TRANSPORTATION TARIFF DISCOUNTS FOR GAS STORAGE

A report to Vereniging Gasopslag Nederland

November 2012

TRANSPORTATION TARIFF DISCOUNTS FOR GAS STORAGE

Contact details

Name	Email	Telephone
Angus Paxton	angus.paxton@poyry.com	01865 812263
John Williams	john.williams@poyry.com	01865 812262

Pöyry Management Consulting is Europe's leading management consultancy specialised in the energy sector, providing strategic, commercial, regulatory and policy advice to Europe's energy markets. The team of over 200 energy specialists, located across 14 European offices, offers unparalleled expertise in the rapidly changing energy sector.

Pöyry is a global consulting and engineering firm. Our in-depth expertise extends to the fields of energy, industry, urban & mobility and water & environment, with over 7,000 staff operating from offices in 50 countries.

Important

This document contains confidential and commercially sensitive information. Should any requests for disclosure of information contained in this document be received (whether pursuant to; the Freedom of Information Act 2000, the Freedom of Information Act 2003 (Ireland), the Freedom of Information Act 2000 (Northern Ireland), or otherwise), we request that we be notified in writing of the details of such request and that we be consulted and our comments taken into account before any action is taken.

Disclaimer

While Pöyry Management Consulting (UK) Ltd (“Pöyry”) considers that the information and opinions given in this work are sound, all parties must rely upon their own skill and judgement when making use of it. Pöyry does not make any representation or warranty, expressed or implied, as to the accuracy or completeness of the information contained in this report and assumes no responsibility for the accuracy or completeness of such information. Pöyry will not assume any liability to anyone for any loss or damage arising out of the provision of this report.

The report contains projections that are based on assumptions that are subject to uncertainties and contingencies. Because of the subjective judgements and inherent uncertainties of projections, and because events frequently do not occur as expected, there can be no assurance that the projections contained herein will be realised and actual results may be different from projected results. Hence the projections supplied are not to be regarded as firm predictions of the future, but rather as illustrations of what might happen. Parties are advised to base their actions on an awareness of the range of such projections, and to note that the range necessarily broadens in the latter years of the projections.

TABLE OF CONTENTS

[This page is intentionally blank]

EXECUTIVE SUMMARY

Vereniging Gasopslag Nederland has commissioned Pöyry to provide a report to support its response to the Agency for the Cooperation of Energy Regulators (ACER) consultation on the proposed Framework Guidelines on gas transmission tariffs. This report will consider whether there is justification for an appropriate discount to apply to transmission capacity tariffs at storage connection points and provides quantitative analysis to support the conclusions.

The key finding of our analysis is that gas storage is located close to European centres of demand and that it allows lower levels of investment in transportation network capacity than would be the case if storage did not exist. As a consequence, there is a benefit to having gas storage connected to the network which should result in a discount to the transmission capacity tariffs. Our analysis supports a discount of 100% to the gas transmission capacity tariffs.

We estimate that without gas storage, transmission networks and importation infrastructure would need to be significantly bigger – approximately 9% to 16%. Therefore storage provides a substantial benefit which ultimately results in lower prices for gas consumers.

Gas storage supports system stability and in particular helps to reduce wholesale price volatility, which will reduce the costs of managing a sales portfolio and thus result in lower prices for gas consumers.

We believe there are two key reasons for supporting a 100% discount to the gas transmission capacity tariffs:

- as a consequence of the costs that can be avoided due to gas storage, it is arguable that facilities should face negative transmission capacity tariffs, so a 100% discount seems reasonable; and
- a 100% discount would avoid distortion in the European gas storage markets, and would thus support efficient cross-border trading.

Due to the limited time available, Pöyry has undertaken no bespoke modelling to investigate these issues and instead we have relied on previous studies from which we can draw relevant conclusions

[This page is intentionally blank]

1. INTRODUCTION

1.1 Background to this report

Vereniging Gasopslag Nederland[1] has commissioned Pöyry to provide assistance in formulating a response to an Agency for the Cooperation of Energy Regulators (ACER) consultation on the proposed Framework Guidelines (FG) on gas transmission tariffs[2] (the 'tariffs FG'). This report will consider whether there is justification for an appropriate discount to apply to transmission capacity tariffs at storage connection points and provides quantitative analysis to support the conclusions.

In its Draft Initial Impact Assessment (IIA) ACER's initial assessment conclusions were that "entry and exit points to and from gas storage facilities shall be priced at an adequate discount in order to reflect the contribution of gas storages to system stability, efficient use of the network, efficient levels of investment , and efficient cross-border gas trade and competition."[3]

To provide quantitative evidence of the contribution of gas storage, we will assess each of these areas in turn:

- system stability;
- efficient use of the network;
- efficient level of investments; and
- efficient cross-border gas trade and competition.

This report provides evidence and arguments to support the above areas, and discusses some of the wider issues.

The analysis we have undertaken is limited by a number of factors. This includes the fact that the analysis has been undertaken in a relatively short space of time so it has been necessary to rely on results from a modelling exercise which was not designed to assess the impact of different transmission tariffs (but nevertheless does allow us to produce meaningful and insightful analysis of the benefits of gas storage). A more rigorous analysis would produce better evidence in support of our arguments, allowing a more direct quantification of impacts.

We also note that we have been considering the transmission capacity discounts/tariffs that should apply to storage facilities from a European perspective as considered within the FG

---

1 Vereniging Gasopslag Nederland consists of TAQA, Eneco Gasspeicher and Gasunie Zuidwending.

2 'Draft Framework Guidelines on rules regarding harmonised transmission tariff structures for gas', ACER, 4 September 2012 http://www.acer.europa.eu/Official_documents/Public_consultations/PC_2012_G_14/PC_2012_G_14_FG_Tariff_Draft.pdf

3 Framework Guidelines on Harmonised transmission tariff structures (for European natural gas networks) (Initial) Impact Assessment DFGT-2012-G-00X, ACER, 17 September 2012 page 78

1.2 Sources

Unless otherwise attributed the source for all tables, figures and charts is Pöyry Management Consulting.

1.2.1 European Gas Intermittency Project (EGIS)

Within the timescales of the ACER FG consultation, it has not been possible to undertake bespoke analysis to test our hypotheses. We have therefore drawn some modelling results from a recent set of analysis which, whilst undertaken for a different purpose, fortuitously considers some of the relevant issues.

During the first half of 2012, Pöyry were engaged by a set of clients from throughout Europe's gas industry to analyse the effect that increasing levels of renewable generation will have on Europe's gas markets. The study was commissioned by a range of TSOs, utilities traders, and producers: GRTGaz, EGL, Eni, Gasunie, RWE, Statoil, Vattenfall, Dong, Delta, E.ON, EDF, and BKW. The underlying analysis for the study was governed by a committee of founder members (the former seven), who were responsible for agreeing the underlying assumptions for the analysis. This means that the analysis has been closely scrutinised and influenced by wide range of geographical and functional experience.

The analysis presented within this document relies on some of the data produced during this study. Much of the data from this study carries a substantial commercial value for both Pöyry and its clients, so it is not possible for us to release much of the underlying data. We have however been able to produce some meaningful summary statistics from the analysis, which help to prove our hypotheses.

Whilst the analysis is not fully transparent, as much transparency as possible (whilst respecting our clients' value) will be provided by Pöyry on request. Observers are initially directed to the public summary of the study, which is available at www.poyry.com[4]. We are confident that a fully transparent analysis would yield comparable results and conclusions.

