IMPROVING REGULATION OF NATURAL GAS STORAGE\textsuperscript{1}

by

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Abstract
In this paper we focus on the apparent lack of investment in seasonal gas storage facilities in North-western Europe. On the one hand the demand for seasonal flexibility in gas deliveries is expected to at least keep at the current level, while on the other hand, the traditional source of seasonal flexibility, namely flexibility in production, is declining due to depletion of indigenous reserves. Investment in large scale, low deliverability gas storage facilities is not taking off. We discuss the possible reasons for this and provide a preliminary exploration of possible solutions.

1 Introduction

The storage of natural gas is an important part of gas market value chain. It is one of the options to accommodate gas supply to fluctuating gas demand (on daily to seasonal basis) and it can provide relief in times of scarce gas supply due to for example upstream supply interruptions. In the European Union (EU) in general, and in North-western Europe\textsuperscript{2} in particular, there is an increasing need for investment in natural gas storage facilities due to depletion of domestic gas reserves (the United Kingdom and the Netherlands mainly) and a consequently larger import dependence on long-distance imports from regions like Russia and Northern Africa. Höfler and Kühler (2007) provide a forecast of total demand for gas storage in North-western Europe in the period 2005 to 2030. Gas storage facilities can also function as a strategic gas deposit (thereby drawing a parallel with the strategic petroleum reserves); something which is currently discussed within the European Commission (EC) as well.

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\textsuperscript{2} With North-western Europe we refer to the countries of Belgium, France, Germany, the Netherlands and the United Kingdom.
In the last few years, a considerable number of gas storage facilities have been realized or planned that to some degree meet the additional investment requirements. However, new gas storage additions mainly concern small-scale gas storage facilities aimed at delivering short-term (day-to-day) storage services rather than large-scale gas storage facilities aimed at providing seasonal flexibility (Codognet and Glachant 2008, CIEP 2006, De Joode and Touber 2008). Particularly the latter type of storage facilities is highly necessary due to the decreased capability of gas production fields to deliver seasonal flexibility. This is due to earlier mentioned depletion of North-western European gas reserves.

The relative underinvestment in seasonal gas storage facilities can have different reasons. Firstly, market actors might be still adapting to the new investment decision-making environment that has changed due to gas market liberalization and EU market integration. Possibly, they are insufficiently capable of assessing and managing the risks and benefits that are associated with investments in seasonal gas storage facilities. Secondly, the problem can be regulatory in nature. Uncertainty regarding the regulatory regime applicable to (seasonal) gas storage facilities holds investment. Thirdly, the uncertainty on future market conditions is too large to trigger new seasonal storage investments. Although it could be argued that demand for seasonal storage services will continue to increase, the exact dimensions are unknown, thereby giving rise to an investment hold-up. There is no specific evidence that either one of these arguments is dominant in explaining a relative lack in seasonal gas storage investments. However, we observe that FERC (2004, 2005) has acknowledged to some degree that there is more of an investment issue in the gas storage market for seasonal, low deliverability storage services than in the market for short-term, high deliverability storage services in the US as well. Since the US market is considered to be a competitive and liberalized market for already quite some years we hypothesize that the explanation for the relative lack of investment in the EU is lying in the regulatory and market demand context (i.e. explanations 2 and 3). The basic research question in this paper thus becomes: How can we improve the regulation of seasonal gas storage such that a sufficient level of investment in seasonal gas storage facilities is realized?

Although the literature on the impact of regulation on infrastructure investments is quite rich (Guthrie 2006), there is less literature on the impact of regulation on gas storage facilities. What has not been addressed so far, at least to our knowledge, is the impact of gas storage typology on the type of regulation required for a sufficient amount of new storage capacity at affordable (social) cost. FERC (2004, 2005) acknowledges that US gas storage regulation based on rate-of-return regulation provided rather strong incentives for investment in seasonal storage facilities but rather weak incentives for investment in smaller gas storage facilities. Von Hirschhausen (2008) discusses the history of gas infrastructure regulation in the US, with a focus on the distinction between merchant and regulated TPA

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3 See for example the gas storage database updates provided by Gas Infrastructure Europe (www.gie.eu.com).

