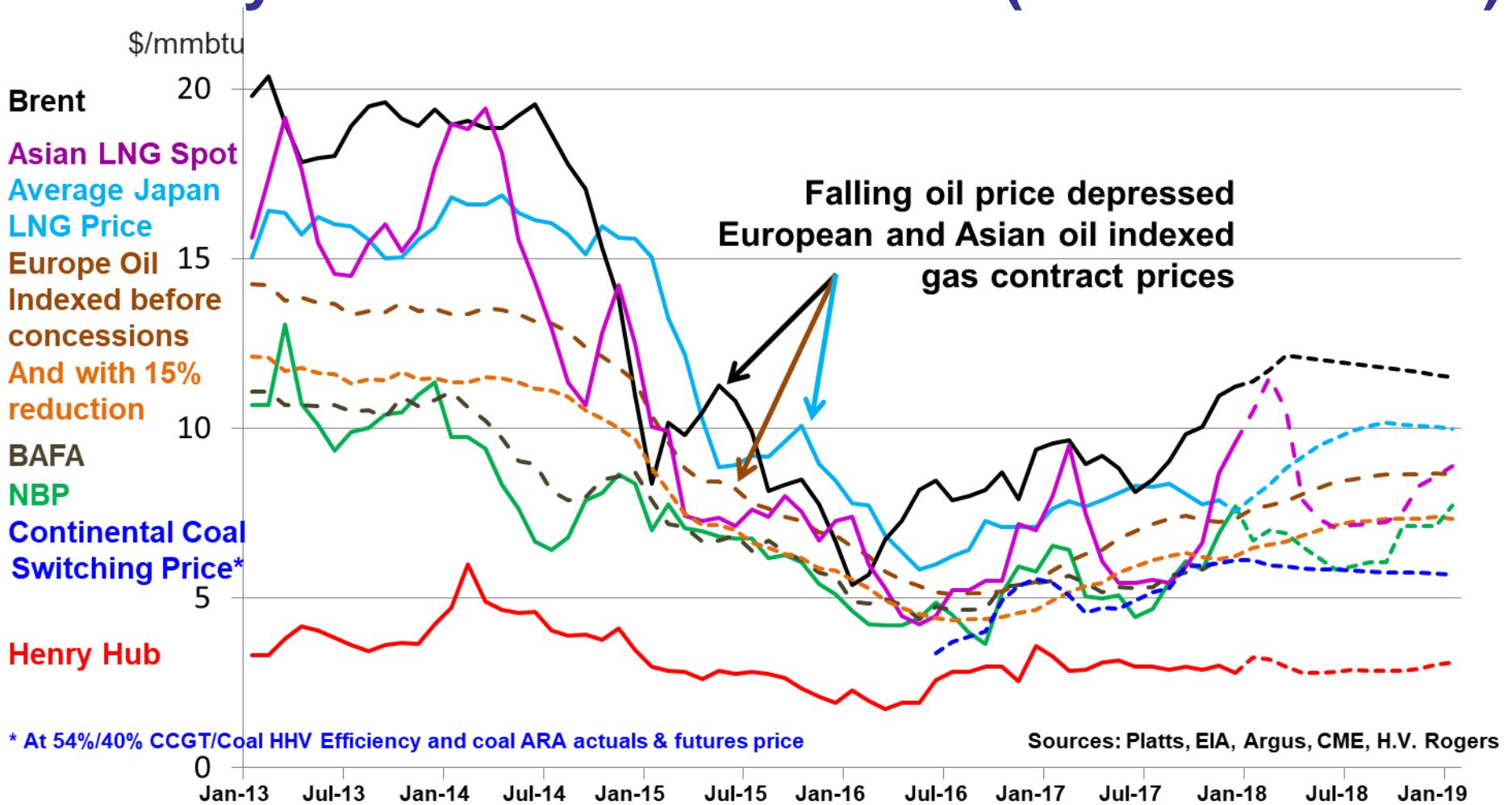


MID-STREAM GAS COMPANIES: the new gas departments of energy utilities; retained LT supply/transmission contracts, with financial risk and subject to continual renegotiation/arbitration; customer base attacked from upstream (producers) and downstream LDCs seeking to “cut out the middleman”

Contractual structure of gas trading

What is the situation today in Europe?

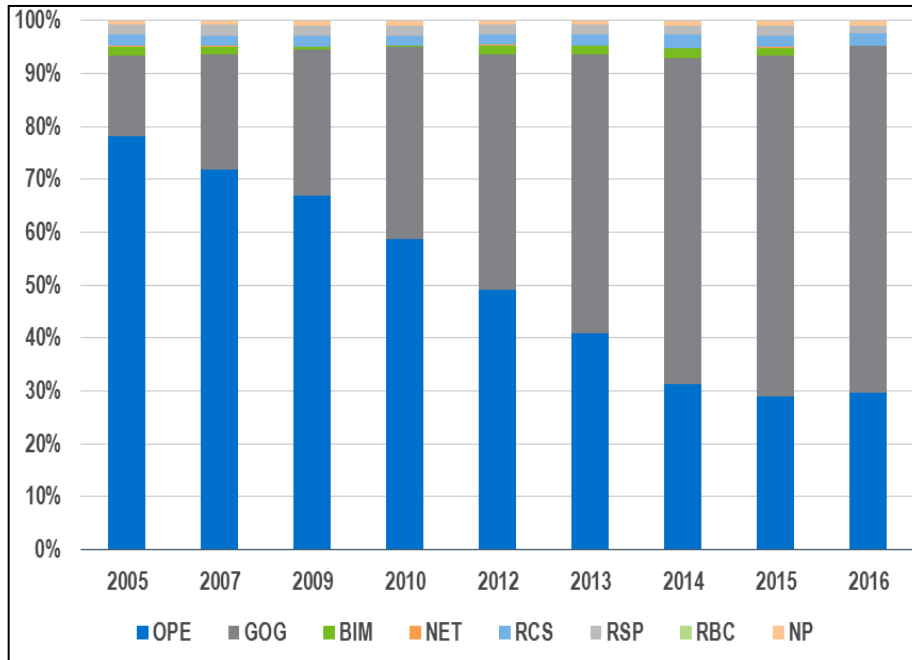
Global gas and Brent prices: January 2013 – December 2017 (curve to Dec18)



Low oil indexed prices provide 'ceiling' for hub prices and put pressure on LNG spot prices. Henry Hub and European hub prices further depressed by weak fundamentals, BUT... the new 'LNG Wave' has barely begun!