4 http://www.poyry.com/sectors-services/management-consulting/poyry-point-view/gas-intermittency

2. REGULATORY BACKGROUND

2.1 3rd Energy Package and Network Codes

As part of the implementation of the 3rd Energy Package a number of Network Codes (NCs) are being developed in the following areas:

- capacity allocation mechanisms (CAM);
- balancing;
- interoperability and data exchange; and
- tariffs.

Once developed and agreed, these NCs are to be implemented within the European Union by becoming binding legislation.

The European Commission (EC) is required to ensure that any proposed legislation, which is to be taken through the 'comitology' process[5] (such as NCs), is accompanied by a formal Impact Assessment (IA). (This is distinct from the Initial Impact Assessments (IIAs) that are currently being produced by ACER.)

An IA examines the costs and benefits of proposed legislation across all sectors of the European economy, as well as the impact on non-economic concerns such as the environment or social cohesion. The individual EC Directorate-Generale is required to produce the IA. The IA provides supporting evidence to the proposed legislation though the entire comitology process.

2.2 Framework Guidelines on harmonisation of tariffs

The proposed tariffs FG is concerned with many aspects of gas capacity tariffs. Tariff setting in gas transmission is a challenging subject because of the conflicts that exist due to:

- the regulated monopoly status of most gas transmission assets, such that a specific revenue is to be recovered by the relevant TSO by way of the applicable tariffs, possibly also correcting previous under- or over-recovery;
- the expectation that the applicable prices and volumes sold might be set by an auction, thereby leading to significant uncertainty in any forecast or expectation of revenue;
- the obligation to be non-discriminatory and requirements to apply principles of cost-reflectivity; and
- the inherent complexity of calculating the effective costs (be they long-run marginal, long-run incremental, etc.) of transportation capacity, noting that they are a function of both possibly arbitrary flow scenario assumptions and very complicated engineering calculations.

5 Comitology refers to a process used to refine and pass relatively minor legislation which does not require debate in the European Parliament.

In addition to this, different networks have different levels of complexity, which can drastically alter the complexity of these considerations. For example, single pipeline systems do not need to consider location as they only have one physical entry point and one physical exit point in any given flow scenario; however, in more complex systems assumptions of flow at other entry/exit points can be key pricing determinants.

The draft tariffs FG was published by ACER on 4 September 2012. Subsequently, ACER published a draft IIA of the tariffs FG on 17 September 2012. Alongside these documents, ACER is undertaking a detailed consultation exercise with market participants and accordingly has issued a detailed questionnaire requesting views in a number of areas.

One of the areas in which ACER is requesting views concerns the application of transmission capacity discounts to storage capacity bookings, which we have summarised as follows:

- Do you agree with proposed option to base tariffs for entry and exit capacity on the transmission network to and from gas storage facilities at an adequate discount to other entry and exit points on the TSO?
- Do you agree with harmonization of such a discount across all storage points in the EU?
- If you prefer harmonization for an 'adequate' discount, which level of such a discount applied to firm capacity level do you advocate?
- What are your views on harmonization of tariff measures, leading to harmonization of transmission tariff levels across all storage points in the EU (instead of harmonizing a discount across all storage points in the EU)?

In each case, ACER has requested that respondents provide quantitative evidence, tables and examples to support each submission.

2.3 Objectives of the Framework Guidelines

The main objective of the FGs on tariffs is to set out clear and objective requirements to harmonise gas tariff structures across the EU that contribute to non-discrimination, effective competition and efficient functioning of the market. The FGs set out specific criteria that tariffs and the methodologies used to calculate them shall:

- be transparent;
- take into account the need for system integrity and its improvement;
- be cost-reflective;
- be non-discriminatory;
- facilitate efficient gas trade and competition;
- be set separately for every entry point into, and exit point out of, the transmission system ensuring that network charges shall not be calculated on the basis of contract paths;
- neither restrict market liquidity, nor distort trade across transmission system borders;
- avoid cross-subsidies amongst network users; and
- provide incentives for efficient new investment and maintain or create interoperability of transmission networks.

2.4 Application of discounts for storage

The IIA that has been published by ACER draws upon work completed by the Brattle Group, which in August 2012 produced an impact assessment. In this study, Brattle specifically addresses the issue of discounts to be applied to transmission capacity tariffs at storage points.

Brattle points out that TSOs currently differ in the treatment of entry/exit tariffs for gas storage and that storage is different to other entry and exit points in that it does not represent a net source of supply or demand. Storage, in effect, shifts supply and demand from one time period to another. In situations where storage is located close to demand there can be a beneficial effect in that import pipelines can be sized for average rather than peak demand. The storage acts to make up the difference between average supply and peak demand and can therefore result in smaller and cheaper import pipelines.

The different TSO approaches to setting storage tariffs may attract storage developers to markets where the tariffs are cheaper rather than where the storage is needed most. This may then result in inefficient pipeline investment as import pipelines may be sized for a market that has little or no storage. In addition, if storage tariffs do not reflect the beneficial effect of encouraging efficient pipeline investment then there may be the additional issue of lack of cost-reflectivity.

Taking account of this, Brattle suggests that a harmonised tariff policy for gas storage across the EU could act to reflect the network benefits of storage and avoid distorting signals to invest in storage. This, in turn would lead to the underlying economics of relative locations playing a greater part in the decision to invest in storage.

Brattle makes a number of further points in considering some of the issues involved in harmonising storage tariffs.

- Any storage discount or tariff must remain non-discriminatory.
- A tariff that recognises the efficient network investment benefits would need to estimate future network costs without storage, the costs with storage and a mechanism to pass on some of the savings realised by virtue of the storage facility being developed.
- There may be other users of the network that could claim that they also provide benefits to the system in a similar way, or at least impose lesser than average costs on the network.
- A cost reflective tariff (without any specific discounts) should benefit storage as transporting gas from the import point to storage exit point in summer and then from the storage entry point to the exit point in winter should imply lower costs as summer capacity should be less than winter capacity and due to the shorter transportation distance travelled in winter. It may be the case therefore that a harmonised approach to tariffs overall would benefit storage without the requirement for any discounts – which may risk being discriminatory.

Brattle concluded that whilst some harmonisation of transmission capacity tariffs for storage connections is required, that this should be part of a broader harmonisation of tariffs. Brattle “do not therefore recommend a specific or tailor made entry/exit tariff regime for gas storages”.

ACER's IIA and conclusion

Referencing the work undertaken by Brattle and in particular the issue of discrimination, ACER highlights the differences between storage and other entry/exit points. ACER considers that the discrimination issue can be overcome since storage does not represent a net supply or demand to the transportation system, but rather a shift in the time of consumption. Therefore storage should not be compared to other entry and exit points.

There is currently a large degree of variation in storage transmission tariffs due to different cost allocation and tariff methodologies. This absolute difference in tariffs will influence storage developers when considering in which geographical location to invest. This may result in an inefficient outcome both for investment and the utilisation of networks.

Therefore, ACER argues, efficiency could be improved by developing harmonised storage tariff methodologies both within and across member states.

Gas storage facilities compete with other storage facilities within the same country and also against facilities in neighbouring countries and potentially further afield. Since transportation tariffs make up a significant element of the variable cost of storage, different treatment of tariffs may hinder the development of efficient trade and competition.

Harmonised storage tariffs should therefore lead to the efficient use of the network, efficient investments, and efficient trade and competition.

ACER's IIA concludes that:

> " …. entry and exit points to and from gas storage facilities shall be priced at an adequate discount in order to reflect the contribution of gas storages to system stability, efficient use of the network, efficient level of investments, and efficient cross-border gas trade and competition."

