



STORAGE, GAS PRICES AND SECURITY OF SUPPLY

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EXECUTIVE SUMMARY

In October 2005 UKOOA commissioned ILEX to produce a report summarizing our views for UK gas storage facilities and the medium term outlook for UK gas prices. This study follows on from ILEX's previous reports on UK gas prices for UKOOA¹. Gas prices have increased over the past 18 months and the increases are causing concern to industry, the regulator (Ofgem) and end user representative organisations.

This study looks at:

- the use of UK gas storage facilities;
- the quantities of the different type of storage in the UK; and
- the projected UK gas storage position for 2010.

We also compare both the amount and the use of UK gas storage facilities with how storage is used in wider Continental Europe. We look at the economics of building new gas storage for the UK market, and the impact that a second large storage facility, the size of Rough, might have on gas prices in the UK.

Finally, we give our views as to whether the market can provide the economic signals to incentivise investment in both what we term "commercial" and "strategic" storage.

UK Gas Storage

All the storage facilities in the UK are operated on a commercial basis unlike gas storage on the Continent. The storage facilities are owned by storage operators who seek to maximise the value of the facility either using the facility for their own internal portfolio, or selling services to external customers (usually shippers).

There is a substantial list of potential projects for new storage in the UK. These projects are at various stages ranging from conceptual, to seeking planning permission (or undergoing an enquiry), to holding planning permission, to under construction. We believe that by 2010 there will additional UK storage capacity in the following categories:

- Depleted field storage: there will be no new offshore facilities. However, we assume an increase of around 30% capacity by the construction of a number of new onshore storage facilities.

¹ 'What influences gas prices in the UK and why have they increased through 2000?', ILEX, January 2001; 'UK gas prices: past and future', ILEX, March 2002; 'Gas prices in the UK', ILEX, September 2004.

- Salt cavern storage: there will be considerable growth in the volume of salt cavern storage with the construction of a number of onshore facilities and the volume of gas stored increases by around 300% over the period.
- LNG: there will be no addition to the existing peak shaving LNG facilities.

We expect the UK to have more coverage for short-term supply problems in 2010 than it has today. In terms of long-duration loss of supply the new facilities will provide some, but not much extra cover to the security of supply in the UK.

In summary, the amount of UK gas storage has in the past been sufficient to meet our security of supply requirements - based on our previous supply position - where we have produced all or most of our gas requirements from the UKCS.

Storage in Europe

The technical, operational and contractual characteristics of storage facilities operated on Continental Europe reflect the fact that most facilities were developed under markedly different market conditions, namely a market structure with a monopoly gas company and dependence on gas produced and transported from distant sources. The new legislative and regulatory frameworks necessary to create the single energy market have not fully evolved to accommodate the use of storage in a competitive market. In March 2005 an agreement was reached for the Guidelines for Good Practice for Storage System Operators (GGPSSO) in line with the 2003 European Gas Directive. The GGPSSO had a deadline of 1st April 2005 for most of its provisions.

The European Regulators Group for Electricity and Gas (ERGEG) launched a monitoring programme via questionnaires to assess the progress of the GGPSSO's implementation and issued its initial report in September 2005. The report concluded that the implementation was not good in a number of areas including transparency and secondary markets. The ERGEG states that access to storage plays a key role in the development of gas-to-gas competition in Europe.

Economics of new storage

Whenever storage users purchase capacity from storage operators they are likely to calculate a market value for the storage service. The market value depends on a number of factors including the expected value at the prevailing market gas prices (the mark to market value) *after* taking account of storage usage costs, transportation cost to the NBP and allowing for perceived risks, e.g. storage reliability.

The market value of storage is derived from the *differences* in gas prices at different times of the year (e.g. between summer and winter), and the *differences* in prices over shorter time periods (e.g. between weekends and weekdays, or when there is a short term price spike). Storage is an arbitrage between low priced and high priced periods. On a day to day basis the operational use of storage is an arbitrage between the price of gas today and the price of gas in the future (if it is cheaper then inject, if more expensive then withdraw).

All storage facilities can arbitrage between the summer and winter prices. Storage facilities that are capable of injecting during the winter period once they have started emptying have further additional value from cycling (i.e. filling the facility more than once). The nature of the arbitrage is different for each type of storage facility and depends on how rapidly the storage facility can fill and empty.

We believe that a potential problem exists with the signalling of the requirement for new storage investment in a liberalised gas market. This is due to what we have called the “ILEX storage paradox”. When gas prices are low shippers view the risks of being out of balance as low and the value of storage is low. Past experience indicates that market players become less willing to book storage when annual prices are low. However, as the annual gas price increases the cost of providing the cushion gas needed to fill the non-working capacity of a new storage facility becomes exorbitant.

The ILEX storage paradox.

When gas prices are low nobody wants storage.

When gas prices are high nobody can afford to build new storage.

Thus a wider summer/winter price spread associated with a higher annual gas price does not always feed through to trigger investment in new storage projects. The value of the cushion gas required for a Rough sized storage facility is over £2,000 million, equivalent to 18 p/th of working storage volume. There are a number of other costs that must be included in a new storage facility including capital investment and annual operating costs that need to be included in the decision to build new storage. ILEX analysis estimates the capex and opex costs to be in the range 3 to 6 p/th of working storage volume.

At the current market price (50 p/th for annual gas), the market value of storage would have to exceed 21 to 24 p/th (the annual cushion gas charge, plus capital investment and operating costs) in order to make it commercially attractive to develop new offshore depleted field storage. The market value would have to exceed the storage cost for a period of ten or more years to make it attractive to invest.

We also view the changes by Transco to the Storage Monitor regime (see section 2.32) as potentially damaging the operation of existing storage facilities and hence investment in new storage capacity. In our view Transco, HSE and Ofgem should reconsider the arrangements allowing Transco to increase Safety Monitor levels.

ILEX view of gas prices out to 2011

Gas prices have increased markedly in recent years. Over the past year, wholesale gas prices have increased by 40%, with even further increases expected over the coming winter. Increases in wholesale gas prices eventually feed through to the delivered gas prices seen by gas consumers in the domestic and industrial sectors. The high gas prices are also feeding through to create record high electricity prices. Industrial gas consumers are complaining that such gas and electricity prices are damaging their profitability and threatening their very existence.

The ILEX approach to projecting prices is to construct three possible UK future scenarios which describe the supply, demand and transportation capacity for natural gas, and the effect that this would have on the price for natural gas. A summary of the ILEX scenarios is as follows.

- **High price scenario**

In this scenario demand for gas remains high with limited demand reduction despite high prices and high priced import capacity increasing to cover the shortfall. Market liberalisation on the Continent is limited despite high oil prices at around \$60/bbl. Therefore gas prices are relatively high and remain indexed to oil and oil products.

- **Central price scenario**

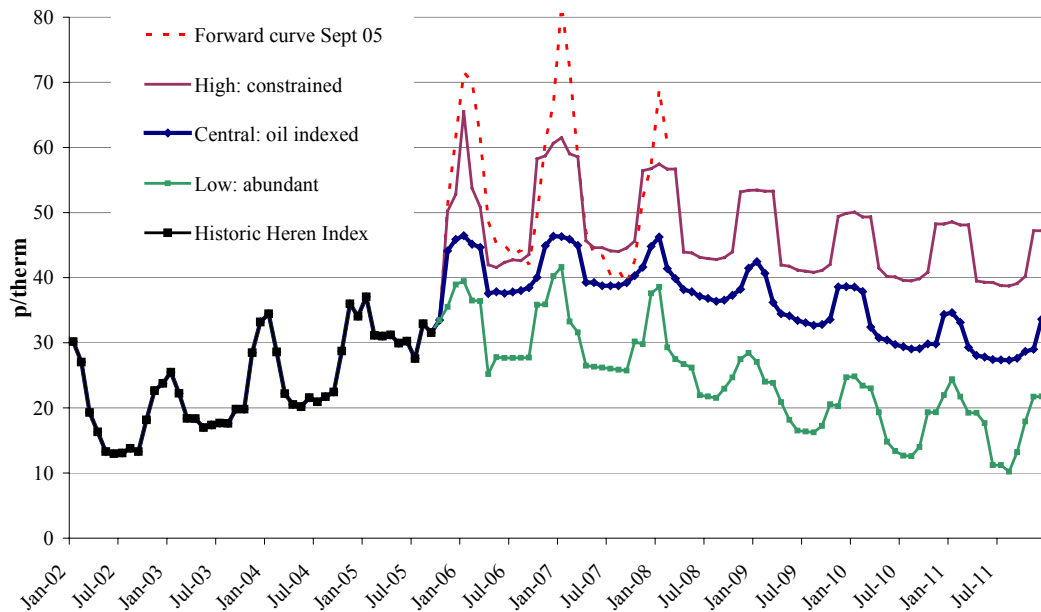
In this scenario, the supply-demand balance remains tight in the shorter-term, but after 2007 with the arrival of a number of new import projects, the supply constraints are eased. However, the link between gas prices on the Continent and oil (which declines to around \$35/bbl in real terms by 2011) remains strong throughout; consequently, gas prices are moderate to high.

- **Low price (bubble) scenario**

In this scenario, gas supply to the UK is abundant, with production and import capacity in excess of a relatively low demand growth. The relative oversupply both in the UK and NW Europe means that the Continental market is largely liberalised by 2010. Gas prices are therefore relatively low.

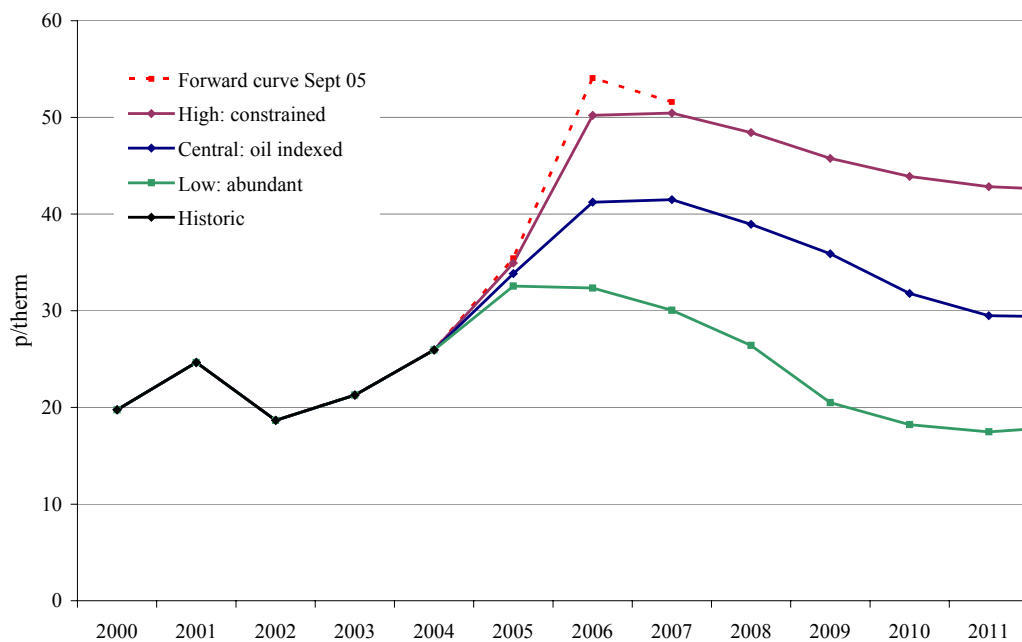
The projections of the spot gas price for the above three scenarios are presented in Figure 1 and Figure 2. All the prices referred to are for wholesale gas bought at the National Balancing Point – the NBP.

Figure 1 – Monthly NBP gas price projections (2005 p/therm)



Source: ILEX analysis. Forward curve from Heren Energy Ltd

Figure 2 – Annual spot gas price projections at the NBP (2005 p/therm)



Source: ILEX analysis. Forward curve average of Sept 05 Heren forward curves (Heren Energy Ltd).

ILEX believes that the UK gas market is currently relatively constrained and is tracking our High gas price scenario and gas prices are at a peak. We expect

wholesale gas prices to weaken somewhat and move towards annual gas prices of around 42 p/therm by 2011 a reduction of around 20% from current prices. The fall in gas price is a result of weakening oil prices over this period. Oil price remains the main driver for gas prices in this future.

This view is based on an assumption that liberalisation of the wider European energy markets will not be completed successfully by 2011. Even if liberalisation of the Continental market was complete before this we do not believe that gas prices will completely de-link from oil. Hence the lower gas prices in our Central scenario are more a result of the lower oil prices from our Central oil price scenario than a direct result of liberalisation.

We do not expect our Low scenario to come about since this future is dependent on a successful liberalisation of the Continental gas market and a full de-linking of gas prices, probably as a result of an excess supply over demand ie a “gas bubble” developing.

Gas prices and storage

ILEX has used its modelling capability to simulate what might have happened to market prices had another Rough sized storage facility (R2) been built, and been commissioned during summer 2005. This scenario assumes that the R2 is available for the winter of 2005/06 onwards.

There would be two main impacts of building a R2:

- the winter/summer differential decreases, as R2 supplies the winter period and replaces some of the more expensive salt cavern and peak LNG storage; and
- the market value of storage, which is built up from the difference between summer and winter gas prices, would reduce. The additional storage capacity would probably take us back to a situation similar to that in 1999 when Rough was not fully sold and there was a surplus of gas supply in winter.

We conclude that although UKplc (the entire country) would have benefited from the building of a further Rough (with hindsight), there was no possible economic justification for any one organisation to build it. The building of a second large storage facility of this size in the UK could not have been undertaken by the market.

Our Conclusions

Gas storage facilities increase the security of gas supply for the UK gas consumers. It allows shippers/suppliers to inject gas during periods of low demand during the summer when gas prices are low, and withdraw gas in the winter when demand is much higher and prices higher. However, the amount of gas storage in the UK reflects the past position when the UK was fully self sufficient in gas from production on the UKCS. When the UK had production close to our centres of demand and the ability to vary this production (swing) the

amount of storage was probably correct. However, as a consequence of depleted indigenous production and following a number of years of surplus storage capacity, the UK storage position is tight in the winter of 2005/06 and the next two winters until new supply projects come on stream.

If the 2005/06 winter experiences severe weather then there is a need to cut off end users (load shedding) to a volume equivalent to one Rough storage facility. This could result in much of UK industry being without gas for much of the winter. It is too late for storage to deliver enhanced security for this winter. The lead time to develop and build new storage is 3 years or more, so if the go ahead were given today to build a second Rough then by the time the storage came to market the short-term tightness of supply-demand in the UK will have passed.

New storage projects are being developed for the UK. However, planning constraints slow down developments. The lack of liquidity in the wholesale traded gas market beyond the next 18 months also means that new facilities cannot rely on price signals from the traded markets to underwrite storage development. Instead, new storage facilities will need long-term contracts with shippers/suppliers to underwrite the investment. However, gas shippers/suppliers are unlikely to be willing in our view, given the current outlook for the winter/summer differentials, to commit to long term gas storage contracts with storage developers.

