

# Gas Storage:

## Securing the future of the UK energy market

## Executive Summary

Gas is the single most important fuel in the UK's energy mix today and is now recognised to be at the centre of a low carbon future.

The closure of many ageing coal and gas power stations has created an increasingly tight electricity market. Coupled with increasing intermittent renewable power generation, the need for new gas powered generation to support the electricity industry is evident. This has been highlighted by the government who believe 15GW of new gas powered generation is needed by 2030.

However, the UK's secure indigenous supplies of gas are in sharp decline and relying on the global market for imports brings with it new supply risks and price shocks as witnessed over the last few years.

Delivering energy security is the number one priority for DECC. Gas storage can make a significant contribution to achieving this by ensuring that gas supplies are maintained at times of major supply or demand shocks. It also protects consumers from price spikes ultimately reducing overall gas bills; therefore gas storage is vital for the efficient operation of the UK energy markets.

However, in recent times the market value of storage has significantly deteriorated resulting in extremely challenging conditions for operators. This has led to the withdrawal of some existing capacity and the stalling of investment in new facilities; unless this is addressed by policymakers and addressed urgently, the Gas Storage Operators' Group believes that further reductions in storage capacity are inevitable. The fact that unlike other types of energy infrastructure, once gas storage facilities have been decommissioned, they are inevitably lost for good makes this issue even more pressing.

This paper identifies the multitude of benefits that gas storage provides to the energy market and outlines those benefits that are not captured by the current commercial arrangements; these 'societal' benefits include the contribution to security of supply (or the insurance value), the value of reducing customers' bills, and the avoided network investment. It also provides an explanation as to why the market value for gas storage has deteriorated.

While these benefits of gas storage remain unrecognised it is highly likely that sub-optimal levels of storage capacity will be available to the market, resulting in diminished physical and price security, and as this report explores, the effects of this will be felt at both societal and economic levels.

If this outcome is to be avoided policy makers need to take action now to introduce mechanisms and fiscal regimes that fully reflect the true value of gas storage to the UK energy market.

This paper is aimed at policymakers and key stakeholders who have an interest in the continuing secure and efficient operation of the UK energy market.



## Introduction

**Gas is the single most important fuel in the UK's energy mix today. It is the primary fuel used to generate around one third of our electricity and heats around 80% of our homes.**

Gas will continue to play a vital role for many years to come providing an essential bridge to the UK's low carbon future with forecasts predicting gas will play a central role in the energy mix up to 2030 and beyond. The early closure of coal and gas plants and the challenges presented by intermittent renewable generation bring immediate pressures on electricity capacity margins, with forecasts predicting them to fall into negative territory this winter. Policy makers recognise that these pressures can only be alleviated by the deployment of additional gas generation.

The future energy mix now clearly has to rely on gas far more than was previously anticipated; this introduces new risks associated with security of supply and security of price.

The UK is becoming ever more dependent on the global gas market for its supplies; by 2020 60% of the UK gas supply is set to be imported, rising to 90% in 2035.

Whilst investment in the UK gas market import infrastructure has improved physical supply security, this has done little to mitigate the increasing risk of volatile and high prices as well as unserved demand (through self-imposed 'price' disconnection) of non-domestic consumers, including electricity generators and electricity consumers. These price risks will undermine the competitiveness of the UK industry and ultimately feed through as higher costs to domestic energy users.