This paper, commissioned by Gas Storage Netherlands, presents quantitative and qualitative arguments to support the ACER assertion that discounts should be applied to storage tariffs.

3. BENEFITS OF GAS STORAGE

This chapter is mostly concerned with describing the individual benefits that gas storage provides – providing a direct response to the considerations in the IIA. Firstly however, we discuss the future world that should be assumed.

3.1 Introduction – baseline counterfactual

In order to assess the impact of particular policy options, it will be necessary to understand the future that would have existed had the prevailing policy remained unchanged. This establishes a baseline against which proposals for change can be assessed.

The baseline counterfactual does not therefore reflect the current market situation, but reflects the future situation given the application of all planned policy changes. Given the significant impact of the rest of the 3rd Energy Package will have on Europe's gas markets, it is essential therefore to consider this within the baseline counterfactual.

We therefore consider that the baseline against which policy options should be assessed should assume that:

- liquid, traded wholesale markets have been established throughout Europe;
- virtual balancing/trading hubs have been established with cost-reflective imbalance pricing, meaning that wholesale market prices drive shipper-led system balancing actions and that TSOs are not normally actively involved in day-to-day balancing;
- wholesale market prices are set by gas supply and demand considerations, establishing gas-on-gas competition, with wholesale prices that reflect marginal costs;
- there are minimal price differentials where there is available interconnection capacity, leading to:
  - pan-European gas trading and commerce; and
  - price convergence; and that
- access arrangements are designed to be efficient and non-discriminatory.

The market that this describes probably also features pan-European retail market competition, and pan-European utilities seek to optimise their portfolio as a single entity rather than treating them as a number of different portfolios in different jurisdictions.

This market, as today, uses a number of ancillary services – secondary capacity trading, metering, connections activities, etc. – and we expect many of these services to be competitive. Included within this is a European gas storage market, providing both seasonality and flexibility services to the competitive European gas market.

Relationship to EGIS data

It is this general picture that has shaped the scenarios we have used in the EGIS study, and the data we draw from in the following sections has come from a scenario designed to describe this baseline counterfactual position. The scenario assumed:

- a realistic penetration of Wind & Solar generation;
- European hub prices de-linked from oil;

- suppliers compete in freely traded wholesale markets;
- that trading occurs at long-run marginal costs; and
- that commercial entities adopt strategies that maximise the present value of assets – production, storage, networks, etc.

A sensitivity to this scenario was created that examined the impact of an additional level of storage capacity within Europe (there was an additional 8.7bcm storage assumed).

We would need to undertake time consuming bespoke modelling to understand the exact impact of the policy options discussed herein, however the baseline scenario and the storage capacity sensitivity contain meaningful data which allows us to demonstrate the impact that gas storage has on the gas market.

3.2 System stability

We note that the IIA lacks a clear definition of system stability. We consider that the main concern of system stability is the stability of the gas supply chain. This is best measured by the stability of wholesale market prices, which can be seen as the direct inverse of price volatility.

Gas storage plays a role to manage both the largely predictable seasonality of gas demand and to manage the more unpredictable day-to-day swings in gas demand. The seasonality of gas demand generally drives a seasonality of gas price which is observable in the gas price forward curve. However, gas demand is less predictable on a day-to-day basis as it generally responds to weather. Gas storage is a key source of flexibility to many of the markets of Europe; enabling storage users to respond to both these types of change in demand.

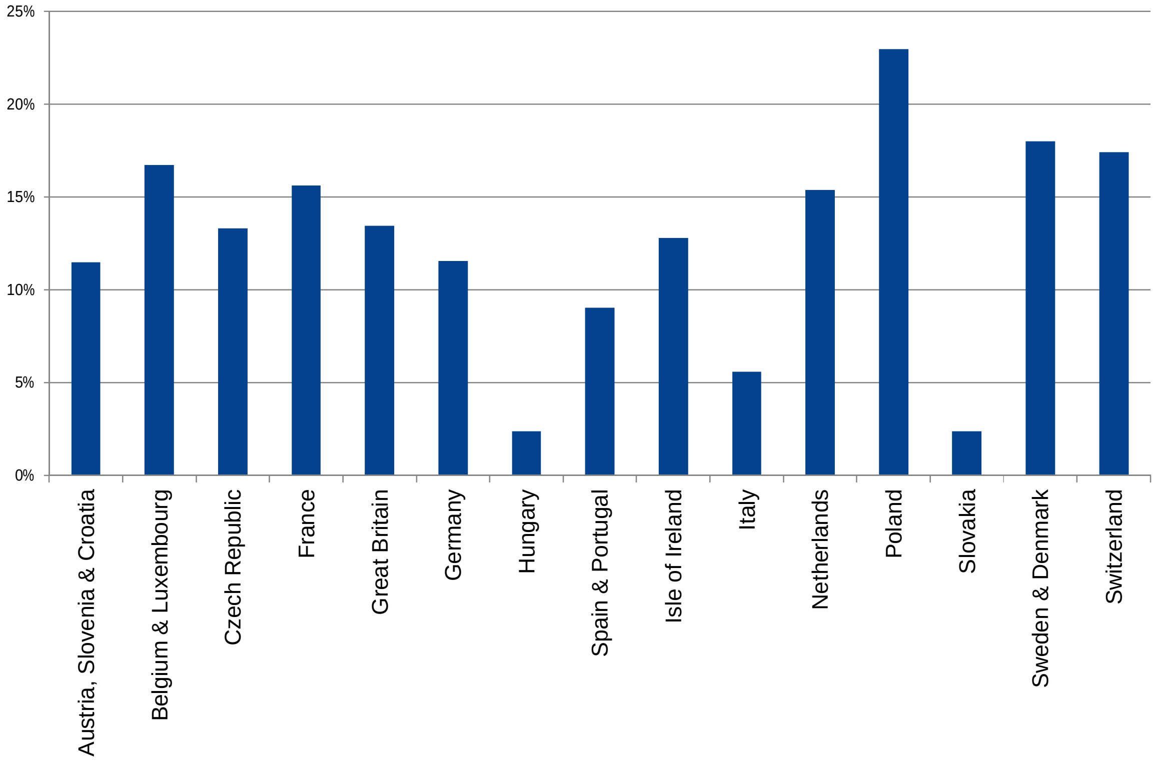
3.2.1 Quantification of storage benefit

In order to quantify the role that gas storage plays, we have considered the results from our recent study into the effect of gas intermittency in Europe, as described in Section 1.2.1.

Within the study, we evaluated the volatility of wholesale market gas prices at two different levels of storage – whilst holding all other input assumptions constant. The results showed that increasing the total working gas volume of the countries studied by only 8.2% resulted in a reduction in absolute price volatility of €0.24/MWh or 17%. (We measure price volatility as the standard deviation of changes in price from one day to the next.)

Figure 1 demonstrates the average reduction in daily price volatility across the range of countries that formed the study.

Figure 1 – Reduction in daily price volatility caused by increasing levels of gas storage



Source: Pöyry Management Consulting

Figure 2 shows the standard deviation of daily changes in prices from 2030 from a scenario which considered existing storage, plus committed storage projects, plus any storage required by 2030 in order to avoid demand shedding. We modelled supply and demand in 2030, assuming historic weather patterns (shown in Figure 2 as Historical Year).

