RESEARCH INTO GAS FLEXIBILITY SERVICES

METHOD DECISION FLEXIBILITY SERVICES 2011

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1 Introduction and Summary

The Dutch Gas Act stipulates that, if GasTerra has a dominant position in the market for flexibility services, the national operator of the gas transmission network (Gastransport Services or GTS), must offer flexibility services to shippers.[1] GasTerra is also obliged to make GTS an offer for the requested flexibility services based on 'reasonable' tariffs and conditions.

The Dutch Gas Act specifies that the *NMa Energiekamer* (NMa) is responsible for determining whether GasTerra has a dominant position in the market for flexibility services at regular intervals. Specifically, the focus is on short-term flexibility products that would be offered to manage differences in supply and demand over the following week, as opposed to seasonal flexibility which manages differences between demand in the summer and the winter. NMa carried out the last assessment in 2008 for the period 2009 - 2011 inclusive, based on advice from Frontier Economics summarised in a 2008 report (hereafter referred to as 'the 2008 Report').[2] The NMa concluded that GasTerra was dominant in this period.

In 2011 the NMa must assess whether GasTerra has a dominant position in the market for flexibility services for a three to five year period starting in 2012. The NMa has chosen to analyse the period 2012-2016 inclusive, and has retained *The Brattle Group* to analyse GasTerra's position in the flexibility market over this period. This report summarises out findings, and is intended for consultation. A final version of the report will be issued following the consultation.

The starting point for our analysis is the method the NMa applied to assess GasTerra's dominance in 2008 (hereafter referred to as the '2008 Methodology'). In our report we highlight where our methodology differs from or extends the 2008 Methodology. For a general description of the Dutch gas market we refer reader to the 2008 Report. However, it is worth highlighting that a number of changes occur in the period 2012 – 2016 which affect the flexibility market. These include:

- The construction of new gas storage facilities controlled by parties other than NAM/GasTerra;
- GasTerra's introduction of a relatively large amount of a virtual storage product, through which GasTerra makes flexibility available to third parties;
- The increase in import capacity as a result of Gas Transport Services open season process, which increases the ability of parties to import flexibility to the Netherlands;
- The decline of production from the Groningen field [deleted due to confidentiality].

[1] A new balancing system came into effect in the Netherlands in April 2011, which involves a balancing market or bid ladder. GTS will continue to offer a flexibility product in 2011 – the main difference being that shippers will nominate hourly values for the use of the flexibility service the day ahead. Shippers can re-nominate their use of the flexibility service within the gas day.

[2] Frontier Economics, 'Research into gas flexibility services' May 2008.

Simple market share analysis

We calculate GasTerra's share of all flexibility available to serve demand in the Dutch market. This analysis does not differentiate between the differences in costs of flexibility supply, but rather assumes that all sources of supply are substitutes for one another. The 2008 methodology referred to market shares calculated in this way as 'capacity shares'.

One key difference between our methodology and the 2008 Methodology is that we consider that flexibility dedicated to export contracts is controlled by the gas buyer outside of the Netherlands. Therefore this flexibility cannot be withdrawn by GasTerra, and is not under GasTerra's control. However, we also take the case that most flexibility sold in export contracts cannot be re-imported into the Netherlands at a competitive cost, because the gas is delivered outside of the Netherlands and buyers would have to find replacement sources for flexibility. Therefore the majority of the export flexibility is removed from the supply side of the market.

Our analysis reveals that:

1. Foreign gas buyers (exports) control a significant portion of Dutch flexibility;
2. GasTerra's new virtual storage product represents a significant portion of flexibility supply;
3. If we did not allocate control of some flexibility to exports, then GasTerra's share of the flexibility market would be about 60% in 2012.[3]

We calculate that GasTerra's market share starts at 46% in 2012, and the arrival of new sources of flexibility, in particular in 2014, reduce GasTerra's market share to just above 37% by 2016. The European Commission (EC) and the European Court of Justice (ECJ) would presume dominance, absent evidence to the contrary, if GasTerra's market share exceeded 50%. Therefore we conclude that, based on a simple, share of the supply-side of the market, GasTerra is not dominant in any of the years analysed.

A sub-market share analysis

The previous analysis assumed that all flexibility products are substitutes for one another, regardless of their costs. But a key idea in competition analysis and economics is that products are only considered substitutes if they have similar costs. Typically, economists and the EC itself would consider that if one source of flexibility was about 5% to 10% more expensive than another, then the two products would not be substitutes.

Ignoring the difference in the costs of alternative products can give very misleading impressions of a party's market position. A dominant player could claim that customers could rely on alternative products and so it does not have a dominant position. But if the alternative products are much more expensive than the products under the dominant player's control, then the dominant player could raise the price of flexibility significantly above the competitive level, even though its market share of all products seems to be small.

[3] Parties other than GasTerra also export gas, and so not all of the exports would be re-assigned to GasTerra in the event that we ignored foreign gas buyers' control of some Dutch sources of flexibility.

The 2008 methodology addressed the issue of the differences in costs between alternative flexibility sources qualitatively. Since, in 2008, it was clear that the simple market share analysis found GasTerra dominant, and that an approach which focused in costs in more detail would only enforce that conclusion, there was no need to investigate costs in more detail. However, because of recent developments in the flexibility market GasTerra's position in the market is not as clear. As we noted above, the simple market share analysis finds that GasTerra is not dominant, and therefore it is more important to address the differences in the costs between difference flexibility sources and the resulting sub-markets in more detail. Accordingly, in this analysis we take a more detailed quantitative approach relative to the 2008 methodology, and estimate the fixed and variable costs of alternative sources of flexibility. We then arrange the alternative sources of flexibility into ascending order of cost to form a supply curve or 'merit order'. The intersection of the merit order with the vertical demand curve yields the expected market price of flexibility. We define the demand side of the market as the difference between maximum gas demand in any given week less the average gas demand over a season – meaning that there are 52 demand points and prices for each year in our analysis.

