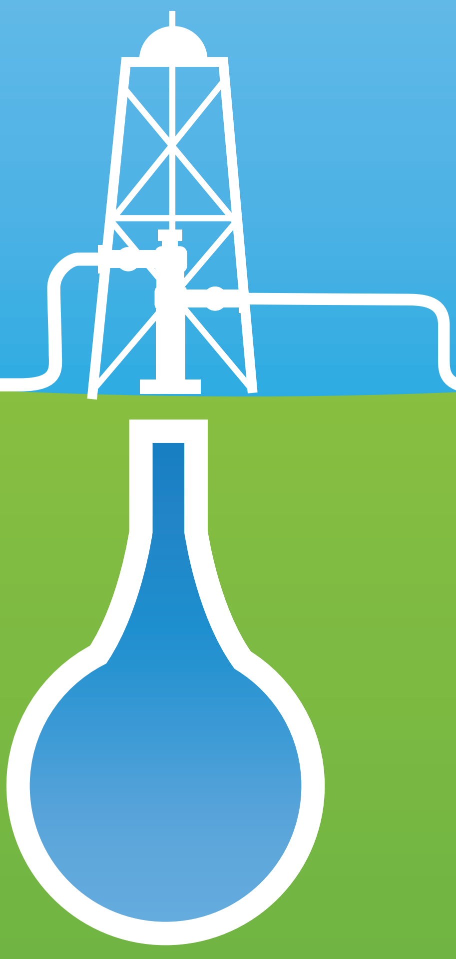
Gas Infrastructure Europe

The value of gas storage

Questions and Answers



May 2015

Do shippers really need gas storage? Why can't they just rely on other flexibility tools?

Storage is the guarantor of ***physical*** supply flexibility

Gas Infrastructure Europe (GIE) is an association representing the interests of European natural gas infrastructure operators active in natural gas transmission, storage and LNG regasification. 31 Storage System Operators (SSOs) with around 110 storage sites in 16 countries, representing approximately 84 bcm, i.e. 87% of EU technical storage capacity, are members of GIE. They are committed to improving the regulatory and investment framework for storage activities in order to help its members to continue providing secure, efficient and valuable storage services to the market.

Today shippers can choose between a variety of competing flexibility tools, such as storage, spot purchases, LNG cargos, long-term supply contracts flexibility or interruptible contracts. All of these tools differ in terms of price, the nature of the service (asset-backed or purely commercial) and availability. Their use ultimately depends on the shipper's portfolio and strategies.

Since a couple of years, shippers tend to favour spot purchases in covering their flexibility needs as sourcing gas on spot markets is simply more economically attractive. On the other hand, underground gas storage has become less interesting as the gas price differential between the injection and withdrawal season (seasonal spread) has narrowed down.

Whereas the choice of flexibility tools is driven mainly by economics, when valuating flexibility instruments more than just the price should be taken into account. For instance, unlike spot markets, storage offers the advantage of a physical asset located close to demand areas. In fact, storage is a flexibility tool that can be *physically* guaranteed allowing a shipper to hedge the supply and price risk. In other words, it provides an insurance against unexpected events. Such events may be of different nature but are often triggered by weather conditions, for instance cold snaps or prolonged periods of below-normal temperatures, as those witnessed in Europe in 2012 and 2013 or in the USA in early 2014, the latter of which witnessing temperatures as low as -40°C. Furthermore, storage can be used to capture price opportunities in case of sudden price spikes and thus has an "optionality" value. Finally, it is an important tool for shippers to balance their positions at the end of the day and manage supply interruptions and for transmission operators to ensure physical system integrity.

Why can't shippers just buy all the flexibility they need on the hub?

A gas hub has never produced any gas...

Storage and hub flexibility are complementary. Volumes traded on a hub must be eventually physically delivered otherwise price spikes may occur and continuity of supply may be endangered. Many storage operators already provide their products on a hub allowing shippers to trade and optimise their portfolios, while ensuring the physical availability of gas. Given its proximity to demand areas, storage can deliver gas to meet demand even if cross-border transmission capacity is saturated or unavailable. It can also alleviate local network bottlenecks. It is important to note that unlike the electricity market, the European gas market is dependent on sources from external suppliers. Most of the gas consumed in Europe is produced away from Europe and is transported over long distances. Gas supplies are thus subject to number types of risks : technical, geopolitical or economic.