Figure 2 – Standard deviation of daily changes in prices, low storage scenario

2030 absolute volatility with existing/committed + minimum required storage capacity

€/MWh		Historical year						
		2004	2005	2006	2007	2008	2009	**Average**
Country	Austria, Slovenia & Croatia	0.61	0.94	0.66	0.49	0.72	1.01	**0.74**
	Belgium & Luxembourg	0.52	2.49	0.64	0.45	0.49	0.49	**0.85**
	Czech Republic	0.59	0.84	0.62	0.47	0.66	0.89	**0.68**
	France	0.62	2.52	0.76	0.54	0.58	0.57	**0.93**
	Great Britain	0.81	2.59	0.91	0.77	0.73	0.71	**1.09**
	Germany	1.02	2.65	1.16	0.97	1.03	0.99	**1.30**
	Hungary	0.64	0.69	0.71	0.93	0.67	0.87	**0.75**
	Spain & Portugal	0.81	1.30	0.88	0.79	1.08	1.32	**1.03**
	Isle of Ireland	0.81	2.60	0.90	0.78	0.73	0.70	**1.09**
	Italy	1.27	1.58	1.28	1.17	1.37	1.63	**1.38**
	Netherlands	0.64	2.52	0.72	0.54	0.60	0.59	**0.93**
	Poland	2.19	1.76	1.94	2.35	2.32	2.13	**2.11**
	Slovakia	0.63	0.68	0.71	0.92	0.65	0.86	**0.74**
	Sweden & Denmark	0.48	2.51	0.61	0.42	0.44	0.44	**0.82**
	Switzerland	0.53	2.51	0.61	0.47	0.47	0.50	**0.85**
	Europe (average)	**0.811**	**1.879**	**0.874**	**0.804**	**0.835**	**0.913**	**1.019**

Source: Pöyry Management Consulting

Figure 3 shows the standard deviation of daily changes in prices from 2030 from a parallel scenario which had exactly the same assumptions as the case from Figure 2, with the only difference being a higher level of gas storage capacity.

Figure 3 – Standard deviation of daily changes in prices, high storage scenario

2030 absolute volatility with profitable storage

€/MWh

		Historical year						
		2004	2005	2006	2007	2008	2009	**Average**
Country	Austria, Slovenia & Croatia	0.57	0.95	0.56	0.50	0.61	0.66	**0.64**
	Belgium & Luxembourg	0.55	0.45	0.54	0.47	0.47	0.46	**0.49**
	Czech Republic	0.56	0.82	0.51	0.48	0.54	0.56	**0.58**
	France	0.61	0.55	0.67	0.55	0.56	0.55	**0.58**
	Great Britain	0.84	0.70	0.83	0.77	0.72	0.70	**0.76**
	Germany	1.05	0.94	1.11	0.96	1.01	0.99	**1.01**
	Hungary	0.63	0.68	0.66	0.95	0.70	0.76	**0.73**
	Spain & Portugal	0.78	1.21	0.82	0.80	0.93	1.01	**0.92**
	Isle of Ireland	0.84	0.73	0.84	0.77	0.73	0.71	**0.77**
	Italy	1.23	1.48	1.27	1.18	1.25	1.37	**1.30**
	Netherlands	0.67	0.54	0.63	0.54	0.59	0.56	**0.59**
	Poland	1.54	1.46	1.57	1.74	1.65	1.76	**1.62**
	Slovakia	0.63	0.67	0.65	0.94	0.68	0.75	**0.72**
	Sweden & Denmark	0.49	0.42	0.47	0.44	0.43	0.41	**0.44**
	Switzerland	0.54	0.48	0.49	0.48	0.46	0.45	**0.49**
	Europe (average)	**0.769**	**0.804**	**0.775**	**0.770**	**0.756**	**0.781**	**0.776**

Source: Pöyry Management Consulting

Figure 4 – Percentage difference in standard deviation of daily changes in prices between high and low storage scenarios

Percentage reduction in price volatility caused by storage

€/MWh

		Historical year						
		2004	2005	2006	2007	2008	2009	**Average**
Country	Austria, Slovenia & Croatia	6%	-1%	15%	-1%	15%	34%	**11%**
	Belgium & Luxembourg	-5%	82%	16%	-3%	4%	6%	**17%**
	Czech Republic	6%	2%	18%	-1%	18%	37%	**13%**
	France	0%	78%	11%	-3%	3%	4%	**16%**
	Great Britain	-3%	73%	9%	1%	1%	1%	**13%**
	Germany	-3%	65%	4%	1%	2%	0%	**12%**
	Hungary	0%	1%	7%	-2%	-5%	13%	**2%**
	Spain & Portugal	4%	7%	7%	-1%	14%	24%	**9%**
	Isle of Ireland	-3%	72%	7%	1%	1%	-1%	**13%**
	Italy	3%	7%	1%	-1%	9%	16%	**6%**
	Netherlands	-3%	79%	11%	-1%	2%	4%	**15%**
	Poland	29%	17%	19%	26%	29%	17%	**23%**
	Slovakia	0%	2%	7%	-2%	-5%	13%	**2%**
	Sweden & Denmark	-2%	83%	23%	-5%	2%	6%	**18%**
	Switzerland	-3%	81%	20%	-4%	1%	11%	**17%**
	Europe (average)	**5%**	**57%**	**11%**	**4%**	**9%**	**14%**	**17%**

Source: Pöyry Management Consulting

3.2.2 Conclusion

It is clear that gas storage contributes to system stability through having a stabilising impact on gas prices. In a year with typical weather (as demonstrated by the average), volatility is reduced by 17 per cent. However, when there is cold weather (as demonstrated through the historical year 2005), additional storage helps to reduce day-ahead price volatility by up to 57 per cent.

We would expect the reduced level of volatility to lower the risks of trading within the market, lowering the costs of retailing and lowering the costs of capital sought by shippers and traders. Both of these effects could be expected to lower the costs faced by consumers.

There are further benefits which gas storage brings to system stability through increasing security of supply. Holding gas in storage reduces dependence on import infrastructure and interconnection in the event of breakdown. However, we have not attempted to quantify this benefit to system stability.

3.3 Efficient use of the network

We note that the IIA also lacks a clear definition of this concept. We consider that there are two potential interpretations of the concept:

- firstly, that there is an operational efficiency gain resulting from the location of gas storage in respect of demand; and
- secondly, that predictable bottlenecks that occur seasonally can be overcome by the intertemporal nature of gas storage.

We discuss each of these concepts below.

In addition, there is also a perspective that gas storage facilities lead to more efficient networks because of their location in respect of demand. We have considered this perspective in the following section 3.4, where we discuss the efficiency of network investment.

3.3.1 Efficient operation of compression

Injections into storage in the summer months increase compressor running over this period. As the gas storage facilities are located close to demand (as discussed below), less compression than otherwise required is used during the winter period when gas storage facilities are typically withdrawing. This means that gas networks run more efficiently, as:

- when purchased on a forward basis, the cost of gas to fuel summer running is typically lower than the winter cost and which results in lower gas costs to the TSOs;
- because the transporter's compressor fleet duty is required to be less variable as would otherwise be the case, it can be designed to operate with better fuel efficiency and lower emissions; and
- because gas storage facilities often compress the gas before it re-enters the gas transmission network, it provides additional support to the network.

We note that these efficiencies relate to the operational costs of operating a network, and question whether it is appropriate to place weight on the potential efficiencies gained here in an assessment of capacity tariffs. As such, we have not attempted to quantify them, however we note them here as additional potential benefits.

3.3.2 Inter-temporal debottlenecking

If a route between two markets is predictably constrained for part of a year, it should be expected that costlier routes will be used during the period of constraint. Gas storage located downstream of the constraint should enable more gas to flow through the less costly route for a longer period, and so, all other things being equal, there would be an increase in the overall level of efficiency of the network. This would manifest itself in higher load factors for constrained routes, and lower load factors for unconstrained routes, ultimately leading to lower long-term differences in wholesale market prices across Europe, reducing the costs of serving European consumers.

