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Dear Regulators,

IUK Response to "Open letter: Call for evidence on the use of the gas interconnectors on Great Britain's (GB's) borders and on possible barriers to trade"

Further to your "Open Letter" dated 1 October 2012, we are pleased to submit this response to the three National Regulatory Authorities (NRAs).

The key points from our analysis are that:

- Market arrangements on IUK offer considerable flexibility to customers, including the ability to react to within day market requirements. Shippers are effective and efficient in using IUK capacity to execute profitable trading opportunities. IUK's arrangements are not causing a barrier to cross-border flows.
- Taking into account transportation charges, the data shows that IUK flows are highly responsive to market prices; and that Flows Against Price Differentials (FAPDs), even when comparing day ahead prices against actual end of day flows, are not significant in number or value.
- It is misleading to regard partial use of IUK capacity as inefficient under-utilisation. IUK is typically used as an arbitrage and balancing tool, and as a marginal supply source, brought into play when other sources do not fully meet GB gas demand requirements. IUK could not play this vital role if it was used in a more baseload mode.

We are pleased that the Regulators organised the public workshop in London on 21 November 2012 and this was well attended by market participants, TSOs, the EC and Regulators. We believe that the feedback from the workshop supported the key points above. In particular, market participants confirmed that they found IUK capacity to be flexible and identified no problems in their ability to access or use it.

Our analysis does, however, point to a clear GB export bias through IUK. This export bias is caused by high commodity charges in GB, which create high marginal costs and a disincentive to flow gas into the NBP. The high commodity charges are a direct consequence of zero reserve prices for GB short term capacity which has led to significant under recovery of National Grid Gas' allowed entry capacity revenue. We see this as a structural problem within the GB charging arrangements and one which Ofgem may wish to address.

With a number of European and national initiatives underway which will require many changes, it is important that sufficient time is allowed to assess the impact of European initiatives already in progress before further initiatives are considered. Any further interventions should be undertaken only after a proper identification of the problem, an evaluation of its impact on consumers, and a cost benefit assessment of the solutions put forward for dealing with it.

We note that some of the concerns raised in the Open Letter also appear in Ofgem's Gas Security of Supply Report, published on 29 November 2012¹. We hope that the points made in this response also feed into Ofgem's security of supply thinking. In particular, it could be worth considering changing the structure of GB's gas transmission charges to reduce GB commodity charges. More generally, IUK has been instrumental in boosting NBP liquidity, attracting LNG import terminal investment and cargoes to GB, and developing gas-on-gas competition in Continental Europe. As such it has made a significant contribution to safeguarding GB security of supply and promoting the internal market in Europe. We hope that regulatory developments allow us to continue to play this vital role to the benefit of consumers.

We would be happy to have further discussions with Regulators. In the meantime if you have any questions on the analysis presented in this response please do not hesitate to contact me.

Yours Sincerely

Robert Sale
Business Development and Regulation Director

- Annex 1: IUK's main response: analysis of flows across IUK and response to the Open Letter consultation questions
- Annex 2: Additional analysis covering within day flexibility provided by IUK
- Annex 3: Additional analysis covering IUK utilisation

¹ <http://www.ofgem.gov.uk/Markets/WhlMkts/monitoring-energy-security/gas-security-of-supply-report/Documents1/Gas%20SoS%20Report.pdf>

Annex 1: IUK's main response: analysis of flows across IUK and response to the Open Letter consultation questions

We start with some general remarks about the initial analysis presented in the Open Letter and then answer the five questions posed in the Open Letter. The analysis that we presented at the 21 November workshop is included in our response to questions 1 and 2. Our research highlights that flows across IUK are efficient and that the number of FAPDs is small and of low value.

General remarks on the high level assessment in the Open Letter

The limitations of comparing day ahead prices with actual flows

It is important to note that comparing day ahead prices to actual flows does not provide an accurate picture of how shippers utilise IUK capacity and therefore caution is needed in interpreting such analysis. Regulators acknowledge the limitations of day ahead prices in the Open Letter and concede that the analysis does not capture developments within the day. IUK shippers are free to nominate and re-nominate continuously until two whole hours prior to actual gas flow and there is considerable change within day on IUK (see Annex 2 for further information on this point). Shippers can, and do on occasion, change a high import nomination to a high export nomination. Our current nomination and re-nomination rules are among the most flexible in Europe and provide shippers considerable within day flexibility to react to the latest prices and their balancing needs. Day ahead prices by comparison are usually an assessment at 16:30 UKT the day before but may actually be assessed several days in advance, as is normally the case for Sundays, Mondays and public holidays.