European Gas Price Formation: 2005-2016

Europe Price Formation: 2005-2016



Europe Gas Supply by destination and pricing: Q4-2016

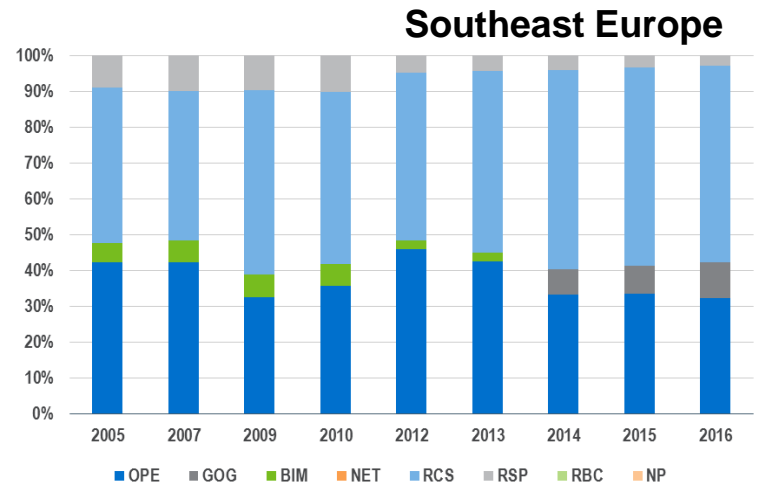
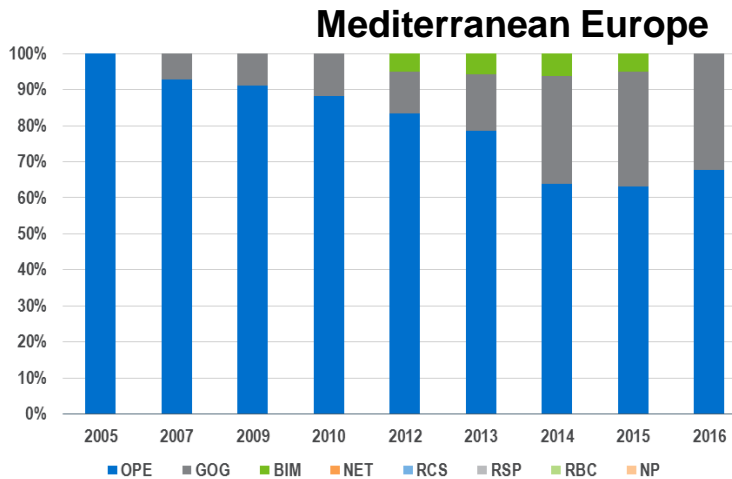
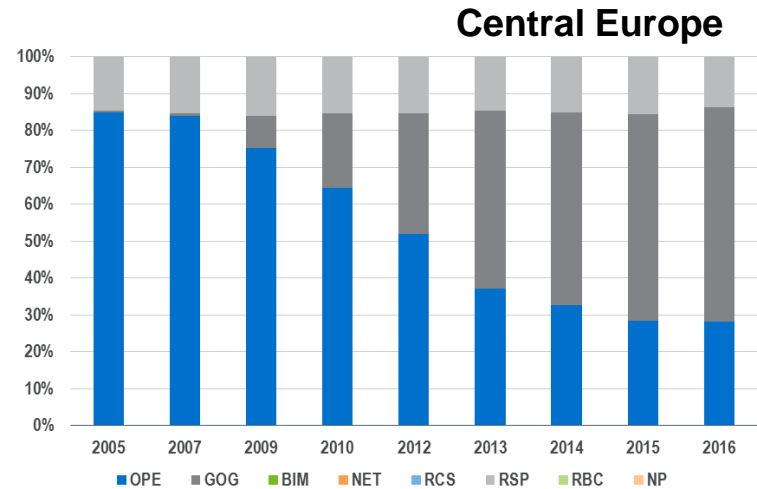
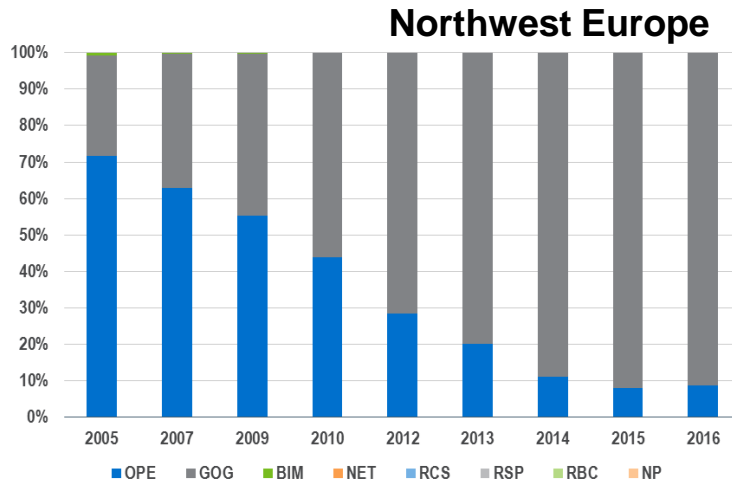
Region and approx. % of total European demand	OPE	GOG	REGULATED		
			RCS	RSP	BIM
North West Europe 55%	9	91			
Central Europe 15%	28	58		14	
Med. Europe 25%	68	32			
South East Europe 5%	32	10	55	3	
Europe Total	28	67	3	2	5

OPE: Oil Price Escalation GOG: Gas-on-Gas Competition RCS: Regulated Price (Cost of Service) RSP: Regulated Price (Social and Political)
 BIM: Bilateral Monopoly NP: No Price North West Europe: Belgium, Denmark, France, Germany, Ireland, Netherlands, UK.
 Central Europe: Austria, Czech Rep, Hungary, Poland, Slovakia, Switzerland. Mediterranean Europe: Portugal, Spain, Italy, Greece, Turkey.
 South East Europe: Bosnia, Bulgaria, Croatia, Macedonia, Romania, Serbia, Slovenia.