4 A recent study by Rambol (2008) did not distinguish between daily and seasonal flexibility in its projections for future demand for gas storage. Consequently, the study can’t provide insight in the (in)sufficiency of current investment plans for seasonal gas storage facilities.
regimes, and devotes some words to particularly the regulation of high short-term, high deliverability gas storage facilities. He describes booming investments in US gas storage facilities while noting that the overwhelming majority of new investments concern small-scale high deliverability storage facilities, and not the larger seasonal gas storage facilities. Codognet and Glachant (2008) address investment incentives within the regulatory framework for seasonal gas storage in the UK. The UK has implemented a regime of negotiated TPA with the option of granting exemptions from any TPA obligation to certain new investment. They conclude that this framework is not conducive for new investment in seasonal gas storage.

In this paper we describe the supply situation regarding seasonal flexibility in North-western Europe and the current regulatory stand with respect to the regulation of seasonal gas storage facilities. In addition we provide a short problem analysis and an exploration of possible regulatory improvements.

The remainder of the paper looks as follows. First, in section 2, we describe the background of the issue at hand. This includes an explanation of the relevant concepts when addressing seasonal gas storage, and a description of current regulatory practice in North-western Europe. Section 3 is devoted to the main problem statement. Thereafter we discuss possible solutions in section 4. Section 5 finally summarizes and re-states some main points to be taken from this paper.

2 Background

2.1 Gas storage characteristics

The storage of natural gas can be characterized by relatively high capital intensity, irreversible investment, long lead-times of investment and asset specificity. A relatively large part of the long-run marginal costs of providing gas storage services can be attributed to the initial investment. This includes the costs of maintaining pressure within the gas storage facility, by keeping a permanent amount of cushion gas within the reservoir, in order to continue the provision of storage services. For a seasonal gas storage facility the cost of cushion gas can vary from 50 to 85% of the total investment cost (Codognet and Glachant 2008). Once the gas storage investment is undertaken, it cannot be undone with significant loss of economic value. The lead-times for investment in gas storage facilities are considerably large and can vary from 1-5 years for a cavern, 5-8 years for a depleted gas field, and up to 10-12 years for an aquifer.
<table>
<thead>
<tr>
<th>Type of storage facility</th>
<th>Working capacity [mcm$^3$]</th>
<th>Send-out capacity [mcm / day]</th>
<th>Injection Capacity [mcm / day]</th>
<th>Investment cost [m€]</th>
<th>Lead-time of investment [years]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depleted gas field</td>
<td>2,500</td>
<td>30</td>
<td>10</td>
<td>700</td>
<td>5 - 8</td>
</tr>
<tr>
<td>Aquifer</td>
<td>2,500</td>
<td>30</td>
<td>10</td>
<td>800</td>
<td>10 - 12</td>
</tr>
<tr>
<td>Cavern</td>
<td>30 - 70</td>
<td>2 - 4</td>
<td>1 - 7</td>
<td>40</td>
<td>1 - 5</td>
</tr>
<tr>
<td>LNG tank</td>
<td>50</td>
<td>50</td>
<td>0.25</td>
<td>200</td>
<td>5 - 7</td>
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</tbody>
</table>

Seasonal gas storage facilities have relatively large working capacity, but comparatively little send out capacity. In addition, it generally takes about 3-6 months to fill up this type of storage facilities to maximum working capacity. Gas storage for specifically peak gas demand is generally provided by gas caverns. On average, they have relatively little working capacity but relatively high send-out capacity. It generally takes little time to (re-)fill these type of gas storage facilities. Finally, LNG storage tankers (not to be mistaken with LNG liquefaction or re-gasification terminals) are designed to deliver the absolute peak demand, a small number of hours or days a year, when extremely cold weather conditions apply. Gas injection up to full capacity can easily take about 6 months for these high deliverability facilities.

Besides the different gas storage technologies, there are more options that provide flexibility in gas supply. As mentioned in the introduction, also gas production can to some degree provide (seasonal) flexibility. Other flexibility options such as lime pack and interruptible contracts are not suitable for the delivery of seasonal flexibility.

The preferred option for seasonal gas storage operations are depleted gas fields, mainly for economic efficiency considerations. In some countries aquifers are developed for seasonal gas storage. This is for example the case in France, which lacks suitable depleted gas fields for this purpose.

### 2.2 Gas market developments in North-western Europe

The share of gas in the overall energy mix is particularly high in the North-western European countries, where gas is not only an important fuel for domestic heating but also for electricity generation (for example in the Netherlands). In contrast with the use of gas in industrial applications, the consumption of gas in the residential and energy sector is known to largely vary throughout the year. For example, based on monthly data on Dutch gas consumption$^6$ we observe that peak monthly gas demand in the residential sector can be 2.4 times higher than average monthly gas consumption. For gas consumption in the Dutch electricity generation sector this value is 1.4. For the UK, based on quarterly data$^7$, we find that peak quarterly gas

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$^5$ Mcm stands for million cubic meters.