**Secure and affordable gas supplies must be maintained at times of high demand if the 'lights are to be kept on'.**

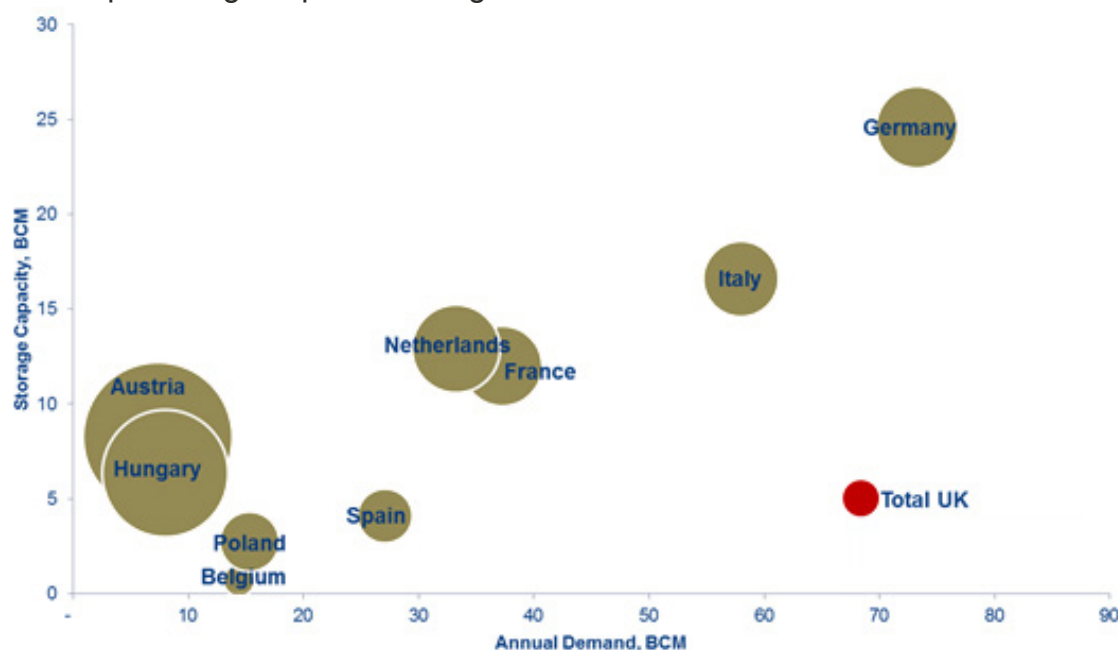
The insurance provided by gas storage not only enhances physical gas security, but insulates those countries from the vagaries of the global gas market and its associated price risks. In short, gas storage is a vital national asset which contributes to the economic wellbeing of the majority of European member states.

Other European countries that rely on the global market for gas imports have significantly higher levels of gas storage to help protect them from supply and demand shocks as Figure 1 illustrates (the bubble size represents the present storage capacity expressed as a percentage of annual demand).



**Gas is the  
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Figure 1. Europe storage capacities vs. gas demand.



Source: Centrica Storage Limited

The UK's comparatively low level of storage does not look set to improve with a number of proposed storage projects (that had been granted planning permission) having been recently cancelled, such as Baird, Caythorpe and Whitehill or put on hold. Table 1 below summarises the storage projects which currently have planning permission, but have not achieved final investment decision.

Table 1: Proposed storage projects

Project	Operator/Developer	Location	Space (bcm)	Status
Deborah	Eni	Offshore Bacton	4.6	Planning granted, no FID
Islandmaghee	InfraStrata	County Antrim, NI	0.5	Planning granted, no FID
King Street	King Street Energy	Cheshire	0.3	Planning granted, no FID
Preesall	Halite Energy	Lancashire	0.6	Planning granted, no FID
Saltfleetby	Wingaz	Lincolnshire	0.8	Planning granted, no FID
Gateway	Stag Energy	Offshore Barrow in Furness	1.5	Planning granted, no FID
Total			8.3	

Source: National Grid Gas

Note: This list may not be exhaustive; other storage projects have at times been reported in the press.

To compound the problem, during 2015 Centrica Storage (Rough) and SSE (Hornsea) announced reductions in the level of capacity which would be offered at their respective facilities.

**There is a danger that further temporary or, more likely, irreversible reductions in storage capacity may be announced in future as the economic case for owning storage**

## The Benefits of Gas Storage (“why does it matter?”)

Gas storage provides a multitude of benefits to the UK energy market, in particular it:

- delivers physical gas and is more reliable than other sources of gas supply as it is not exposed to the same risk of being diverted to other markets
- is located close to, and often embedded in, the UK gas market and so can react quickly to demand or supply shocks
- provides delivery support for other sources of supply
- reduces the average cost of consumers’ bills
- reduces the investment needs of the national transmission system and importantly for the physical security of supply
- is available to be called upon by National Grid in a Gas Emergency

However, not all of the value associated with these benefits is captured by the current commercial arrangements between storage providers and market participants.