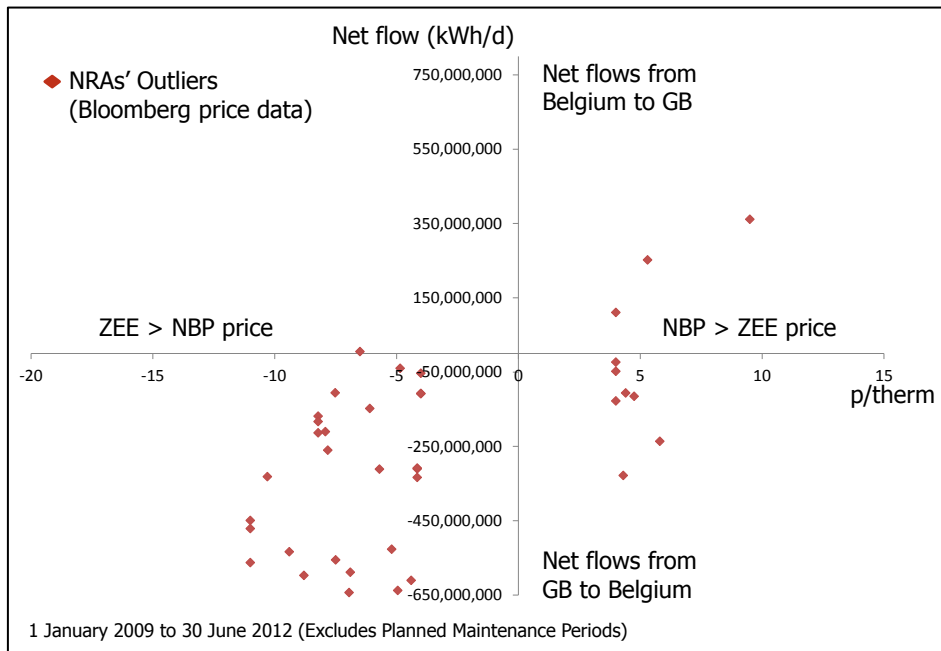
Different sources of price data can produce very different results

We were surprised to see such high price differentials highlighted in the Open Letter analysis as it did not correspond with the price data that we had seen for these particular days. We note that the Open Letter uses Bloomberg data, which we understand is a price assessment based on 3 broker price quotes. In analysis done by Eclipse for us using Spectron price data (average price in a window) and in our own analysis using ICIS Heren price data (assessment at 16:30 UKT) we do not find such high price differentials.

The impact of data sources is shown in Figures 1 and 2 below. Figure 1 shows the outlying data points presented in the Open Letter analysis – with outliers defined as points where the spread was greater than +/- 4p/therm. Figure 2 presents the same data points using ICIS Heren data. It is immediately clear that in Figure 2, most of the outlying data points are significantly changed, with results more in line with what would be expected from a price-responsive interconnector.

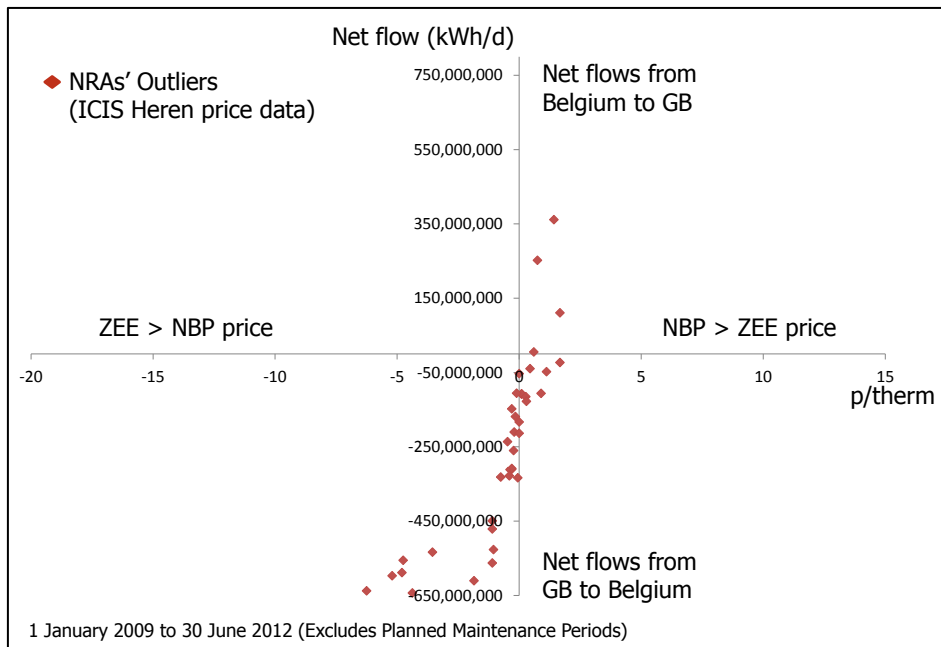
Given the good alignment between the ICIS Heren and Spectron data sources, and the use of these price reports in contracts, we believe the price data presented in our analysis in Annex 1 is a more representative source to use. This was supported at the workshop by those market players present.

Figure 1: Outliers presented in Open Letter



Source: Prices from Ofgem (Bloomberg), flows from IUK website

Figure 2: Outliers using ICIS Heren price data



Source: Prices from ICIS Heren, flows from IUK website

Question 1: What are your views on the economic efficiency of cross-border gas flows between GB, Belgium and the Netherlands? How important do you consider this review into cross-border flows to be?

