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Agenda

Advancing economics in business

Strong nerves needed? The economics of gas storage investment

The UK government has traditionally relied primarily on market mechanisms to deliver the appropriate mix of gas infrastructure. This means that gas storage investors face the full commercial risk of their projects and need to consider carefully the business case for their investments. This article sets out an approach to understanding the implications of different market scenarios for storage value

The resilience of the UK gas market has been tested on two occasions in recent years: in the winter of 2005/06 by a succession of cold snaps, the under-utilisation of import capacity, and the failure of the only large storage facility in the UK (the Rough facility); and in January 2010 by a prolonged cold spell and a series of outages at production facilities in Norway. On both occasions, suppliers and network operators managed to avoid disruption by calling on alternative supplies and interrupting large customers on commercially agreed terms (as part of 'interruptible contracts').

Nevertheless, these episodes have led policy-makers and others to question the adequacy of gas storage capacity in the UK. Domestic resources from the UK Continental Shelf (UKCS) have traditionally provided market participants with a relatively cheap and reliable source of flexible production to match fluctuations in gas demand. This indigenous source of flexibility has enabled the UK market to function at a much lower level of storage capacity than most other European markets. For example, the UK currently has 4.3 billion cubic metres (bcm) of storage capacity, which is equivalent to 15 days of national consumption, whereas France and Germany each have around 80–90 days of coverage.[1] The gradual depletion of UK domestic gas reserves, and their replacement by less flexible imports from more distant fields, could make UK storage infrastructures look inadequate.

Most European governments have developed regulatory mechanisms to ensure that there is sufficient storage capacity in place, and sufficient gas in store, to mitigate the risk of disruption. These mechanisms generally take the form of public service obligations (PSOs) that are imposed either on suppliers (as in France, where suppliers are required to hold specified amounts of gas in store), or on transmission system operators (TSOs) (as in Belgium, where the TSO, Fluxys, holds gas in stock at the Loenhout and Dudzele facilities to meet its security of supply obligation).

In the UK, by contrast, the government has traditionally relied primarily on market mechanisms to deliver the appropriate mix of gas infrastructure. As such, gas storage investors in the UK are exposed to the full commercial risk of their investment, and the promoters of storage projects need to consider the business cases for their investments carefully. The gas market is likely to undergo a series of structural changes in the coming years, with implications for the demand for storage and, therefore, the business case for new storage projects.

The pipeline of current storage projects comprises facilities with very different characteristics, not just in terms of location or technology, but also in terms of service offering. While certain projects are designed to offer large volumes of storage capacity but with relatively low delivery rates, others are designed to be much more responsive to short-run market dynamics. Different types of storage will succeed in different market environments. Against this backdrop, the question facing storage investors is not only whether more storage is needed (it probably is given the expected rise in import dependence), but also what type of storage will be viable under different market scenarios?

In this highly complex market and policy environment, it is essential for project sponsors to use the right valuation tools to assess the economics of their projects. While the future configuration of the gas market cannot be known with certainty, it is possible to use modelling tools to understand the implications of different scenarios for storage value. This article sets out a possible approach to analysing the economics of gas storage.

Gas storage risks and opportunities

The value of gas storage capacity is driven by the ability of its users to arbitrage between periods of high and low gas prices. The value to a storage developer also depends on the perceived risks faced by storage users and their willingness to pay for capacity.

Profitable opportunities to inject or withdraw gas arise as gas prices respond to periods of relative supply–demand tightness. The incentive and ability of storage users to act on these opportunities depend on two factors: the dynamics that determine gas price movements; and the physical characteristics of the storage facility that determine the amount of gas that can be stored and the ability to inject and withdraw gas.

While storage derives its value from gas price differentials, greater storage levels increase the supply of flexible gas, which is one of many factors that determine gas prices in peak periods. This circularity means that significant increases in gas storage can depress expected price differentials and the value of storage. These dynamics are summarised in Figure 1.

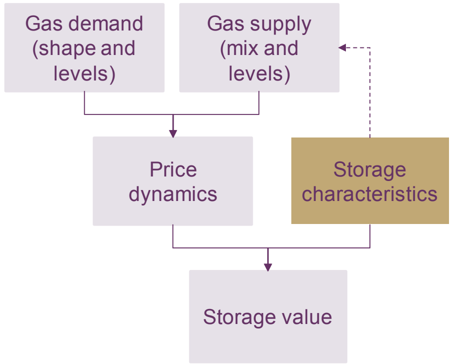
The impact of supply and demand characteristics on gas price dynamics can be separated into different components.

- A seasonal trend, in which prices are typically higher in winter, created by the fact that gas production is typically 'flatter' and less variable than gas demand, and driven by, for example, seasonal heating requirements.
- Shorter-term price fluctuations around this trend can be thought to represent temporary mismatches between supply and demand—for example, as a result of unexpected movements in demand arising from changing weather as well as supply disruptions.