These include (i) the contribution it makes to energy security of supply, (ii) the impact it has on reducing consumer bills and (iii) the impact gas storage has on avoiding the need for costly network investment. These are each explored in turn in more detail below, and their associated benefits are then quantified.

### (i) Contribution to Energy Security of Supply

Gas storage makes an essential contribution to the UK’s energy security of supply.

The speed of response and greater certainty of delivery means that gas storage provides an effective insurance against disruption for consumers; this is only likely to become more important given expected future energy market developments.

#### *Factors effecting security of supply: The Future of Gas Supply*

The future shape of gas supply to the UK is changing dramatically. Not so long ago, the vast majority of our requirements were met from North Sea production whereas now we import over 50% and this is forecast to rise to over 90% within the next 20 years. At the same time the gas market has become more global. An increasing import dependency and a more global gas market increase the risk that gas imports to the UK can be diverted elsewhere in response to external market conditions.

Gas storage helps insulate the UK from the impact of these global events.

#### *Factors affecting security of supply: The Future of Gas Demand*

The future shape of gas demand in the UK is also changing. The end of unabated coal-fired power stations and the introduction of new gas-fired power stations means that there will be a significant shift to gas as the primary source of fuel for electricity generation.

In addition there is likely to be greater volatility in gas demand as more renewable generation is deployed and back-up sources of generation are required to compensate for the associated intermittency.

As a flexible source, gas storage makes a significant contribution towards managing both volatility and demand peaks, thus maintaining UK security of gas and electricity supplies.

Annex A - **Factors Affecting Security of Supply**, provides further details of how security of supply will be impacted by changes in supply and demand.

## **(ii) Impact on reducing Consumer Bills**

Gas is typically put into storage when it is relatively cheap and taken out of store when expensive. This market price responsive use of storage has the effect of reducing the average cost of gas, which in turn reduces overall consumer gas bills.

This market responsive operation of storage also provides further benefits to the gas market by providing **greater price stability** and by providing **insurance against extreme prices**.

### *Greater price stability*

As well as reducing the overall cost of gas to consumers, it reduces volatility in gas prices, providing greater price stability and certainty to industry and consumers. This happens as storage will generally add supply to the market when demand and prices are high, putting downward pressure on prices. The consequence of this operation is an overall reduction in price volatility. A Timera Energy report explores this issue in more detail concluding.

*“This cycling flexibility of fast cycle storage acts to reduce market price volatility. It also acts to increase prompt market liquidity (e.g. within day & day-ahead), as storage capacity owners manage their injection and withdrawal exposures in the market. Both of these factors ultimately contribute to reducing the cost of supplying gas to customers.”*

Gas storage provides a reliable source of supply at times of high demand. This prevents the need for costly investment in other physical facilities (LNG import terminals, interconnectors, offshore pipelines), that may or may not supply gas to meet a potentially transient or temporary peak in gas demand.

### *Insurance against extreme prices*

In a similar way that gas storage provides an insurance against physical supply disruption for customers, it also provides an insurance against extreme prices. In emergencies gas storage can react quickly and, because it is physically located and embedded in the UK network, there is no delay in delivery and no need to source supply from the international market at potentially very high prices. This contributes to reducing customer bills.



### (iii) Reduces need for costly Network Investment

Gas storage provides significant benefits to the gas network. It reduces the need for the Network Operator to invest in the pipeline network to accommodate additional imports of gas. Because of its location in the network, typically close to areas of demand coupled with the fact that gas storage is highly likely to deliver gas on high demand days, it will have a positive impact on the gas network, alleviating the need to invest in additional network capacity to meet peak demand.

In contrast, other sources of supply, such as imports (via pipeline, interconnector or LNG terminals) tend to arrive on the extremities of the network and require significant system reinforcement and investment to accommodate additional imports.