Sources: IGU Wholesale Gas Price Survey - 2017 Edition; P.Heather

Oil indexation is no longer relevant; the logic for gas-to-gas 'market pricing' is apparent and its share has exceeded 50% since 2013, reaching 67% in 2016

European Price Formation: 2005-2016



Source: IGU Wholesale Gas Price Survey - 2017 Edition

Across the European regions the shares are very different: regulated prices dominate in SEE and are still present in CE; Med GOG is mainly Italy

European gas is being market priced

- Britain now has **100%** market pricing

Britain has had market pricing for many years; price formation on the Continent is changing, at a different pace North-West vs. South-East

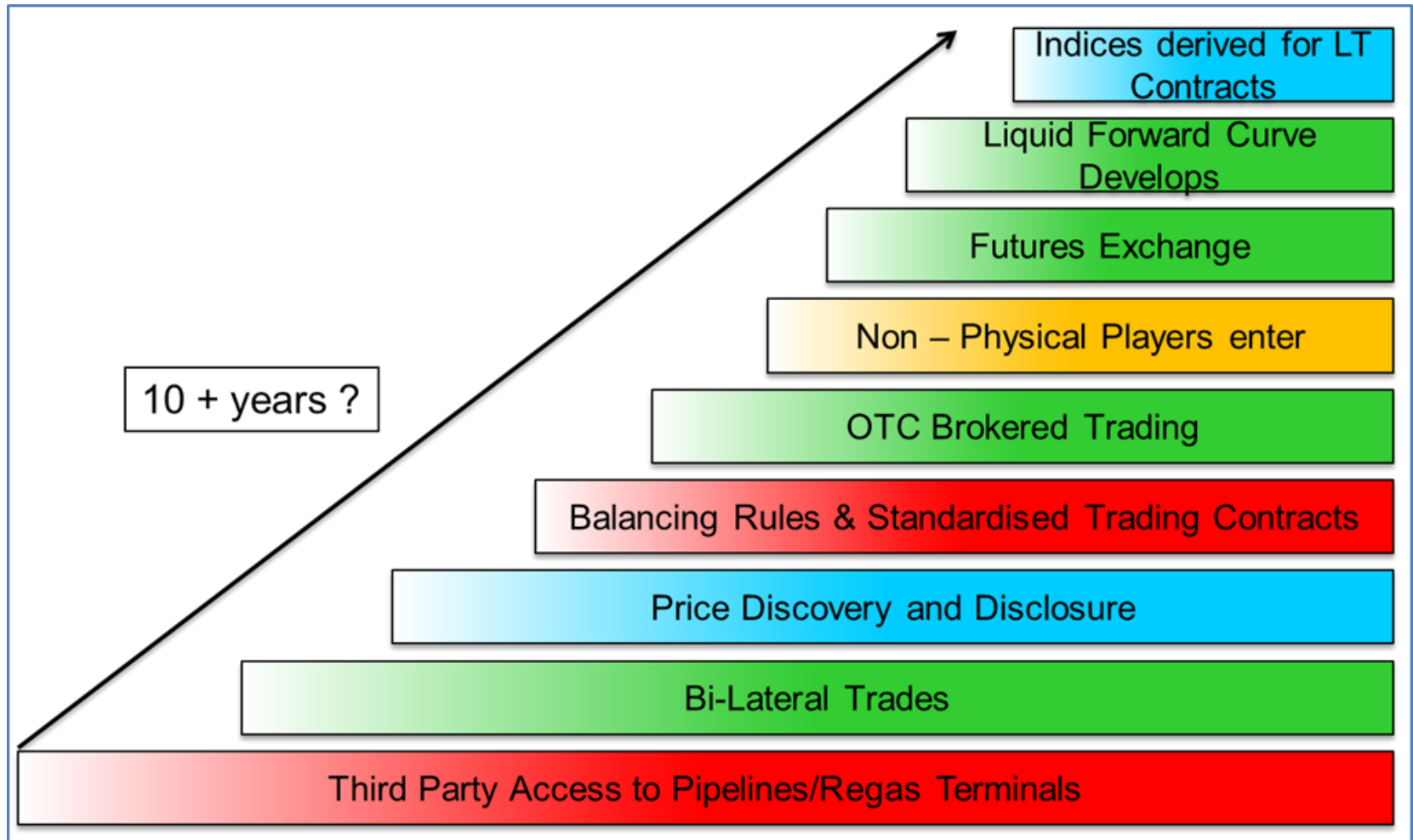
- Continental Europe is now c.34% oil indexation
[plus 5% regulated pricing]
- Continental Europe is now **c.61%** market priced
- Increasing volume of spot priced gas
- Eastern and Southern Europe resisting change

How long the transition to fully liberalised, commercial, hub-priced gas markets will take to complete is uncertain: it will take time and it will be costly but competition will mean that gas-to-gas pricing will ultimately prevail

European gas hubs today

Path to maturity and European gas regions

What constitutes a 'good' hub?