$^6$ Data obtained from CBS Statline (www.cbs.nl).

$^7$ Data obtained from BERR (www.berr.gov.uk).
consumption is 1.7 and 1.2 times the average quarterly gas consumption in respectively the residential electricity generation sector. Figure 2.1 illustrates the level of this so-called ‘swing factor’ and its development over time for the Netherlands. We define the swing factor for a certain time unit (e.g. day, month, quarter) to be the actual demand (supply) of gas divided by the average demand (supply) in the particular year.

![Swing factor graph](image)

**Figure 2.1 Swing factor of Dutch gas consumption in the period 1995-2008**

The largest provider of flexible delivery of gas to end-consumers in North-western Europe is the large Dutch Groningen gas field (De Joode and Touber 2008, Höfler and Kübler 2007). In addition, a large part of flexibility is provided by UK gas production. Figure 2.2 shows that the amount of flexibility in UK gas production has been declining over the last 5 years. At the same time UK gas imports have been showing considerable more flexibility in recent years.
Figure 2.2 Total UK gas production, gas imports and gas exports in the period 1998-2008

The increasing international role of Groningen in North-western European market for flexibility is confirmed by Dutch gas production and gas export data. Figure 2.3 shows an increasing amount of gas exports while the swing factor of total gas exports is maintained.

Figure 2.3 Total Dutch gas production, gas imports and gas exports in the period 1995-2008

But within the next decades, also Dutch gas production and its exports of flexible gas will decline. De Joode and Touber (2008) estimate that total peak capacity of the large Groningen field will decline with possibly 50%. This will imply a considerable reduction in seasonal swing capacity as well. Since importing
flexibility over very large differences is not economic, the main alternative source of flexibility needs to be found in seasonal gas storage.

However, when looking at current investment plans in gas storage facilities we observe that most investment activity is aimed at high deliverability, small(er) scale gas storage facilities. See for example the earlier mentioned gas storage investment database kept by Gas Storage Europe. Although small-scale gas storage facilities can certainly contribute to the provision of seasonal swing, their contribution is very limited. Apart from a planned, but yet to be realized, investment by Taq in a 3200 million cubic meter storage facility in the Netherlands, there are no known initiatives with respect to seasonal gas storage in North-Western Europe. Recently, a study for the European Commission (EC) on gas storage was finalized (Rambol 2008). It presents forecasts for the amount of seasonal swing required when certain gas demand projections materialize and confronts with current investment plans. However, it compares total demand for seasonal swing with total working volume of all storage facilities, including the high deliverability facilities. This approach might give rise to misleading results. After all, small-scale storage facilities might focus more and more on extraordinary peak gas demand days (or weeks) and only very limitedly contribute to seasonal swing needs. In addition, during winter periods these facilities might find it uneconomic to refill and extract another gas cycle.

2.3 Gas storage regulation in the EU

Whereas the wholesale and retail markets are deemed to be competitive markets, the infrastructure related capacity markets for transmission, distribution and storage of gas are assumed to be essential facilities for which regulation is required. At least, that is the basic reasoning behind current gas storage regulation. The basic approach towards gas storage as laid down in the current gas Directive is as follows. In principle the access to gas storage is considered vital for competition on the gas market. As such gas storage is seen as an essential facility. Consequently, third party access (TPA) regulation is imposed. However, member states are free in determining the type of TPA imposed on gas storage capacity. Member states can either opt for regulated TPA (rTPA) or negotiated TPA (nTPA). Both require non-discriminatory access to storage capacity. Under rTPA the access conditions are regulated: gas storage users pay a regulated tariff for gas storage services acquired. Under nTPA access conditions are under the supervision of regulatory authorities but tariffs for the provision of gas storage services are negotiated between the storage operator and the customer. The basic choice between implementing rTPA or nTPA on a member state level can be dependent on the level of competition on the market for gas storage. When the gas storage market is deemed to be competitive, implementing an nTPA regime might be sufficient since competitive pressure will put downward pressure on tariffs for gas storage services. However, when the market is concentrated an rTPA regime is required: leaving access conditions negotiable would imply the risk of market power abuse and monopolistic-like storage tariffs.
However, the implementation of TPA regulation in gas storage suffers from the same concerns as voiced in the case of gas pipelines. Requiring TPA at all times can substantially weaken investment incentives. After all, after realization of a new investment project, the operators must provide access to all third parties, including competitors. For this reason Article 22 of the gas Directive is applicable to all types of gas infrastructures, including gas storage facilities. Article 22 of the second Gas Directive (EC 2003) states that major new infrastructures may be exempted from the provisions of Articles 18, 19, 20 and 25 ((2), (3), (4)) of the Directive if certain conditions are met. This effectively means that it is possible for gas storage investors to apply for an exemption of TPA regulation. The leading principle in the awarding of exemptions is the proportionality principle: the scope of the exemption must be in proportion with the costs, benefits and risk involved for the consumers and operator of the infrastructure: a large new infrastructure project with large investment risk should be rewarded a more generous exemption than a major new infrastructure with relatively little investment risk. The envisaged impact of this exemption regulation is re-establishing firm incentives for new investments in all types of gas infrastructure projects, including (seasonal) gas storage facilities.