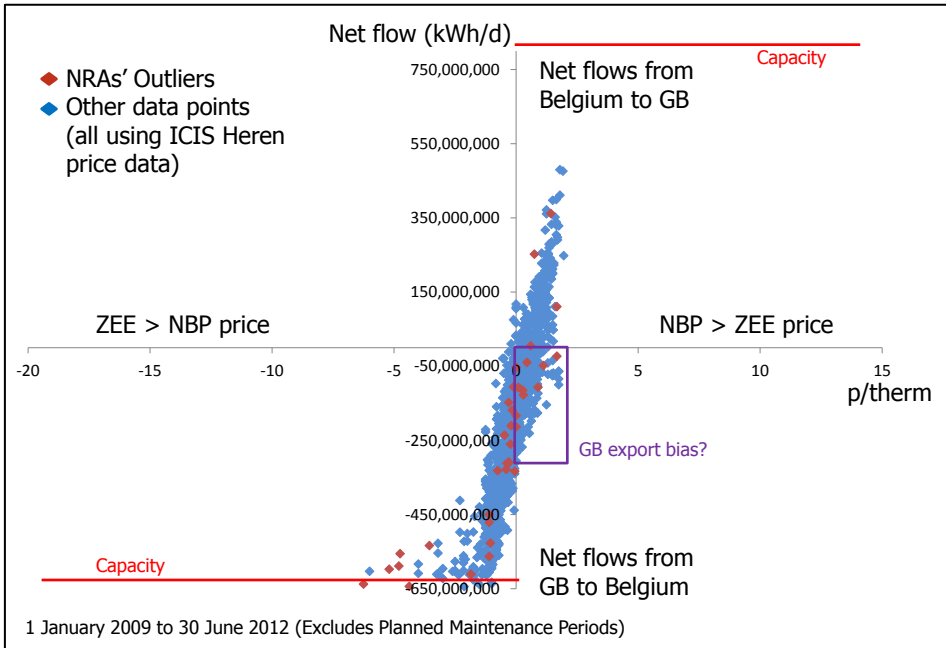
Question 2: What is your experience with cross-border gas trading between GB, the Netherlands and Belgium? What, if any, are the key barriers to economically efficient gas trades happening across our borders? Please provide any evidence or analysis that would contribute to our understanding of the observed behaviour of cross-border gas flows.

We outline below our response to both questions 1 and 2. Our analysis shows that flows across IUK are efficient and that a bias to GB exports is caused by high GB commodity charges that result from the large under-recovery of capacity charges in GB.

Figure 3 presents the flows against price differences for the period 1 January 2009 to 30 June 2012 (the period presented in the Open Letter). All the price data is drawn from ICIS Heren. The outlier points identified in the Open Letter have been highlighted in red. We can see that these points are not in fact outliers when using ICIS Heren price data. It is also clear from the graphic that there is a very close relationship between IUK flows and the NBP-Zee price differential.

The Open Letter considers cross-border trades to be economically efficient if gas flows from the low priced to the high priced market. Figure 3 demonstrates a strong linear relationship, with flows responding in a clear way to day ahead price signals. Flows do generally move in the direction of the high price market. However, the Figure also highlights in a box the data points where NBP>ZEE but flows go from GB to Belgium. This indicates a GB export bias through IUK.

Figure 3 – IUK flows versus price differentials

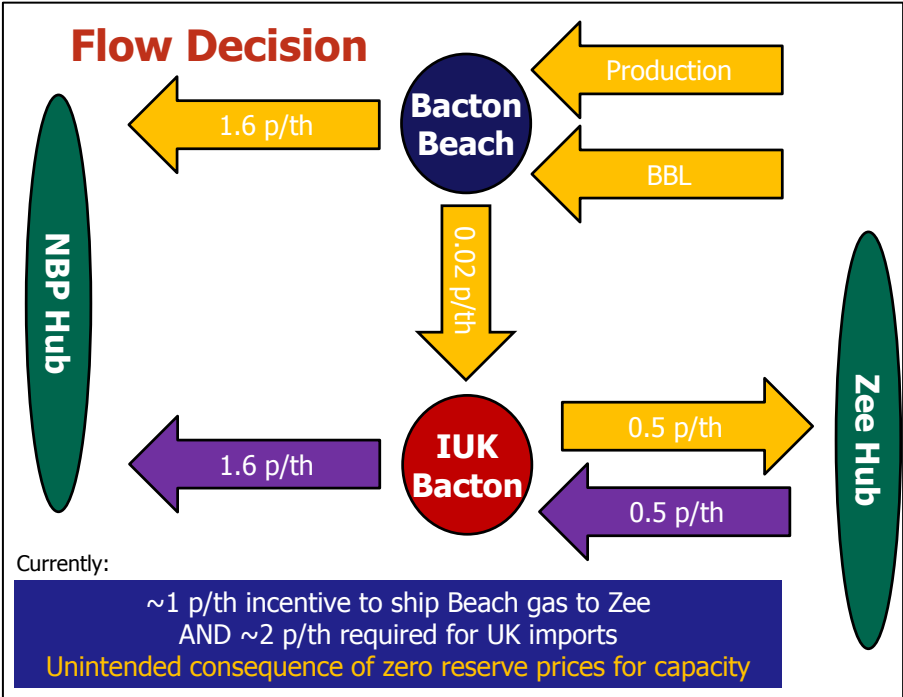


Source: Prices from ICIS Heren, flows from IUK website

While a GB export bias would, at first glance, seem to support the notion that there are some inefficient flows on the Interconnector, once you consider the transportation charges and arrangements for flowing gas into GB compared to flows out of GB, it becomes clear that high GB commodity charges create a rational incentive to export Bacton beach gas to Continental Europe. This is the underlying cause of the GB export bias observed on IUK flows.

Consider Figure 4 below. Shippers are able to trade the significant quantity of gas that is landed at Bacton beach either from upstream production or delivered from the BBL pipeline. They must decide whether to deliver the gas to the NBP and incur approximately 1.6p/therm entry commodity charge or deliver the gas through IUK to Zeebrugge². The high GB commodity charges effectively give a 1.1p/therm incentive to flow Bacton beach gas to Zeebrugge. The high GB commodity charge also means that shippers need a price differential of at least 2p/therm to incentivise flows into GB from Zeebrugge.