3.3.3 Quantification of storage benefit

We have been unable to quantify of the impact of gas storage on the efficient operation of network compression within the timeframes for this study.

We have examined data from the EGIS study does support the argument that that constrained routes would be used for a longer period of the year. Evidence from the model does suggest that there is a change to the pattern of flows experienced within the European gas network, with many of constrained routes being used for longer periods. However there is a degree of variance in the results which requires further investigation before concrete numerical evidence can be provided. Our preferred approach would be to construct bespoke modelling analysis to test that the argument is robust to a variety of dimensions.

3.3.4 Conclusion

Whilst we have been unable to provide a robust quantification of the impact that gas storage has on the efficient use of the network (however this is defined), there are clear arguments that support the hypothesis that gas storage increases network efficiency.

We would expect these increased efficiencies to be reflected in lower costs to consumers, either via the revenues of gas transporters or via a greater use of lower cost routes by shippers.

3.4 Efficient level of investments

The existence of gas storage will affect the required levels of investment in alternative sources of supply.

3.4.1 How gas storage affects the efficient level of investments

The following quotation from the Brattle Group provides a succinct summary of the benefit that gas storage brings to encourage efficient levels of investment.

“Gas storage is somewhat different from other entry-exit points, because it is not a net source of demand or supply but rather shifts consumption from one period to another. Suppose that gas must travel some distance from the border to a centre of demand, and that a storage facility is built close to the demand centre. Absent the storage, the TSO will have to size the import pipeline to supply the peak demand. With gas storage, the pipeline can be sized for the average demand, and the storage can make up the differences between the actual and average demand. In this way the storage allows a reduction in the size and cost of the required import pipeline”[6]

Gas storage allows more efficient levels of investment in both in the pipeline network and in import/production assets than would be the case if storage were not present.

---

6 ‘Impact Assessment for the Framework Guidelines on Harmonised transmission tariff structures’, The Brattle Group, 6 August 2012

Without the presence of gas storage transmission, networks would be bigger; in a forward looking context, less gas transmission investment is needed in Europe if there is additional European gas storage capacity. Pursuant to the requirement that transmission tariffs should be cost reflective, it follows that gas storage facilities transmission capacity charges should be negative. If implemented in this way, as networks would need to maintain target network revenues, other transportation capacity tariffs would need to be greater.

3.4.2 Quantification of storage benefit

In this section, we will provide two analyses to quantify the benefit that gas storage brings to encourage efficient levels of investments:

- a demonstration that gas storage in Europe is built close to the centres of population, and thus close to demand; and
- an illustration of the network costs which can be avoided due to the existence of gas storage facilities.

3.4.2.1 Gas storage is close to demand

We hypothesise that gas storage in Europe is located close to Europe's population. We consider that, in the absence of a more detailed modelling of the physical layout of Europe's gas network, the location of population can be used as a proxy for the location of demand.

The analysis presented in Annex A provides strong support for this hypothesis. We therefore conclude that, assuming the population is an appropriate proxy for gas demand, Europe's gas storage facilities are close to demand. Gas storage therefore provides support to the European gas transmission network and, in aggregate, alleviates transmission capacity requirements.

3.4.2.2 Avoided network investment costs

Peak day analysis

From our EGIS work, we have analysed the flows of gas on peak demand days. Our analysis shows that based on a cold winter (for example 2009) on the day when demand is at its highest level across the range of European nations within the study, storage flows comprise between 29% and 39% of flows. As a consequence, if Europe were to meet peak day demand without storage, European import facilities would need to be 9% to 16% larger. This would require investment in the import facilities themselves (LNG regasification terminals, pipelines) and in the transmission networks within Europe to transport the peak day gas requirement from the entry point to consumers. This analysis is presented in Figure 5.

Figure 5 – Import capacity required to meet peak demand without storage

Year	Peak day demand mcm	Flows from gas storage mcm	*Flows from gas storage %*	Flows from other sources mcm	Capacity of other sources mcm	New capacity required to meet demand without storage mcm	*requiredto meet demand without storage %*
2012	2676	868	*32%*	1,787	2409	246	*10%*
2015	2751	787	*29%*	1,978	2530	235	*9%*
2020	2891	908	*31%*	1,998	2660	246	*9%*
2025	3020	976	*32%*	2,044	2708	312	*12%*
2030	3156	1,234	*39%*	1,916	2726	425	*16%*

Source: Pöyry Management Consulting

The potential avoided costs to be in the region of 9% to 16% of the value of the prevailing infrastructure. We note that these are avoided costs, and that the benefits of the reduced levels of network investment would result in capacity charges, generally, that are lower than they otherwise would have been. The reduced level of network investment would mean lower allowed revenues for transmission networks which results in lower costs to consumers.

GB market analysis

A 2007 report by Waters Wye Associates considered the benefit that gas storage sites bring to the transmission system in Great Britain. The benefits came from gas storage delivering gas to the system on peak days close to consumer demand, thus reducing the need for investment in pipe and compression capacity. Their results show a range of annual savings of between £24m and £200m "with most concentration around the £30m to £40m range[7]. These savings represent the annualised savings from avoided capital expenditure, and did not include any potential OPEX savings.

If the core range of Waters Wye's results for Great Britain is assumed to be representative for the gas market of Europe, then as Great Britain represents approximately 17% of EU gas demand, a the total savings in network capacity could be in the range of £204m to £270m in 2012 money (sterling).

3.4.3 Conclusion

In summary, we see strong support for the premise that gas storage lowers the level of investment that would be required if it were not present. Through storage being located close to demand and through smoothing peaks in demand, storage allows more efficient levels of investment in both network capacity (pipelines and compressors) and import/production capacity.

We estimate the potential avoided costs to be in the region of 9% to 16% of the value of the prevailing infrastructure. We note that these are avoided costs, and that the benefits of the reduced levels of network investment result in capacity charges, generally, that are lower than they otherwise would have been. The reduced level of network investment would mean lower allowed revenues for transmission networks which results in lower costs to consumers.

---

7 £30m-40m in 2007 money is equivalent to £34.8m-46.4m in 2012 money when adjusted for historical inflation levels

[This page is intentionally blank]

3.5 Efficient cross-border gas trade and competition

If there is sufficient interconnection capacity, European gas storage facilities can compete with each other to provide a range of flexibility services – both long-term (seasonal) and short-term – to producers, utilities, consumers and TSOs.

We believe that the focus of the FG should not be restricted to consideration of only the efficiency of cross-border **gas** trade and competition alone – we consider that the important concern is of efficient cross-border trade and competition, generally. As gas storage is a European market in its own right, we have considered the impact of transmission tariffs on the efficient cross-border **gas storage** trade and competition.

3.5.1 European gas storage trade and competition

There are gas storage facilities located in most of the countries of Europe, and as ACER notes "Gas storages typically compete not only with storages in the same country, but may also compete with storages in neighbouring countries."[8]

There is strong evidence to say that the Belgian, Dutch and British markets are, subject to transportation capacity availability, tightly connected (i.e. price convergent) markets. One manifestation of this is the extent to which changes in future price spreads (summer/winter differentials) in one market are reflected in another market. A market participant with a portfolio encompassing any two of these markets will, subject to interconnection capacity, be able to make supply/capacity procurement decisions for its overall portfolio. If it requires storage capacity, it will need to decide on the appropriate proportion to procure from each market.