Source: Heather (2015)

The 'Path to Maturity' starts with Third Party Access and, over a period of time, develops to provide first OTC then financial products, ending with Indices used as reference prices in physical contracts

Development of the hubs

- The **most developed** part of Europe in terms of liberalised gas hubs is in the **North-West** but this is also the one with the **most disparity**
- The **Central European** region is the one showing **most promise** for further development
- Most of **Eastern Europe** is still heavily dependant on Russian gas supplies, arriving through the historic network of 'transit' pipelines

**Europe is not one homogenous gas market:
neither in infrastructure nor in political desire to change**

European gas hubs today

**How traded gas hubs
help the gas markets evolve**

Mature gas markets: their function

- Open and Transparent markets:
 - Foster trading, competition and, ultimately, the ‘best’ or ‘right’ price at any given time
 - Attract many participants of different types who bring liquidity
- Liquid markets allow for the ability to:
 - Physically adjust portfolio volumes over time
 - Financially risk manage gas portfolios
- Mature gas markets can help provide:
 - Security of supply and security of demand
 - Providing a market place for the buying and selling of, usually, marginal quantities of physical gas

Most of all, mature, open, transparent and liquid markets provide secure Risk Management tools

Gas exchanges: their role and function

- **Price Discovery & Transparency**
 - The ability to know the price of gas now and in the future (up to six years ahead on ICE NBP and five years for ICE-Endex TTF)
 - Publicly and easily accessible
- **Supply/Pricing flexibility**
 - The ability to separate price function from supply function
- **Physical balancing**
 - Providing a market place for the buying and selling of, usually, marginal quantities of physical gas
- **Risk Management**
 - Providing a facility for managing price risk through a **secure and regulated market** – hedging and trading

Exchanges are complementary to the OTC markets and assist in the development of traded gas hubs in a secure, regulated environment

European gas hubs today

The 5 Key Elements

5 Key Elements

In order to evaluate the **depth, liquidity and transparency** of the traded gas hubs across Europe, I analyse the results of **5 key elements**; as far as these are available

The 5 key elements analysed are:

who trades in each of the hubs

what **products** are traded there

how much **volume** is traded, and over which periods

the **Tradability Index**

the **churn rates**

They are all important but the churn is the most

It is essential to review as a minimum these 5 criteria to permit a rigorous analysis; but not all of the elements are always available in all of the hubs

Summary of the 5 Key Elements

2016	5 KEY ELEMENTS					
HUB	Active Market Participants	Traded Products*	Traded Volumes	Tradability Index (Q4)	Churn Rate	Score /15**
TTF	>40	53	22230	20	57.1	15
NBP	>40	47	20045	19	22.1	15
NCG	30	29	2080	16	4.0	10
GPL	30	23	1110	15	2.5	9
PSV	18	23	885	15	1.2	7
ZEE+ZTP	15	17	780	10	4.1	7
PEG Nord	15	18	550	14	1.7	7
VTP	15	14	530	10	5.7	7
VOB	<10	6	105	8	1.1	5
PEG TRS	<10	13	100	7	0.6	5
PVB	<10	9	30	0	0.1	5

* Score /64 derived from the OTC and Exchange product categories in the Traded Products Table.

Source: Heather (May 2017)

** Score based on each of the Key Elements scoring zero for Grey; 1 point for Red; 2 points for Amber; 3 points for Green.

This table gives the 'rankings' of the European traded gas hubs in my map; there are only 2 Mature hubs and 2 Active hubs, plus 7 Poor hubs

European gas hubs today

The 3 Main Indicators

3 Main Indicators

In order to evaluate the **path to liberalisation and market development** of the traded gas hubs across Europe, I analyse the results of **3 main indicators**; as far as these can be assessed

The 3 main indicators analysed are:

- The **political will** in each of the Member States

- The **cultural attitudes** to trading and change

- Which then dictate the level of **commercial acceptance**

These metrics are more subjective but equally important to assess when determining the level of market development

The Main Indicators are inter-dependent on each other to enable the move towards fully liberalised gas markets across the entire EU

Summary of the 3 Main Indicators

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,
- 6 TSO conditions
- and 6 market conditions

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

Source: EFET 2016 Review of Gas Hubs Assessments

This independent analysis, using very different criteria to mine, arrives at much the same conclusions as to the European hubs' stages of development

Summary and conclusion

Summary

Varied development of gas hubs globally over the past 30 years...

US gas markets started liberalisation **in the 1980's** but took nearly **20 years** to become a '**regulated competitive market**', only truly liberalised at the wholesale level

Britain's gas markets liberalised **in the mid-1990's** and reached '**maturity**' within **10 years**, albeit at a high cost

European gas markets really started **in the mid-2000's** but are far from being fully liberalised across all countries

Asian gas markets have just started **in the mid-2010's** to move away from oil indexation towards market pricing

Henry Hub is the benchmark for Nth American gas and some LNG supplies

NBP is the £ benchmark for gas in British Isles and some LNG supplies

TTF is the € benchmark for North West European gas supplies

Further down the line another European hub is feasible

and there will almost certainly be at least one Asian hub

However, it must be remembered how long the process of change takes!

Conclusion

The messages for emerging gas markets is clear:

There must be strong underlying **commercial reasons** for a hub to develop; this will often reflect the **physical flows of gas** in that country, as well as the **contract structure**

3 Main Indicators are pre-requisites to enable a market to start on the **Path to Maturity**:

Possibly the most important indicator is that of **political will** to provide the right framework

There must also be the right **cultural attitude** to make the most of the liberalising market

Finally, there needs to be **commercial acceptance** to **deliver the financial results** to the market participants and **more competitive pricing** to the consumers

The emerging and developing markets can take their guidance from the two mature, successful Benchmark hubs, NBP and TTF, whilst adapting to their own particular needs. They should especially take note of the 3 Main Indicators to get their hub 'off the ground' and allow it to grow

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Thank you!