We also recognise that the supply of short-term flexibility will vary over the year. In winter, sources of gas will already be producing at a higher rate and so there will be less scope for them to increase production further. Accordingly the supply of short-term flexibility will be less in winter than in summer, while the data shows that the demand for short-term flexibility is higher in winter than in the summer. We define a separate winter supply curve and a summer supply curve. This approach will tend to over estimate supply in the height of winter, and underestimate supply in the shoulder periods. But on average it will give an accurate representation of how the potential to exercise market power varies over the year, while keeping the analysis tractable.

Having derived merit orders for each year, and defined demand, we carry out an analysis of 'sub-markets' within the flexibility market for each of the 52 weeks in each year under analysis. For each week, rather than including all sources of supply, regardless of cost, we only include flexibility products that are no more than 10% more expensive that the competitive price of flexibility in the week being considered. That is for each week we define the relevant product market in that particular week to include all flexibility services with costs less than or equal to 1.10 times the market price defined by the intersection of supply and demand. The 10% boundary to define relevant markets is typically applied in competition analyses by the European and US regulatory and antitrust authorities. The intuition behind making this distinction is that sources of supply which are much more expensive that the marginal source of supply do not apply a significant competitive constraint on the dominant supplier. Even large quantities of expensive capacity would not restrict the dominant player from raising prices by 5-10%.

Our analysis confirms that the simple market share analysis[4] underestimates GasTerra's actual market shares. Between 2012 and 2016 GasTerra has at least 50% market share for about 85% of the time. GasTerra has higher market shares largely in the summer months where GasTerra has total control of the very cheap flexibility from the Groningen field. [deleted due to confidentiality].

[4] In the simple market share analysis we estimate the shares of all available suppliers of flexibility services, regardless of the cost to provide those services.

That is not to say that GasTerra only has a high market share in the summer – GasTerra also has market shares of over 50% in many of the winter weeks.

We also perform a pivotal supplier test (PST), using the same 110% rule to define the relevant product market as used in the sub-market share analysis. If demand for flexibility cannot be satisfied without at least some contribution from GasTerra, then GasTerra is pivotal. The PST accounts for a situation where there is an excess of supply over demand, in which case a firm might be dominant, in the sense that it controls a large percentage of available supply, but it would be unable to exercise market power. We find that GasTerra is pivotal around 84% of the time for the period 2012-2016. GasTerra becomes slightly less pivotal over time as new sources of third-party supply come online [deleted due to confidentiality].

Withholding analysis

In our final piece of analysis we perform a 'withholding analysis'. The withholding analysis measures GasTerra's ability and incentive to raise prices by withdrawing capacity from the market. In economic terms, the withholding analysis determines not only whether the dominant player has the ability to raise prices – which the pivotal supplier test determined – but whether it has the incentives to do so. Accordingly the withholding analysis is the most complete test of the risk of market power abuse, and is commonly used in the analysis of market power in energy markets.

To determine whether GasTerra has the ability and incentive to withhold capacity, we calculate the initial profit that GasTerra makes on flexibility services as the difference between its cost of flexibility and the prevailing price multiplied by the volume of services sold. We then gradually withdraw GasTerra's flexibility from the market – starting with the most expensive capacity first – and calculate both the effect on the price of flexibility and on GasTerra's profits. An ability by GasTerra to profitably raise the price of flexibility services by more than 10% above the competitive level is evidence of GasTerra's ability and incentive to exercise market power.

We find that in 2012 GasTerra would have the incentive and ability to raise prices by more than 10% above the competitive level for 2012 for 83% of the time. Additional sources of flexibility restrain GasTerra's market power later in the period, but even so GasTerra has the incentive and ability to raise prices by more than 10% nearly 70% of the time.

Conclusions

A simple market share analysis indicates that GasTerra may not be dominant between 2012 and 2016. However, this simple analysis underestimates GasTerra's actual market power because it assumes that some products are close substitutes when in reality they are not. Therefore the actual market is often much more concentrated than this simple analysis suggests.

Based on a more sophisticated analysis, which accounts for both the differences in costs of difference sources of flexibility and the varying demand and supply of flexibility over the year, we conclude that even in 2016, when the market has benefited from new third party sources of flexibility, GasTerra is dominant for about 85% of the time. Similarly, GasTerra has the incentive and ability even in 2016 to withhold capacity and raise prices by more than 10% about 70% of the time.

We also note that our results are robust to changes in the input assumptions. We have re-calculated the results making different assumptions regarding the cost of gas storage and assuming a demand increase of 10%. In all the scenarios GasTerra has a market share of at least 50% for about 70% - 80% of the time.

2 The flexibility market

To determine GasTerra's position in the market, we must first define the relevant market. This means determining the group of flexibility products and the geographic areas that place competition limitations to GasTerra. This section provides an overview of the flexibility products and geographical areas we are analysing and some of the main questions and issues to resolve before we go further.