Has the market worked in the UK?

Looking at the UK as a whole, we believe that the gas market has responded reasonably correctly and efficiently to economic signals: there has not been, even with perfect foresight, any robust commercial case to build a second Rough. However, our analysis summarised in Table 5 – Savings to UK plc from building a second Rough – does appear to suggest that the market has not delivered the most efficient outcome for UK gas consumers. Gas prices would have been significantly lower if a second Rough had been commissioned by summer 2005. However, in our view, it is dangerous to assume that decisions made by Government to centrally plan the “correct” amount of UK storage is any more likely to deliver the optimum outcome for gas prices than the market.

Instead, the market is delivering new “bite-sized” storage facilities to the market. The economics of relatively small storage facilities favours onshore facilities rather than offshore because of the high operating costs offshore. However, we have concerns that the planning process is delaying the development of new onshore storage.

Strategic storage – does the UK need it?

“Strategic” storage is a difficult term to define. We believe that the market should and can deliver sufficient “commercial” storage capacity to provide for the normal seasonal variation in demand between winter and summer. Thus commercial storage should be capable of providing sufficient gas – at a reasonable price – to maintain gas supplies to all domestic consumers and most of industry and the

power generation sector through a cold winter. Our existing commercial storage capacity fails this test for this winter. National Grid Transco, in its Winter Outlook, suggests that a significant amount of industrial demand would need to stop consuming gas for much of the winter. National Grid Transco estimates that 2.2 bcm of load shedding would be required if the winter is 1:10 cold, and 3.6 bcm of load shedding would be required if the winter is 1:50 cold. However, it is likely this is a temporary problem for the next few winters until the new depleted field storage and new gas importation projects are commissioned and make up for the reducing swing from UKCS supplies. The UK will, however, face the potential diversion of both pipeline gas and LNG cargoes to other markets if prices are higher in those markets.

If we accept that the market can deliver “commercial” storage, what can we deduce about the market signals for “strategic” storage capacity? Firstly, a case can be made that, as a result of the change in the UK supply situation caused by the need to import gas from remote sources, the UK should build strategic storage to maintain security of supply. We define strategic storage as storage only used in extreme circumstances that arise as a result of a major supply side problem. An example of such a problem would be the loss of the IUK interconnector or the Langede pipeline – both will be capable of supplying over 20% of UK gas demand. The risk of such a supply side problem is low and the market is unlikely to be willing to “insure” against the risk by funding another one or two Rough equivalents.

The alternative to the market providing strategic storage would be for Government to impose the costs of funding strategic capacity on the industry. The full evaluation of both the requirement and the funding solution for UK strategic gas storage is beyond the scope of this study. In our view the Government should examine this issue in the coming energy review.

1. INTRODUCTION

- 1.1 In October 2005 UKOOA commissioned ILEX to produce a report summarizing our views for UK gas storage facilities and the medium term outlook for UK gas prices. This study follows on from ILEX's previous reports on UK gas prices for UKOOA².
- 1.2 Gas prices have increased over the past 18 months and the increases are causing concern to industry, the regulator Ofgem and end user representative organisations.
- 1.3 The Trade and Industry Committee recently announced an investigation³ to follow-on from the earlier investigation which reported in March 2005⁴. The closing date for written submissions to the Committee is Tuesday 25 October.
- 1.4 We understand that our report may be submitted to the Trade and Industry Committee by UKOOA. We emphasise that our report is solely the view of ILEX and does not represent the view of UKOOA or its members.
- 1.5 Our study looks at the use of gas storage facilities and the quantities of the different type of storage in the UK (in section 2) and the projected storage position for 2010. We also compare both the amount and the use of UK gas storage facilities with how storage is used in wider Continental Europe (in section 3). We then examine the economics of building new gas storage for the UK market (in section 4), and the impact that a second large storage facility, the size of Rough, might have on gas prices in the UK (in section 5).
- 1.6 The objective of our report is to assist the Committee and the wider public, who are not gas market specialists, in understanding the role of gas storage in the UK gas market. Our study looks at both security of gas supply and how gas storage plays a part in the formation of gas prices. Our conclusions are presented in section 6.

² 'What influences gas prices in the UK and why have they increased through 2000?', ILEX, January 2001; 'UK gas prices: past and future', ILEX, March 2002; 'Gas prices in the UK', ILEX, September 2004.

³ New inquiry: Security of the gas supply, 27 September 2005
http://www.parliament.uk/parliamentary_committees/trade_and_industry/tisc_pn05_0506.cfm

⁴ Trade and Industry – Twelfth Report, March 2005
<http://www.publications.parliament.uk/pa/cm200405/cmselect/cmtrdind/279/27902.htm>

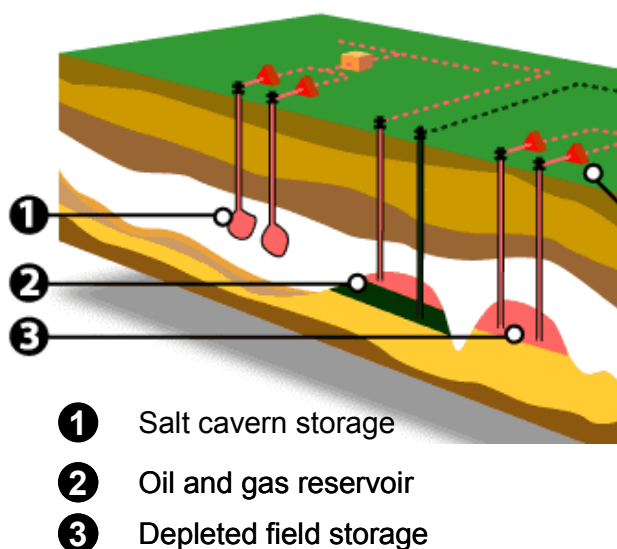
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2. STORAGE IN THE UK

Storage facilities in the UK

- 2.1 There are three different types of storage facility in the UK: depleted gas field/oil and gas reservoir (which can be either on-shore or off-shore), salt caverns and liquefied natural gas (LNG). Figure 3 illustrates schematically the different types of underground storage facility. LNG is a cryogenic liquid⁵ and is stored above ground in highly insulated tanks. Examples of each type of storage facility are described in turn.

Figure 3 – Schematic of different types of underground storage facility



Source: Ontario Ministry of Natural Resources, ILEX

- 2.2 Table 1 lists the UK storage facilities that were operating in 2004/05 by storage type.

⁵ Natural gas cooled to minus 160 degrees Celsius.

Table 1 – Storage facilities operating in the UK in winter of 2004/05

Storage Type	Facilities operating in 2004/05
Depleted field	Rough, Hatfield Moor
Salt Cavern	Hornsea, Hole House
Liquefied Natural Gas (LNG)	Glenmavis, Partington, Avonmouth, Dynevor Arms.

Isle of Grain LNG was operating on a restricted basis in 2004/05 but has now been converted to an LNG importation terminal.

Rough

- 2.3 Rough is by far the UK's largest UK gas storage facility and is a partially depleted, offshore gas field. Gas is contained within the rock strata called the Rotliegendes sandstones some 2700 metres under the seabed. The reservoir is a fault bounded anticline approximately 10km long by 3km wide and it varies in thickness from 24 to 35 metres. Gas is withdrawn from the reservoir, through 30 wells drilled and completed from the reservoir to the platforms, as a 'vapour' and undergoes several separation processes offshore, before being sent via a 36 inch subsea pipeline to the Easington terminal. These same wells are used to re-inject the gas back into the reservoir. Compression is required for injection and for transporting the production into the National Transmission System (NTS) the on-shore gas grid.

Hornsea

- 2.4 Hornsea is a set of nine man-made salt caverns at a depth of 1.8 km below the surface. Compression is required to inject gas into the salt cavern. Gas flows under its own pressure on withdrawal.
- 2.5 Salt caverns are man made. The process involves pumping water down into the cavern to dissolve the salt and to produce a cavern of the necessary size. The brine which is produced by this process is either disposed of by pumping it into the sea, or used as a raw material feedstock. It takes several years to leach a new salt cavern.

LNG

- 2.6 The four LNG storage sites liquefy natural gas by cooling it to -160 degrees Celsius and store the liquid above the ground in a highly insulated container. Their key feature is their ability to rapidly re-vaporise the natural gas and deliver it to the NTS. It is important to note that the LNG storage sites pre-date the recent developments in LNG importation.

Storage availability over the 2005/06 winter

- 2.7 In addition to the facilities listed in Table 1 there is new storage capacity available from the Humbly Grove facility for the coming winter. Humbly Grove is an onshore oil field. It is estimated that Humbly Grove will store 300 million cubic meters of gas, and will take around 40 days to fill and estimated 60 days to fully empty⁶. Star Energy, the developer of the facility, has announced that it plans to start injections of gas into store in late October 2005. If the facility's operation goes according to plan Humbly Grove could fill in the autumn of 2005 and be full in time for active use in January 2006.
- 2.8 Additionally, the deliverability at Hole House has been doubled so that it is capable of emptying in 5 days rather than 10 days. The enhancement will help with short term supply problems but will not make any difference to the volume of gas stored for the winter.

Access to gas storage facilities in the UK

- 2.9 All the storage facilities in the UK are operated on a commercial basis unlike gas storage on the Continent. The storage facilities are owned by storage operators who seek to maximise the value of the facility either using the facility for their own internal portfolio, or selling services to external customers (usually shippers).
- 2.10 There is a distinction between storage facilities that are required to give non-discriminatory third party access (TPA) and facilities that are exempt from third party access requirements. TPA is required for Rough, Hornsea and the LNG storage facilities, but not for Hatfield Moor and Hole House which have been granted exemption under section 19A(6)(a) of the Gas Act 1986 from the negotiated TPA requirements contained in section 19B of the Gas Act 1986⁷.
- 2.11 In 2005 the services sold to third parties under TPA arrangements were provided under negotiated third party access; the regulator Ofgem has no role in setting storage prices. Where TPA is required the storage operator is ring-fenced in a separate business unit (e.g. Centrica Storage Limited owns and operates the Rough facility). Storage operators of facilities requiring TPA are required to offer services on a non-discriminatory basis.
- 2.12 The commercial framework for storage services began as a service contained within the Network Code. In 1998 a Storage Services Contract (SSC) for the Rough and Hornsea storage facilities was developed by the then owner, BG Storage, in consultation with the industry. This enabled the Rough and Hornsea

⁶ The withdrawal rate reduces as the facility empties

⁷ As a result of the entry into force of the Second EU Gas Directive (2003/55/EC) there have been a number of changes made to the legal and regulatory framework applying to gas storage facilities in Great Britain. These changes were made through the Gas (Third Party Access) Regulations 2004 which transposed the second gas directive into GB law.

facilities to be moved out of regulation and allowed third parties to access services according to a standard set of contractual conditions. The contract continues to this day and is the basis on which storage services are provided from Rough and Hornsea.

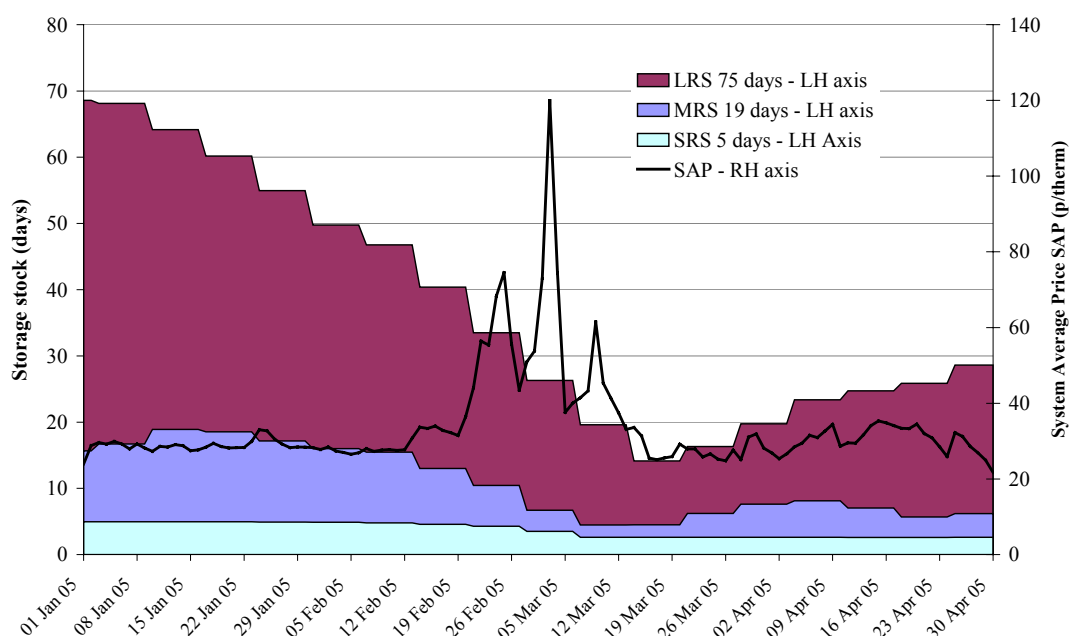
- 2.13 The storage service is usually sold on an annual basis: this means that each year capacity at Rough and Hornsea is available for sale. The capacity is acquired in the spring (or from April) with no gas in store and is then filled during the summer. The capacity at Rough is sold subject to a number of conditions that were recommended by the Competition Commission in August 2003 following the Centrica acquisition of the Rough facility. The conditions relate to how the capacity is sold and the maximum storage holding Centrica can take for its own gas supply business.
- 2.14 Storage facilities that are exempt from TPA can sell services to third parties entirely at their own discretion but subject to normal competition law and are also in competition with services from Rough, Hornsea and LNG facilities.

Commercial use of storage

- 2.15 In the UK the different types of physical storage have different commercial uses. We describe each of the storage types in terms of the main commercial driver. There are additional value drivers described further in section 4.
- depleted field storage store large volumes of gas. The facility fills at times of when the gas price is cheapest (typically summer) and delivers the gas at times of highest gas price (typically the following winter season);
 - salt cavern storage is used to supply short periods of peak supply. Like depleted field storage it fills at times when the gas price is cheapest, however salt cavern storage empties more rapidly and is capable of emptying in less than 20 days; and
 - LNG is used for a few days in the winter when prices spike upwards. LNG is inflexible on filling: the process of liquefying gas is complex and the plant will be set up to inject over the months of the summer. LNG empties most rapidly and the facilities empty in 5 days or less.
- 2.16 Storage is operated so that it is ready to call on at short notice. Under the SSC storage can be nominated at short lead times of typically a few hours. Storage provides a flexible source of supply. Storage usage in the UK is responsive to the market price at the UK NBP with most storage withdrawals taking place in the first quarter of the year – when the weather is coldest and demand the highest.
- 2.17 Figure 4 shows the storage stock during the first four months of 2005. Storage stocks are reported by Transco each week for three categories of storage similar to the types of storage described above, but grouped as follows:
- LRS is long range storage and comprises Rough;

- MRS is mid range storage and comprises Hornsea, Hole House and Hatfield Moor; and
- SRS is short range storage and comprises the LNG facilities.