3 Problem analysis

3.1 Lack of seasonal storage: a hold-up problem?

As mentioned earlier, a possible reason for the observed lack of investments in seasonal gas storage facilities is regulatory uncertainty. In economic literature this issue is known as the hold-up problem. Due to the discussed specific characteristics, the hold-up problem could be applicable to gas storage investments. The gas storage facility has very limited, if any, alternative use after it has been constructed, which creates a quasi-rent which is the difference between an investment’s pay-off in its current use and in its highest alternative use. In addition, the decision to build a gas storage facility is often based on negotiations between a specific consumer (or as a ‘representative’ the regulatory authority) and a gas storage operator. The high capital intensity and long lead-times for investment imply that both actors are locked into a long-term bilateral dependency which changes through time and which impact the appropriation of the quasi-rent. Prior to the investment, the storage operator has a relatively strong

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8 This can be considered a form of regulatory holiday (Gans and King 2003).
bargaining position, as the agent – the consumer (or regulatory authority) – depends on him for the undertaking of the investment. However, after the investment has materialized the limited alternative use of its sunken investment shifts the bargaining power to the consumer (or regulatory authority) since the investor is tied to the market for the remainder of the lifetime of the gas storage facility. This provides him with the incentives to adapt his policy in order to increase his own or society’s rents at the expense of the investor’s through appropriating the quasi-rent. The investment hold-up problem arises if these threats induce the investor to postpone or even cancel his investment. Does this hold for the case of seasonal gas storage investment in North-western Europe?

As we have seen, current EU legislation basically has three different regulatory regimes for gas storage operations: rTPA, nTPA and exemptions from TPA (‘regulatory holiday’). Given the large investment costs and long pay-back times for investment regulatory uncertainty can be considered an issue in rTPA and nTPA regimes. After all, regulated tariffs in the rTPA regime are periodically reviewed and adjusted, thereby creating revenue uncertainty for the investor.

The question is whether the hold-up problem manifests itself in the same degree in the markets for short-term, high deliverability storage services on the one hand and seasonal, low deliverability storage services on the other. Given the much larger initial investment and long pay-back time for seasonal gas storage facilities compared with smaller gas storage facilities we infer that the hold-up problem could be more relevant for the former type of facilities. It seems that the impact of regulatory uncertainty on project profitability is at least an issue in the one and only currently planned investment in seasonal gas storage in North-western Europe, the Bergermeer project in the Netherlands.

3.2 Lack of seasonal storage: a demand commitment problem?

The market mechanism may be able to efficiently allocate scarce resources under certain conditions (Arrow 1985). But if conditions are not met there might be a case for the implementation of an alternative (regulatory) arrangement that leads to an efficient allocation of scarce resources (Arrow 1969). The case for regulation in the best interest of society as a whole (Pareto-optimality) can arise for different reasons. Public interest theory roughly distinguishes between four different categories: (1) imperfect competition, (2) unbalanced market operations, (3) missing markets, and (4) undesired market outcomes. For the case of gas storage, and more specific, the distinction between small- and large (seasonal) gas storage facilities, the missing market argument might be relevant.

The major uncertainty for investors in seasonal gas storage facilities is the future demand for the services it provides. At the moment of investment decision-making, information on the potential future value of the investment is scarce. Liberalized and liquid gas markets might provide investment signals though forward contracts for gas delivery, but these typically do not exceed three or four years ahead. The willingness to pay for seasonal storage services in the long-run by (potential) customers is not something that is readily facilitated in markets.
4 Exploring possible solutions

Traditionally, there are four solutions for tackling the hold-up problem: i) long-term take-or-pay contracts, ii) vertical integration, iii) regulation (of a natural monopoly), or iv) public (government) ownership.