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Additional material

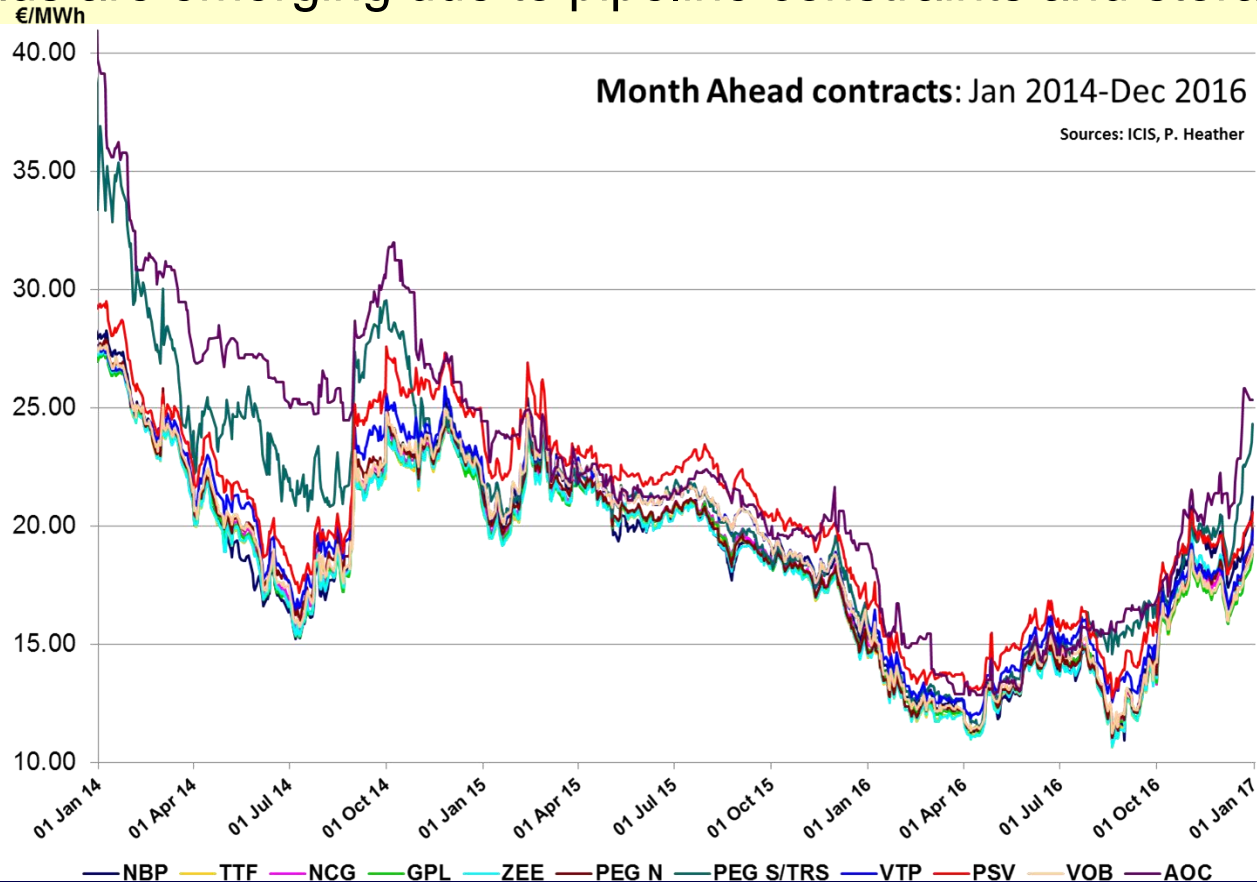
The European traded gas hubs

- **NBP**
 - National Balancing Point; GB; 1996
- **ZEE/ZTP**
 - Zeebrugge Hub / Zeebrugge Trading Point; BE; 2000/2012
- **TTF**
 - Title Transfer Facility; NL; 2003
- **PSV**
 - Punto di Scambio Virtuale; IT; 2003
- **PEG (N,S,T)/TRS**
 - Point d’Echange de Gaz (Nord, Sud, TIGF); FR; 2004
 - Trading Region South (merger of PEG S and PEG T); FR; 2015
- **AOC/PVB**
 - Almacenamiento Operativo Comercial / Punto Virtual de Balance; ES; 2004/2015
- **GTF**
 - GasTransfer Facility; DK; 2004
- **CEGH/VTP**
 - Central European Gas Hub / Virtual Trading Point; AT; 2005/2013
- **GPL**
 - Gaspool; DE; 2009
- **NCG**
 - NetConnect Germany; DE; 2009
- **VOB**
 - Virtuální Obchodní Bod; CZ; 2011
- **VPGS**
 - Virtual Point Gaz-System; PL; 2014

NWE/CE/SE/SWE hubs price correlation: 2014-2016

Price correlation means prices move in the same direction at the same time by about the same amount; it does not mean 'same price'

Physical connectivity and **commercial trading** bring price correlation; but spreads are emerging due to pipeline constraints and storage factors



Price correlation in itself is no indicator of one hub being active or inactive, in absolute terms or in relation to the other hubs

European gas hubs today*

The 5 Key Elements

*The following slides show data for 2016; not all 2017 data are yet published and the results of their analysis will be available from March/April

Key Element 1: Market Participants

HUB	Market Participants*			Active**		
	2005	2011	2014	2014	2015	2016
TTF	37	60	c.130	30	45	>40
NBP	c.80	c.160	c.200	40	45	>40
NCG+GPL	n/a	n/a	c.95	25	>25	30
PSV	n/a	112	118	12	15	18
ZEE+ZTP	53	78	82	15	15	15
CEGH/VTP	n/a	40	53	10	15	15
PEG Nord	23	36	55	10	10	15
PEG TRS				5	5	<10
VOB	n/a	n/a	16	<10	<10	<10
PVB	n/a	n/a	70	<5	<10	<10