Is it true that the more integrated the market, the less gas storage is needed?

Liquid and integrated markets need physical flexibility of storage.

An increasingly integrated market creates opportunities for market parties as they can more easily access different sources of flexibility, including storage. Easier access to gas from storage facilities across borders helps ensure reliable supplies to end-customers. For instance, the exceptionally long winter of end 2013 saw increased withdrawals from German storages to supply the UK market. This helped maintain the continuity of supply and reduce price volatility.

While market integration facilitates gas exchanges by reducing entry and exit barriers between markets, the creation of bigger market areas may trigger the occurrence of some local bottlenecks and thus require investment in the core network. However, if properly taken into account in the market design, storage can contribute to reducing these costs thus enhancing overall system optimization.

Does gas storage offer the right products?

Storage meets increasingly varied users' needs.

As the market develops and the user requirements become more complex, storage operators adapt their services by providing both standard and innovative products. This requirement is expected to grow in the future along with the development of renewable energy sources. From unbundled products, through hub-indexed storage products to products allowing reversing of flow between seasons or even joint storage-transmission products, storage operators adapt their offer to users' needs and seek to provide solutions which facilitate the market.

Is the seasonal spread a proper reference for storage value ?

Seasonal spread is a price forecast, not a storage value indicator.

The seasonal spread between summer and winter gas prices has been used to reflect the traditional use of storage residing in balancing a relatively stable annual supply and a highly seasonal demand. Today, it is the fundamental driver of storage value from the shipper's point of view.

In recent years the gas market fundamentals have undergone a significant shift in Europe altering the supply/demand balance. This has been triggered by several factors including the integration process, energy market globalization, macroeconomics and political choices. As a result, the seasonal spread has narrowed down considerably, removing price signals for storage.

While seasonal spread may be a legitimate criterion to valuate storage, it should not be the only one. As much as it can offer a *forecast of average commodity prices* at a given point in time, it does not reflect the complete value of storage. In fact, seasonal spread:

- CANNOT PREDICT EXCEPTIONAL EVENTS: it is a virtual, not physical, estimate based on market sentiment about the availability of gas in a given period. It cannot thus predict exceptional events and their impact. A technical failure, a political fall-out, an exceptionally cold weather etc., may significantly affect the supply-demand balance, generating a risk of physical supply interruptions and/or price spikes.

  This is crucial as Europe is increasingly interconnected but also increasingly import-dependent and exposed to global market dynamics. In fact, an exceptional event in one market will affect other markets. An unusually cold weather in Germany may push up prices in the Netherlands or in the UK. Similarly, LNG diversion to higher-priced markets may increase price pressure in Europe if it coincides with peak demand.

- CAN BE A VISCIOUS CIRCLE: in some instances, the use of storage to ensure continuity of supply may paradoxically reduce its intrinsic value as expressed by the seasonal spread. Increased withdrawals at winter end may have a bullish effect on summer gas prices narrowing further the seasonal price differential.

- IGNORES SHORT-TERM VALUE EXTRACTION: it tells little of the value that can be extracted from storage through shorter-term price spreads. This "extrinsic" value of storage is difficult to quantify as it depends on a range of factors such as short-term price variations and individual arbitrage strategies.

- DISREGARDS SYSTEM EFFICIENCY: it cannot capture the contribution of storage to reduced network costs. Storage is located close to demand areas and thus allows to reduce the peak load that the network would need to be tailored to otherwise. This allows to avoid investments. According to Pöyry, without storage Europe's transmission and import infrastructure would have to be sized upwards by up between 9% to 16%.

- REFLECTS ONLY PART OF THE MARKET: it is based on futures contracts which account for only a small part of demand. The bulk of physical supply to Europe is based on long-term contracts.