2.1 Product market definition

As in the 2008 Methodology, we begin by analysing the relevant product market, and in particular the potential sources of flexibility products. These include:

- Interruptible demand – for example a power station that can make more gas available at short notice by either interrupting production or switching to burning oil;
- Gas storage;
- Production flexibility – in this category we differentiate further between;
    - Production flexibility from the Groningen field. This is in turn split between 'free-flow' flexibility, that is gas flexibility using the natural pressure of the reservoir, and compression flexibility, which is provided by well-head compression.
    - Production flexibility from smaller onshore and offshore fields.
- Import flexibility – typically import contracts allow the gas buyer to vary their purchases from day to day, and are therefore a source of flexibility;
- Line pack – the volume of gas in the pipelines can be varied to provide some flexibility.

These sources of flexibility are very similar to those considered by the UK's Office of Fair Trading (OFT)'s advice to the UK Competition Commission in a recent case involving the analysis of flexibility.[5] We describe how we measure flexibility in section 3.1.

Note that we do not consider the Dutch gas market (TTF) as an additional source of physical flexibility. At the point of delivery, a purchase of gas on the TTF must always be provided by one of the underlying physical sources of gas flexibility listed above. While the TTF helps allocate flexibility sources among buyers in an efficient way, it does not provide a net contribution to flexibility supply.

2.2 Long-term and short-term flexibility

We note that the Gas Act only requires the NMa to regulate 'short-term' flexibility products of one week or less – that is, flexibility that a shipper could use for at most one week. This has

[5] The OFT's advice to the Competition Commission on Centrica plc's request for a review of undertakings under section 88(4) of the Fair Trading Act 1973 given on 8 September 2010, ¶20 p.6.

implications for which sources of flexibility are considered on the supply side of the market. For example, some flexibility sources – typically interruptible demand – can only be used for relatively short periods, whereas some gas storages provide seasonal flexibility over an entire winter. We conclude that since long-term flexibility can also be used to provide short-term flexibility, then we will include both long-term and short-term flexibility products in the supply side of the market. This is in line with the 2008 Methodology.

Flexibility products typically supply the ability to go long or short for an hour and the ability to have cumulative imbalances. Our analysis focuses on the provision of hourly flexibility, since hourly flexibility products can, in general be added together to enable a cumulative shortage. The exception to this is interruptible capacity, and line pack, neither of which can be used for extended periods. However, we note that for interruptible capacity several different users could be interrupted alternately to create a cumulative product.

The 2008 Methodology addressed the question of whether there was a separate market for 'unpredictable' and 'predictable' flexibility. The 2008 Methodology defined predictable flexibility as the flexibility required to meet expected increases or decreases from average demand – for example higher gas demand in winter. Arguably a short-term flexibility product is typically used for unpredictable flexibility needs. The 2008 Methodology concluded that these unpredictable and predictable flexibility products were substitutes, and could be treated as a single source of demand.

2.3 Upward and downward flexibility

Flexibility sources can also provide downward flexibility – that is, they can reduce their output at the request of a shipper who is 'long'. This raises the question – are there separate product markets for upward flexibility (requested by a shipper who is 'short') and downward flexibility (requested by a shipper who is 'long')?

We think that the supply of downward and upward flexibility by differ, and so these are likely to be separate product markets. However, we also note that if GasTerra is dominant in either the upward or downward flexibility markets, then GTS will offer a flexibility product that delivery both upward and downward flexibility. That is, the requirement for GTS to offer a flexibility product will address market power issues in both the market for upward flexibility and the market for downward flexibility. Accordingly, we first analyse the market for upward flexibility. If GasTerra is not dominant in that market then we will go on to analyse the downward flexibility market.

2.4 H-gas and L-gas

There are several different gas qualities defined in the Netherlands, broadly split into high-calorific value gas (H-gas) and low calorific value gas (L-gas). The 2008 Methodology considered both separate H-gas and L-gas markets and a combined market. Since the 2008 Report, the cost of converting from H-gas to L-gas has been rolled into the general tariffs for gas transport, so that the cost of quality conversion has been socialised. Shippers can convert between L-gas and H-gas at zero incremental cost. Therefore, in this analysis we consider a single market, and in general we do not differentiate between L-gas and H-gas flexibility.

We describe an exemption to this 'single market' treatment latter in the report, where we do consider L-gas and H-gas separately for the purposes of deciding which exports use which sources of flexibility.

2.5 Geographic market definition

We adopt the same geographic market definition as the 2008 Methodology. To summarise, the balancing area defined by GTS extends across the Netherlands, and GTS calculates shippers' imbalances across the entire network. Therefore there are no geographic submarkets for flexibility within the Netherlands – flexibility services can be delivered from anywhere as long as they connect to the GTS system.

Because there are gas transportation constraints on the border, the Dutch border defines the limit of the relevant geographic market for the analysis. This was also the approach taken by the 2008 Methodology. Defining the Netherlands as the relevant geographic market does not mean that we exclude the import and export of flexibility. Rather, it means that it would not be correct to assume that, for example, shippers in the Netherlands can use German storages to provide flexibility without accounting for gas transport constraints. However we do account for the possibility to import flexibility from outside of the Netherlands. Our assessment of the extent of import flexibility is based on historic gas-flow data and an assessment of how import capacity will increase in future. We also consider storages that are physically outside of the Netherlands but have a dedicated connection to the GTS network as being within the Netherlands for the purposes of this study.

3 Simple market share analysis

3.1 Measuring the supply of flexibility

As a first step we calculate GasTerra's share of the supply side of the market, ignoring differences in the cost or price of different flexibility services. In common with the 2008 Methodology we calculate the supply of flexibility as the maximum less average production. The logic is that this measure would give the average ability of these production sources to increase their production at short notice. Note that for gas storages this definition means that flexibility is approximately equal to the withdrawal capacity of the storage.