*the number of companies registered to trade at each of the hubs, or registered as Shippers;

** the estimated number of participants who regularly trade.

Source: Heather (May 2017)

The absolute number of market participants can be misleading as, in reality, it's the number of 'active' participants who regularly trade that really counts: the more there are, the more liquidity there will be in a market

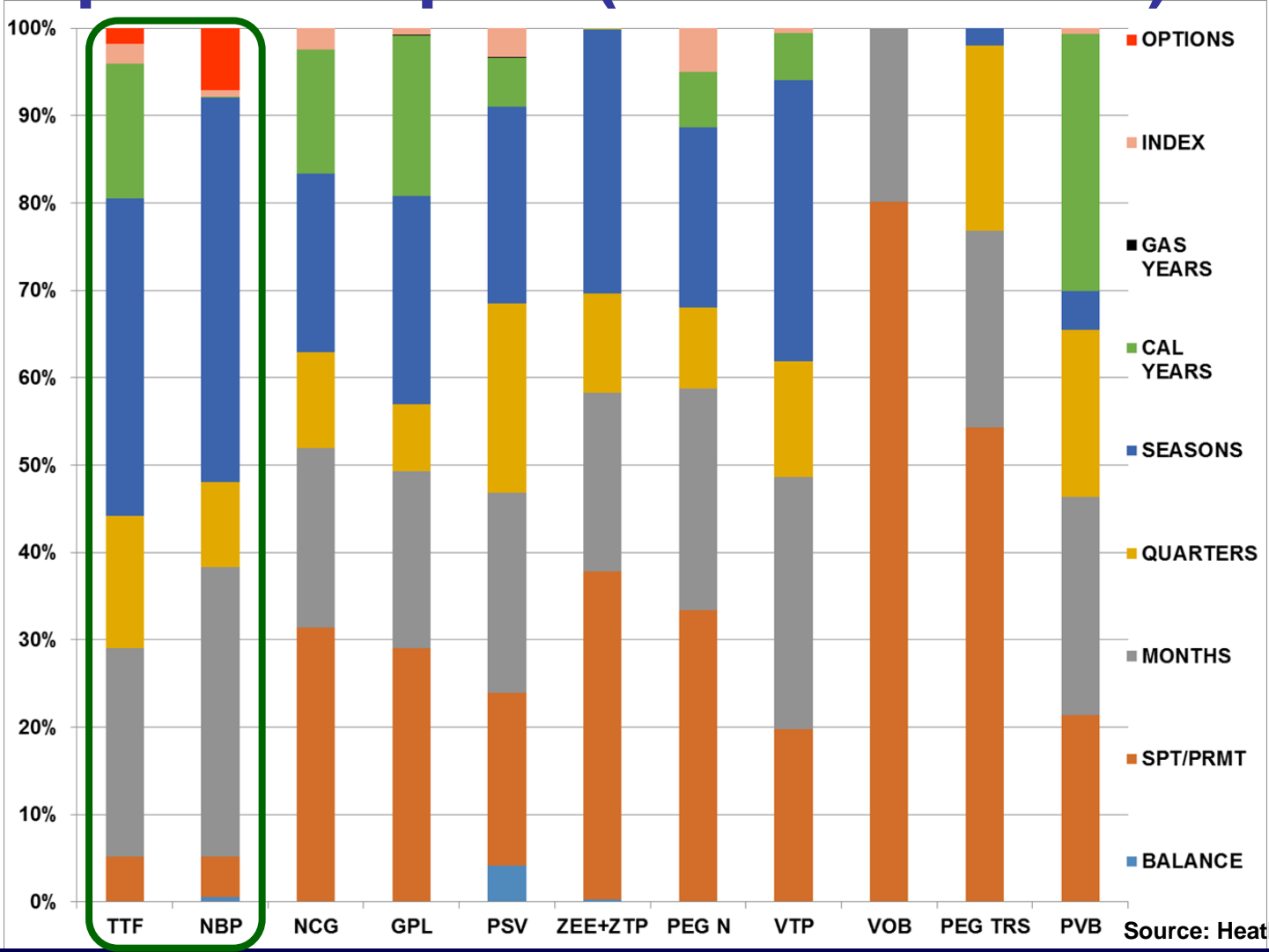
Key Element 2: Traded Products - 2016

2016																					
Product valuation based on absolute volumes*	OTC	CLEARING	WD DA	BOW W/E WDNW BOM	MA MONTHS	QUARTERS	SEASONS	CAL YEAR	GAS YEAR	INDEX	EXCHANGE	(% SHARE)	BALANCING TRADES	SPOT PROMPT	FUTURES MONTHS	FUTURES QUARTERS	FUTURES SEASONS	FUTURES YEARS	OPTIONS MONTHS		
																				ICE	PGS
TTF	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	ICE 82	82	N	Y	Y	Y	Y	Y	Y		
											PGS 17	17									
											CME 1	1									
NBP	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	ICE 99	99	Y	Y	Y	Y	Y	Y	Y		
											PGS 0	0									
											CME 0	0									
NCG	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	PGS 99	99	N	Y	Y	Y	Y	Y	N		
											ICE 0	0									
GASPOOL	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	PGS 99	99	N	Y	Y	Y	Y	Y	N		
											ICE 1	1									
PSV	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	GME 66	66	Y	Y	Y	Y	Y	Y	N		
											PGS 30	30									
											ICE 3	3									
PEG NORD	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	PGS 100	100	N	Y	Y	Y	Y	Y	N		
ZEE + ZTP	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	ICE 93	93	Y	Y	Y	Y	Y	Y	N		
											PGS 7	7									
VTP	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	CGH 100	100	N	Y	Y	Y	Y	Y	N		
PEG TRS	Y	N	Y	Y	Y	Y	Y	N	N	N	PGS 100	100	N	Y	Y	N	N	N	N		
PVB	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	MIB 100	100	N	Y	Y	N	N	N	N		
VOB	Y	Y	Y	Y	Y	N	N	N	N	N	CGH 100	100	N	Y	Y	N	N	N	N		
*KEY:	GREEN: =>600TWh		AMBER: <600tTWh		BLUE: <250TWh		RED: <50TWh		GREEN: =>500TWh		AMBER: <500TWh		BLUE: <100TWh		RED: <30TWh						
GREY:	Hubs column based on OTC + Exchange 'score'/64; OTC column based on 'score'/36; Exchange column based on 'score'/28																				
No volumes	ICE=ICE/Endex			PGS=PEGAS			CME=CME Europe			CGH=CEGH			MIB=MIBGAS			Y=AVAILABLE			N=NOT AVAILABLE		