Figure 4: Flow decision after considering transportation charges

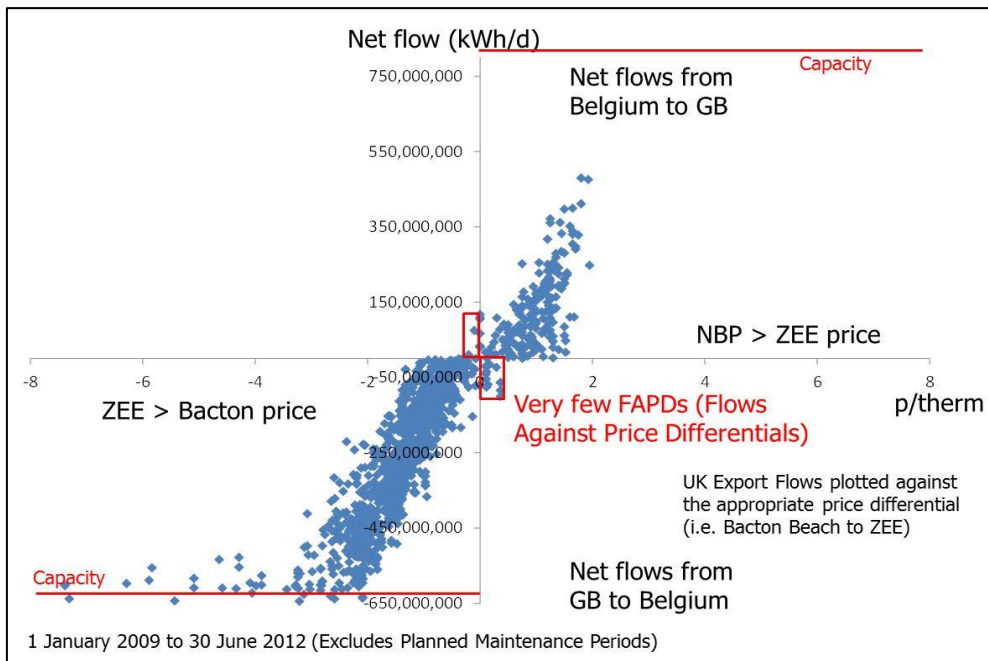


Source: IUK, National Grid Gas, ICIS Heren

In Figure 5 we have plotted IUK's GB export flows against the more relevant Bacton beach/ Zee price differential for GB exports³. The Bacton beach/Zee price differential is the most relevant differential when examining the incentives which shippers face when deciding whether to utilise their IUK export capacity.

² The period of analysis is prior to the Zee Beach and ZPT Hubs
³ Appropriate price differential for GB exports is taken as the price differential plotted in Figure 3 less the GB entry commodity costs applicable on that gas day.

Figure 5: IUK flows versus correct price differentials



Source: IUK, National Grid Gas, ICIS Heren

We can see from Figure 5 that, on this basis, there are in fact very few FAPDs. Flows are responding closely to the effective price differentials which traders face. The volume and values on FAPDs are summarised in Figure 6. We can see that the handful of days where FAPDs did occur were days of low flow and consequently low economic value. From the FAPD analysis, it is reasonable to conclude that flows across IUK are efficient.

Figure 6 – FAPDs^a – volumes and values

FAPDs	
Number of Days	17
% of days	1.4%
% of volume	0.3%
% of value	0.03%

a. Based on Figure 5

Finally, we note that the Regulators have suggested that if IUK flows were efficient, they would expect to see full utilisation of all technically available capacity whenever the (day ahead) hub price differential rises above a certain threshold (covering the marginal costs of transport). This apparent “under-utilisation” issue appears in the Open Letter analysis in the

form of a theoretic red line in the graphic which switches from zero to maximum utilisation whenever the differential is positive, and which is said to depict the “economically efficient flow”. We believe that this represents a misreading of the gas market. Such a flow pattern would be observed only on the assumption that there is deep liquidity on the day ahead market at both ends of the pipeline, sufficient to provide and absorb the full volume of gas that could be transmitted through the interconnector without causing the hub price to move. It would also require other sources of supply to be pushed out to make room for the flow coming from the interconnector. These assumptions are simply not the case in reality. It is misleading to jump from a failure to meet a theoretic benchmark which utilises unrealistic assumptions to the conclusion of inefficiency in the interconnection asset. Annex 3 explores this issue in more detail. In reality, IUK has been used as a marginal source of flexibility. It is precisely its spare capacity under normal conditions that enables it to fulfil its valuable role as an additional source of gas when weather conditions and or the unavailability of other baseload or flexibility sources creates the market need. A good example of this can be seen in IUK’s flows over the period October – November 2012. An additional example is during January 2009 when flows through IUK helped alleviate a lack of supply in South Eastern Europe.

Question 3: How could current market arrangements be improved so that they better promote the objectives of promoting a competitive internal market, eliminating restrictions on cross-border trade in gas and enhancing the integration of national markets as well as security of supply? In your response, please specifically refer to a) IUK, b) BBL, c) the adjacent market arrangements and whether more common arrangements are needed where relevant and possible.

Market arrangements on IUK are working well. They offer considerable flexibility to its users and are not causing a barrier to cross-border flows. IUK has, through negotiation with market players, developed its arrangements consistently reflecting the principles of openness, flexibility and transparency. Its arrangements have been specifically examined by European Authorities in 1995, 2001 and again in the sector inquiry in 2005 and on each occasion no issues have been raised. We have demonstrated that flows across IUK are efficient and FAPDs are not significant in number or value. Stakeholders at the 21 November 2012 workshop confirmed they believed that flows across IUK and IUK’s business rules were working well. This included the European Commission, which in its presentation also confirmed the number of FAPDs across IUK were not significant and indeed compared favourably with other parts of Europe⁴. Regulators also acknowledged at the workshop that there were no shippers “knocking on their door” saying they could not get access to IUK capacity.