As noted in the 2008 Report assessing GasTerra's dominance, the use of a maximum less average definition of flexibility was first defined in the UK Competition Commission's (CC) 2003 investigation of Centrica's acquisition of the Rough storage facility in the UK.[6] In April 2010 Centrica asked for a review of the conditions imposed upon it by the CC following its acquisition of Rough. In reviewing Centrica's request, both the CC and the OFT carried out a new assessment of

[6] The Competition Commission, Centrica plc and Dynegy Storage Ltd and Dynegy Onshore Processing UK Ltd – A report on the merger situation, August 2003 (hereinafter 'the 2003 Report').

the UK flexibility market.[7] Both the OFT and the CC continued to use the product market definitions applied in the 2003 Report. Moreover, since 2003 a two UK gas storage projects have applied for exemptions from Third Party Access, and the GB energy regulator, Ofgem, has analysed the effect of the exemption applications on competition using the CC's 2003 methodology for defining competition.[8] At the same time, it is worth stressing that in this report we are analysing a short-term flexibility product. Therefore some of the product markets analysed in the Centrica case – for example a winter period market – will not be relevant to this analysis.

Imports are also a source of flexibility, and we calculate the amount of import flexibility again taking the maximum less average level of imports. All calculations are based on hourly gas flow data provided by the NMa for 2009. NMa also provided data back to 2006, but we took the view that it was better to use the most recent data available rather than an average of several years, this is because Dutch gas production is declining over time, and so using an average of several years would over estimate the amount of flexibility currently available.

GTS no longer offers line pack as a separate flexibility product – rather GTS uses line pack to manage the system and avoid recourse to the Balancing Bid Ladder or BPL. Therefore we do not include line pack on the supply side of the market, since the effect of line pack is to reduce the demand for flexibility services. In the analysis described in the following sections we account for the presence of line pack on the demand side.[9] Similarly, we do not include GTS's Maasvlakte LNG facility in our analysis, because GTS does not offer this to the market as a commercial service. Rather the Maasvlakte LNG facility is only to be used to preserve system pressure under exceptional circumstances.

Flexibility defined as the maximum less average production is a proxy for, on average, how much a field could increase production at a given moment to provide flexibility. This is if course a simplification. The amount that a gas source can increase production is conditional on what it already producing. The maximum production of gas storage facilities in particular depend on how full they are. Nevertheless, since all sources should be producing more gas at the same time – for example in winter – this simple approach should provide a good approximation of the relative ability of any supply to provide flexibility at a given time. Moreover later in the analysis we will relax this assumption, and account for the fact that the supply of flexibility varies between summer and winter.

For each source of flexibility supply, we calculate the quantity of flexibility available and who controls it. We also recognise that GasTerra has recently replaced the 'bundles' of storage that it

[7] See Competition Commission, Provisional decision on variations to the Undertakings, 8 March 2011 and the OFT advise *loc. cit.* footnote 5. Both available from: http://www.competition-commission.org.uk/inquiries/ref2010/centrica_review/index.htm

[8] See Final Decision EDF Energy application for an exemption from section 19B of the Gas Act 1986 - (Reference number: 65/10) and Final Decision on Storengy UK Limited's application for an exemption from section 19B of the Gas Act 1986 - (Reference number: 155/09) available at www.ofgem.gov.uk.

[9] We aware that the amount of line pack available varies over the year, and reduces at lower temperatures. However in our analysis we assume a constant level of line pack. This will tend to underestimate GasTerra's ability and incentive to exercise market power.

used to offer in Grijpskerk and Alkmaar and instead replaced it with a larger volume of a virtual flexibility product. We assume that the full volume of flexibility product is controlled by parties other than GasTerra, and that GasTerra provides the product using existing sources of flexibility under its control, such as the Groningen field, Grijpskerk, Alkmaar and Norg gas storages. Appendix I provides details of how we calculate the volume and ownership of flexibility.

3.2 Treatment of exports

A key difference between our methodology and the 2008 Methodology is the treatment of exports. There are two key issues:

1. Flexibility dedicated to export contracts is controlled by the gas buyer outside of the Netherlands.

2. We take the case that the majority of flexibility sold in export contracts cannot be re-imported into the Netherlands at a competitive cost. Therefore most export flexibility is removed from the supply side of the market.

With respect to the first point, we note that gas is typically exported under long-term contracts. This is certainly true for GasTerra's exports. These long-term contracts typically contain a given amount of flexibility or 'swing' that the gas seller is obliged to provide on demand of the gas buyer. Therefore, the flexibility is under the control of the gas buyer, not the gas seller. Note that it is the length of the export contracts – which are typically 10-20 years if not more – that transfer the control of flexibility, implying that GasTerra could not withdraw flexibility sources dedicated to serving the export market, in an attempt to increase market prices in the Netherlands.

For example, if a power station sells power to a customer for the next day only, we would not consider that the customer controls the power station. The owner of the power station could easily withdraw the offer to sell power the following day, thereby increasing prices. But if the power station signs a 20 years contract with a customer, under which the customer can chose how much power it receives every day, then it is the customer that controls the power station from the point of view of market power analysis. The length of the contract determines control.