The recent proposal to modify the Code of Operations in Ireland illustrates the international aspect of gas storage competition "users of storage facilities in Ireland have to pay a shrinkage charge whereas users (including Irish users) of similar facilities in Great Britain do not. This practice puts Irish storage facilities at a significant competitive disadvantage relative to GB based competitors."[9]

There are a number of storage sites which can already provide services to more than one country, for example the facilities at Epe, Eztel and Nuttermoor which are located in Germany and connected to the Dutch systems, and 7Fields and Haidach which are located in Austria and connected to the German system.

When we consider these current observations in the light of the baseline counterfactual situation, we see that gas market participants are expected to be able to trade gas easily across borders, thus enhancing competition in the European gas storage market.

There is a potential for both under- or over-recovery of network revenues and decisions on network regulation, such as cost of capital or engineering specifications, to significantly impact the level capacity charges levied for similar use of different networks. This would potentially significantly distort the European gas storage market.

---

8 Framework Guidelines on Harmonised transmission tariff structures (for European natural gas networks) (Initial) Impact Assessment, ACER, 17 September 2012, page 78

9 Code Modification Number: A052, Gaslink

3.5.2 *Quantification of storage benefit*

We have been unable to identify a means of quantifying the impact that alleviating these potential distortions would have.

3.5.3 *Conclusion*

To avoid unnecessary distortion of the European gas storage market it would be necessary to ensure that there is no undue discrimination arising from national regulation or from under- and over-recovery situations. This could be achieved through drastic approaches such as the harmonisation of network regulation, although there are several severe complications with this and it may not satisfy EU subsidiarity principles.

Distortion can also be avoided through the use of a uniform absolute tariff for gas storage facilities. Because of the avoided cost arguments, there is evidence to suggest that such a uniform cost should be negative.

3.6 Other considerations

3.6.1 *Electricity markets*

There is wider system stability and investment efficiency that can be observed –gas storage, considered alongside gas fired power generation, provides a valuable tool for electricity markets to balance intermittent generation from renewable sources. Whilst our EGIS study examined the impact of intermittency on the gas market for different levels of storage investment, the study did not then examine the impact of the storage investment in the electricity markets.

It is perfectly feasible to examine the impact that gas storage investment would have on the electricity market, however it has not been possible to undertake such an analysis during the course of the FG consultation, and we do not have any ‘off-the-shelf’ material that is available.

3.6.2 *Cost reflectivity*

Gas transmission capacity has many different definitions (shippers see it as a simple contractual right to enter/exit gas, TSOs see it as an incomplete description of tangible, physical asset), and different timescales (contractual day-ahead capacity products are backed by long-term physical assets).

In the context of facilitating a market, cost reflectivity ensures that appropriate incentives are placed on the market participants, whilst avoiding undue market distortions, to encourage ‘helpful’ behaviour. Capacity pricing should therefore be aimed at recovering the forward looking long-run costs of the transportation network.

Within monopoly regulation however, true cost reflectivity is not always achievable because of a need to capture the effects of revenue under- or over-recovery. This can lead to a significant instability in capacity charges, to the extent that charges are no longer cost reflective.

3.6.3 *‘Double counting’*

We note that another consideration is whether users of storage capacity are essentially paying twice for the same service. Assuming that the gas is withdrawn from storage at periods of high demand, we believe this is the case.

4. CONCLUSIONS

There are two key observations that we take from the above evidence:

- firstly, that European gas storage facilities are located close to centres of demand; and
- secondly, that European gas storage is a market in its own right, with facilities competing to provide storage services to various market participants.

The first point leads to the observation that, given the fluctuating (both between and within seasons) nature of European gas demand, in aggregate gas storage lowers the level of transportation capacity that would otherwise be needed within Europe. We estimate that without gas storage, transmission networks and importation infrastructure would need to be significantly bigger – approximately 9% to 16%. This should otherwise imply, under a cost reflective charging regime, that gas storage facilities should attract a negative transmission capacity tariff.

In addition, our analysis suggests that gas storage supports system stability and in particular helps to reduce wholesale price volatility, which will reduce the costs of managing a sales portfolio and thus result in lower prices for gas consumers.

There is a potential for both under- or over-recovery of network revenues and decisions on network regulation, such as cost of capital or engineering specifications, to significantly impact the level capacity charges levied for similar use of different networks. This would potentially significantly distort the European gas storage market.

To avoid unnecessary distortion of the European gas storage market it would be necessary to ensure that there is no undue discrimination arising from national regulation. This could be achieved through drastic approaches such as the harmonisation of network regulation, although there are several severe complications with this and it may not satisfy EU subsidiarity principles.

On the basis that there is a requirement to prevent distortion of the European gas storage market to encourage cross-border trade of gas storage services, and because there is strong evidence to suggest that gas storage facilities do not impose long-run costs on Europe's transmission network, we recommend that a 100% discount is applied to transmission capacity charges for gas storage facilities.

We also note that there are other benefits provided to the gas market and consumers – lowered wholesale market price volatility, more efficient use of the European gas network, and more efficient operation of the networks – which further support the concept that gas storage facilities should attract a discount.

[This page is intentionally blank]

ANNEX A – ANALYSIS OF THE LOCATION OF GAS STORAGE FACILITIES

A.1 Introduction

We hypothesise that gas storage in Europe is located close to Europe's population. We consider that, in the absence of a more detailed modelling of the physical layout of Europe's gas network, the location of population can be used as a proxy for the location of demand.

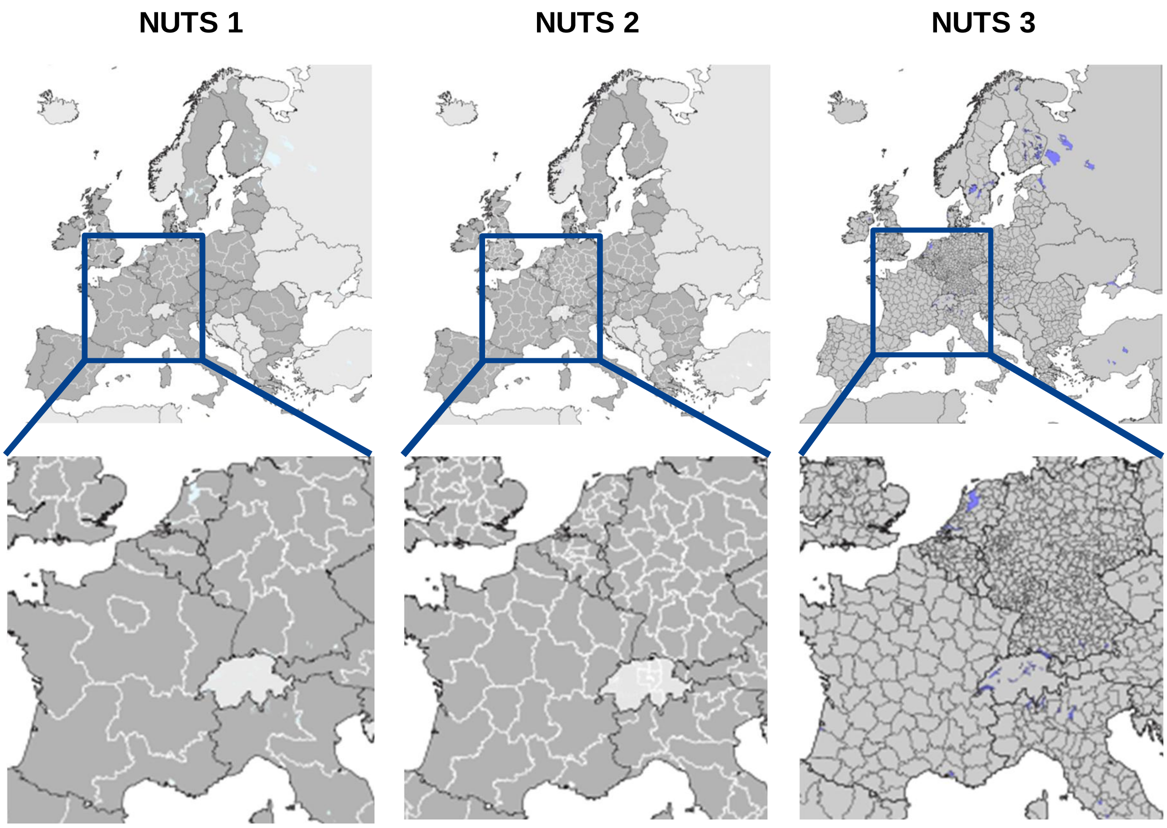
In order to test this hypothesis, we have examined the population density at the locations of storage facilities, using data obtained from the Eurostat database. This database provides demographic information for official Nomenclature of Territorial Units for Statistics[10] (NUTS) areas at 3 levels of resolution:

- NUTS 1 - splits the 27 Member States into 97 areas;
- NUTS 2 - splits the 97 NUTS 1 areas into 271 areas; and
- NUTS 3 - splits the 271 areas into 1303 areas.

These resolutions are presented in Figure 6, below.

10 Further information on the definitions and the nomenclature can be found in http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-11-011/EN/KS-RA-11-011-EN.PDF

Figure 6 – NUTS resolutions



Source: Eurostat

The analysis presented below shows that in Europe in general, storage facilities are located in areas of above average population density. We therefore conclude that our hypothesis is correct – European gas storage is located close to European demand.

We note that the average population density of Europe is 116.6 inhabitants per square kilometre, whereas the European average population density in the proximity of storage facilities ranges between 164 and 224, depending on the geographical extent of the measure and the averaging technique.

We have mapped each gas storage facility in Europe into each of the three applicable NUTS regions. This allows us to draw a number of observations at each level of geographical resolution that considers the location of the individual storage facility and the location of the storage facility within the Member State.

A.2 Analysis

Table 1 presents some summary results of our analysis. This shows, for each Member State with gas storage facilities:

- 2011 gas consumption, storage capacity, and population density; and
- for each level of NUTS resolution, the average population density of the storage facilities within the Member State.

To produce the storage facilities' population densities averaged at Member State level, we have weighted the average according to the storage capacity of the individual storage facilities. This avoids placing undue weight on small facilities within the averaging, and the approach provides less support for the hypothesis than a non-weighted average.

Table 1 – Storage facilities' population densities

Country	Gas consumption (mcm) - 2011	Storage capacity	Population density (#/km^2)	Capacity-weighted average population density of storage facilities' locations		
				NUTS 1	NUTS 2	NUTS 3
Germany	77,597	20,455	229.0	320.1	242.3	213.3
Italy	77,917	16,487	200.7	239.2	314.7	388.1
France	41,205	12,700	102.5	117.2	101.2	97.7
Austria	9,475	7,451	101.8	93.0	175.8	112.3
Hungary	11,557	6,130	107.5	106.2	75.1	76.5
Netherlands	47,887	5,258	492.2	285.7	291.3	208.6
Spain	33,555	2,726	91.8	69.3	122.0	107.1
United Kingdom	82,622	4,319	254.2	305.2	145.1	175.8
Czech Republic	8,944	3,432	136.2	136.2	157.1	204.4
Slovakia	5,623	2,905	110.7	110.7	304.8	304.8
Romania	14,394	2,684	93.2	107.5	145.4	125.1
Latvia	1,583	2,320	36.0	36.0	36.0	2858.8
Poland	17,171	2,052	122.1	98.7	117.1	121.4
Denmark	4,179	1,025	128.7	128.7	218.0	165.2
Belgium	16,882	700	358.7	467.9	619.2	999.8
Bulgaria	3,300	450	69.1	86.6	48.0	54.9
Ireland	4,844	230	65.4	65.4	90.0	53.5
Portugal	5,171	171	115.4	113.9	84.3	158.8
Sweden	1,330	9	22.9	53.1	99.4	54.6
Total	465,236	91,504				
EU - unweighted			116.6	164.9	169.3	154.4
EU - capacity weighted				219.3	200.1	177.0
EU - consumption weighted				224.6	205.3	184.5

Source: Pöyry analysis of Eurostat, IEA, GIE

Note: we have excluded Spanish LNG gas storage facilities within the average densities presented above, as these storage facilities are usually considered as part of the relevant importation facility, and because similar facilities are not included in the storage statistics for other LNG importing countries, e.g. France, United Kingdom, Italy. Analysis which includes these capacities does not affect the conclusions.

We have chosen to present the analysis of all 3 NUTS regions because:

- at the smallest resolution, NUTS 3, some population densities are very high as little 'green belt' land is counted, which means some storage facilities appear to be located within large cities; and

- at the largest resolution, NUTS 1, storage facilities in low density locations attract more distant population.

Both of these observations, whilst valid, are difficult to accept.

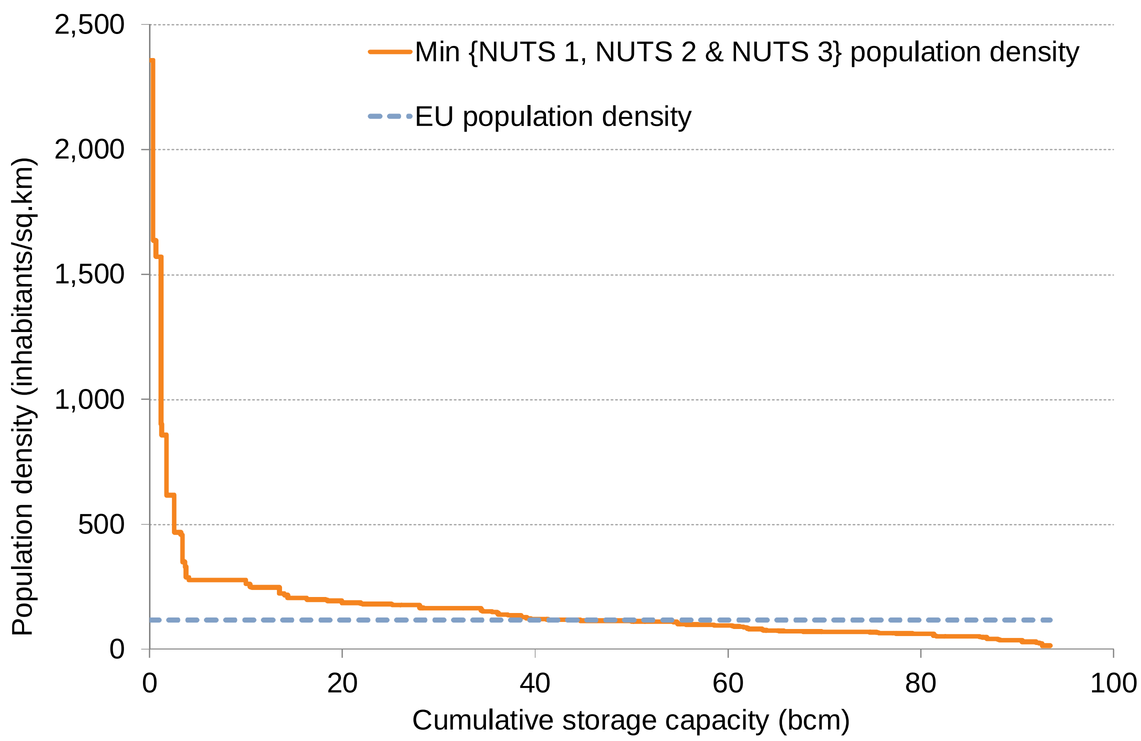
Table 1 presents a range of different results across the different NUTS resolutions, with variance typically +/-25% across the resolutions. We note that when examining the resolutions across each Member State, five maximum densities occur at NUTS 1, eight at NUTS 2 and six at NUTS 3, and that eleven minimum densities occur at NUTS 1, four at NUTS 2 and four at NUTS 3. We consider that the selection of NUTS resolution should therefore not introduce bias when examining Europe.