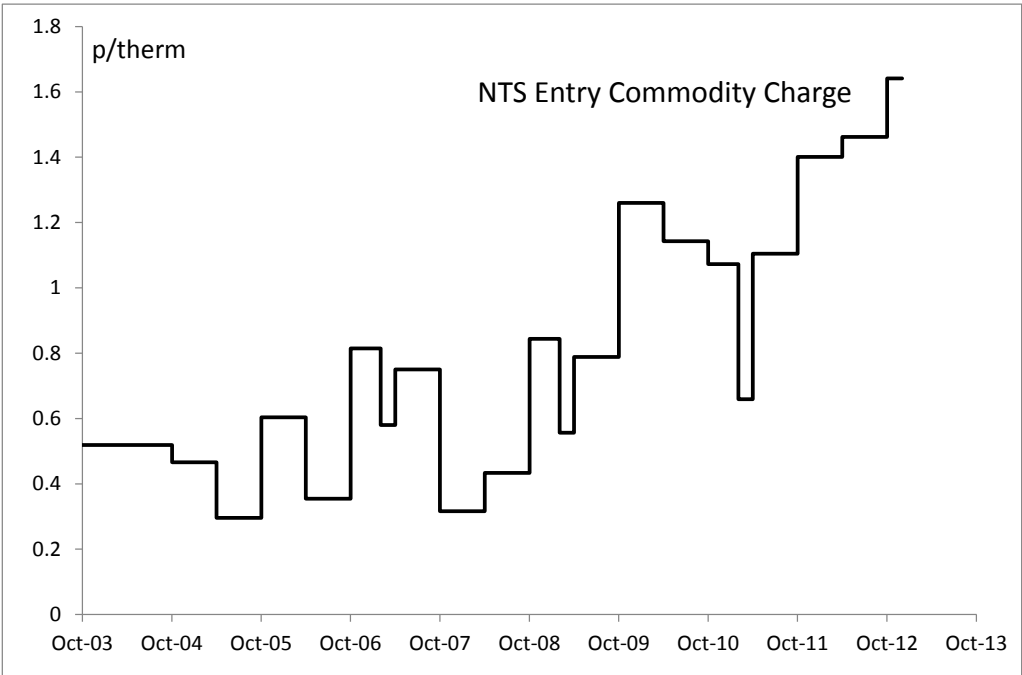
If Regulators believe it is a priority to reduce the few number of FAPDs to an even lower level than we currently see, attention should be focused on tackling high commodity charges in GB. High and escalating GB commodity charges are creating uncertainty and distorting flows into GB. As highlighted earlier the current GB charging arrangements lead to a net 1.1p/therm export incentive for shippers to flow gas from Bacton beach to Zeebrugge. The distortion to flows is an unintended consequence of the requirement for National Grid to charge zero reserve prices for short term entry capacity auctions. Capacity auctions have under-recovered against allowed revenues and the shortfall has been collected through commodity charges. Whilst commodity charges are a valid mechanism for managing minor

⁴ European Commission presentation given by Dinko Raytchev at the 21st November 2012 workshop.

under-recovery, they have become a major and distorting element within the GB gas transmission charging regime.

As can be seen in Figure 7 below, commodity charges have grown very significantly over the last few years. National Grid Gas is now recovering around two-thirds of its allowed revenue from commodity charges. The significant step changes in charges resulting from the under/over-recovery mechanism also result in corresponding step changes in the incentives faced by market participants. We believe that Ofgem should review how the reserve prices for short term entry capacity are calculated to ensure that National Grid Gas can recover the majority of its allowed revenue from capacity sales as was originally intended. This will lead to the level of commodity charges reducing to a more sensible level, ensure that provision of capacity is appropriately recompensed, and remove the current distortion to cross-border trade.

Figure 7: Growth in the NTS Entry Commodity Charge



Source: National Grid Gas

Question 4: Should we try to proceed with minimum necessary changes or should the regulators be looking more holistically at a wider review of arrangements that may present barriers? Should we be considering piloting some deeper regional integration or joining initiatives that are already going on in Europe?

The European Commission believes that the gas market in the North West European area is generally working well with some of the most liquid hubs in Europe⁵. With a number of European and national initiatives underway which will lead to significant changes, it is important that sufficient time is allowed to assess the impact of current initiatives before further regulatory interventions are considered. It is also important that attention is focused

⁵ DG ENERGY MARKET OBSERVATORY FOR ENERGY VOLUME 4, ISSUE 4: October 2011 – December 2011
 VOLUME 5, ISSUE 1: January 2012 – March 2012
http://ec.europa.eu/energy/observatory/gas/doc/qregam_2011_quarter4_2012_quarter1.pdf

on tackling clearly identified problems that are demonstrated to be causing consumer harm. Finally, any proposed regulatory intervention should be undertaken only after a cost benefit assessment which demonstrates that the intervention is tailored and proportionate.

Question 5: What process may help us to achieve the best outcome? What role should regulators, market parties and TSOs have in this process? How would it interact with pan-European policy initiatives?

Below we set out a number of principles which we think should underpin Regulators' further work in this area.

1. Consider additional changes only after assessing the effectiveness of current European initiatives

With respect to the European Network Codes, the Open Letter talks about possibly needing additional changes besides the legally binding requirements of the European Network Codes. IUK's view is that it is premature to be thinking about additional changes when the European Network Codes are still being finalised and implementation has not taken place. It would be prudent to allow sufficient time after implementation of the various European Codes to evaluate their effectiveness. Only then should additional measures be considered. This was the clear message given by stakeholders at the GRI NW implicit auctions workshop held on 19 October 2012.