To account for control of export flexibility by foreign gas buyers we:

- Calculate the export flexibility demand for GasTerra and non-GasTerra shippers based on data provided by NMa. Again, export flexibility demand is defined as maximum exports less average exports. We base this calculation on gross exports – that is, the physical exports observed plus backhaul volumes. Gross exports represent the demand for export flexibility, without accounting for the re-import of some flexibility (discussed below);

- Allocate export flexibility demand between GasTerra and other shippers, again based on data provided by NMa.

In essence, the effect is that some of the flexibility sources that appear to be under the control of GasTerra are actually under the control of gas buyers outside of the Netherlands. Allocating control of a given amount of flexibility to gas buyers reduces GasTerra's market share, relative to the 2008 Methodology. We calculate the amount of flexibility associated with GasTerra's export contracts, and deduct this from flexibility owned or contracted to GasTerra. Similarly we calculate

the flexibility associated with non-GasTerra shipper export contracts, and deduct this from sources of flexibility not belonging to GasTerra.

With regard to the second point above, we consider that while the gas buyers control the flexibility, it would not be practical in most cases for these foreign gas buyers to use that flexibility in the Netherlands. We understand that the point of delivery of the majority of export contracts is outside of the Netherlands. To use flexibility in the Netherlands, the customers would have to bring the gas back into the Netherlands. This would involve buying back-haul capacity which is non firm. It also assumes that the customer could replace the GasTerra flexibility with another source of flexibility at some acceptable price.

To form an estimate of how much flexibility is re-imported into the Netherlands, we have looked at data on back-haul flows provided by NMa, and calculated the flexibility associated with back-haul flows. We then take the case that this is the flexibility which is re-imported into the Netherlands, and this flexibility is added to the supply side of the market.

Export flexibility that is not re-imported cannot exert a competitive constraint on GasTerra in the Dutch flexibility market – in effect this flexibility does not reside in the Dutch geographic market. Therefore after allocating control of a given amount of flexibility to foreign gas buyers we then remove this flexibility from our market share calculation. The effect is to reduce the supply of flexibility relative to the 2008 methodology. To give a sense of the numbers, in 2009 export flexibility was about 5.9 million cubic metres per hour, whereas re-imported back-haul flexibility is about 0.8 million cubic metres per hour.

One could argue that, if GasTerra attempted to increase the price of flexibility, an increasing volume of flexibility under the control of foreign buyers would be re-imported into the Netherlands via back-haul nominations. Under this view, assuming that the amount of flexibility which is re-imported into the Netherlands is fixed will underestimate the actual competitive constraint. On the other hand, if more flexibility was re-imported into the Netherlands, the buyers would need to find alternative sources of replacement flexibility in their domestic markets at some higher price. We take the case that such replacements would be sufficiently expensive that it would be highly speculative to assume a significant increase in re-imported flexibility in response to an increase in the price of flexibility within the Netherlands.

One could also take the view that, since the delivery point is outside of the Netherlands, GasTerra could export gas at a steady rate and then use foreign flexibility products to meet the flexibility needs of its customers. In this way GasTerra would maintain control of the domestic flexibility sources.

However, the historic data on exports illustrates that this is not what GasTerra does in reality. Accordingly, our assumption that GasTerra exports flexibility from within the Netherlands matches the current facts. Moreover, it is worth noting that if we made the opposite assumption – that GasTerra sources flexibility for foreign buyers from outside of the Netherlands – then this would increase GasTerra's market share, relative to a case where we assume that GasTerra uses domestic sources of flexibility to meet the demands of foreign buyers.

3.3 Allocation of control of flexibility

Figure 1 shows the allocation of control of flexibility products in the Netherlands for 2012. Note that these percentages are *not* market shares – since exports are not part of the relevant product market and thus they will be removed from our market share calculation. Figure 1 illustrates three key points:

1. Foreign gas buyers (exports) control a significant portion of Dutch flexibility (about 28% of the total sources of flexibility);
2. GasTerra's new virtual storage product represents a significant portion of flexibility supply (around 6%);
3. GasTerra exports the vast majority of gas from the Netherlands. Therefore, based on Figure 1, we see that if we did not allocate control of some flexibility to exports, then GasTerra's share of the flexibility market would be about 61% in 2012.[10]