Figure 4 – Stock levels of storage in the UK during the first four months of 2005



Durations of storage when full: LRS=75 days; MRS=19 days; SRS=5 days Source: Weekly stock data published by Transco, prices from ESGM

2.18 All the storage facilities in the UK are used for commercial balancing and by early March 2005 the total storage stock in the UK was equivalent to less than 15 days. The rapid decline in stock from mid-February to mid-March reflected the high prices seen in the UK during this period, and the build up of stocks in late March and April is the commercial response to lower prices seen during this period.

Storage and security of supply

2.19 Up until 2004 Transco managed security of supply to the UK gas market through the ‘Top-up’ arrangements. These were originally put in place at the time of the Network Code in 1996. The purpose of the Top-up arrangements was to underpin security of supply to firm customers by ensuring that sufficient volumes of gas were retained in storage throughout the winter, consistent with 1 in 50 weather demand. If necessary, Transco would buy gas to put in storage in order to ensure that Top-up requirements were maintained.

2.20 In 2004 Safety Monitors were introduced and these replaced Top-up. The focus of the safety monitors is public safety rather than security of supply. Transco’s safety case requires them to monitor the system and to take action to ensure that storage stocks do not fall below the volumes defined by the safety monitors. The

storage volumes established by the safety monitors are those required to ensure an adequate pressure can be maintained in the network at all times and thereby protect public safety. The safety monitors ensure the preservation of supplies to domestic customers, other non-daily metered customers and certain other customers who could not safely be isolated from the gas system if necessary in order to achieve a supply-demand balance.

- 2.21 There are three safety monitors: one for long-range storage (Rough); one for mid-range storage (Hornsea, Hatfield Moor, Hole House and Humbly Grove combined); and one for short-range storage (the four LNG facilities combined but not including the Isle of Grain terminal).
- 2.22 On 5th October 2005 National Grid published the ‘Winter Outlook Report 2005/06’. This document gave the updated position for gas and electricity supply and demand in the forthcoming winter.
- 2.23 National Grid updated the safety monitor levels from those they published in May 2005. In the light of possible diversion of LNG cargoes to the US this winter, National Grid increased the storage monitor levels as shown in Table 2.

Table 2 – National Grid Safety Monitor Level

Storage Type	Revised October 2005	Proposed May 2005 Scenario 1 to Scenario 2	Winter 2004/05
Short-range storage (LNG)	26%	18 to 54%	18%
Medium-range storage (Hornsea, Hatfield Moor, Hole House and 75% of Humbly Grove)	13%	5 to 13%	10%
Long-range storage (Rough)	23%	7 to 18%	7%

Source: National Grid. Scenario 1 and scenario 2 relate to assumptions on offshore supply availability, interconnector imports.

- 2.24 The long-range storage monitor was increased to 23% in October 2005 to allow for an additional 10 mcm per day to replace LNG supply from the Isle of Grain that could be lost if LNG cargoes are diverted to the US instead of landing in the UK.
- 2.25 Prior to this year Transco had the right to interrupt end users when demand was above 85% of the peak day. However, Transco no longer has this right for winter 2005/06 onwards. Transco can still interrupt if there are transportation capacity constraints, but that is all. Thus the onus is on shippers to interrupt end users before an emergency situation arises. Transco is hoping that shippers will call commercial interruption to balance supply and demand on the day.
- 2.26 Transco has calculated the volume of interruption required under average and colder than average weather conditions. The interruption requirement for the

winter as a whole are given in Table 3. We translate the volume of interruption into an additional storage requirement based on Rough storage (capacity 3.3 bcm). Even with this additional storage we estimate that interruption of industrial customers would still be required at times of highest demand (as the peak withdrawal rate would be insufficient); however, the quantity and number of days interruption would be drastically reduced.

- 2.27 A Rough equivalent (RE) is our measure of storage capacity that we use when talking about security of supply. Of the existing storage facilities in the UK, only Rough has sufficient size and duration to provide security over the full winter period. Other storage facilities would empty part way through the winter.

Table 3 – Winter severity in 2005/06 and the demand size response and the Rough equivalent⁸

Winter Severity	Overall Demand Response	Rough equivalent (RE)
Average Winter	0.1 bcm	<0.1 RE
1 in 10 cold	2.2 bcm	0.66 RE
1 in 50 cold	3.7 bcm	1.1 RE

Source: Transco

- 2.28 The additional storage requirement to provide security for a 1 in 50 cold winter in 2005/06 is approximately one Rough equivalent (one RE). Under average winter conditions the requirement in 2005/06 is less than one tenth of a Rough equivalent (one RE).

Operation of the safety monitor

- 2.29 The National Grid safety monitors do not relate to any particular weather conditions. Instead the safety monitor represents a minimum stock required for National Grid under its Safety Case agreed with the Health and Safety Executive. In its role as Network Emergency Coordinator (NEC) National Grid is required to monitor storage stock for a breach of (or indeed an anticipated breach of) Safety Monitors, that would trigger a Network Gas Supply Emergency (NGSE). In the case of a NGSE, the NEC has rights to prevent shippers withdrawing gas from storage. Under an NGSE triggered by a shortage of gas supply, the actions of the NEC will be to force demand side reduction in order to balance supply and demand, and to maintain the storage stocks.
- 2.30 The safety monitors provide a trigger mechanism for declaring a gas supply emergency (as defined in the Gas Safety (Management) Regulations).

⁸ Winter Outlook Report 2005/06 – National Grid 5 October 2005.

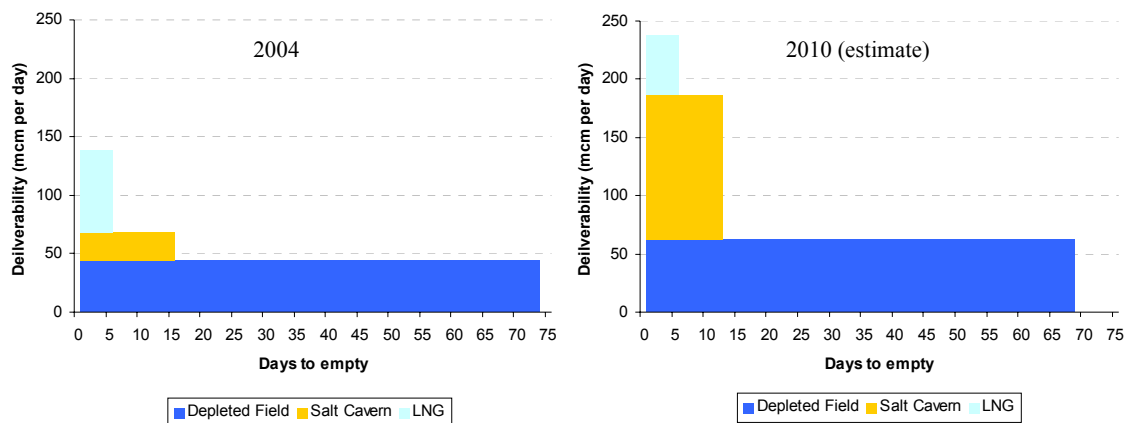
- 2.31 Recently, the gas industry and Ofgem, have amended the emergency cash out regime to ensure that an adequate price signal is provided to the market when commercial interruption is required. It is also currently being proposed that Transco introduces a gas system alert at a time when there is a potential breach of the safety monitor. This is being likened to the NISM (Notification of Insufficient System Margin) used in the electricity industry. The detail of how a gas system alert would operate has still to be agreed.
- 2.32 It should be noted that some gas shippers are very unhappy about the way that storage monitors can be changed by Transco so affecting their commercial position. Transco can increase the storage monitor mid way through a winter in order to meet the requirements of the safety case. This means that shippers who have booked and paid for gas storage in order to maintain supplies to their customers may be told that they cannot withdraw gas. Transco is financially indifferent to the change although a shipper's commercial position is affected.
- 2.33 We view the changes by Transco to the Storage Monitor regime as potentially damaging the incentives to book existing storage and hence investment in new storage capacity. In our view Transco, HSE and Ofgem should reconsider the arrangements allowing Transco to increase Safety Monitor levels.

Storage capacity in 2010

- 2.34 There is a list of potential projects for new storage in the UK. These projects are at various stages ranging from conceptual, to seeking planning permission (or undergoing an enquiry), to holding planning permission, to under construction. To produce a forecast of which new facilities will be available in 2010 it is necessary to take a view on future planning and construction. We include facilities currently under construction and with planning permission, and some of the facilities currently seeking planning permission.
- 2.35 Due to the long lead times to get planning permission and to construct facilities we do not expect any new facilities not already on the list to be completed and operational by 2010, although there could be enhancements to some of the existing depleted field and salt cavern storage facilities.
- 2.36 Figure 5 shows the storage facilities operating in 2004 and a forecast for what storage capacity might be available in 2010. Each type of storage facility is represented as a block whose dimensions are the number of days to empty from full, and the average storage withdrawal rate. The area of each block then represents the storage volume. The additional storage is as follows:
- Depleted field storage: there are no new offshore facilities. However, it is assumed that around 30% is added to the volume of depleted field storage by the construction of a number of new onshore storage facilities.
 - Salt cavern storage: there is considerable growth in the volume of salt cavern storage with the construction of a number of onshore facilities and the volume of gas stored increases by around 300% over the period.

- LNG: it is assumed that there is no addition to the existing peak shaving LNG facilities. The reduction between 2004 and 2010 is due to the change in use of the Isle of Grain facility from a peak shaving facility to an importation terminal in 2005.

Figure 5 – UK storage capacity operating in 2004 and estimate of availability in 2010



Source: Transco and ILEX assumptions

- 2.37 From Figure 5 we can see that we would expect the UK to have more coverage for short-term supply problems in 2010 than it has today. Swing to the UK can only be supplied from long-duration storage in depleted fields (shorter duration storage facilities hold an insufficient number of days stock). The additional depleted field volume added by 2010 will make up for only part of the loss in swing from UKCS supplies; the remainder will need to come from increased swing on the interconnectors and imports (see Figure 20). In terms of long-duration loss of supply the new facilities will provide some, but not much extra cover to the security of supply in the UK.
- 2.38 In summary, the amount of UK gas storage has been sufficient to meet security of supply requirements based on our previous position of producing all or most of our gas requirements from UKCS. In the next section we look at how Continental gas markets use gas storage and try to learn lessons from operation of storage in their markets.

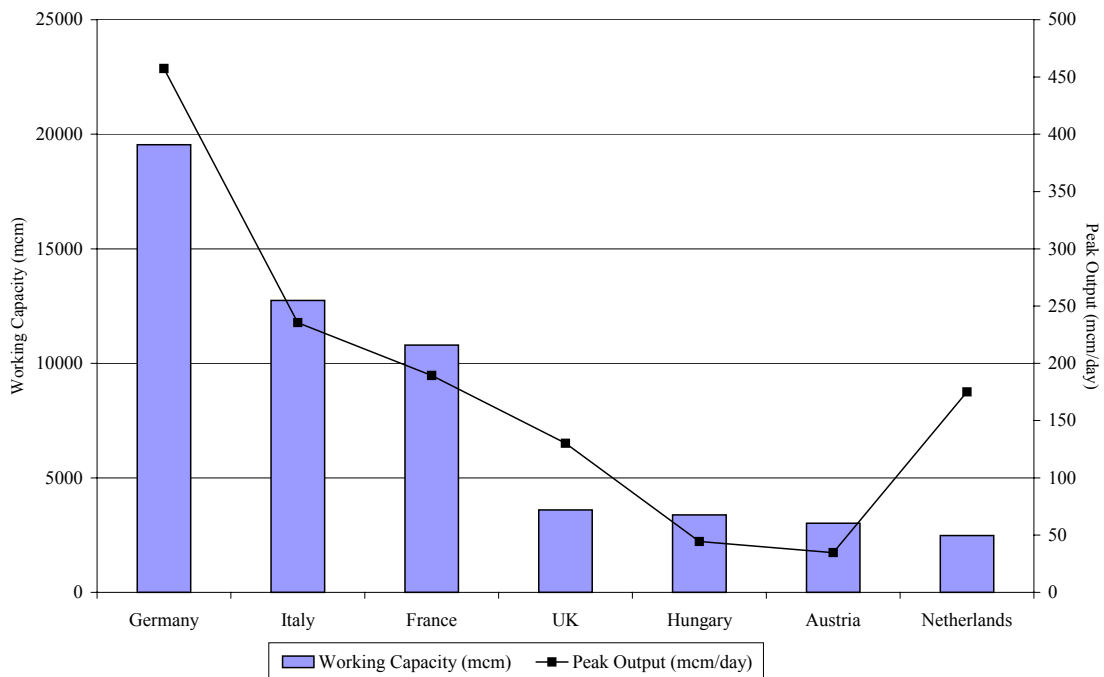
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3. STORAGE IN EUROPE

The UK market compared with other European markets

- 3.1 Figure 6 shows the seven European countries with the largest working volumes of gas storage. The UK and the Netherlands have LNG peak shaving facilities boosting their peak output relative to their working capacity.

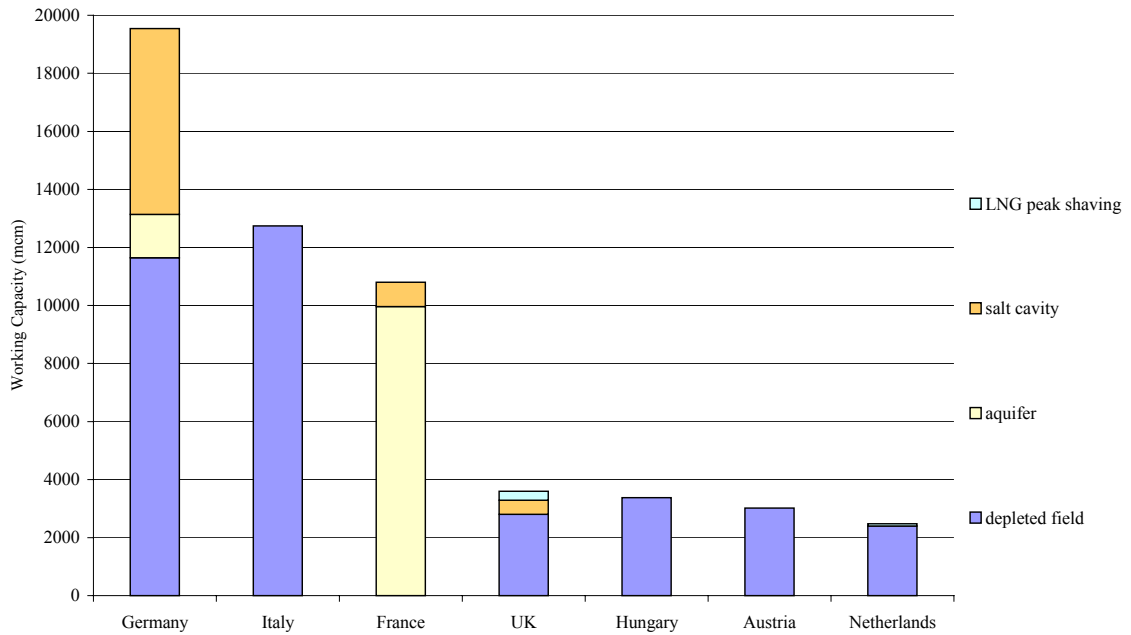
Figure 6 – Gas Storage Capacities around Europe



Source: IEA Natural Gas Information 2004

- 3.2 Figure 7 shows the types of gas storage available around Europe. It is worth noting that some storage is designed to supply local networks rather than national markets. The extent to which this storage can meet a national need will depend on the available transportation capacity and some markets may be isolated from the main national market (e.g. balancing point). However, we do not consider this to have a significant impact on the available storage volume, as gas withdrawn from storage in one location can release gas to be transported to markets elsewhere.