At the bottom of the table, we present three approaches for averaging the Member State level data to a European perspective: a non-weighted average across the Member States, and two weighted averages – one weighted on storage capacity, and the other weighed on gas consumption. Regardless of the averaging technique employed the conclusion is consistent: European storage facilities are located close to the European population.

We conclude that the analysis supports our hypothesis.

In order to ensure that the conclusion is robust to more severe interpretations of the population data we have also examined the minimum population densities (selected from the three NUTS resolutions) for the individual storage sites, against the EU population density. To visualise this we have constructed a duration curve which orders Europe's gas storage facilities in terms of their selected population density, and plots these against the accumulation of storage capacity. This is shown in Figure 7.

Figure 7 – Minimum density duration curve



A.3 Potential shortcomings

We have identified two potential shortcomings in the methodology described above, which we describe below.

A.3.1 Demand/population correlation

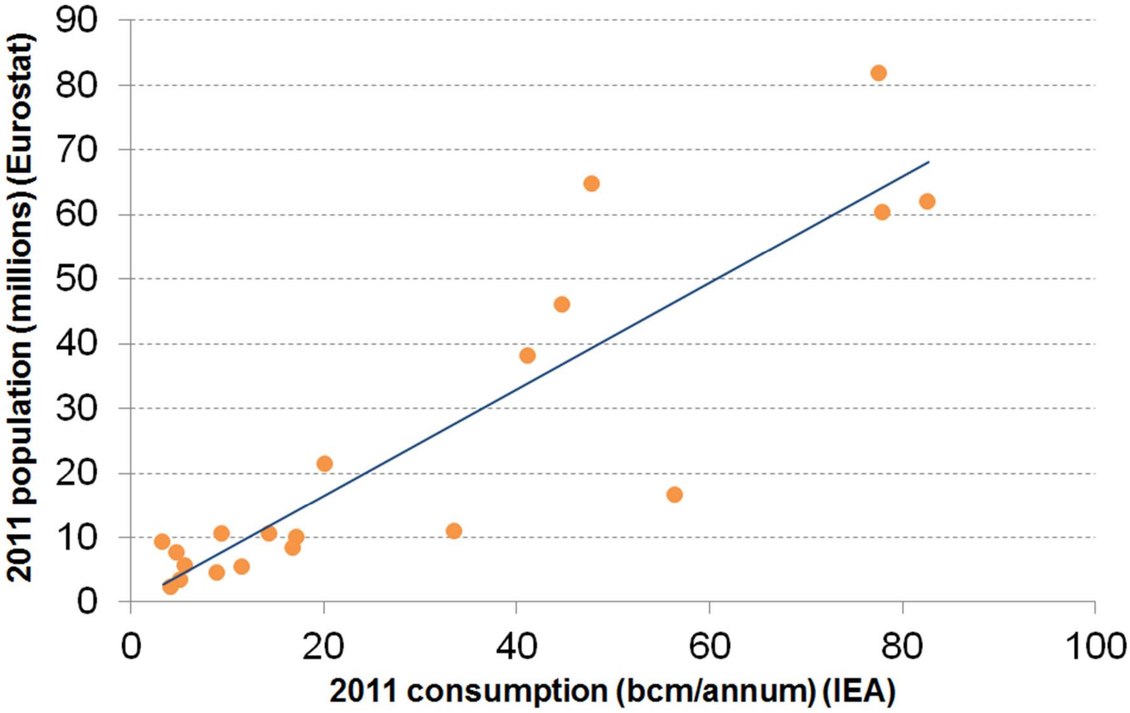
The approach we have adopted is potentially inaccurate because it assumes that there is a correlation between gas demand intensity and population density at a regional level. This introduces two potential sources of error.

- The actual location, within a transmission network, of demand to serve a population might be dislocated from the population if there is a significant distance of further transportation (i.e. distribution) required.
- The location of a storage facility within a transmission network might be dislocated from the identified geographical location of the storage, where there is a dedicated connection pipeline that forms part of the storage facility.

These sources of potential error can only be corrected through a more detailed examination of the physical layout of Europe's gas network and the location of storage connections and demand within it. This would require a level of detail which we understand is beyond the level of detail modelled by ENTSOG in the Ten Year Network Development Plan.

From a European perspective, we believe that such an enhanced level of detail would not change the conclusions we have drawn as because we have drawn our conclusions from the resultant averages – correction would produce both there will be both positive and negative changes to the underlying dataset, having little impact on the results of the analysis. We also note that, from a European perspective and an examination of Member State level data, there is a clear correlation between population and demand (which shows a correlation coefficient of 0.891). This relationship is demonstrated in Figure 8 below.

Figure 8 – Member State population and demand



Source: Eurostat, IEA

A.3.2 Accuracy of data

Because of the short period of time available for us to undertake this analysis, we have been unable to undertake an exercise to validate our dataset. We are aware that some of the gas storage facilities' locations held within our database have been estimated based on commercial intelligence, and have not been previously validated. This could introduce a small amount of erroneous locational data. We believe that the potential impact of this is mitigated through the use of all three NUTS resolutions and the various averaging techniques.

A.4 Conclusion

The analysis above provides strong support for our hypothesis that European gas storage is located close to Europe's population. We therefore conclude that, assuming the population is collocated with gas demand, Europe's gas storage facilities are close to demand. Gas storage therefore provides support to the European gas transmission network and, in aggregate, alleviates transmission capacity requirements.

QUALITY AND DOCUMENT CONTROL

Quality control		Report's unique identifier: 2011/600
Role	Name	Date
Author(s):	Angus Paxton	November 2012
Approved by:	Matt Brown	November 2012
QC review by:	Beverly King	November 2012

Document control			
Version no.	Unique id.	Principal changes	Date
v1_0	2011/600		November 2012
V2_0	2011/600		November 2012

Pöyry is a global consulting and engineering firm.

Our in-depth expertise extends to the fields of energy, industry, urban & mobility and water & environment.

Pöyry plc has c.7000 experts operating in 50 countries and net sales of EUR 796 million (2011). The company's shares are quoted on NASDAQ OMX Helsinki (Pöyry PLC: POY1V).

Pöyry is Europe's leading management consultancy specialised in the energy sector, providing strategic, commercial, regulatory and policy advice to Europe's energy markets. The team of 200 energy specialists, located across 14 European offices offers unparalleled expertise in the rapidly changing energy sector.

Pöyry Management Consulting

King Charles House
Park End Street
Oxford, OX1 1JD
UK

Tel: +44 (0)1865 722660
Fax: +44 (0)1865 722988
www.ilexenergy.com
E-mail: consulting.energy.uk@poyry.com

PÖYRY

Pöyry Management Consulting (UK) Ltd, Registered in England No. 2573801
King Charles House, Park End Street, Oxford OX1 1JD, UK

www.poyry.com