Figure 1: Allocation of control of flexibility supply in percentage terms, 2012

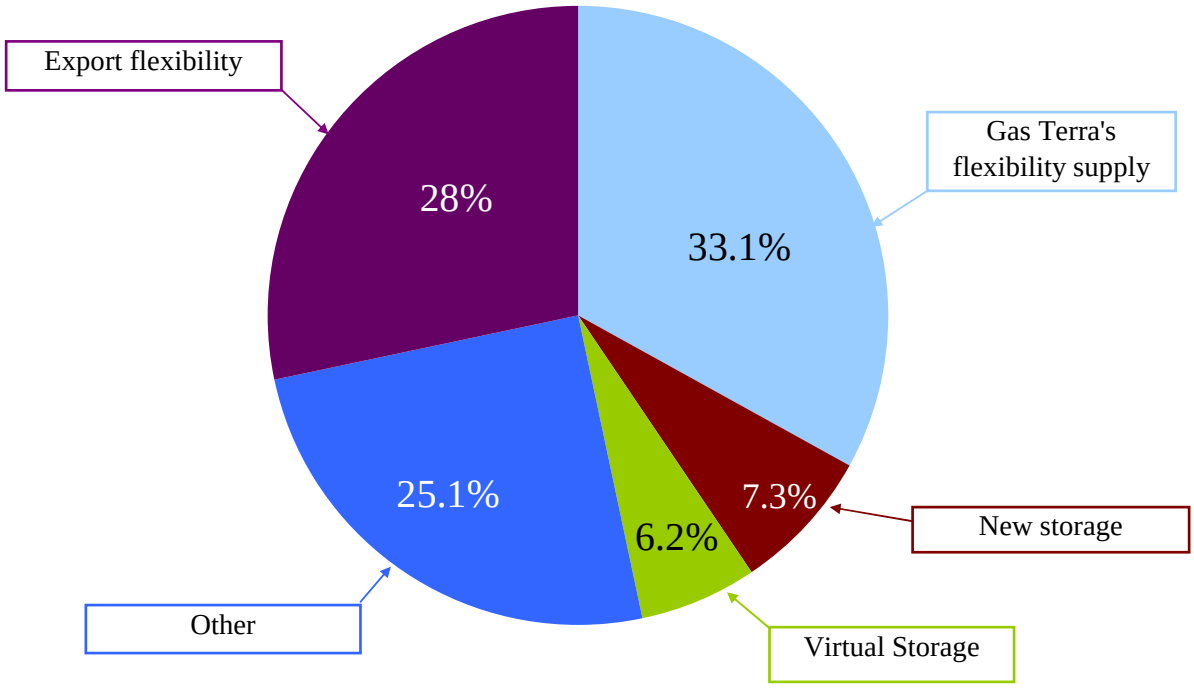
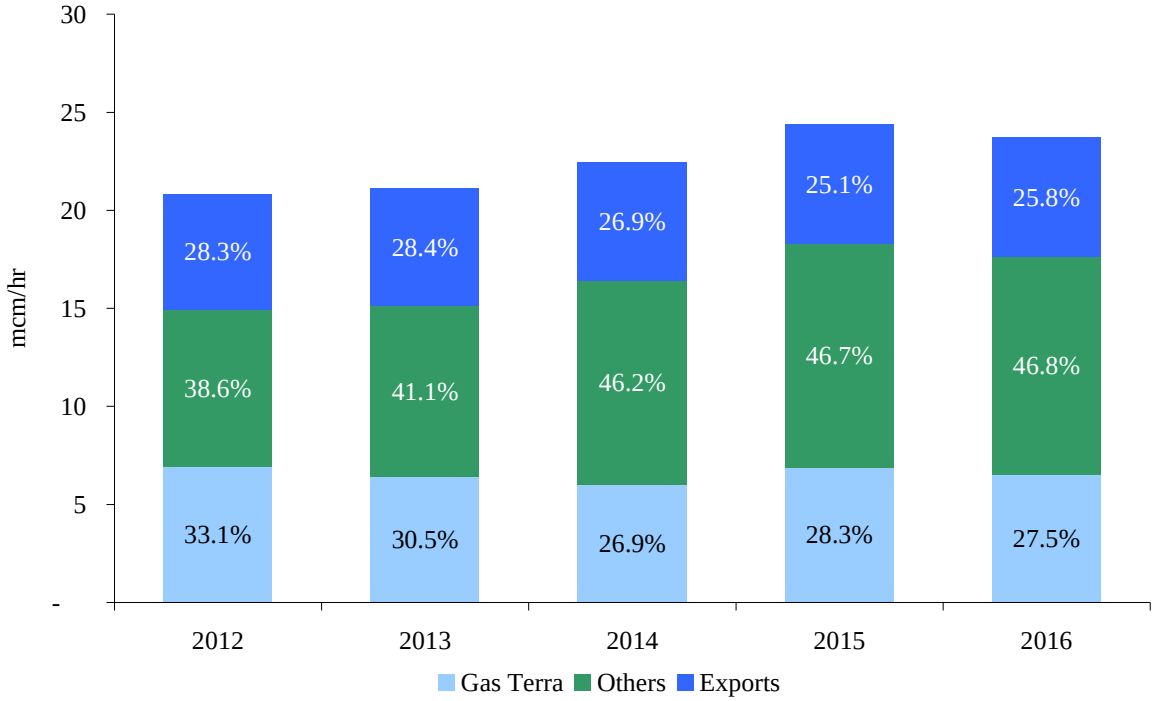


Figure 2 illustrates the absolute supply of flexibility, measured in million m^3/hour, for the period 2012 to 2016 and the control of flexibility. Again, this chart does *not* represent market shares, since it includes exports. In 2015 the supply of flexibility increases largely due to the

[10] Parties other than GasTerra also export gas, and so not all of the exports would be re-assigned to GasTerra in the event that we ignored foreign gas buyers' control of some Dutch sources of flexibility.

expected completion of the Bergermeer and Zuidwending (Nuon) gas storages and the expansion of the Norg storage facility.

Figure 2: Allocation of control of flexibility supply, 2012-2016



3.4 Results of simple market share analysis

The EC and the ECJ concede that a company with less than a 50 percent share of the relevant market is unlikely to be dominant.[11] It is generally accepted that firms with market share below 25 per cent are unlikely to be dominant.[12] More recently, in its 2009 Guidance Paper on the application of Article 82 EC Treaty to exclusionary abuses of a dominant position the EC has taken a more cautious approach to market shares as a proxy for market dominance. It offers a soft 'safe harbour' in stating that market dominance is not likely if the undertaking's market share is below 40 percent in the relevant market.[13] For the purpose of our analysis, and conservatively, we presume dominance, absent evidence to the contrary, if GasTerra's market share exceeds 50%.