This benefit is widely recognised with the Council of European Regulators stating in a recent policy paper on gas storage:

*“When located close to demand areas, storage helps to lower network investment costs by reducing the size of the pipelines necessary to meet peak demand and can improve the efficiency of system operations”*

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### (iv) Quantifying the Benefits of Gas Storage

#### *The contribution to security of supply*

It is very difficult to provide a wholly reliable view on UK’s future security of supply position as there are any number of influencing factors, such as; future gas demand and supply patterns, government policies, economic climate and geo-political risks, to name but a few. What cannot be disputed, however, is that the UK will become more reliant on imports and as a result will be more and more exposed to the vagaries of the global gas markets.

In recent years, a number of studies have been carried out focused on providing an assessment of security of supply in the UK gas market. All of the studies concur that storage makes a significant contribution to the nation’s security of supply and without it the UK would be vulnerable to changes in the global supply and demand dynamics.

The DECC Assessment of UK security of supply (2014) shows that although the gas market passes the EU N-1 test, under all of its demand scenarios, gas storage plays a pivotal role in ensuring that UK consumers are supplied with gas. In particular it is evident that in the event of a supply shock, gas storage is vital to the security of our gas supplies.

This view is supported by Ofgem where according to analysis carried out by its consultants, Poyry, **the direct costs to the economy of a Gas Deficit Emergency** (i.e. a period when the supply of available gas is not sufficient to meet UK demand) **could be in excess of £50bn**.

### *Reduced consumer bills*

A number of studies were carried out in 2012/13 to derive a price benefit of gas storage. The government explored this issue to aid its investigation into whether market intervention in the gas storage sector could be justified to support the roll-out of additional storage facilities. In parallel, Centrica Storage and ENI UK also commissioned independent studies which focused principally on the societal benefits delivered by Long Range Storage (LRS) projects.

Although the government steered away from any form of market intervention, in common with the other studies it recognised that gas storage is an important source of flexibility, helping the gas market balance when demand is high. The underlying analysis also recognized that support for seasonal storage would significantly reduce the overall retail cost of gas and in certain scenarios would have a significant positive cost benefit analysis.

Industry studies reached similar conclusions regarding the positive impact of gas storage on the market:

- An ENI study showed that the construction of an additional LRS facility would provide societal benefits in the region of £400m p.a.
- A Centrica study showed that **if Rough storage was removed from the market, average household bills would increase by £20 p.a.** Centrica's study also showed that in a scenario where the IUK outage on 26 March 2013 had been extended over a 10 day period, then prices would have trebled as LNG was delivered to supply the shortfall. Contrastingly, if a new LRS facility was operating, prices would have been between 15 -30% lower over the same period.

### *Avoided network investment*

A number of studies have been carried out to attempt to derive the value of gas storage to the UK network. Most recently, a 2014 WWA study for GSOG attempts to estimate the investment costs avoided due to storage deliveries on peak demand days, delivering to the system close to consumer demand, thereby reducing the need for investment in pipe and compression capacity between alternative sources of gas and the demand. It concludes:

*“There are significant benefits to the transmission system provided by storage. The benefits have been calculated on the basis of avoided CAPEX with greatest concentration around £350-£600m in terms of total savings (£40-£65m pa). This is equivalent to 7-10% of TO allowed revenue” – WWA UK gas transmission system benefits from gas storage – an update to the initial report produced in 2007, A report for GSOG April 2014*



## The challenges that gas storage faces

Gas storage is going through a very challenging time with very low revenues and high costs. This has led to the withdrawal of some existing capacity and the stalling of investment in new facilities.

### (i) Low Revenues; Intrinsic and Extrinsic Value has reduced significantly

Gas storage in the UK is valued and contracted for on the basis of the intrinsic and extrinsic value perceived by the commodity market on a forward basis, a value which is lower than the real value delivered to customers every day.

The intrinsic value reflects the seasonal spread. Simply put this is the value of storing relatively low priced summer gas and selling it during the higher priced winter months. The extrinsic value reflects the optionality of capturing short term price volatility and is related to the number of cycles that a storage facility can perform.