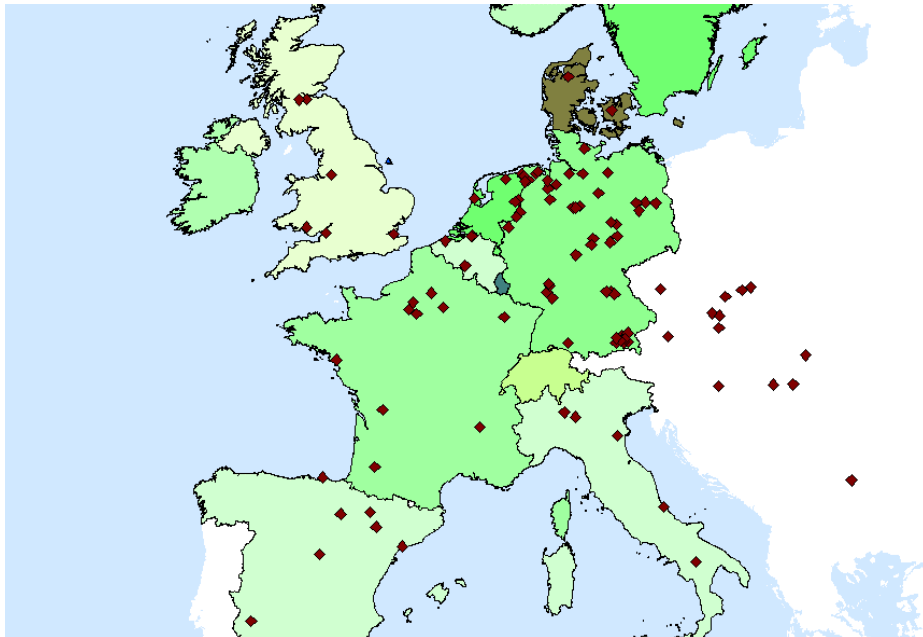
Figure 7 – Type of gas storage (mcm)



Source: IEA Natural Gas Information 2004

3.3 Figure 8 shows the location of storage facilities in Europe. The storage facilities are geographically spread around Europe, with a concentration of facilities in NW Europe in Germany and the Benelux countries.

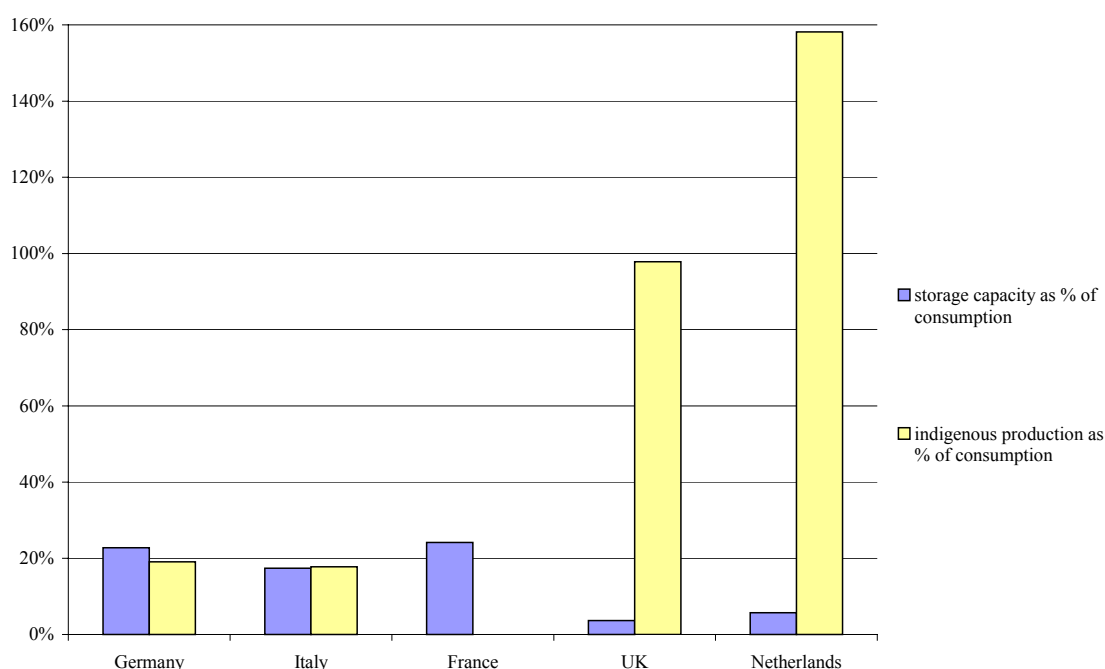
Figure 8 – Map showing location of storage facilities in Europe



Source: ILEX

3.4 Figure 9 shows that whilst the UK and the Netherlands have a much smaller percentage of storage available compared with Germany, Italy and France, they have a much higher proportion of indigenous production to supply the home market. In the case of the Netherlands, it exports much of the natural gas production to supply neighbouring countries. Germany, Italy and France can supply around 20% of the annual demand from storage. In these countries, storage is used to supply demand during most of the winter period, *and* to provide strategic storage in case there were a loss of importation supply.

Figure 9 – Storage capacity and indigenous production as % of consumption



Source: IEA Natural Gas Information 2004 and BP Statistical Review 2005

- 3.5 As can be seen from the analysis above, the countries with the highest storage capacity are those where indigenous production is low, hence imports from more remote sources are substantial.
- 3.6 The increased dependence of the UK gas imported over long distances has led to the suggestion that further increases in storage capacity in the UK will be required to provide adequate security of supply. We will examine this at the end of the section.

Storage regulation in Europe

3.7 The technical, operational and contractual characteristics of storage facilities operated on Continental Europe reflect the fact that most facilities were developed under markedly different market conditions, namely a market structure with a monopoly gas company and dependence on gas produced and transported from

distant sources. The new legislative and regulatory frameworks necessary to create the single energy market have not fully evolved to accommodate the use of storage in a competitive market.

- 3.8 In March 2005 an agreement was reached for the Guidelines for Good Practice for Storage System Operators (GGPSSO) in line with the 2003 European Gas Directive. The GGPSSO had a deadline of 1st April 2005 for the introduction of most of its provisions.
- 3.9 The GGPSSO specifies that proposed storage services must cover the technical capacity, excluding the portion used for production operation and capacities reserved exclusively for transmission system operators in carrying out their functions. Storage system operators (SSOs) should offer a menu of services, taking into account the technical constraints and the economically efficient use of storage infrastructure, which include:
- standard bundled units (SBUs) of space and injectability/deliverability, with the possibility of injecting and withdrawing gas at any time and without unjustified extra costs; and
 - other services that must be available by 1st April 2006 at the latest: unbundled services supplementing the SBUs, daily services, and, interruptible services.
- 3.10 According to the GGPSSO data concerning capacity and flows must always be published if the storage system is used by three or more users.
- 3.11 The GGPSSO provides for secondary capacity markets to be set up. SSOs should allow and facilitate users to trade SBUs and unbundled capacity on the secondary market from 1st April 2005. The transfer of ownership rights must be possible no later than 1st April 2006.

Compliance with GGPSSO

- 3.12 The European Regulators Group for Electricity and Gas (EREG) launched a monitoring programme via questionnaires to assess the progress of the GGPSSO's implementation and issued its initial report in September 2005⁹. EREG state that access to storage plays a key role in the development of gas-to-gas competition in Europe.
- 3.13 EREG received 39 questionnaire responses from SSOs representing around 87% of working storage capacity in the EU, and 33 responses from storage users.
- 3.14 EREG found that the significant areas where implementation is not good are the areas of transparency, and the development of secondary markets. Not sufficient operational data – particularly aggregated inflows and outflows of gas – has been published. The majority of SSOs consider that they are exempt as they have less

⁹ EREG Report on Monitoring the implementation of the Guidelines for Good TPA Practice for Storage System Operators (GGPSSO), September 2005

than three users, or because of commercial confidentiality. In some cases the publication of the main commercial conditions, which is required by the Gas Directive, has not been implemented.

- 3.15 The responses from storage users – particularly those that are not affiliated in some way to an SSO – also highlight significant concerns regarding the implementation of the GGSSO. Some users do not consider that the full menu of services is being offered and they are critical of the capacity allocation mechanisms used by SSOs. Storage users interested in secondary trading said that lack of liquidity makes trading impossible.
- 3.16 Table 4 shows the details of the largest of the storage operators responding to the ERGEG questionnaire. Technical storage capacity is the maximum storage capacity that the SSO can offer storage users, excluding capacity for SSOs operational needs. Available capacity indicates whether any part of the technical storage capacity is not contracted at that moment and still available to other storage users, and is not excluded from TPA.

Table 4 – Top 15 (in terms of capacity) SSOs responding to ERGEG questionnaire

Name of Storage Operator	Country	Technical capacity (bcm)	Available capacity?	No of users who own cap rights
Stogit	Italy	12.5	No	34
Gaz de France	France	8.8	No	Confidential
E.On Ruhrgas	Germany	5	Yes	<3
Wingas	Germany	4.2	Yes	>3
MOL	Hungary	3.4	No	3
CSL	UK	3.2	No	39
Latvijas Gaze	Latvia	2.3	No	4
TIGF	France	2.2 (estimate)	Yes	4
VNG	Germany	2.1	Confidential	1
RWE Transgas	Czech Republic	2.1	Confidential	1
Enagas	Spain	2.1	No	12
OMV Gas (OGG)	Austria	1.8	Yes	5
NAFTA	Slovak Republic	1.7	No	Confidential
NAM	Netherlands	1.4	Yes	4
BEB	Germany	1	No/ confidential ¹⁰	3-5

Source: ERGEG

¹⁰ BEB revealed information on capacity only for Harsefeld facility

Capacity allocation and strategic storage

- 3.17 There are a number of different approaches that can be taken to allocate storage capacity, including:
- first come (i.e. requested) first served e.g. facilities in UK offering TPA;
 - first committed (i.e. credit guarantees) first served; and
 - capacity follows customer (i.e. capacity linked by law to supplies, mainly households) e.g. France.
- 3.18 In some countries capacity allocation arrangements are defined by national legislation, which can include provisions for ‘strategic’ storage.
- 3.19 In France, Gaz de France and TIGF apply a capacity allocation mechanism defined by a detailed Government decree, along the lines of a ‘capacity follows customer’ approach. The law requires that all suppliers operating on the French market to stockpile gas before the winter according to:
- other means of flexibility that the supplier possesses; and
 - the characteristics of each supplier’s customer market.
- 3.20 Gaz de France defines a storage right according to the end user’s annual consumption profile. End users are classified according to 12 profiles. A storage right in a balancing zone, equal to the sum of storage rights of its customers in this zone, is then distributed between various storage groups.
- 3.21 We have seen that to provide security of supply to the UK for severe weather in 2005/06 would require the equivalent of a second Rough facility (see Table 3). As we will see in section 5, releasing additional storage the size of Rough onto the UK market would ‘flood’ the market and impact the value of storage in the UK.
- 3.22 If the UK developed a second Rough as a strategic reserve, then the model in France would be one way to allocate the storage (and cost) to end users. The costs would be effectively recovered through a charge on all users according to the ‘peakiness’ of their winter demand. However, the use of the withdrawals from the strategic reserve would have to be carefully thought out to avoid undermining the value of commercial storage.

4. ECONOMICS OF NEW STORAGE

- 4.1 This section describes the drivers for investment in new storage and we offer our view as to whether new storage should or will be built for the UK market.

Market value of storage

- 4.2 Whenever storage users purchase capacity from storage operators they are likely to calculate a market value for the storage service. The market value depends on a number of factors including the expected value at the prevailing market gas prices (the mark to market value) *after* taking account of storage usage costs, transportation cost to the NBP and allowing for perceived risks e.g. storage reliability.
- 4.3 The market value of storage is derived from the *differences* in gas prices at different times of the year (e.g. between summer and winter), and the *differences* in prices over shorter time periods (e.g. between weekends and weekdays, or when there is a short term price spike). Storage is an arbitrage between low priced and high priced periods. On a day to day basis the operational use of storage is an arbitrage between the price of gas today and the price of gas in the future (if it is cheaper then inject, if more expensive then withdraw).
- 4.4 All storage facilities can arbitrage between the summer and winter prices. Storage facilities that are capable of injecting during the winter period once they have started emptying have further additional value from cycling (i.e. filling the facility more than once). The nature of the arbitrage is different for each type of storage facility and depends on how rapidly the storage facility can fill and empty.
- 4.5 Option valuation techniques split the value of storage between:
- intrinsic value – the value that can be calculated directly from the forward curve. This is the difference between the lowest price period taking account of the days to fill, and the highest priced period taking account of the days to empty; and
 - optimal value – the value arrived at from the optimum usage of the storage taking account of the daily volatility in prices. The optimal value is higher than the intrinsic value and is calculated using an options calculator. The optimal value requires an assumed volatility of daily prices.