In principle, the 'intrinsic' value from the seasonal spread can be observed and realised by trading forward contracts for the purchase of gas in summer and delivery in winter, although the extent of forward trading may in practice be limited by wholesale market liquidity. Profitable trading opportunities may also arise from changes in seasonal price differentials throughout the year.

Physical storage characteristics such as capacity and the rates of gas injection and withdrawal are also fundamental drivers of the value of storage facilities.

Figure 1 Drivers of the value of gas storage



Source: Oxera.

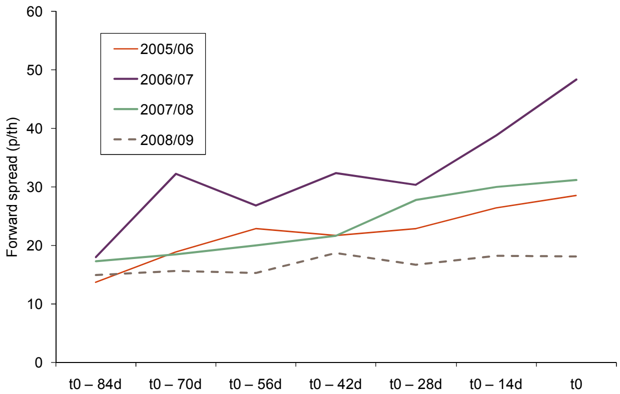
These affect the intrinsic value described above, as well as allow repeated 'cycling' of the working gas capacity within the year to capture the 'extrinsic' value from short-term price movements. For example, seasonal storage facilities typically have much lower cycling capabilities than salt caverns.

The outlook for prices

Recent seasonal spreads (eg, the difference between summer and Q1 prices) have typically exceeded 10 pence per therm (p/th) and have been as high as 40p/th, as shown in Figure 2. The chart also shows the evolution of the forward spread in the days leading up to the start of the storage year (t0 in Figure 2). A particularly striking feature of the chart is the volatility of the spread from year to year, which highlights the sensitivity of the intrinsic value of seasonal storage facilities to both the supply- and demand-side drivers and trends referred to above.

In future, increased volatility might be expected due to the impact of increasing intermittent wind capacity in power generation and the need for increased flexibility from gas plant. This could be offset to the extent that

Figure 2 Recent forward spreads



Source: Bloomberg and Oxera analysis.

large sources of flexible European unconventional gas are developed and an efficient European single market evolves. Policy proposals to encourage security, such as obligations on suppliers to contract for supply and demand flexibility, may also include greater demand-side participation in balancing.

Given the uncertainty of future gas market developments, scenario analysis provides a tool with which to consider the implications of a wide range of possible outcomes for the value of storage.

The value of storage

Scenario parameters can be developed and used within a modelling framework such as that used by Oxera's gas storage model in order to derive projected revenues. Scenario data on the expected forward spread, storage utilisation and price volatility is used to calculate the potential intrinsic value of a storage facility, as well as the total value that might be captured by storage operators. Total value is calculated by applying a share of the potential extrinsic value of the site that storage users are prepared to pay to project sponsors.

A typical process includes:

- developing a stochastic model of the gas price, calibrated to the scenario price parameters to create a number of possible price paths;
- these price paths are used as inputs into the gas storage model to derive the full value of the facility based on a set of optimal operating decisions over the course of the year, using expectations of the deviations within prices.

By way of illustration, the differences in annual revenues and financial metrics for three hypothetical storage sites are examined below using an illustrative scenario in which seasonal spreads and spot price volatility are roughly equal to the five-year historical average (21p/th, 150% annualised daily volatility). Around this, results are shown for sensitivities combining higher and lower spreads (30p/th and 10.5p/th), and in which price volatility is varied by +/–50%.[2] The storage sites examined include:

- a relatively large seasonal storage facility with a capacity of 2,500 million cubic metres (mcm) and able to cycle around once per year ('offshore seasonal');
- a smaller offshore facility with a capacity of 1,000mcm capable of cycling over twice per year ('offshore mid-range'); and
- a smaller onshore facility with a capacity of 300mcm and capable of several cycles per year ('onshore short-range').

For illustrative purposes, it is assumed that capital expenditure unit costs are between 70p and 85p per cubic metre of capacity; operating expenditure unit costs are between 1.5p and 3.5p per cubic metre per year; and the real, post-tax weighted average cost of capital is 10%.

Table 1 shows how the profitability of the projects (and their ranking) changes between scenarios. Broadly:

- the offshore seasonal project is viable under the 'business as usual' scenario, but marginal or loss-making under the two 'low spreads' scenarios;
- the two other facilities present comparable metrics, albeit that the offshore mid-range facility performs more effectively in high-spread environments, and the onshore short-range site captures more value in high-volatility environments.