Unfortunately for storage owners, both intrinsic and extrinsic value has reduced significantly over the past few years to a level which is below the operating cost for many. Seasonal spreads have declined by 75% since 2010, in part due to reduced seasonality of demand and the availability of LNG.

Figure 2. Summer/Q1 NBP seasonal spreads history 2010 / 2015 (p/th).

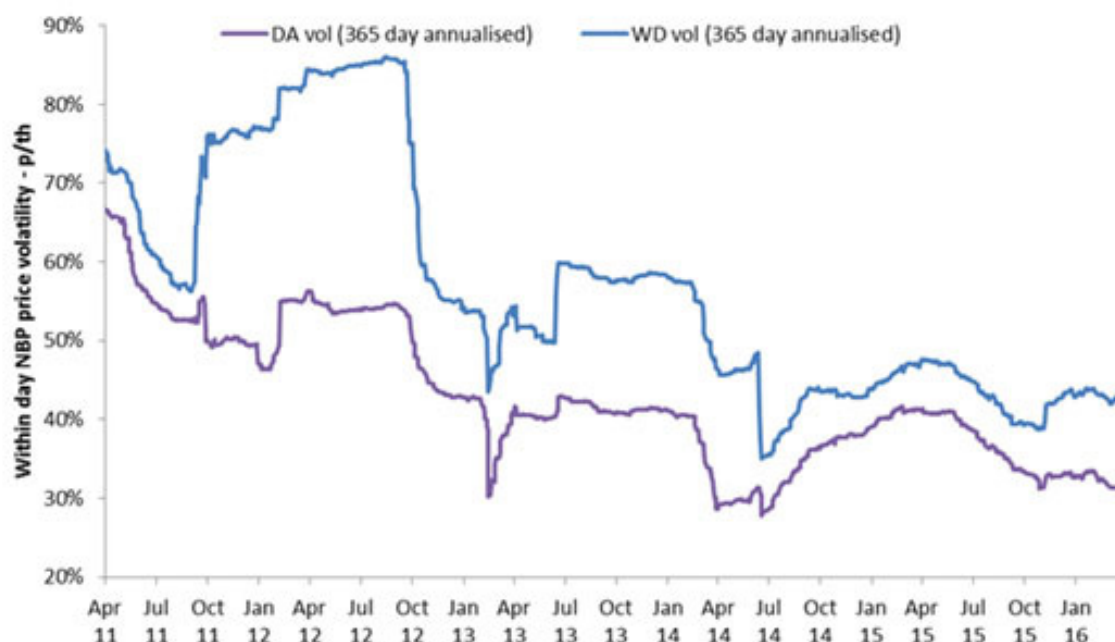


Source: Centrica Storage Limited

Low volatility reduces the extrinsic value of fast cycling plants and the revenue they can earn; with the capability to profile flows to meet inter day and intraday price movements. Price volatility has halved since 2010 as the ample supply means demand spikes can be met quickly without the need for large price increases; as a result revenue per unit of withdrawal has also halved.

The chart below shows the decline in spot price volatility from 2010 to 2015.

Figure 3: Spot Price Volatility 2010 / 2015 (DA = Day ahead, WD = within day)



Source: Centrica Storage Limited

Looking forward the future is uncertain; however in the very short term it is unlikely there will be any relief for gas storage in the UK in the form of widening spreads or upsurges in volatility.

For potential investors in new storage capacity there is an additional challenge; storage projects are long term investments which require long term commercial contracts to underpin the investment.

In the fully competitive UK market storage has to sell its services to the users of the network, the shippers and suppliers. These users acquire storage services to hedge against market risk, for example to limit their exposure to varying demand and prices.

These risks are typically evaluated on a relatively short term basis, normally on an annual basis, reflecting the length of supply contracts with customers. The result is that storage owners are mostly only able to secure annual or even shorter-term contracts for their services. This renders future revenues uncertain and does little to encourage development of any new facilities.

## **(ii) High costs; An unfair tax burden**

Whilst the value that the market places on gas storage has more than halved since 2010, Business Rates have remained steadfastly high. Current business rates, set at values based on conditions in 2008 when the market was at its peak, are woefully out of touch with what is affordable and fair. For some, these costs are equivalent to over half the revenue.