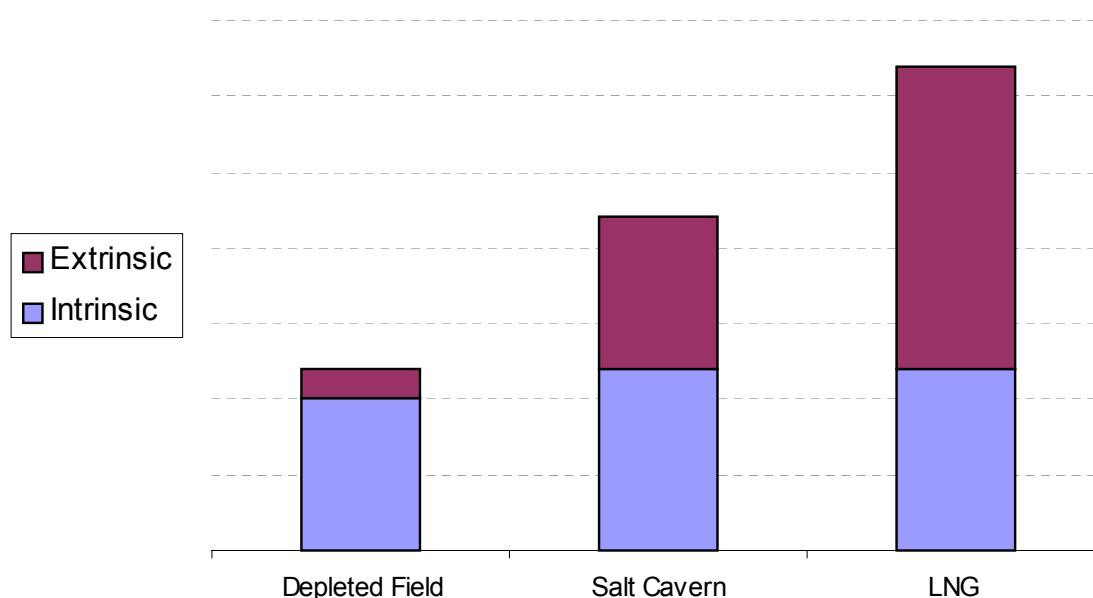
$$\textit{Optimal value} = \textit{intrinsic value} + \textit{extrinsic value}$$

- 4.6 Different storage facilities have a different split between intrinsic and extrinsic values depending on the physical characteristics of the facility in terms of the days to fill and the days to empty. The intrinsic value of the different facilities is similar (as it is the difference between summer and winter prices), however, the extrinsic value is highest for facilities that can inject in winter and which have

short times to fill and to empty. Cycling of storage adds to the extrinsic value of storage.

- 4.7 A description of the values of the different types of storage facility is as follows:
- Depleted field storage takes large volumes of gas and fills at the cheaper summer price and delivers into the following winter season when prices are higher. Most of the value is derived from the difference in the forward gas prices between the forthcoming summer purchase and the following winter sales price.
 - Salt cavern storage is used to supply short periods of peak supply and derives considerable extrinsic value from the volatility of the daily prices. The amount of extrinsic value is largely determined by the days taken to fill which varies between a season for Hornsea and as little as 5 days for Hole House. The new salt cavern facilities are rapid fill, high-cycle facilities, and they can effectively shift considerable volumes of gas between the different prices at weekdays and weekends.
 - LNG is used for a few days in the winter when prices spike upwards. LNG facilities are slow to fill and do not generally inject during the winter. However, they are rapid to empty and are valued based on a handful of highest prices expected in the winter.
- 4.8 Figure 10 shows the split between of the value for different storage facilities between intrinsic and extrinsic.

Figure 10 – Storage valuation illustrating the relative values of different types of storage (based on the older facilities*)



Days to fill	190	165	220
Days to empty	70	18	5
Max. cycles in a year	1.4	2.0	1.0

* The new storage facilities have shorter fill and empty periods and have higher extrinsic value. Source: ILEX.

- 4.9 The intrinsic value of storage can be calculated directly from the differences in prices on the forward curve. The traded markets can be used to hedge the intrinsic value up to a maximum of three years into the future. Given the lead time to develop new storage is around three years, the forwards markets cannot be used to hedge new storage developments. As a consequence developers of new storage facilities require long-term storage contracts to underwrite the investment.

Economics of converting a depleted gas field to a storage facility

- 4.10 The factors that have to be taken account of when developing a new storage facility from a depleted off-shore field include the following:

- cushion gas requirement;
- investment in infrastructure and operating costs;
- planning and safety requirements;
- lead time to develop new storage; and
- availability of suitable fields in UKCS.

- 4.11 Cushion gas is required to provide the pressure within the depleted field store for storage withdrawals. There is no economy of scale as the cushion gas requirement is in proportion to the working volume. At Rough, the largest storage facility in the UK, the cushion gas requirement is around four times the design working volume of 3 bcm (1,000 million therms). At a gas price of 50 pence per therm, the current annual gas price, the value of the cushion gas is around £2,000 million.
- 4.12 A gas field that has been used as a producing facility already has the infrastructure for gas production in place. It has a connection to the sub sea pipeline to transport gas from the facility to the beach and has a connection to the NTS. Additional investment will be required in compressors to inject the gas into the facility. Rough is a manned facility and there is requirement for accommodation and service facilities on the platform. There are fixed costs, for example of manning a platform, that can be shared over a larger facility so leading to economies of scale. There is also a trade-off between capital spend and annual operating costs, since additional investment up front can reduce the ongoing operating costs.
- 4.13 The planning requirements for offshore storage are not seen as a major issue as the platform is already constructed and operational. This is a marked contrast to onshore storage facilities where the planning permission for new facilities has been a major stumbling block. Many new storage projects have been met with resistance from local residents¹¹.
- 4.14 There will be additional health and safety regulations for a manned operation. The offshore safety requirements are stringent and include emergency isolation, running an offshore emergency support vessel and evacuation procedures.
- 4.15 Recent experience of new onshore storage facilities has indicated the build time for a new storage facility, after it has been granted planning and including connection to the NTS, is typically around 3 years. To build a new offshore storage facility, if the existing infrastructure is in good condition, the lead time could be less than 3 years. However, expansion of an existing facility is likely to involve taking the facility off-line for one year while the facility is being upgraded (e.g. additional compression, drilling extra wells), thus losing all revenue for one year.
- 4.16 The geology of the field must be carefully chosen. An effective store will have high porosity to enable gas that is injected to diffuse rapidly through the reservoir. Rough was carefully chosen for its geological qualities.
- 4.17 Another important factor is the condition of the field after it has been used for years of production, as there is a risk of sand damage to the reservoir during the

¹¹ Byley gained planning permission after an intervention in the national interest by the Deputy Prime Minister. At time of writing the planning for Welton submitted in late 2003 has not been heard by the County Council. The planning application for the Fleetwood facility has gone to an inquiry.

production of gas. Our understanding is that the field geologies vary significantly and the choice of field must be carefully made.

- 4.18 We note that most of the depleted field storage in Continental Europe is onshore.
- 4.19 In summary an offshore depleted field is likely to be attractive for conversion to an storage facility if:
- it is located close to the shore, as providing high swing capability over long distances is uneconomic;
 - the reservoir is in the earlier, rather than the later stages of depletion (to avoid damage to the reservoir, and the need to inject cushion gas); and
 - the reservoir has a favourable geology.
- 4.20 It is likely to take a period of time from commissioning a new storage facility for the reservoir to stabilise and for the reservoir cycling to become settled and established. The lead time to bring on a new storage facility is around three years.

Economics of storage compared with the economics of production

- 4.21 A producing gas field that is suitable for being used as a storage facility faces the economic decision of when to stop producing gas and start to operate as a storage facility. A significant volume of gas (the cushion gas) is required to provide the pressure in the reservoir to give the rapid rates of production required for storage withdrawal. Operating as a storage facility means that the cushion gas is not produced until the end of the life of the storage facility.
- 4.22 To calculate the annual charge for cushion gas (p/th) we compare the value of producing the cushion gas now, with delaying the production of cushion gas by 20 years until the end of the assumed life of the storage facility. We assume:
- a price of 50 p/th for annual gas (the current market price) to value the cushion gas;
 - cushion gas is either produced in the first four years, or is produced at the end of the life of the storage facility (assuming a life of 20 years);
 - there is four times the volume of cushion gas to working gas; and
 - a discount rate of 10%.
- 4.23 Under these assumptions the cushion gas would need to be charged at an annual charge 18 p/th of working storage volume to recover the opportunity cost of delaying the production of the cushion gas until the end of the life of the storage facility.

Conclusion

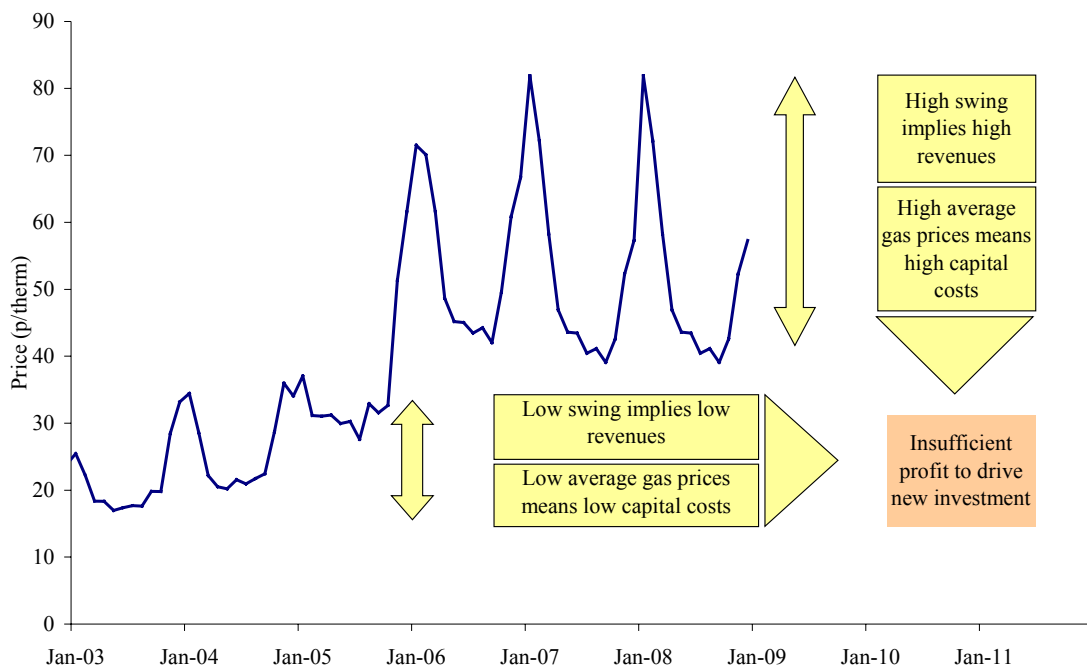
- 4.24 We believe that there is a potential problem with the signalling of the requirement for new storage investment in a liberalised gas market.

The ILEX storage paradox.

When gas prices are low nobody wants storage.

When gas prices are high nobody can afford to build new storage.

Figure 11 – The storage paradox



- 4.25 Thus a wider summer/winter price spread associated with higher annual gas price does not feed through to the attractiveness of investing in new storage projects.
- 4.26 The value of the cushion gas required for a second Rough storage facility (R2) under the above assumptions is currently over £2,000 million, equivalent to 18 p/th of working storage volume.
- 4.27 There are a number of other costs that must be included in a new storage facility including capital investment and annual operating costs that need to be included in the decision to build new storage. ILEX analysis estimates the capex and opex costs to be in the range 3 to 6 p/th of working storage volume.
- 4.28 At the current market price (50 p/th for annual gas), the market value of storage would have to exceed 21 to 24 p/th (the annual cushion gas charge, plus capital investment and operating costs) in order to make it commercially attractive to

develop new offshore depleted field storage. The market value would have to exceed the storage cost for a period of ten or more years to make it attractive to invest.

- 4.29 As noted in section 2.33, we view the changes by Transco to the Storage Monitor regime as potentially damaging the incentives to book existing storage and hence investment in new storage capacity. In our view Transco, HSE and Ofgem should reconsider the arrangements allowing Transco to increase Safety Monitor levels.

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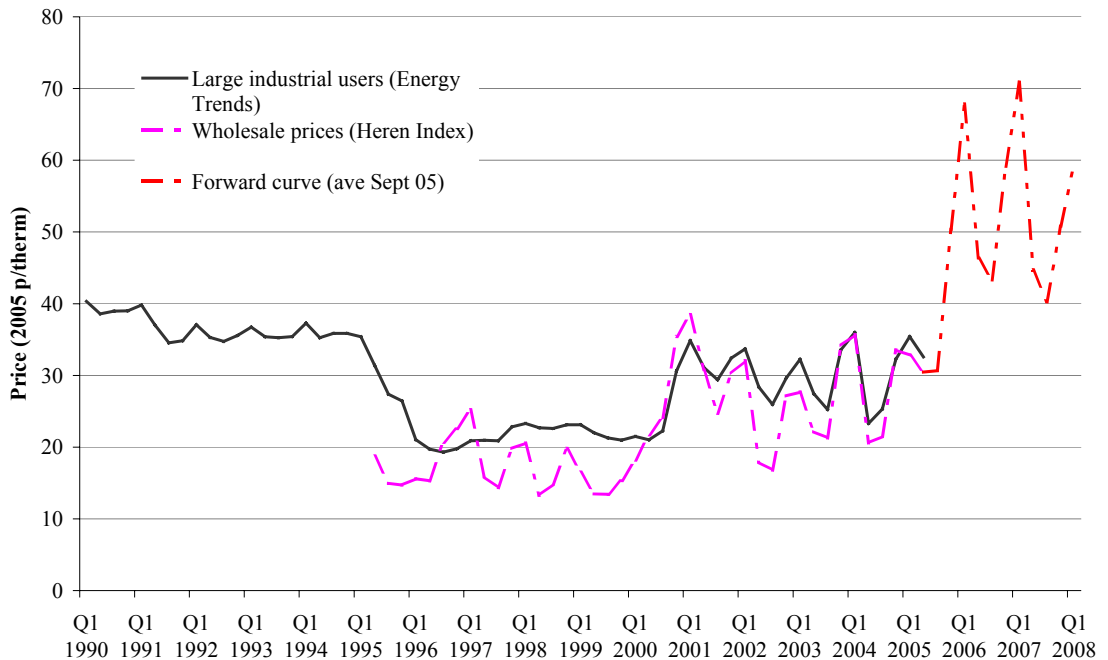
5. GAS PRICE FORECASTS AND IMPLICATIONS FOR STORAGE

- 5.1 ILEX has had many years of experience projecting gas prices for the UK and has developed a number of models. A summary of our modelling approach can be found in Annex A. This section describes ILEX's latest views of gas prices and then indicates what implications these have for the development of storage facilities in the UK.

ILEX view of gas prices out to 2011

- 5.2 Gas prices over the last 15 years are shown in Figure 12. The first step change occurred through 1995/96, with the introduction of competition combined with an over-supplied market, causing annual prices to fall sharply. The second step change occurred in 2000, after oil prices had increased significantly, raising Continental gas prices due to most of their contracts being oil-indexed. Due to the physical interconnection between the UK and the Continent, UK prices were also dragged up, leading to a significant increase in annual UK gas prices.
- 5.3 Gas prices have increased markedly in recent years. In Figure 12 the forward curve for years 2006 and 2007 show a step increase with annual prices of over 50p/th. Over the past year, wholesale gas prices have increased by 40%, with even further increases expected over the coming winter. Increases in wholesale gas prices eventually feed through to the delivered gas prices seen by gas consumers in the domestic and industrial sectors. The high gas prices are also feeding through to create record high electricity prices. Industrial gas consumers are complaining that such gas and electricity prices are damaging their profitability and threatening their very existence. The increases have led to a number of investigations¹² and studies in an attempt to understand the fundamental reasons behind the rise in prices. In this section we set out our thinking on the outlook for gas prices for the UK gas market and the implications of these prices on the implications for gas storage.