2. Base any proposals for further regulatory interventions on sound problem identification

IUK's business is facilitating cross-border trade and our business rules have been effective in enabling gas to flow between GB and Continental Europe. The European internal energy market is important to us and we are committed to working with all stakeholders to make it better. We believe that Regulators should focus attention and resource on key problems that are causing significant issues. Regulators should identify the problem that they are seeking to resolve and, wherever possible, quantify the magnitude of the harm caused by it. This will provide a sound platform for evaluating policy interventions.

3. Respect legacy contracts

When considering how to implement the Network Codes, it is important that legacy contracts are respected as much as possible, consistent with achieving compliance with the Codes. This will give investors maximum confidence in regulatory stability and create trust that contracts agreed today will not be overturned at a future date following a change in regulatory thinking. Consumers will benefit through the lower cost of capital arising from this confidence. This point is significant for IUK, as we consider how best to preserve our long term contracts whilst implementing the Network Codes. Doing this successfully will be of long term benefit to consumers in GB and Continental Europe.

4. Look to apply proportionate rules

We note the European Network Codes have been developed mainly with meshed networks in mind and some of the requirements do not readily fit the circumstances of single pipe line interconnectors. Regulators should look to apply the Network Codes with care, in a

pragmatic and proportionate way, taking account of the differences between TSOs. For example, the Balancing Code has been designed for meshed networks. IUK has concerns that the new rules, if applied in a non-proportionate way, could lead to a backwards step in terms of the flexibility that we currently offer shippers through the variable inventory service. IUK has developed fit for purpose balancing arrangements that include within day obligations and it is important that key elements of these arrangements are retained.

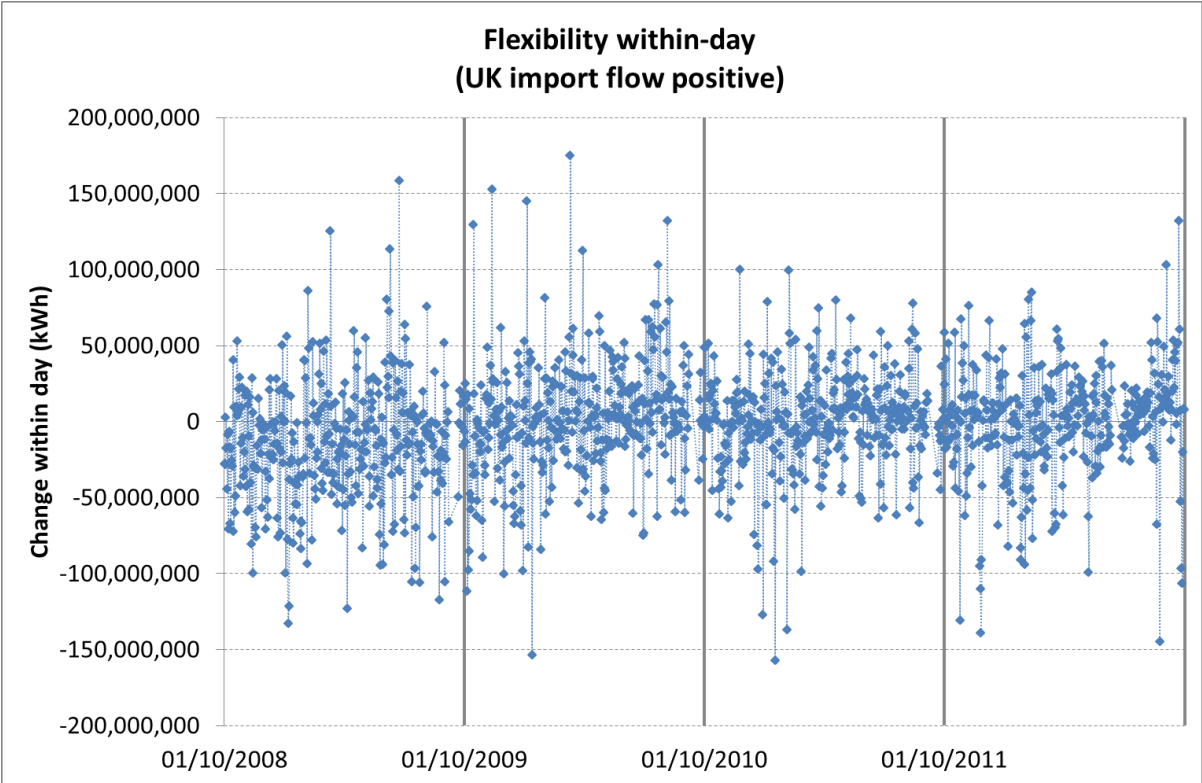
Annex 2: Additional analysis covering within day flexibility provided by IUK

IUK’s market arrangements allow significant within day flexibility to shippers. Gas flows are initially scheduled day ahead and then dynamically rescheduled during the gas day as shippers re-nominate flows at just two hours’ notice. There is no ‘gate-closure’ and shippers are able to nominate continuously ahead of and during the gas day with immediate confirmation of their change in nomination(s).

Figure 8 below plots the within day changes over a four year period. We did this by taking the difference between the scheduled nomination at the end of day and the scheduled nomination at the start of the day (06:00 hours). A positive number is either the result of an increase in the GB import flow or a reduction in the GB export flow within-day.