From the market perspective, is there value in storage beyond "intrinsic value"?

Storage is a lever for value creation from short-term trading.

The market part of the storage value has two components: intrinsic and extrinsic value. While intrinsic value is a static view of the forward curve, *extrinsic* value is a complex function of the seasonal spread, spot price volatility, forward spread volatility, asset flexibility and individual optimisation strategies.

Although extrinsic value is more difficult to assess, it can actually help generate substantial revenues. A good example of an opportunity to harvest extrinsic value from storage is when a spread between the spot price and the month-ahead futures price develops during the winter season. This enables the storage user to buy spot gas and at the same time conclude a futures contract to sell the gas for the month ahead. By way of example, such an opportunity happened in January 2014 where the spread between the spot price and the February month-ahead contract on TTF was close to 1€/MWh some days representing a substantial added value over a short period of time, especially, when considering that the summer/winter spread was below 2€/MWh.

Is storage too expensive?

No, storage benefits outweigh its costs.

With the currently low seasonal spreads, many market players consider physical storage "too expensive" compared to hub-sourced products. However, such a comparison ignores the principal advantage of storage which is the guarantee of a physical asset. In fact, storage may act as an "insurance" against exceptional events (cold weather, supply interruptions etc.) which could otherwise generate substantial costs for a supplier. And, while storage helps limit risk exposure, it represents only between 5% and 10% of the end-customer gas bill.

Moreover, consideration should also be given to the fact that the adjacent transmission infrastructure can have a significant impact on the competitive position of storage vis-à-vis other flexibility tools.

In fact, high transmission tariffs at storage points can lead to situation where storage users subsidize other users of the network, thus bearing a bigger burden of the network costs. It is worth stressing at this point that storage differs from other entry and exit points on the network as it is not a net source of supply and demand outlet but merely shifts consumption over time. Moreover, high transmission tariffs disregard the benefits that storage brings to the system as a whole (and thus to all network users), namely avoided investment costs, reduced operating expenditure as well as support to system stability.

The impact of transmission tariffs has been particularly pertinent in recent years. As has been observed between 2011/2012 and early 2014, seasonal spread decreased significantly to the range of ca. 1€/MWh and 2€/MWh (depending on market zone). Against this background, it is striking to note that in extreme cases transmission fee exceeds 1€/MWh, which is almost prohibitive to storage use.

Finally, it is worth noting that the current spread level of 1-2 €/MWh is below the costs that storage operators incur to operate and maintain underground storage facilities. Such prices essentially rule out new investments.

Who benefits from storage?

All network users and consumers benefit from storage.

Storage provides benefits along the whole gas value chain from production, through transmission network to end-user supply.

At the level of gas production, underground gas storage allows to reduce investment expenditure in wells and surface facilities and to manage more efficiently production operations. It also provides security in case of technical problems. This translates into reduced costs, extended lifespan of production fields and maximized volumes extracted.

Moreover, storage is an important element of the gas chain as it increases its overall efficiency. Located close to demand areas, storage helps lower the peak load of the network, limiting the otherwise necessary network investment whose costs would need to be borne by end-users. By providing additional pressure to the system, storage also helps reduce the run time of compression stations along the transport lines, thus lowering the operating costs.

On the supply side, storage allows to balance seasonal and shorter-term fluctuations of demand and reduces the usually costly upstream flexibility needs (supply and transport). It also helps ensure continuity of gas supply and safeguard suppliers from sudden price spikes. This is important as unusual weather conditions may have a significant intensity and length resulting in an elevated demand and market prices.

Although the value of storage can be looked at for each of these elements separately, ultimately, it is the end-customer that benefits most from storage. This is because the value created by storage along the whole value chain allows for greater efficiency – and hence reduced costs – as well as security of supply. In fact, storage users indirectly provide a benefit to the system as a whole and thus “subsidize” also those market players who do not contract storage.

Should storage facilities be simply mothballed or shut down if demand for storage is weak?

Taking storage offline would be irreversible, costly and short-sighted.