¹² Ofgem price probe report, October 2004; FSA gas price report, October 2004; House of Commons Trades and Industry Select Committee March 2005; Global Insight report from the DTI 'Ensuring effective and efficient forward gas markets', March 2005.

Figure 12 – Gas prices historically (2005 real p/therm)

Source: Heren and Dti

5.4 The ILEX approach is to construct three possible future scenarios for the UK, which describe the supply, demand and transportation capacity for natural gas, and the effect that these would have on the price for natural gas. A summary of the ILEX scenarios is as follows:

- **High price scenario**

In this scenario demand for gas remains high with limited demand reduction despite high prices and high priced import capacity increasing to cover the shortfall. Market liberalisation on the Continent is limited despite high oil prices at around \$60/bbl. Therefore gas prices are relatively high and remain indexed to oil and oil products.

- **Central price scenario**

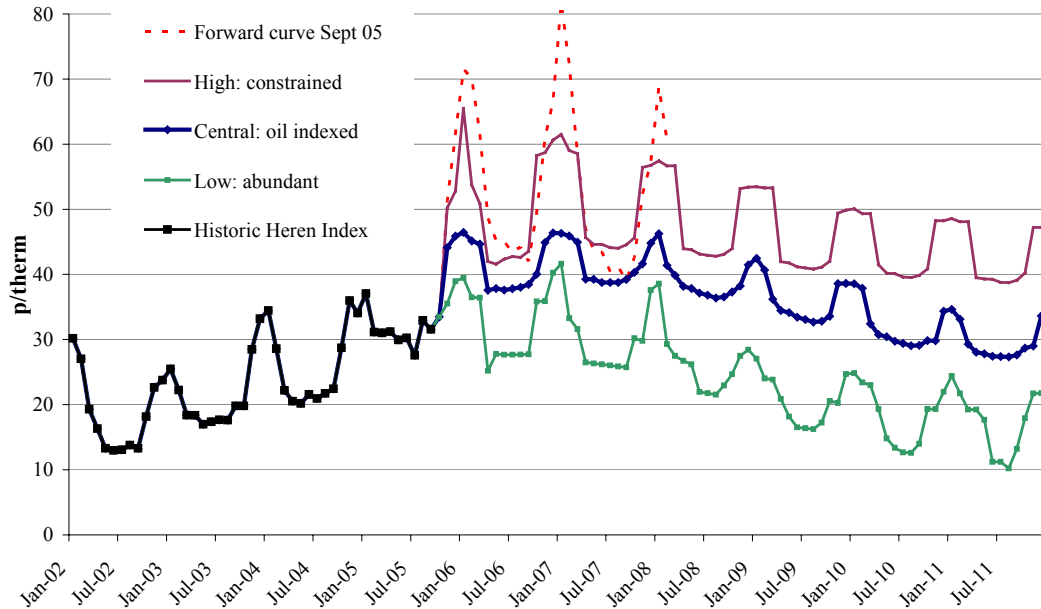
In this scenario, the supply-demand balance remains tight in the shorter-term, but after 2007 with the arrival of a number of new import projects, the supply constraints are eased. However, the link between gas prices on the Continent and oil (which declines to around \$35/bbl in real terms by 2011) remains strong throughout; consequently, gas prices are moderate to high.

- **Low price (bubble) scenario**

In this scenario, gas supply to the UK is abundant, with production and import capacity in excess of a relatively low demand growth. The relative oversupply both in the UK and NW Europe means that the Continental market is largely liberalised by 2010. Gas prices are therefore relatively low.

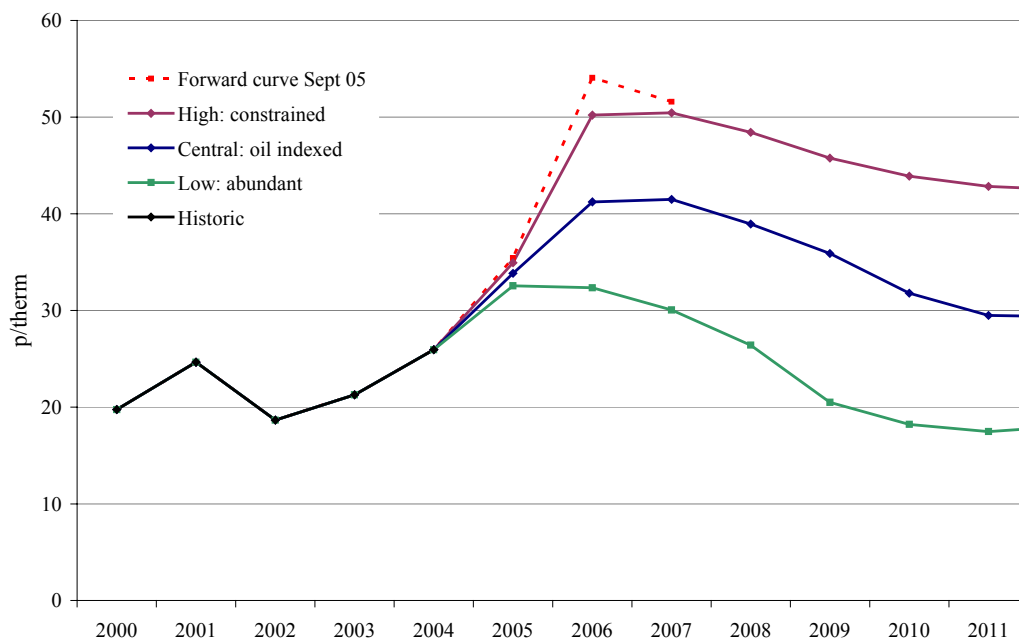
5.5 The projections of the spot gas price for the above three scenarios are presented in Figure 13 and Figure 14. Further information on the ILEX modelling methodology is included in Annex A. All the prices referred to are for wholesale gas bought at the National Balancing Point – the NBP.

Figure 13 – Monthly NBP gas price projections (2005 p/therm)



Source: ILEX analysis. Forward curve Heren Energy Ltd

Figure 14 – Annual spot gas price projections at the NBP (2005 p/therm)



Source: ILEX analysis. Forward curve average of Sept 05 Heren forward curves.

- 5.6 Gas prices in the UK are determined by the forces of supply and demand for the various market segments and the influence of prices in neighbouring markets. In early summer 2005 wholesale gas prices in the UK were at all time highs with Q1 2006 at over 82 p/therm. January 2006 was reported at 91.75 p/therm on the International Petroleum Exchange.
- 5.7 Historically, gas demand growth in the UK has been high due to the impact of power generation shifting from coal to gas, although since 2000 demand growth has been relatively flat. Since 1990, demand from residential customers has grown at only 2% and I&C customers at 1%. The biggest driver of demand growth in the future¹³ will be from the power sector. Thus demand growth will be dependent on coal, oil and gas price relativities, as well as new-build, carbon and SO_x/NO_x assumptions. ILEX simulates this by iterating with its bespoke electricity model, GBGen, to ensure that the complexity of the interactions is modelled correctly. In the next few years, demand growth is unlikely owing to high gas prices, and we see gas demand dropping by 4% in our Central scenarios owing to generation running coal preferentially. However, from 2008 onwards, we see gas demand growing once again due to lower gas prices and the effect of closing coal plant combined with a price for carbon.
- 5.8 As the United Kingdom Continental Shelf (UKCS) continues to deplete, the UK's supplies are being replaced by new sources of gas, in particular from Norway and from LNG from around the world. The next two years seem likely to produce a tight supply-demand position, as the UKCS depletes faster than some expected, but following the arrival of new import projects the UK should return to a more comfortable supply-demand position with a larger margin.
- 5.9 However, if all the planned import projects come in on time, we would expect to have an excess of gas in the UK, with a potential further 60bcm added to UK capacity by 2010, of a market where demand will be about 105bcm. Whether a gas bubble materialises in the UK depends on a number of factors:
- the speed of UKCS depletion;
 - whether LNG cargoes divert to different markets (for example the US or Spain), or whether it baseloads to the UK;
 - whether some of the proposed projects are delayed or withdrawn; and
 - the ability of the Continental NW European gas market to absorb the potential gas bubble from the UK.
- 5.10 Given the interaction between the UK and the Continental NW European gas market, it is important to understand the position of the UK in a wider context. Reserves of gas available to Europe are large and, assuming reasonable demand estimates, there is sufficient gas to last until at least 2040.

¹³ Excluding any effects from weather

- 5.11 By modelling the supply-demand balance in NW Europe, it is clear that sufficient capacity to import gas to Europe is likely to be built, and a comfortable system margin is likely to be maintained. Unlike the UK, supplies from the most significant sources of gas to NW Europe, such as Norway, the Netherlands and the FSU are not declining at such a fast rate. There maintains the prospect of an excess of supply to NW Europe, particularly in a Low demand situation, which could lead to prices (particularly in summer) dropping below their long run marginal cost (LRMC). However, provided that market liberalisation continues to have only a limited effect on oil indexation in gas contracts¹⁴, price collapses are likely to be avoided.
- 5.12 The most likely source of supply for gas users in the UK is from the UKCS and Norwegian Continental Shelf (NCS) by means of direct connections to offshore fields. Through increased interconnections with the Continent, renewed imports from Norway and LNG terminals, the UK supply-demand balance is going to be increasingly influenced by the wider European market.
- 5.13 There still remains considerable uncertainty both about the rate of progress of liberalisation and whether liberalisation will formally break the oil-indexation link for gas prices. This is due to three main reasons. Firstly, in the US, often cited as an example of gas-on-gas competition following market liberalisation, there appears to be a link between oil and gas prices perhaps as a result of tightening supply-demand position following years of over-capacity. Secondly, gas production economics remain linked to oil both at the well-head (through associated fields) and at the burner tip (through interoperability of boilers, power stations, and in the future gas-to-liquids technology). Finally, the fact that historically oil and gas prices have been linked means that even if the 'official' link in contracts no longer existed, the markets would probably still look to crude oil as a benchmark and as a hedging tool. The lack of liquidity in the gas market's forward curve may drive gas traders to opt out of the gas markets to hedge gas via the oil market. As a result, ILEX believes that even in a fully liberalised scenario there remains a reasonable likelihood, depending in part on the supply-demand position, that gas prices will remain 'linked' to oil prices in some way.
- 5.14 From our analysis of the UK market, ILEX has concluded that, given the increased physical interconnection between the UK and the Continent and the increased role of LNG, the price linkage between the UK and the rest of Europe can only increase. From 2010 the UK will have interconnector import capability of 40bcm (almost 40% of annual demand) and possibly similar in export mode and LNG cargoes can be diverted from UK re-gasification terminals to terminals on the Continent, thus the UK will become more a part of a heavily interconnected NW European gas market where gas prices move in unison for much of the year.

¹⁴ Most long-term contracts are indexed to oil and oil product prices, so changes in the oil price affect gas prices even if the economics of the gas market are not in line.

- 5.15 From our modelling of Continental European prices and their effect on the UK, it seems unlikely that a gas bubble will emerge as previously seen in the UK in the mid-1990s. This is because any excess gas in the UK will be exported to the larger Continental market. Although excess capacity of 15bcm in the UK market could be considered high, within a NW European context it represents only 6% of the 250bcm of demand. Thus a price collapse to sub-15p/therm (or lower) on an annual basis remains unlikely, although summer prices could possibly drop to this level.
- 5.16 The most likely pattern of prices is continued high prices for the next few years, followed by a weakening of the gas price. The gas price falls in our Central scenario because we project oil prices to fall and the new import capacity comes on-stream. We doubt that prices fall as far as our Low scenario since this outcome is dependent on many of the new import projects coming on-stream together and oil and gas prices de-linking on the Continent.
- 5.17 In the medium-term, whether or not successful liberalisation of the Continental energy markets occurs, the consequent de-coupling from oil prices seems less likely than in the past. As a result, the biggest single driver of annual prices will probably remain the price of oil in the medium-term.
- 5.18 As can be seen from inspection of Figure 13 and Figure 14 the forward curve for gas at the NBP is a little above our High scenario projections of gas prices for Q1 2006. Our projections of gas price for UK Q1 2006 are based on gas prices on the Continent as indexed to oil prices of some 6 to 9 months before the time of summer injection, due the lag in the gas contracts on the Continent. If we use the 2005 spring/summer Continental gas price of around 28 p/therm and assume average UK storage costs based on the primary cost of Rough, salt cavern and LNG capacity of around 37 p/therm – the total cost of commodity plus storage will be 65 p/therm. The forward curve price for Q1 is now (October 2005) around 68 p/therm. In the early summer of 2005 Q1 2006 prices reached 86 p/therm. In our view, it was very difficult to provide any fundamental analysis in support of a price of 86 p/therm. We believed that the additional premium of more than 20p/therm above our projection could only have been based on market sentiment, which may have been assuming a very cold winter or beach supply problems. We were of the view then, subsequently proved correct, that traders would become better informed and move closer to the market fundamentals. This has happened through the summer.
- 5.19 However, the forward curve for Q1 2007 and 2008 is significantly above the ILEX projections in our High scenario. The market may be assuming higher oil prices than our projections but Hurricane Katrina does appear to have strengthened the oil price and it may well be that the medium term oil price will be greater than \$60 we assume in our modelling.