Source: Heather (May 2017)

The type of products available to trade and their traded volumes are a good indication of whether a market is used for balancing or risk management

Traded product splits (% total volume): 2016



Source: Heather (May 2017)

The product splits across the hubs show interesting results: TTF and NBP ‘mature’ risk management hubs, through to PEGs, VTP and GPL ‘balancing’ hubs; NBP leads in options trading (9%); PSV increasing curve trading

Key Element 3: Traded volumes

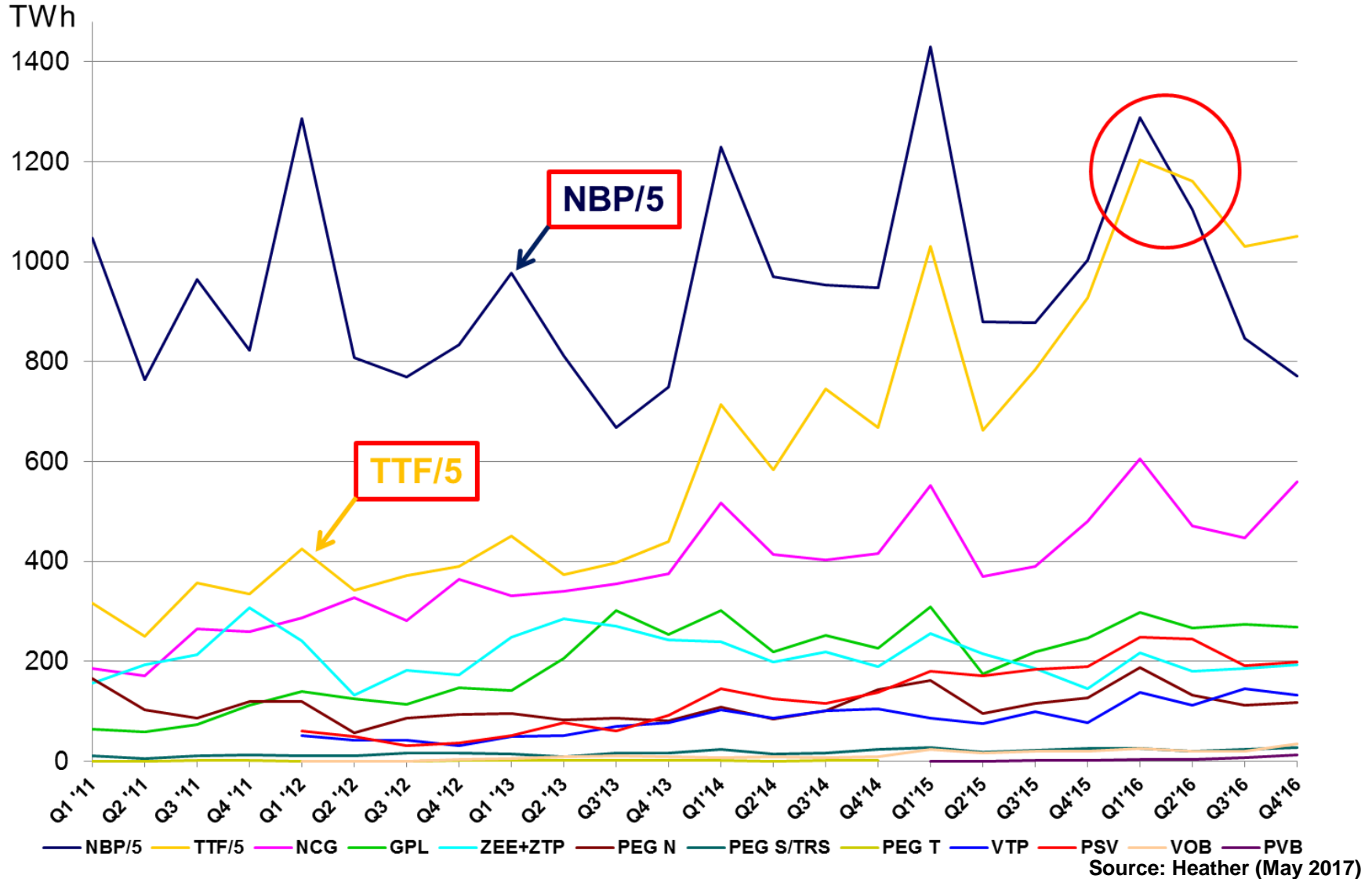
HUB	TOTAL TRADED VOLUMES* (TWh)						
	2008	2011	2014	Δ% =>	2015	Δ% =>	2016
TTF	560	6295	13555	+26	17080	+30	22230
NBP	10620	18000	20505	+2	20955	-4	20045
NCG	360	880	1750	+2	1790	+16	2080
GPL		310	1000	-5	950	+17	1110
PSV	160	185	525	+37	720	+23	885
ZEE+ZTP	500	870	850	-5	805	-3	780
PEG Nord	185	430	435	+15	500	+10	550
CEGH/VTP	165	170	400	-15	340	+56	530
VOB	n/a	n/a	35	+129	80	+31	105
PEG TRS	n/a	SUD 40 TIGF 5	80 5	TRS -27	65	+54	100
PVB	n/a	n/a	n/a	-	<10	+200	30