[11] See European Commission Directorate General on Competition (2005). *DG Competition Discussion Paper on the Application of Article 82 of the Treaty to Exclusionary Abuses*. December. ¶ 31, hereinafter, the "Discussion Paper"; and European Court of Justice (ECJ) judgment of 3 July 1991, C-62/86, *AKZO Chemie* v. *Commission*, [1991] ECR I-3359, ¶ 60.

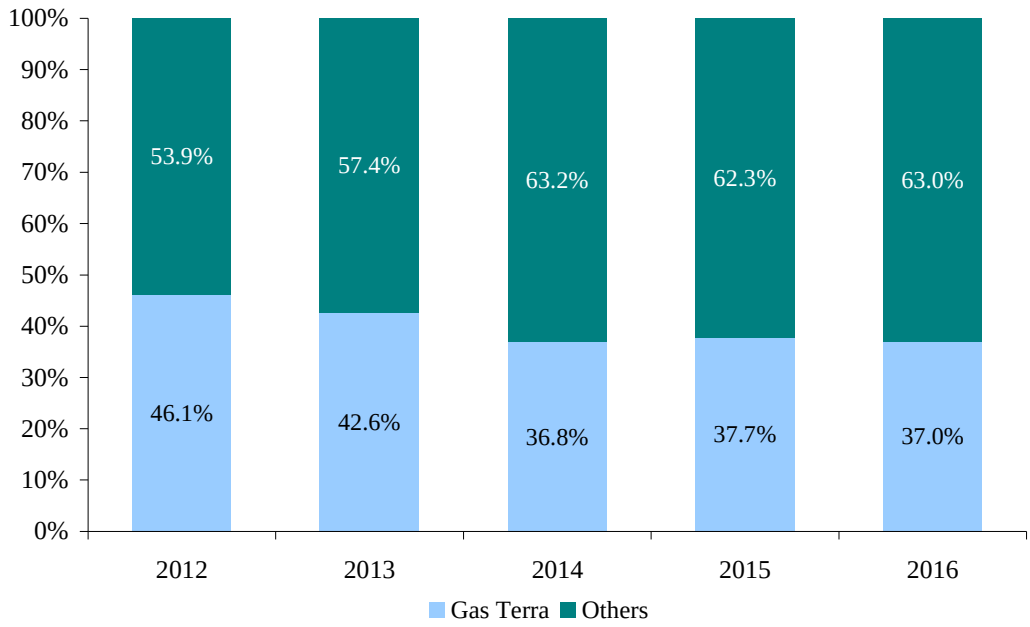
[12] See Discussion Paper, ¶ 31.

[13] See Communication from the Commission C (2009) 864 final — Guidance on the Commission's Enforcement Priorities in Applying Article 82 EC Treaty to Abusive Exclusionary Conduct by Dominant Undertakings, ¶ 40.

Figure 3 illustrates calculated market shares once exports which are not re-imported via backhaul have been removed from the market. The figure shows that GasTerra's market share starts at just above 46%, and the arrival of new sources of flexibility, reduces GasTerra's market share to close to 37%. Therefore we conclude that, based on a simple share of the supply-side of the market, GasTerra is not dominant in any of the years studied.

Note that in the 2008 methodology, what we refer to as 'simple market shares' were called 'capacity shares' (as opposed to market shares). The distinction between market shares and capacity shares in the 2008 methodology is similar to the distinction we make here between simple market shares and more sophisticated market share calculations which we discuss in the following sections.

Figure 3: Market shares of flexibility supply (capacity shares), 2012-2016



GasTerra's 2012 market has fallen relative to GasTerra's market share calculated for 2011 in the 2008 investigation.[14] This is for several reasons:

- The allocation of control of export flexibility to foreign gas buyers in this analysis will have reduced GasTerra's market share relative to the 2008 Methodology;
- GasTerra has sold a relatively large volume of its new virtual flexibility product to third parties. This has further reduced its market share;
- Import capacity and the potential for imported flexibility increases over the period 2012 to 2016. [deleted due to confidentiality].

[14] 2008 report, Table 3 p. 31 for the GTS case (i.e. combined H and L gas market case).

On the other hand, removing exports will increase GasTerra's market share, relative to the 2008 methodology where exports were considered as part of the market. This is because, as Figure 2 shows, GasTerra controls about 27% of flexibility supply in 2014-2016, while exports control about 26%. However, this effect does not fully offset the other effects above, and overall GasTerra's market share decreases relative to the market share calculated in the last methodology for 2011.

4 Cost differentiation

4.1 Relevant market definition and cost of flexibility services

The simple market share analysis in section 3 assumed that all flexibility products are substitutes for one another. Thus, we estimated the shares of all available suppliers of flexibility services, regardless of the cost to provide those services. But a key idea in competition analysis and economics is that products are only considered substitutes if they have similar costs. Typically, economists would apply the 'Small but Significant and Non-transitory Increase in the Price' or SSNIP test to establish if two products are part of the same relevant market. The question to be answered by the SSNIP test is whether the firm's customers would switch to readily available substitutes in response to a hypothetical small (in the range 5 % to 10 %) but permanent relative price increase in the products being considered. If substitution were enough to make the price increase unprofitable, additional products are considered substitutes and must be included in the relevant product market. The products included in the market increase until the set of products is such that small, permanent increases in relative prices would be profitable. Roughly speaking, if one source of flexibility was about 5% to 10% more expensive than another, then the two products would not be substitutes.