Summary – gas prices

- 5.20 ILEX believes that the UK gas market is currently tracking our High gas price scenario and gas prices are at a peak. We expect wholesale gas prices to weaken

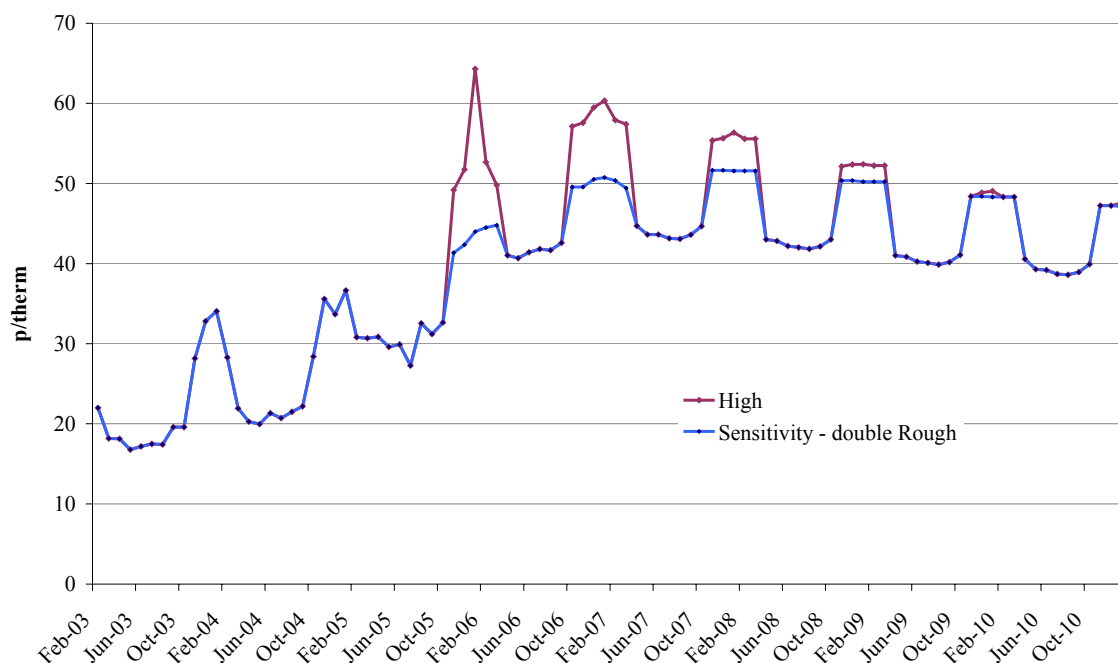
somewhat and move towards annual gas prices of around 42 p/therm by 2011 a reduction of around 20% from current prices. The fall in gas price is a result of weakening oil prices over this period. Oil price remains the main driver for gas prices in this future.

- 5.21 This view is based on an assumption that liberalisation of the wider European energy markets will not be completed successfully by 2011. Even if liberalisation of the Continental market was complete before this we do not believe that gas prices will completely de-link from oil. Hence the lower gas prices in our Central scenario are more a result of the lower oil prices from our Central oil price scenario than a direct result of liberalisation.
- 5.22 We do not expect our Low scenario to come about since this future is dependent on a successful liberalisation of the Continental gas market and a full de-linking of gas prices, probably as a result of an excess supply over demand ie a “gas bubble” developing.

Gas prices and storage

What if another Rough had been built for the coming winter?

- 5.23 ILEX has used its modelling capability to simulate what might have happened to market prices had another Rough been built, and been commissioned during summer 2005, as shown in Figure 15. This scenario assumes that the second Rough is available for the winter of 2005/06 onwards.
- 5.24 As can be seen, the summer/winter differential drops significantly over winters 2005/06 – 2008/09 compared with the High scenario without a second Rough as presented above.

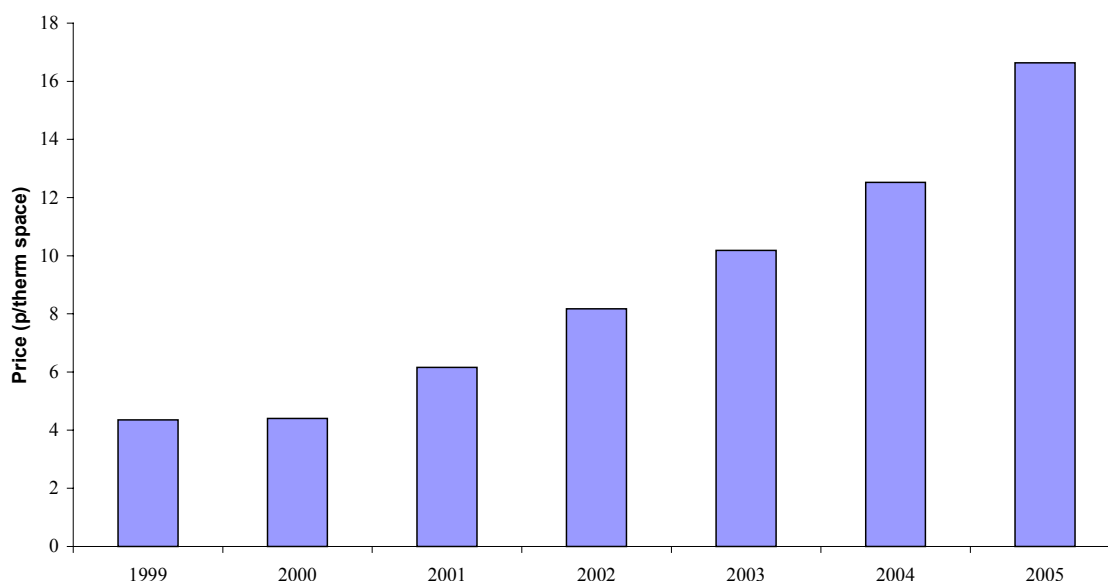
Figure 15 – Impact of building a second Rough

Source: ILEX analysis

5.25 There would be two main impacts of building a second Rough (R2):

- the winter/summer differential decreases, as R2 supplies the winter period and replaces some of the more expensive salt cavern and peak LNG storage; and
- the market value of storage which is built up from the difference between summer and winter gas prices would reduce. The additional storage capacity would take us back to a situation similar to that in 1999 when Rough was not fully sold and there was a surplus of gas supply in winter.

5.26 Figure 16 shows the history of Rough storage prices in pence per therm of space. The prices are the average prices paid for annual storage capacity. In 1999 and 2000 the capacity cleared at close to reserve price and there was capacity unsold during the summer period. From 2001 onwards all of the capacity was sold and the average price has increased each year since then, as the UK supply/demand position has continued to tighten. As we discuss later this shows that the UK market is “working” and shipper/suppliers will value storage more when the demand/supply position is tight.

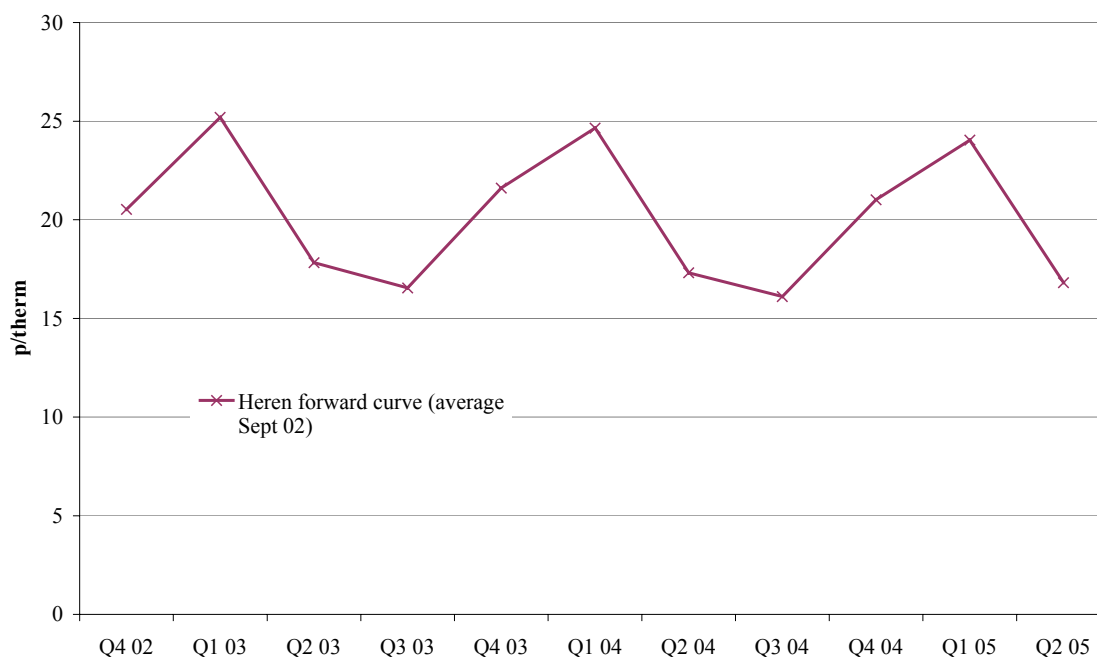
Figure 16 – History of Rough storage prices

Source: ILEX analysis

Should this theoretical second Rough (R2) have been built?

- 5.27 The question whether a second Rough (R2) should have been built can be addressed in two ways.
- 5.28 Firstly, by looking at the forward curve as seen by the gas market players 3 years ago as shown in Figure 17. The forward curve at this time had a winter/summer price differentials of around 8p/th and would not have signalled the construction of R2. The economics of a new facility based on annual gas price at the time of around 20p/th would have been:
- cushion gas charge (annual gas price of 20 p/th) of 7 p/th;
 - opex and capex charge in the range 3 to 6 p/th; and
 - market value required to make the project economic = 10 to 13 p/th.
- 5.29 To make the project economic the forward curve in 2002 would have needed to show winter/summer price differentials between 11 to 14 p/th (market value required of 10 to 13 p/th plus 1 p/th usage costs). The price differentials would needed to have been sustained for at least ten years into the future to make the project economic.

Figure 17 – Forward curve as of September 2002



Source: Heren. Average of September 2002 forward curves.

5.30 Secondly, by looking at the benefit to the entire UK (UKplc) from having R2 in place now, we can ask if there would be an ex-post economic justification for having built R2 prior to the coming winter (by taking a decision in 2002). As can be seen from Figure 15, R2 has the effect in our models of reducing the winter prices significantly for the next three winters.

Table 5 – Savings to UK plc from building a second Rough

	2005/06	2006/07	2007/08	2008/09
Price differential (p/therm)	4.2	4.1	1.7	0.8
Volume of UK market (Mtherms)	40,000	40,000	40,000	40,000
Annual saving (£m)	1,692	1,657	683	332
Discounted saving to 2002	2,740			

Source: ILEX

5.31 After discounting the cost of a second Rough in 2002 would have been in the range £850 million to £1,100 million based on annual charges of 10 to 13 p/th of working storage volume.

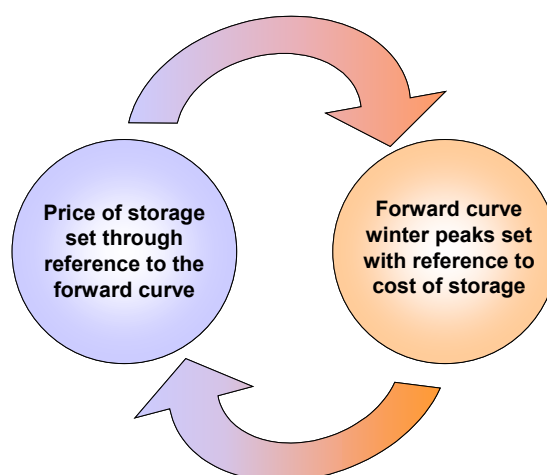
5.32 Thus we conclude that with perfect foresight of the current annual gas prices and winter/summer differentials, rather than the forward curve at the time, see Figure 17, the building of a second Rough R2 would have benefited the country as a whole.

- 5.33 However, the commercial market would not and has not delivered a facility of this size to the UK market. Instead a number of smaller storage facilities have been developed and Humbly Grove is being delivered in time for the forthcoming winter.
- 5.34 The economic cost of a second Rough at today's market prices is in the range £1,800 to £2,100 million based on annual charges of 21 to 24 p/th of working storage volume.

Investment signals for storage and storage circularity

- 5.35 Valuing storage is complicated by the 'storage circularity' as shown in Figure 18. The price at which storage can be bought is typically set with reference to the forward curve, as this gives a view as to the value that could immediately be 'locked in'. However, the winter peaks of the forward curve are driven (to a large extent) by the cost of buying storage. To some extent therefore, the price of storage is self-referential.

Figure 18 – Storage circularity



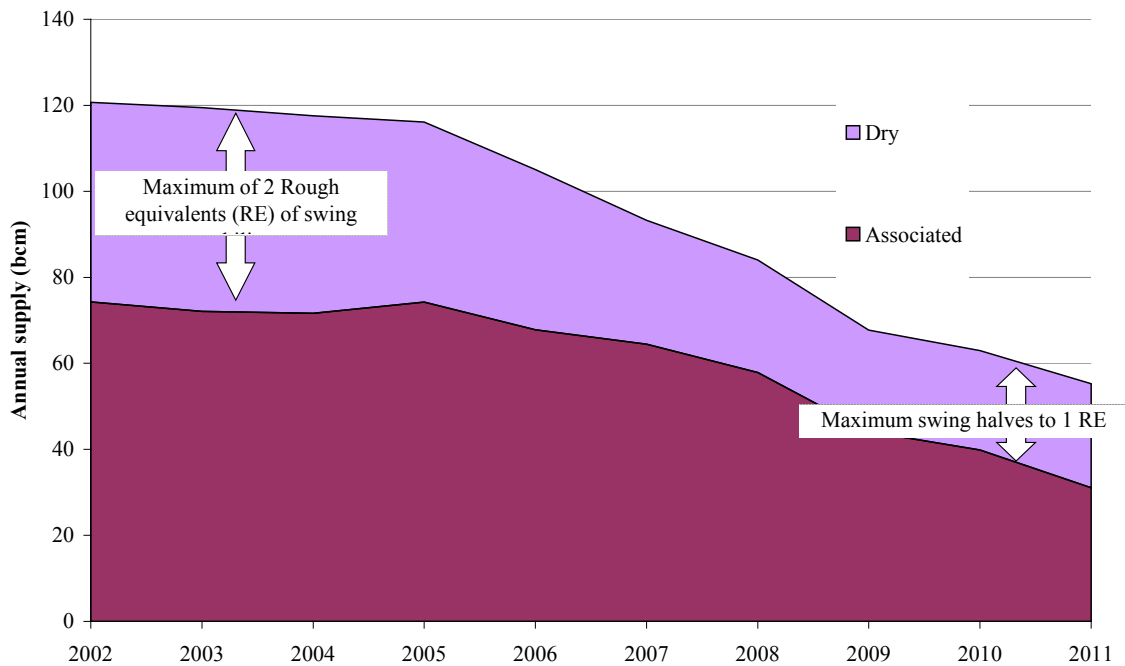
Source: ILEX

- 5.36 In a market where there is a comfortable margin of supply over demand, winter peak prices are capped by the long-run marginal cost of storage. However, when the supply/demand position tightens, as is the case in the UK recently, the cap is removed as participants bid up the price of storage, which in turn pushes up forward prices.

Where will the future UK swing come from?

- 5.37 Figure 19 shows the projected decline in dry gas fields that can provide swing to the UK.