This level of cost cannot continue to be borne by the industry. Looking forward, if this tax burden is not reduced significantly and quickly, it is a likely consequence that further temporary or, more likely, irreversible reductions in storage capacity will be announced.

## Consequences

The current market arrangements do not fully reflect the full value of gas storage.

The intrinsic and extrinsic value of storage is currently below the level that some storage operators need to maintain a sustainable business and the future outlook shows little sign of improvement.

As a consequence, there is the high likelihood that further reductions in storage capacity will be announced.

If gas storage facilities are no longer commercially viable the alternative is to extract the recoverable gas and decommission those sites. This would mean that the facilities would no longer be available for storage operations giving rise to the above risks to supply and price.

Allied to this, there is little incentive to invest in new storage capacity and UK consumers will become increasingly exposed to the global gas market and the uncertainties it brings.

## Options for Policymakers

Action needs to be taken to avoid these consequences. Here are some of the options.

### Security of Supply (or the insurance value)

As outlined earlier in this document, gas storage makes an essential contribution to the UK's energy security of supply. Its speed of response and greater certainty of delivery, helps insulate the UK from supply and demand shocks. It is unique in this aspect. However, unlike most other sources of flexibility, storage is embedded in UK territory with little opportunity to divert supplies to alternative markets. It is, in effect, a sunk investment in the UK market and there is a legitimate expectation that the gas stored in these facilities will be delivered into the network in times of need. This has the consequence of reducing the market expectation of future price volatility or extreme prices. This expectation results in a diminution of the payments which storage owners can expect from storage users, as the very flexibility they provide is factored into, and dilutes the probability of future price volatility.

This price dampening effect is known as 'cannibalisation' of value and represents a societal benefit generated by storage that cannot be captured by storage owners via commercial arrangements.

### Policy Option

Without some form of government intervention it is difficult to see how these structural issues could be solved. A revenue stream which properly reflects the high capital costs required to maintain and operate storage and the supply and price security benefits which it provides should be recognised through a policy to ensure the benefits are properly valued and allocated. This might be achieved by direct subsidies to "top up" revenues, or by reducing the cost burden borne by storage owners, such as a reduction in business rates or by the introduction of targeted fiscal arrangements.

### Within day flexibility

The flexibility provided by gas storage is not properly recognised or valued in current market arrangements. The gas market is founded upon a daily value of gas with no consideration of the within day flexibility that is provided by storage.

This within day flexibility will only grow in importance as investment in renewable power generation increases. The UK power market will require greater responsiveness from the gas network to support the expanding population of small scale gas generation operating alongside the less flexible renewable technologies. Without further investment in flexibility the ability of the gas pipeline operators to meet these demands will be severely tested.

### Policy Option

Gas storage is the most cost effective way of delivering this within day flexibility but its value must be recognised. This could be achieved by placing an obligation on National Grid, in its role of Gas System Operator, to acquire within day flexibility services rather than investing in less economically viable network infrastructure projects.

### The value of storage to the gas network

The benefit provided by storage to the network is not properly recognised or recompensed in current network arrangements. The need for investment by the pipeline operators in the gas network is reduced by the fact that storage is embedded in the network, close to customers and can be relied upon to deliver gas during times of need.

If gas storage was not on the system, not only would UK need to secure additional imports of gas, the network operators would also need to invest in costly system reinforcement to allow the system to deliver that gas to customers. The costs of this reinforcement would ultimately be borne by customers through higher gas bills.

### Policy Option

To correct this anomaly, network tariffs incurred by users of gas storage should be reviewed and reset to better reflect the network investment savings created by storage flows.

**Within day flexibility will only grow in importance.... Gas storage is the most cost effective way of delivering this flexibility.**

## Conclusion

Gas storage provides a multitude of benefits to the UK energy market and is vital for its efficient operation. It lies at the heart of the Government's energy security policy, yet not all the value associated with its benefits is captured by the current commercial arrangements.