As a matter of fact, all solutions are actually reflected in current EU and some member state legislation. Long-term contracts are allowed under a TPA exemption regime, while natural monopoly regulation is implemented on a strict (rTPA) or less strict (nTPA) basis. Vertical integration of (seasonal) gas storage and supply or retail activities is allowed under the condition of functional unbundling, while (partial) public ownership of gas storage still exists in some member states. Below we consecutively discuss the possible solutions for this issue of seasonal gas storage facilities.

4.1 Long-term contracts

As can be seen from the presented figures, demand for seasonal flexibility for a large part originates in the residential and services sector. Demand from this sector is in principal covered by the various national retail companies, which buy gas at the wholesale market or produce gas themselves (i.e. vertical integration of retail and production activities). Although winters can be particularly strong once every number of years, pretty robust estimates for the overall demand for seasonal flexibility from the residential and services sector should be possible. Although an investment in a seasonal storage facility for an individual gas retail company might not be feasible because of the risk associated with it, an investment by a third party that subsequently subcontracts capacity to the various retail companies on a long-term basis should provide a firm basis for investment. Overall investment risk is not mitigated but shared between the main beneficiaries of the seasonal gas storage facility, making the overall investment more acceptable in terms of risk. This is an alternative that was also proposed by Codognet and Glachant (2008). They mention the promotion of open-seasons and long-term contracts so that the risk is spread over different users. A stimulus for successful adoption of this type of solution could be obliging retail companies to match the demand for seasonal flexibility by their customers in their supply portfolio, i.e. imposing explicit storage obligations (Codognet and Glachant 2008).

Exemption regulation and access holiday literature

Current EU exemption regulation is a specific case of long-term contracting. Exemption regulation is basically derived from Access holiday (AH) literature. AH literature is part of regulation theory and is based on the assumption that access regulation truncates profits which impedes investments (Gans and King 2003, Caillaud and Tirole 2004). AH literature submits that a lack of regulatory credibility to leave access regulation unaltered ex-post negatively impacts sunk investments. In such a situation, an exemption during a definite period of time – an access holiday – removes the hazard of ex-post regulation which improves project profitability. In the absence of such a firm commitment, the reduced profitability caused

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9 This section is based on De Joode and Spanjer (2008).
by the imposition of access regulation can lead to a delay or even indefinite postponement of an investment project (i.e., the hold-up problem). Appropriate access charges – access charges set at a level that fully compensates for ex-ante risk – may remove truncation. However, following Gans and King (2003), such regulatory commitment is unlikely in practice due to legal, political, and practical constraints. This lack of regulatory commitment powers creates scope to introduce AHs which remove truncation by allowing an investor to be completely free from any access regulation for a specified definite period of time. The profits retained during the AH should compensate the investor for the loss of profits incurred after expiration of the AH when default access regulation prevails.

According to AH literature, an AH can serve two purposes. Firstly, the profits generated under an AH increase overall profitability which may render a previously unprofitable but socially desirable investment project profitable. Secondly, an AH can align a private investor’s timing of investment with the socially optimal timing of investment. Given the context of this paper we focus on the former purpose. This actually says that an exemption should make a previously unprofitable but socially desirable project profitable. As noted in De Joode and Spanjer (2009) this condition is not properly reflected in the current EU exemption regime. There it states that the level of risk attached to the investment is such that the investment would not take place unless an exemption was granted. This is not a workable condition in practice since any project can show that TPA regulation diminishes its profitability compared to a situation without it, which makes it virtually impossible to deny certain projects an exemption. It thus would therefore be better to rephrase the exemption conditions into “exemptions should only be awarded if TPA regulation would prevent a socially desirable project from being realized”.

4.2 Vertical integration

When considering the option to vertically integrate seasonal storage activities with other activities in the gas value chain there seem to be two clear candidates: retail companies and gas producers. Retail companies are a logical candidate because they deliver gas to the residential and services sector, the sector where most of demand for seasonal flexibility originates. Vertical integration of retail and seasonal storage activities goes one step further than the option of long-term contracting from a third party described above. However, given that individual ownership of seasonal gas storage facilities might be too large a risk burden and common ownership might pose significant organizational problems retail companies would most likely prefer the long-term contracting option over the vertical integration option. For gas producers it might be a logical step to vertically integrate since they actually own the potentially most interesting sites for seasonal gas storage and because they currently are the largest providers of seasonal flexibility through via production. Note that vertical integration of gas storage activities with supply or retail activities is allowed under the current EU legislation, although functional unbundling is required. Hence, there seem to be no legal objections to this solution.