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

Source: Heather (May 2017)

High absolute traded volumes usually indicate a market with high churn, a large and varied range of participants and free from price manipulation

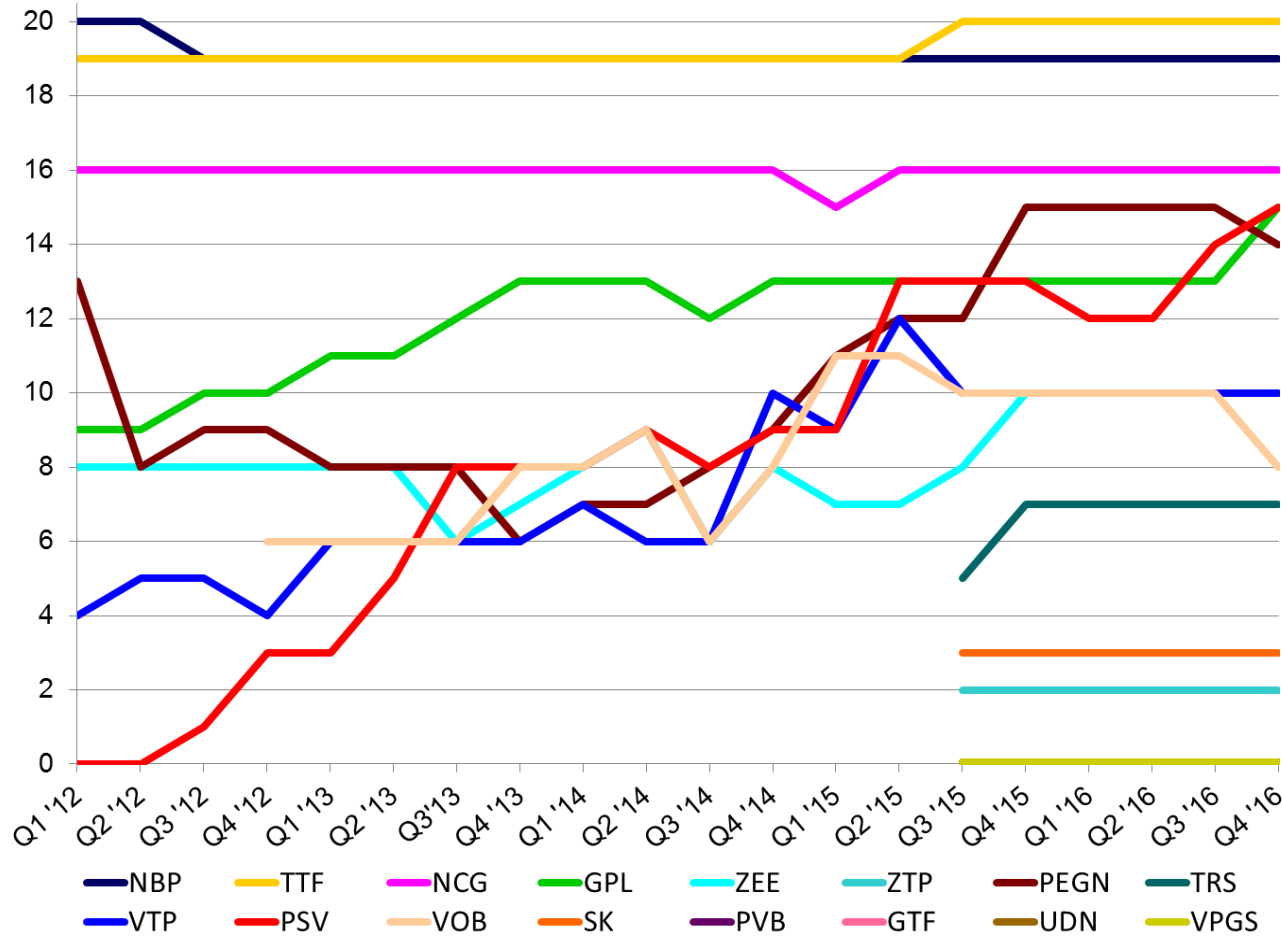
Traded volume development: 2011 - 2016



TTF has seen phenomenal rise in activity since 2014; NBP has been losing volume to TTF since then, especially risk management; TTF now largest hub

Key element 4: Tradability Index: 2012 – 2016

A result below 16 is not very meaningful, whereas a result of 18 or above does indicate that the hub in question does have reasonable liquidity



Sources: ICIS European Gas Hub Reports 2012-2016; P. Heather

TTF and NBP have been at the 'top' for 5 years; NCG is 'stuck' at 16/20; GPL, PSV (and now PEGN) rising to 14-15/20; all other hubs poor/very poor

Key element 5: Churn rates

HUB	TRADED GAS HUBS CHURN RATES*				
	2008	2011	2014	2015	2016
TTF	3.3	13.9	36.0	45.9	57.1
NBP	14.4	19.8	26.2	26.2	22.1
CEGH/VTP	2.4	2.2	4.8	3.9	5.7
ZEE+ZTP	5.1	4.1	4.9	4.3	4.1
NCG	0.4	1.8	4.2	3.9	4.0
GPL		0.8	3.0	2.5	2.5
PEG Nord	FRANCE 0.4	FRANCE 1.0	1.6	1.7	1.7
PSV	0.2	0.2	0.8	1.0	1.2
VOB	n/a	n/a	0.4	1.0	1.1
PEG TRS	n/a	n/a	SUD 1.0 TIGF 0.1	0.6	0.6
PVB	n/a	n/a	n/a	<0.1	0.1

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

Source: Heather (May 2017)

There are two clear benchmark hubs today: NBP and TTF; no other hub is even near to the 10x criterion for mature markets; ZEE continues as essential trading location for large shippers, now joined by VTP; all other hubs struggling