Table 1 Project economics under different gas market scenarios

	Business as usual	Low volatility, low spread	High volatility, low spread	Low volatility, high spread
Post-tax net present value (£m)				
Offshore seasonal	78.0	–407.0	–0.8	327.3
Offshore mid-range	213.2	–93.6	224.4	310.2
Onshore short-range	80.5	–44.0	130.4	74.4
Post-tax internal rate of return (%)				
Offshore seasonal	10.6	6.6	10.0	12.4
Offshore mid-range	13.7	8.3	13.8	15.2
Onshore short-range	14.0	7.6	16.4	13.7

Source: Oxera.

In sum, project sponsors are likely to assess the outlook for future price volatility and seasonal spreads when making their investment decisions. If there is greater confidence in there being high future price volatility, but with seasonal spreads continuing to be either low or uncertain, investment incentives may point towards the development of short- and medium-range commercial projects that are able to profit from these market dynamics. This is likely to be strengthened by the long lead times, high capital costs and risks involved in developing seasonal storage projects. These factors would provide little comfort to those policy-makers looking to secure projects able to serve future UK winter peak demand in the context of greater import dependence. So, is a policy response needed, and if so, what should it be?

Storage policy options

From an economic perspective, regulatory interventions are sometimes motivated by the need to address market failures, as would be the case if one or more features of the market were shown to have an adverse effect on competition.

Alternatively, policy interventions may be targeted where competition is not feasible. For example, in markets where consumers' willingness to pay cannot be revealed, it may not be feasible to rely on the market to deliver the right quantity of a 'public good'. While some consumers may value certain public goods very highly, if the benefits of these goods are shared by all consumers while the costs are borne by a minority, there would be a strong disincentive on consumers to reveal their true preferences.

Depending on the diagnosis of the economic problem affecting the development of gas storage, a policy-maker could design very different policy measures. However, if the diagnosis did not accord with the underlying market failure, the policy may not be welfare-enhancing and could result in unintended, adverse consequences.

For example, depending on the extent of fears over excessive market concentration or vertical relationships resulting in barriers to entry in the downstream gas market, third-party access (TPA) requirements may be strengthened (eg, by mandating non-discriminatory access, capacity auctions, and establishing formal requirements for storage access products).[3] Other things being equal, the impact of strengthening TPA requirements would be expected to decrease the profitability of storage projects by reducing the proportion of the intrinsic and extrinsic value that can be captured by storage owners. In turn, this would be expected to reduce seasonal storage investment incentives. However, to the extent that storage can be shown to be part of a wider market for flexible gas, it may be possible to relax TPA requirements while maintaining a competitive gas market.

An alternative policy that may be better aligned with the desire to encourage the development of seasonal gas storage capacity would be to implement explicit storage obligations on gas suppliers.[4] To the extent that gas security of supply is perceived as a 'public good', this policy would also be directed at a key mode of market failure. Although this policy may directly facilitate investment in certain types of gas storage capacity, its implementation would be complicated by the potential for alternative sources of flexibility to develop in future. This is particularly relevant given the expansion of LNG and pipeline import capacity over the last few years. As discussed above, the gas market is also likely to undergo a series of structural changes in the coming years, both in terms of demand patterns (eg, due to the changing role of gas-fired generation in the power market, and the possible development of heat pumps for domestic heating) and supply sources (eg, due to the depletion of the UKCS, the possible rise in unconventional gas sources, and continued progress towards a single European gas market). Given these complex market dynamics, there is the risk that any explicit storage obligation may be prove expensive if it were to result in too much of the wrong kind of storage in future.

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[1] Source: National Grid (2009), 'Transporting Britain's Energy', p. 57, and European Federation of Energy Traders (2009), 'Gas Storage in Europe', July 3rd, p. 3.

[2] To illustrate the process, results are presented for storage values based on recent historical ranges of price parameters and a simple sensitivity around those values. More detailed scenarios that Oxera has developed consider the underlying evolution of supply and demand characteristics, and the impact that this could have on seasonal spreads and volatility over time.

[3] See Ofgem (2010), 'Preliminary Views on the Third Party Access Regime for Gas Storage Facilities in the GB Market', May 18th.

[4] Although the Department of Energy and Climate Change (DECC) rejected more 'interventionist' policy options before the general election (which could have involved government specifying storage obligations for suppliers, or directly commissioning new storage capacity), the coalition's programme of legislative proposals includes the development of a 'security guarantee' for energy supplies. However, it remains unclear whether such a guarantee would be focused on securing the physical availability of gas and/or addressing concerns over high and volatile prices. See HM Government (2010), 'The Coalition: Our Programme for government', May, p. 16.

If you have any questions regarding the issues raised in this article, please contact the editor, Dr Gunnar Niels: tel +44 (0) 1865 253 000 or email g_niels@oxera.com

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