If long-term price signals for the operation of storage facilities are missing and demand continues to be weak, some storage operators may choose to temporarily mothball some of their facilities or even close them to save operating costs or to reallocate capital to more profitable uses. Such measures can be very costly and have irreversible consequences.

When mothballing an underground storage facility, a certain pressure must be maintained in the underground reservoir to allow using the facility in the future. Storage operators will thus incur one-off and recurring costs including sealing of pipelines, corrosion protection, storage of equipment, maintenance, physical security etc. Bringing a mothballed storage facility back into operation requires additional costs. Moreover, restoring injection and withdrawal rates to pre-conservation levels will not be immediate and may take even a few years, depending on the facility.

The decision to close down an underground storage facility is for all practical purposes irreversible, i.e. the lost capacity cannot be brought back online. The costs are significant and can reach dozens of millions of Euros per facility. They include well liquidation, land clearing and reclamation, pipeline removal and payment of royalties on extracted gas. Revenues from gas sale could come in only slowly as the withdrawal rate could be limited depending on reservoir characteristics.

Taking storage capacity offline may have negative consequences in the future when gas demand picks up again and utilization rates of gas-fired power increase. In fact, while construction of a gas-fired power plant takes 2 to 3 years, around 5 to 8 years are necessary to build the corresponding gas storage back-up capacity. As a result, taking storage capacity off the market may be a short-sighted solution.


TC-6

Will storage demand increase in the future?

Storage demand will rise in the future.

In spite of the current weak demand, low seasonal spreads and "short-termism" of some gas suppliers, underground storage will likely play an important role in the future. Therefore closing down storage facilities due to the currently weak demand would be short-sighted and uneconomical for both storage operators and European consumers. What are the key drivers of the future demand for storage?

- European import dependency is growing rapidly. This has been a fact for a number of years but the fall in domestic production and growth in import dependency will get even more pronounced in the coming years. More imports from distant source countries mean more demand for flexibility closer to European homes, factories and power plants. Underground gas storage is ideally placed to provide such flexibility.

- Even in times of reduced seasonal demand, the requirement to cover peak demand will stay. Storage flexibility will be crucial in covering those needs.

- Gas is the cleanest fossil fuel and is perfect partner for renewable energy sources. When there is little wind or sunshine, little electricity is generated by Europe's wind and solar plants. Gas-fired power plants play an important role as back-up and this role will increase in the future as Europe's climate and energy strategy objectives are implemented. Indeed, gas-fired power plants can step in and start generating the missing output on a very short notice (1 hour), something that coal plants cannot do (4 hours).

- New technologies. Storing gas underground is, essentially, like having a charged battery ready. In the future, surplus electricity generated by renewable energy sources will be used to produce hydrogen or synthetic gas which can be stored underground and used later to generate electricity when required (power-to-gas technology). This perfectly complements the electricity system because there is no large-scale method of storing electricity.

Gas infrastructure including storage is already there – why not keep it up and running to be ready for the future?

What is the right level of gas storage for security of supply?

Storage needs for supply security depend on regional circumstances.

When it comes to security of supply, there is no single "security of supply level". This is because each country is different in terms of its energy mix, indigenous resources, consumption structure, etc.

In countries where indigenous production is negligible and diverse supply sources are lacking, storage usually plays an important role in securing gas supply. In some countries storage is part of security of supply requirements although the applied solutions vary depending on market characteristics and political decisions. For instance, in some countries storage is part of the obligation for suppliers to ensure gas deliveries over a winter period ("storage obligation"). Other countries have decided to build up permanent gas reserves which can be mobilized in exceptional events only ("strategic storage"). Still some others have placed the security of supply obligation through storage exclusively on the transmission system operator.

Although there is no one common "storage prescription" as each country's energy system is unique, some main parameters can be considered when assessing its requirement, among them for instance:

- Import dependency
  (the ratio between imports and demand).
- Demand ratio between summer and winter.
- Ability to cover seasonal modulation needs and peak demand.
- Structure of gas demand
  (household, industry, power generation etc.).
- Characteristics of the existing storage facilities
  (seasonal or quick storage).
- Compliance with Regulation (EU) Nr 994/2010 on security of gas supply, etc.