Figure 8 shows that it is frequent for flows within-day to flex by at least +/- 50GWh. To put this in perspective, this is enough gas to power 10 GW of CCGT operating at a net efficiency of 50% for 2.5 hours within the day and more than enough to cover the tea-time peak in electricity demand.

Figure 8: Changes to IUK flows within day



Source: Interconnector

Changes in the energy supply and demand, which were unanticipated day ahead, routinely happen within-day. Imposing restrictions on, or the removal of, re-nomination rights and the application of a day-ahead gate closure procedure (as are used in implicit auctions) would ‘lock out’ the within day flexibility that is currently provided by IUK, to the detriment of market liquidity and efficiency.

Annex 3: Additional analysis covering IUK utilisation

In this Annex, we set out why it is misleading to assume that if IUK were used efficiently, we would observe maximum flows in the direction of the spread. This implication appears in the Open Letter which states that "IUK was not fully utilised on the 305 days out of the 309 days during which the NBP-Zeebrugge price spread rose above average". It appears more clearly in Ofgem's Security of Supply Report which includes the statement that "if flows are fully responsive to hub prices, gas should flow from the low hub price area to the high hub price area at an interconnector's maximum capacity."⁶

The expectation of maximum capacity utilisation as an efficient response to hub spreads is not appropriate in the case of IUK for a number of inter-related reasons:

- GB has high import capacity relative to average and indeed peak demand levels; high utilisation simply cannot be achieved across all assets. Utilisation will vary according to how each supply source is optimised to meet demand and balancing requirements.
- IUK is one of several alternatives for transporting gas between the GB and Europe, and for arbitraging between different hubs. Utilisation depends on which route shippers choose to use for their arbitrage trades.
- IUK is a balancing pipeline. It does not have a baseload of flow transporting gas from a production zone to a consuming zone.
- From an economic theory point of view, an expectation of maximum utilisation in response to hub differentials implicitly assumes a) low hub-to-hub transmission costs such that any material hub price differential generates a profitable trading opportunity; and b) extremely liquid hubs so that there is sufficient gas available on spot markets to source the very high volume of an interconnection's maximum flow and ample ability in the recipient market to absorb the flow, without moving hub prices. These assumptions do not reflect the reality of the gas market, even in North West Europe, and are not helpful in identifying the real problems in gas markets.

These points are considered further in the remainder of this Annex.

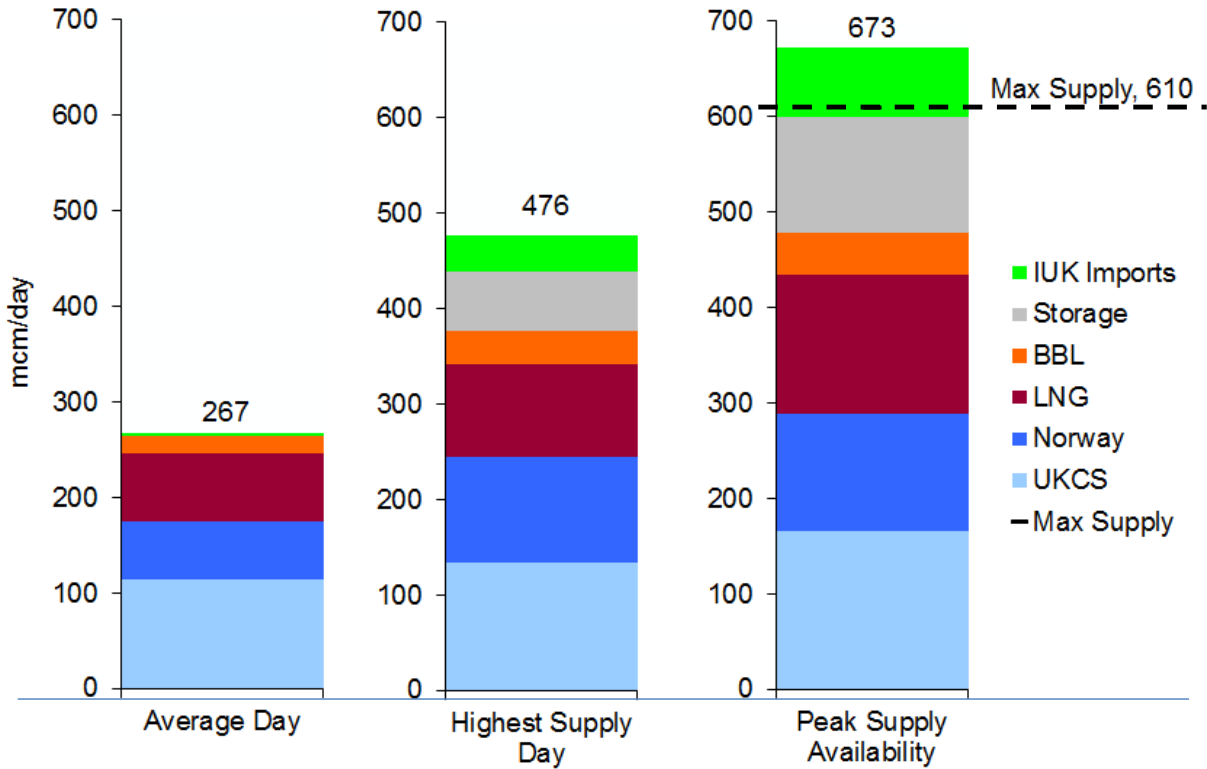
GB Excess Import Capacity

Import capacity to GB far exceeds demand. This provides the market with options regarding where to source gas and resilience in the event of there being supply issues. The demand for gas is heavily seasonal and peak demand is very dependent on the weather. Gas networks are typically sized to be able to cope with demand on a very cold winter's day and therefore are over-sized for all but the most extreme days. This is a reasonable state of affairs given the low cost of providing capacity relative to the consequences of a gas supply emergency and an inability to get gas to end-consumers.