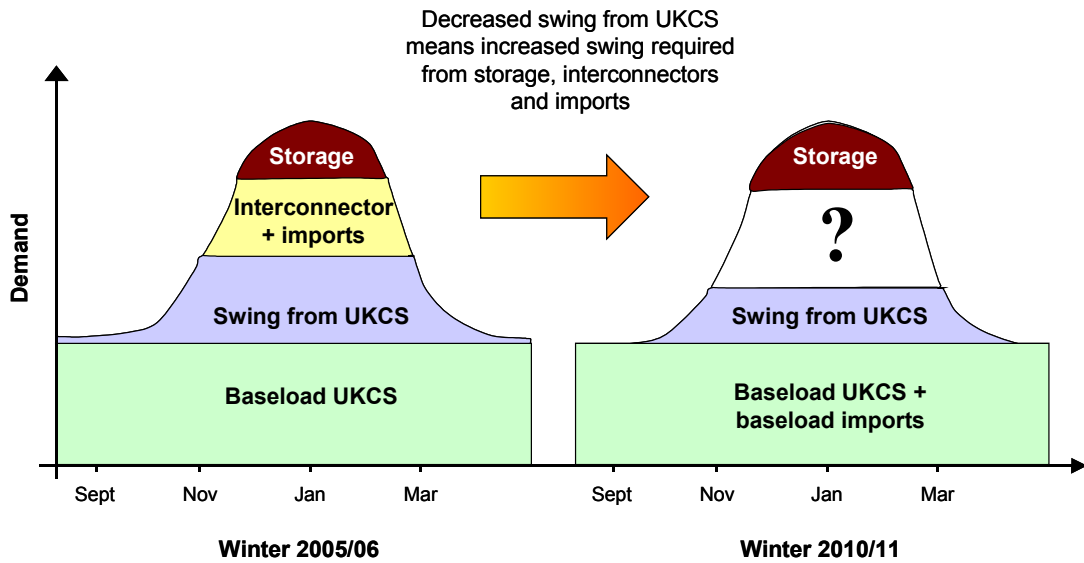
Figure 19 – Projection of UK Continental Shelf, split by associated and dry gas



Source: ILEX analysis

5.38 Figure 20 shows the position in the winter of 2005/06 and the winter of 2010/11. The swing from the UKCS has declined leaving a gap that must be filled by a combination of swing from storage, interconnectors and imports. Swing to the UK can only be supplied from long-duration storage in depleted fields (shorter duration storage facilities hold an insufficient number of days stock). The additional depleted field volume added by 2010 will make up for only part of the loss in swing from UKCS supplies; the remainder will need to come from increased swing on the interconnectors and imports.

Figure 20 – Future sources of swing for the UK



Source: ILEX

- 5.39 The remaining shortfall will be provided by a mixture of IUK imports, swing supply through importation pipelines and/or LNG importation. The UK will, however, face the potential diversion of both pipeline gas and LNG cargoes to other markets if prices are higher in those markets. This diversion of LNG cargoes and of pipeline gas to higher priced markets may result in shortages or lead to increases in the UK prices.

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6. CONCLUSIONS

- 6.1 Gas storage facilities increase the security of gas supply for the UK gas consumers. It allows shippers/suppliers to inject gas during periods of low demand during the summer, when gas prices are low, and withdraw gas in the winter when demand is much higher and prices higher.
- 6.2 However, the amount of gas storage in the UK reflects the past position when the UK was fully self sufficient in gas from production on the UKCS. When the UK had production close to our centres of demand and the ability to vary this production (swing) the amount of storage was probably correct.
- 6.3 However, as a consequence of depleted indigenous production and following a number of years of surplus storage capacity, the UK storage position is tight in the winter of 2005/06 and the next two winters until new supply projects come on stream.
- 6.4 If the 2005/06 winter is 1:10 cold or more severe then a significant amount of industrial demand would need to stop consuming gas for much of the winter. Under 1:10 cold the estimate of load shedding is equivalent to two-thirds of Rough; under 1:50 cold the load shedding is equivalent to one Rough storage facility.
- 6.5 It is too late for storage to deliver enhanced security for this winter. The lead time to develop and build new storage is 3 years or more such that if the go ahead were given today to build a second Rough then by the time the storage came to market the short-term tightness of supply-demand in the UK will have passed.
- 6.6 New storage projects are being developed for the UK. However, planning constraints and inquiries slow down developments. The lack of liquidity in the wholesale traded gas market beyond the next 18 months also mean that new facilities cannot rely on price signals from the traded markets to underwrite storage development. Instead, new storage facilities will need long-term contracts with shippers/suppliers to underwrite the investment. However, gas shippers/suppliers are unlikely to be willing in our view, given the current outlook for the winter/summer differentials, to commit to long term gas storage contracts with storage developers.
- 6.7 We also view the changes by Transco to the Storage Monitor regime as potentially damaging the incentives to book existing storage facilities and hence investment in new storage capacity. In our view Transco, HSE and Ofgem should reconsider the arrangements allowing Transco to increase Safety Monitor levels.

Has the market worked in the UK?

- 6.8 Looking at the UK as a whole, we believe that the gas market has responded reasonably correctly and efficiently to economic signals: there has not been, even

with perfect foresight, any robust commercial case to build a second Rough. However, our analysis summarised in Table 5 – Savings to UK plc from building a second Rough – does appear to suggest that the market has not delivered the most efficient outcome for UK gas consumers. Gas prices would have been significantly lower if a second Rough had been commissioned by summer 2005. However, in our view, it is dangerous to assume that decisions made by Government to centrally plan the “correct” amount of UK storage is any more likely to deliver the optimum outcome for gas prices than the market.

- 6.9 Looking forward, based on the extent of new gas importation projects including LNG regasification terminals, the economic justification for building new large storage facilities is weak. The new importation projects will provide the potential for higher peak flows of gas so reducing the need for storage.
- 6.10 Instead, the market is delivering new “bite-sized” storage facilities to the market. The economics of relatively small storage facilities favours onshore facilities rather than offshore because of the high operating costs offshore. However, we have real concerns about the planning process delaying the development of new onshore storage.
- 6.11 “Strategic” storage is a difficult term to define. We believe that the market should and can deliver sufficient “commercial” storage capacity to provide for the normal seasonal variation in demand between winter and summer. Thus commercial storage should be capable of providing sufficient gas – at a reasonable price – to maintain gas supplies to all domestic consumers and most of industry and the power generation sector through a cold winter. Our existing commercial storage capacity fails this test for this winter. National Grid in its Winter Outlook suggest that a significant amount of industrial demand would need to stop consuming gas for much of the winter. National Grid estimates that 2.2 bcm of load shedding would be required if the winter is 1:10 cold, and 3.6 bcm of load shedding would be required if the winter is 1:50 cold. However, it is likely this is a temporary problem for the next few winters until the new depleted field storage and new gas importation projects are commissioned and make up for the reducing swing from UKCS supplies. The UK will, however, face the potential diversion of both pipeline gas and LNG cargoes to other markets if prices are higher in those markets. This diversion of LNG cargoes and of pipeline gas to higher priced markets may result in shortages or lead to increases in the UK prices.
- 6.12 If we accept that the market can deliver “commercial” storage, what can we deduce about the market signals for “strategic” storage capacity? Firstly, a case can be made that, as a result of the change in the UK supply situation caused by the need to import gas from remote sources, the UK should build strategic storage to maintain security of supply. We define strategic storage as storage only used in extreme circumstances that arise as a result of a major supply side problem. An example of such a problem would be the loss of the IUK interconnector or the Langed pipeline – both will be capable of supplying over 20% of UK gas demand. The risk of such a supply side problem is low and the market is unlikely

to be willing to “insure” against the risk by funding another one or two Rough equivalents.

- 6.13 The alternative to the market providing strategic storage would be for Government to impose the costs of funding strategic capacity on the industry. The full evaluation of both the requirement and the funding solution for UK strategic gas storage is beyond the scope of this study. In our view the Government needs to examine this issue in the coming energy review.

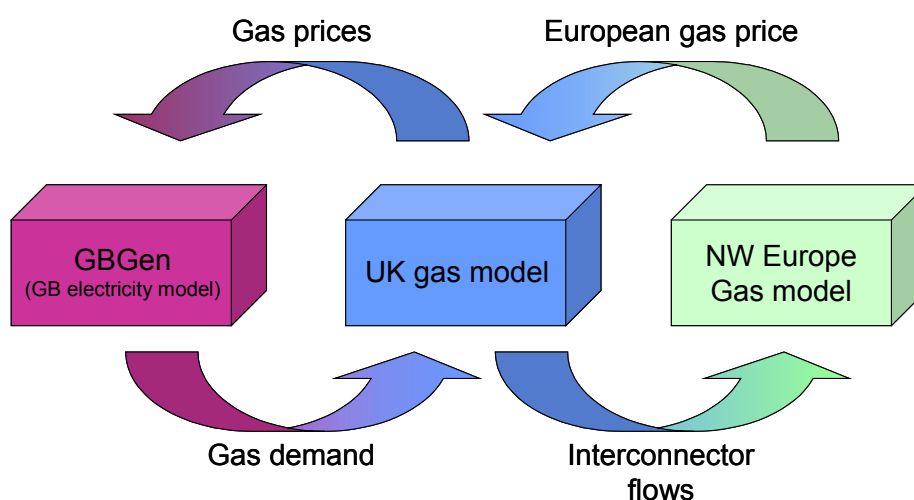
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ANNEX A – UK GAS PRICE MODELLING METHODOLOGY

Overview of methodology

- A.1 UK gas prices are forecast using a merit-order based approach, using 15 different sources, each of which is ranked in a merit order with the lowest priced sources supplying the market demand. For the months March to November we use a single sample day to represent the months, but in the winter months of December, January and February, we model each month in more detail, looking at sample days of business, non-business and peak. This increased resolution allows us to investigate how close the system is to firm-demand shedding under a variety of scenarios.
- A.2 As a core part of our modelling, we carry out iterations with our electricity model (see Figure 21), to understand the effect of changes in gas price on demand for gas, and changes in demand for gas on price (the price elasticity of demand). This iteration between the two models ensures that our assumptions on gas prices and gas demand remain realistic and reflects the elasticity of gas demand given high gas prices.

Figure 21 – Gas and electricity modelling

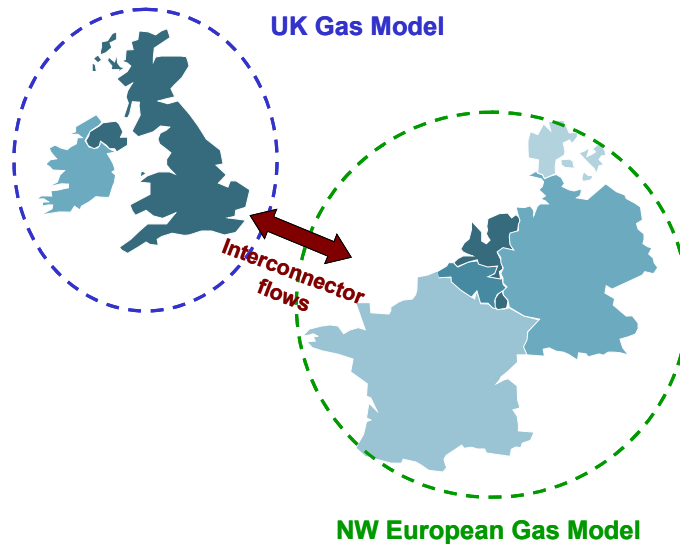


Source: ILEX

- A.3 The UK market is strongly influenced by the wider European market via the Interconnector (IUK), and in the future through the BBL pipeline. ILEX models the European market using our NW European model, which examines the supply-demand balance on a monthly basis in a similar fashion to the UK gas model. However, this model differs as it includes the effect of oil-indexation – that is market prices being set by long-term indexation rather than by the long-run price of the marginal source of gas. We make assumptions on the rate of liberalisation

and de-linking of gas prices from oil, which drive whether the model assumes prices are set by market forces or by oil-indexation.

Figure 22 – Interaction between UK gas model and NW European model



Source: ILEX

- A.4 The interaction between the NW European model and the UK gas models allows us to explicitly examine the effect of NW European supply-demand balance on the UK market. If prices in Europe are assumed to stay linked to a high oil price, we see the interconnectors move to export mode to supply the higher priced market. If the UK market supply-demand becomes tight, prices in the UK rise, leading to gas being imported. If the interconnectors reach maximum import or export, we see prices de-link between the two markets as the marginal source of gas ceases to be from the rival market.

UK modelling assumptions

- A.5 In a liberalised market, it is assumed that prices in the market are set by the marginal player. However, for all scenarios, ILEX assumes that in early years gas prices on the Continent are set by indexation to oil-prices. In the Low scenario, transition to a competitive market, and thus price setting by the marginal player, is assumed to occur in 2010. In the ‘Central oil-gas de-linked’ scenario, this is assumed to happen in 2012, and in both the ‘Central: oil-indexation’ and the High scenario full competition throughout Europe never occurs, and thus gas prices remain indexed to oil throughout.
- A.6 Gas demand in the UK has been forecast by looking at individual forecasts of domestic, industrial and commercial, power generation, Combined Heat and Power (CHP), and exports to Ireland.
- A.7 UK domestic supply and pipeline capacity is forecast using market intelligence and information from industry participants.

- A.8 Fifteen individual sources of supply have been modelled to reflect the range of sources that supply the UK market.
- **UK** – three separate UK supply sources have been modelled: associated gas, which is assumed to have a marginal cost of zero as it is a by-product of oil production; ‘UK Old’, which is assumed to represent old/current fields; and ‘UK New’, which represents fields yet to come on-line.
 - **LNG sources** – ILEX examines LNG on the basis of the source of supply, as this drives both the production costs and the associated transport costs. We look at Middle East (Oman and Qatar), Caribbean (Trinidad & Tobago and Venezuela), North Africa (Algeria, Libya and Egypt), Western Africa (Nigeria and Angola) and North Europe (Barents Sea). Due to the highly fungible and portable nature of LNG, we do not assume that each import terminal has its own price characteristics, but rather group available capacity together into one ‘virtual terminal’. This virtual terminal is split by source, either by contract volumes where known, or by reserves of each supplier where sources are not known.
 - **Pipeline gas** – we assume pipeline gas to the UK comes from either Norway or Benelux (via Interconnector or BBL). The Benelux gas represents gas priced at the NW European price.
 - **Storage** – three forms of storage have been modelled – salt cavity (such as Hornsea or Hole House), depleted fields (Rough) and LNG (e.g. Avonmouth and Partington).
 - **Demand shedding** – we also model active demand shedding, assuming that some demand will shut off from the system if prices are high enough.

ILEX believes that this range of sources accurately reflects UK market behaviour on a monthly basis.

- A.9 The Interconnector (IUK) and BBL pipelines are assumed to be driven solely by the price differential between the UK price (assuming no interconnection) and the Continental price. Thus if demand rises in the winter, requiring use of expensive storage, the interconnectors will reverse direction to import into the UK. Conversely, when demand is low in the summer and UK prices drop to the LRMC of UKCS gas, the interconnectors flip to export to the Continent.

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STORAGE, GAS PRICES AND SECURITY OF SUPPLY

ILEX

Quality Control Check Sheet

STORAGE AND SECURITY OF GAS SUPPLY

Report Unique Serial No: 2005/160

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