What is expected from the European regulatory framework?

The regulatory environment should be conducive to storage use and commercial innovation.

Today, price is the main driver when choosing flexibility tools. In order to compete with other sources of flexibility, storage operators need to be able to offer products that respond to increasingly varied user needs. The regulatory framework should therefore enable storage operators to provide such services while respecting the principle of transparency and non-discrimination.

Moreover, the European regulatory framework should take into account the fact that storage does not operate in vacuum but depends on the adjacent transportation network. The regulatory framework should thus warrant that rules for transmission do not negatively impact on the value of storage and that they ensure equal treatment of storage users and other network users, in particular:

- Transmission fees at storage points should avoid cross-subsidies – simply put, storage users should not pay twice for using the network – and should reflect the benefits that storage brings for final customers.
- Unrestricted access to/from storage facilities from/to transmission network should be guaranteed (by way of firm transmission capacity) so that storage users are treated on equal footing with other network users.
- Storage users should not be penalized in system emergency situations: clear and non-discriminatory rules should be ensured in the case a transmission operator needs to revert to storage in system stress situations.

Should storage be cheaper to compete with low price signals?

Storage responds to market but alignment to current spreads is not sustainable in the long run.

The currently low seasonal spread (1.5€/MWh to 2€/MWh in the period: 2011/2012 to early 2014) and the ensuing fall in demand for storage has put a heavy pressure on storage operators.

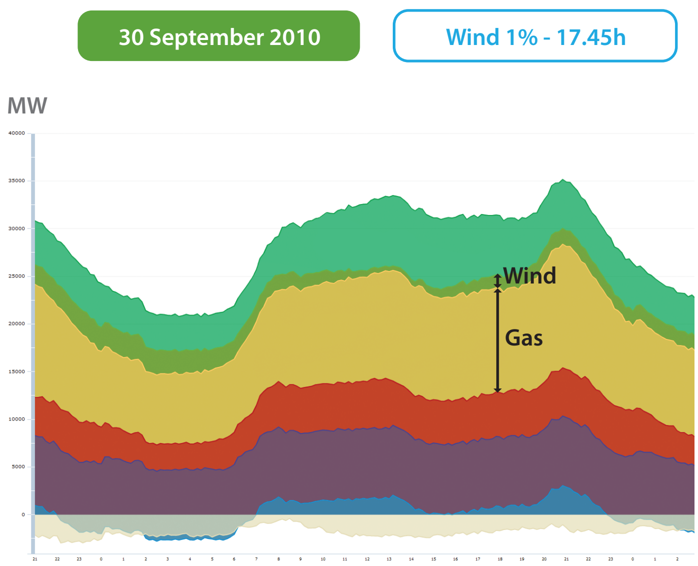
Storage is a long lead-time activity with a pay-back period of 20-25 years. However, today storage operators find themselves in a situation which requires them to compete with price signals that are below the costs they incur to operate and maintain their facilities. While storage operators do react to the current price signals adapting their offers accordingly, alignment to the current spread-based price signals is not sustainable in the long term.

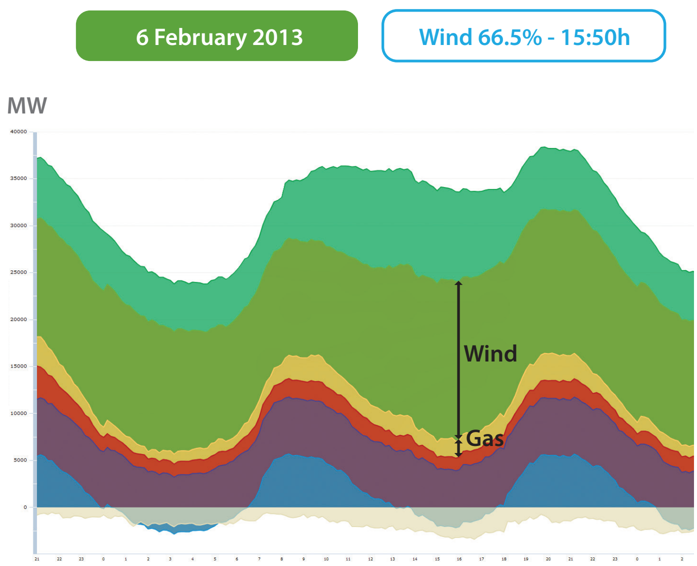
What is the role of gas storage in the transition to low-carbon economy?