Figure 9 shows the sources of GB gas supply in 2010/11 on the average day and on the highest supply-day, along with the peak supply availability. The flow and capacity data are taken from National Grid's "Gas Ten Year Statement", December 2011. NG scales back the peak supply availability by almost 10% to arrive at the maximum supply figure quoted of 610 mcm/day. The Figure illustrates how total capacity (even after scaling back) is significantly above the average day and indeed the maximum day demand. It also shows how IUK capacity was used, in this particular gas year, as an important marginal source of supply to meet the maximum day requirements.

⁶ In both cases, the underlining has been added to the original text.

Figure 9: GB Gas Supply in 2010/11



Source: NG Gas Ten Year Statement 2011

The IUK pipeline has been used as a marginal source of gas supply to GB; or, put another way, it sits relatively high in the GB gas supply merit order and is typically called upon after other sources of supply. Nonetheless, it plays a key role in providing a large source of supply precisely when GB or Continental markets require it. Particular instances include:

- as source of supply to the GB market, following the Rough fire in February 2006 when the IUK pipeline imported gas in excess of nameplate on several days after the incident; and
- as a source of supply to the Continental market during the supply/transit issues in January 2009 when the IUK pipeline shifted to UK export mode for several days, helping to relieve the supply shortage in South Eastern Europe.

In Belgium, it is also the case that import capacity far exceeds national gas demand. The underlying causes for this are somewhat different than in the case of GB, and arise because of Belgium’s key role in providing transit routes linking across Continental Europe. Nonetheless, the same implication arises: it is not appropriate to expect all transmission routes to have high capacity utilisation.

IUK is one of several available arbitrage tools

The IUK connects the GB market with the Continental European market, and provides shippers with an ability to arbitrage between hubs. However, the BBL, the Norwegian pipeline system, and LNG offer alternatives.

Production from the Norwegian Continental Shelf (NCS) has access to both the GB and the Continental markets through several pipeline systems with spare capacity. The Gassled

infrastructure effectively acts as an interconnector allowing Norwegian producers to engage in geographical arbitrage, providing an alternative to the IUK. An example of this was seen in early summer 2012 when more Norwegian gas was directed towards the Continent, as the NBP was at a discount to the Continental markets on the forward curve. The outcome was less demand for GB gas transported via IUK.

The BBL is also an arbitrage tool, although it does not have physical "reverse flow" capacity to Continental Europe. It can increase flows to the GB if there is spare capacity or it can reduce existing forward flows. An interruptible reverse flow service is available that allows nomination from the GB to the Netherlands, subject to sufficient flow in the forward direction. This service allows for further arbitrage between GB and Continental Europe.

Gas available in Zeebrugge also has several alternatives. It can flow to the UK, France, the Netherlands, Germany or be injected into Belgium storage. Gas available in Zeebrugge will be directed to the market or opportunity offering the highest net spread subject to available transportation capacity.

In summary, there are a range of arbitrage routes and opportunities available to shippers. It is misleading to assume that whenever an arbitrage opportunity arises, an efficient market will result in one of several competing facilities being used to its maximum capacity.

Market fundamentals

The IUK is a "balancing" pipeline through which a fundamental imbalance between GB and Continental markets can be "evened out". It is not a connecting pipeline between a producing area and a consuming area such as, for instance, the Langeled pipeline connecting the NCS to GB. Consequently, there is no baseload volume securing high utilisation across IUK on an ongoing basis.

When Continental Europe has a supply surplus and GB a supply deficit then the flow direction and volume is determined by that imbalance. For instance, during winter 2011/12 a mild winter led to a GB surplus and at the same time there was a material decrease in LNG deliveries to Continental Europe. This GB surplus and European deficit led to high IUK exports. Conversely, during summer 2012, IUK exports were at their lowest summer level since April 2008. A large drop in UK LNG send outs and record low UKCS production meant that GB supply was low and could not support high IUK exports.

Market fundamentals are such that the magnitude of flows is determined in large part by the volume of gas available for arbitrage, and not by the transmission capacity available for use.

Theoretic models and assumptions

The expectation of maximum utilisation in response to hub differentials could arise from an economic model which assumes that in an efficient gas market:

- there are low hub-to-hub transmission costs such that any material hub price differential generates a profitable trading opportunity;
- there is deep liquidity on hubs so that there is ample gas available on spot markets to source the interconnection's maximum flow (without moving prices significantly);
- there is ample depth of demand in the delivery market so that the full volume can be absorbed (without moving prices significantly); or the resultant high flow simply pushes out other sources of supply to the delivery market.

However, these assumptions are extreme and do not reflect the reality of gas market arrangements. Marginal gas transmission costs are significant and play an important role in determining flows; liquidity in NBP is high but in Zee less so; and the IUK is an extremely large capacity pipeline, and its full utilisation is highly material in moving markets even in the context of NBP liquidity. For these reasons, the simplifying assumptions outlined above are not useful when coming to judgements about the expected level of utilisation in an efficient market.

It is generally considered that the gas market in North West Europe works well. This can be seen in the very tight correlation of prices across NBP, TTF and Zee, showing that traders are efficient in arbitraging across these markets.