4.3 Natural monopoly regulation

The fact that especially seasonal gas storage facilities are very capital intensive and have long pay-back times for investment makes that they qualify for the natural monopoly label. As an alternative to other more
market-based solutions such as long-term contracts or vertical integration strategies, strict regulation of this activity can be another theoretical option. Here there can be made a distinction with the market for small-scale storage facilities delivering short-term high deliverability services. Regulation meant in this context is somewhat different from the imposed rTPA and nTPA in some member states. It for example means that there is one particular actor made responsible for investment in, and operation of seasonal gas storage facilities. Natural monopoly arrangements for seasonal storage are similar to the current arrangements for the national transmission networks where transmission system operators are held responsible for sufficient market facilitation through network expansion and operation and the maintenance of network quality. Similar as to the case of gas transmission, the costs of seasonal gas storage then can be socialized among its users. To this type of solution, there is the obvious downside of removing competitive pressure on seasonal storage activities, which can lead to worsening efficiency incentives. A more practical (or political) issue that can be raised is the coordination between different member states. Ideally, there is one actor responsible for optimally facilitating the supply of seasonal gas storage for the whole EU, taking into account comparative advantages of countries. When national actors are designated, sub-optimal investment in local seasonal storage facilities is likely to emerge.

4.4 Public ownership

Public ownership of seasonal gas storage is not uncommon in current EU markets, but in the case of gas storage it is accompanied by additional measures such as (TPA) regulation. Different statements can be made on the efficiency properties of firms under public ownership, but it seems to be generally agreed among economists that firms under private ownership have better efficiency properties. Transaction cost economics (TCE) (Williamson 1999) seems to state that public ownership is a relatively better performing solution for cases where a little autonomy is required by the operator, and where frequent adaptations to the environment must be made. When there is an obvious need for autonomy and adaptive capabilities, the preferred governance form is regulation or delegated operation. The latter is called a public bureau in TCE terms and is linked to the idea of designating a third actor as being responsible for seasonal storage services provision within a certain jurisdiction. This was discussed under natural monopoly regulation.
5 Summary and main points

Substantiated with data from the Netherlands and the UK we have shown that a potential problem is looming with respect to investment in seasonal gas storage capacity. While the demand for seasonal flexibility from mainly the residential sector will continue to be there, the currently most important source of flexibility, flexibility in domestic production, is declining. This declining capacity needs to be replaced by seasonal storage facilities. So far, there is very little activity taking place in this field.

The main reasons underlying this problem are twofold. First of all, the regulatory risk associated with seasonal storage investments can be considered to be too high, giving rise to the famous hold-up problem. Second, there might be a fundamental problem with respect to finding firm commitment to demand for seasonal storage services. This gives rise to large market risks that are very difficult to bear by investors in seasonal storage facilities.

We have discussed a number of solutions to the problem, namely: long-term contracting, vertical integration, natural monopoly regulation or public ownership. We stress that a comparative cost-benefit analysis on the different type of solutions would provide a much sounder basis for firm conclusions but based on our initial explorations we would say that given the current regulatory structure (and thus the feasibility of implementation) a firm long-term exemption for seasonal storage would be an attractive solution. This would enable long-term contracting of seasonal gas storage services by retail companies, the suppliers to the main category of consumers demanding seasonal flexibility. Possibly, the risk perceived by retail companies to be associated by this long-term contracting could then still be a hurdle. An extended solution could then be the implementation of some sort of seasonal flexibility contracting obligation for retail companies. This would oblige retail companies to express their willingness to pay for such services.

Alternative solutions such as implementing a regulated natural monopoly where a separate actor is designated to maintain seasonal storage capacity (a la the regulated transmission system operator for networks) could be a very efficient option. However, in the current geopolitical and market structure in the EU this would not turn out this way since one European operator is currently unacceptable and designating national seasonal storage operators would reduce overall efficiency.

In general, this paper highlights the necessity of differential storage regulation of small-scale, high deliverability storage facilities on the one hand, and large-scale, low deliverability seasonal storage facilities. The particular markets serves are quite distinct, as are their economic properties. That being said, we realize that between these two extreme types of storage facilities a grey area exists. Differentiation in the regulation of storage facilities will involve practical difficulties and may create adverse side-effects.

More research on different solutions needs to be undertaken, a more comprehensive comparison included. We believe that the field of transaction cost economics in particular can play a large role.
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