While the full range of benefits of gas storage remain unrecognised it is highly likely that further reductions in gas storage capacity are inevitable and sub-optimal levels of storage capacity will be available to the market. This will result in diminished physical and price security, and as this report explores, the effects of this will be felt at both societal and economic levels.

If this outcome is to be avoided, policymakers need to take action now to introduce mechanisms and fiscal regimes that reduce the cost burden and fully reflect the true value of gas storage to the UK energy market.



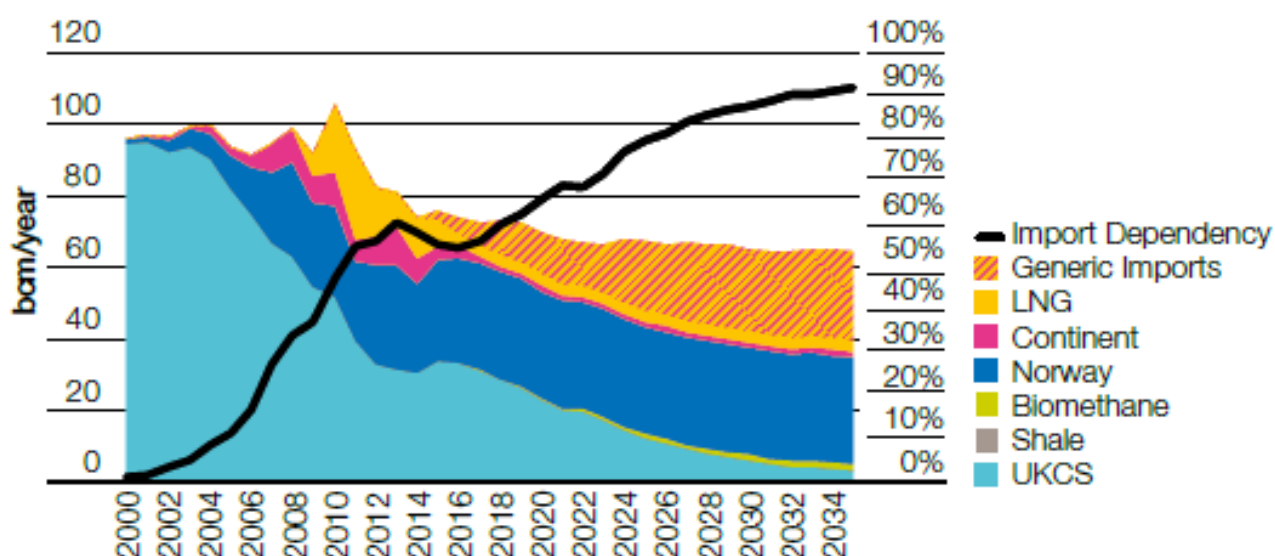
## Annex A - Factors Affecting Security of Supply

### Factors affecting security of supply: The Future of Gas Supply

The UK's ability to withstand shocks is reducing as its import dependency increases. The UK's indigenous North Sea production is ageing, producing less gas and is now less flexible in its operation, a trend which will continue over the coming years.

The flexibility which was once a feature of North Sea supplies was unique to the UK gas market and is the main reason why there are relatively low volumes of gas storage capacity compared to demand. Overall the UK now imports over 50% of its gas, via pipelines from Norway, interconnectors with continental Europe and through LNG terminals. National Grid's forecast in Figure 1 below shows that this trend is likely to continue.