Gas storage will support the integration of renewable energy.

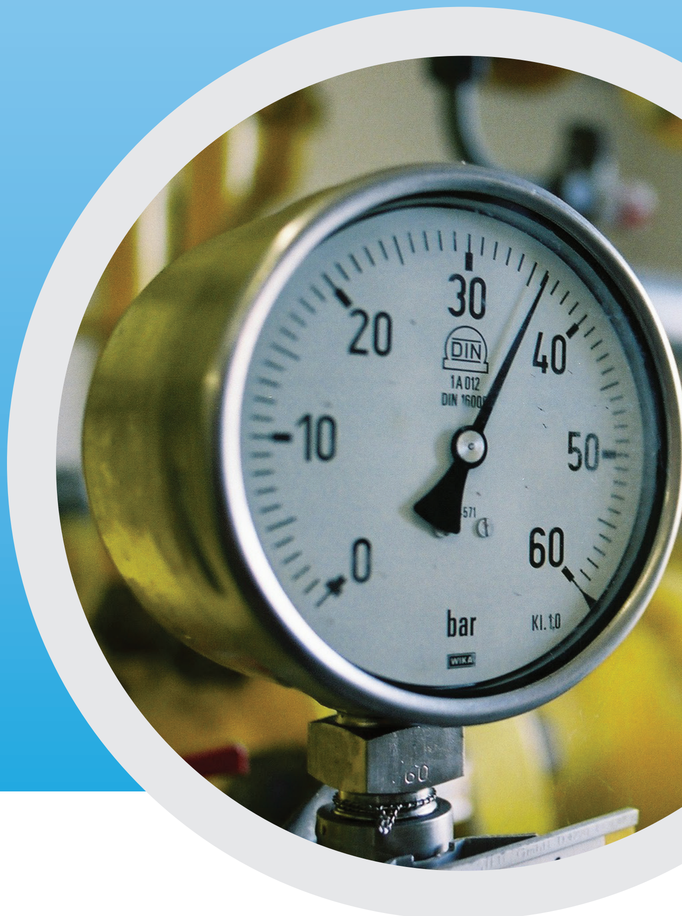
The move to a low-carbon economy future represents several challenges that gas infrastructure – including gas storage – will help to face. In particular, the ongoing development of variable renewable energy sources will require a flexible back-up which can be provided by gas-fired power plants. Gas storage will therefore be needed in order to support the necessary flexibility provided by gas. The importance of this back-up requirement can be observed in the following figure showing the electricity mix and the role of gas for balancing the Spanish system in two different days:

Moreover, gas storage infrastructure will be important in view of the development of new energy technologies looking to make the most of excess renewable energy and integrate it efficiently into the system. For instance, the "power-to-gas" technology will seek to convert excess renewable energy into synthetic natural gas allowing to use the existing gas infrastructure for its dispatch and storage. These examples show that the existing gas storage infrastructure can play an important role in the low-carbon energy system not only by enhancing the security of energy deliveries but also by allowing a more efficient use of resources and the existing assets. Finally, it is worth recalling that gas storage is in fact the first form of "energy storage".





Interconnection | Hydro-electric | Nuclear | Coal | Wind Power | Other | CCGT | Fuel/Gas



Gas Infrastructure Europe

Gas Transmission Europe

Gas Storage Europe

Gas LNG Europe

Gas Infrastructure Europe

Avenue de Cortenbergh 100
1000 Brussels
Belgium

T +32 2 209 05 00
F +32 2 209 05 01

gie@gie.eu
www.gie.eu

Images courtesy of Snam Rete Gas, GAZ-SYSTEM, RWE Gasspeicher