Figure 1. Growth in gas imports under the Slow Progression scenario,

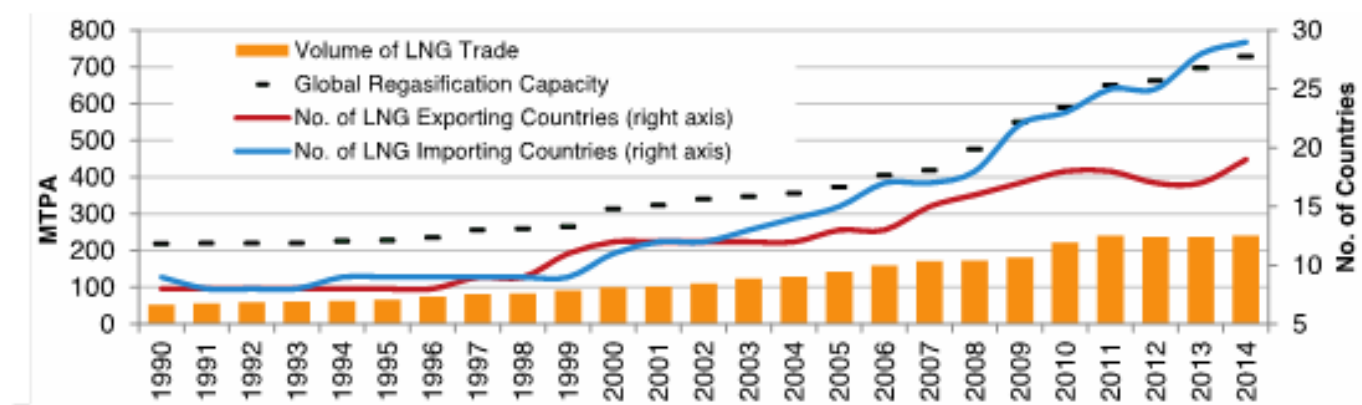


Source; NGG, FES July 2015.

At the same time the gas market has become more global with a greater and more varied international demand for gas. As can be seen in figure 2, whilst there has been an increase in global LNG supply and trade, this has been more than outstripped by an increase in LNG regasification capacity and a growing number of LNG importing countries.



Figure 2 World LNG Report 2015, IGU.



Increasing import dependency and a more global gas market increase the risk that gas imports to the UK can be diverted to other countries in response to external market conditions. This is of particular importance when global or regional events, such as a disruption to Russian gas supplies, or even a NW European wide period of cold weather affect the wider market.

This risk is exacerbated by the UK's lack of long term contracts for LNG imports which puts it at a significant competitive disadvantage compared to other major LNG importing countries such as China, India and Japan where such contracts are in place.

Gas storage helps to insulate the UK from the impact of these global events.

### Factors affecting security of supply: The Future of Gas Demand

In November last year, the Secretary of State for DECC set out a new direction for UK energy policy which proposed to end unabated coal-fired power stations by 2025 and to prioritise the introduction of new gas-fired power stations.

This significant shift in the importance of gas as the primary source of fuel for the electricity generation market is expected to offset any reduction in domestic gas demand resulting from improvements in energy efficiency.

Furthermore, the UK is highly likely to see greater volatility in its gas demand in the near future. Whilst there has always been some variability in gas demand driven by environmental factors such as climatic conditions, volatility is expected to substantially increase as more renewable generation is deployed to help the UK meet its environmental obligations.

Notwithstanding its many benefits, renewable generation results in greater variability in electricity output as it is relatively inflexible in its operation. Typically, it cannot be ‘turned up or down’ and it is only available when conditions, be it wind or sunlight, are available. This means that a backup source of generation is necessary to meet electricity demand and balance the system at short notice. As nuclear power is also a ‘baseload’ source of power and coal has its own environmental issues, backup generation will be provided by gas fired power stations which can quickly ramp up production. This results in additional intermittent gas demand that is likely to further increase overall levels of volatility.

The trend of increasing requirements for flexibility is shown in figure 3 through increased use of linepack swing. Linepack is the gas within the pipeline system and represents within day flexibility inherent in the system. As can be seen the use of this within day flexibility has increased dramatically and there is an expectation that this will be exacerbated in the coming years as a result of the combined impacts of declining offshore flexibility and the roll-out of additional gas fired generation to support the expanding number of renewable projects.

**As a flexible supply source, gas storage makes a significant contribution towards managing both volatility and demand peaks thus maintaining UK security of gas and electricity supplies.** In the context of managing increasing intermittency, DECC recognises the contribution of gas storage stating:

*“Flexible gas supply infrastructure, including gas storage and volumes held at LNG regasification terminals, will become increasingly important as volatility increases.”* DECC 2012 Gas Generation Strategy

Figure 3. Swing in NTS linepack, NGG Winter Review & Consultation, July 2015



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