Specifically, the Commission' guidelines on market definition note that:

> "[t]he assessment of demand substitution entails a determination of the range of products which are viewed as substitutes by the consumer……The question to be answered is whether the parties' customers would switch to readily available substitutes or to suppliers located elsewhere in response to an hypothetical small (in the range 5%-10%), permanent relative price increase in the products and areas being considered."[15]

In other words, the European Commission regards two products – which obviously perform similar functions – priced within 5-10% of each other as reasonable substitutes.

Ignoring the difference in the costs of alternative products can give very misleading impressions of a party's market position. A dominant player could claim that customers could rely on alternative products and so it does not have a dominant position. But if the alternative products are much more expensive than the products under the dominant player's control, then the dominant player could raise the price of flexibility significantly above the competitive level, even though its market share seems to be small. In reality, the player could have a dominant position in the market for 'cheap' flexibility products, and would be able to raise the price of these products to the level of the 'expensive' flexibility products. Traditional market concentration measures – for example

[15] Commission notice on the definition of the relevant market for the purposes of Community competition law. Published in the Official Journal: OJ C 372 on 9/12/1997.

market shares and concentration ratios – can also be imperfect measures of potential market power.[16]

The 2008 methodology addressed the issue of the differences in costs between alternative flexibility sources qualitatively. Since, in 2008, it was clear that the simple market share analysis found GasTerra dominant, and that an approach which focused in costs in more detail would only enforce that conclusion, there was no need to investigate costs in more detail. However, because of recent developments in the flexibility market GasTerra's position in the market is not as clear. As we noted above, the simple market share analysis finds that GasTerra is not dominant, and therefore it is more important to address the differences in the costs between difference flexibility sources and the resulting sub-markets in more detail. Accordingly, in this analysis we take a more detailed quantitative approach relative to the 2008 methodology and calculate market shares taking into account the price of different types of flexibility products. Unlike in the simple market share analysis, in which the relevant market included all flexibility products available regardless of the costs, we now define the relevant product sub-market to include only flexibility services at costs less than or equal to 1.10 times the market price defined by the intersection of supply and demand at each week of the year. The 10% boundary to define relevant markets is typically applied in competition analyses by the European and American regulatory and antitrust authorities.

4.2 Determining the merit order

Our methodology assumes that the price of flexibility services will, in a competitive market, be related to the cost of providing flexibility services.

An alternative approach would be to think about the opportunity cost of various flexibility sources, instead of the capital and operating costs. That is, if a flexibility source produces gas today, it might sacrifice the opportunity to produce that gas at a later date when prices are higher. The difference between the current price and the future high price of gas is the opportunity cost, ignoring the time value of money.

There are two reasons not to apply this opportunity cost approach when analysing GasTerra's position in the market. First, when analysing a dominant position or potentially dominant position the correct approach is to estimate the level of competitive prices. Using actual market prices, which is what is implied by an opportunity cost approach, could lead to an erroneous analysis of the product market. In particular, if the dominant party has already exercised market power, it may have raised the price of some products to a level where they appear to have substitutes, but this is only the case because the dominant firm has exercised market power.[17] While we do use the market

[16] See James Bushnell, (2005), "Looking for Trouble: Competition Policy in the U.S. Electricity Industry," Chapter 6 in *Electricity Restructuring: Choices and Challenges*. Puller and Griffen, Eds. University of Chicago Press., for a discussion of the limitations of concentration measures as indicators of market power in certain markets, for instance electricity markets.

[17] The classic example of this is the so-called 'cellophane fallacy', where a dominant manufacturer of cellophane claimed that aluminium foil was a suitable substitute product and occupied the same product market as cellophane, and that the cellophane firm was not dominant because it faced competition from makers of aluminium foil. However, in this example aluminium foil was only close to the price of cellophane because the dominant cellophane manufacturer had exercised market power. If cellophane was priced competitively, so at its long-rum marginal cost, it was clear that aluminium foil was not a substitute product and that the cellophane manufacturer was dominant.

price of gas storage in our analysis, this is mainly because there is significant uncertainty surrounding the cost of storage. We also perform a sensitivity where we only use the estimated cost of gas storage, and find that this does not affect our results.

Second, most sources of flexibility do not have an opportunity cost of providing upward flexibility. For example, if the Groningen field provides some upward flexibility, this does not limit the field's ability to produce gas later in the year.[18] Rather, there is a cost for the field in building and maintaining the capacity for providing flexibility, and it is this cost that we consider in our analysis. We also do not differentiate between the costs of the gas provided for different sources of flexibility, since this would be the same for all flexibility suppliers at a given moment in time.

There could be an opportunity cost for seasonal storage, which usually injects gas in summer and withdraws it in winter. As we discuss in section 4.3, we address the additional cost of seasonal storage switching from injection to withdrawal in the summer by adding a premium to the cost of upward flexibility from seasonal storages in the summer. One could argue that this premium does not fully cover the opportunity cost of storage, and that by producing gas in the summer the seasonal storage loses the ability to produce the gas when prices are higher in winter. There is some validity in this argument, but we also note that in equilibrium, the summer-winter gas price spread should be about the cost of a seasonal gas storage facility. If it was more than this, developers would find it profitable to build new storages so the summer-winter gas price spread would decrease, until it approximated the cost of seasonal storage, at which point no one would want to build more storage. Therefore we think that it is also appropriate to use the long-run cost of seasonal storage, even when we consider that seasonal storage facilities might have a opportunity cost to producing gas in the summer.

In sum, if one applied an opportunity cost approach to estimating the merit order we could find that a) the opportunity cost of all sources was zero, apart from seasonal storage which would have a positive price in the summer and b) the opportunity cost of storage in the summer may already have been affected by the exercise of market power. The use of a cost-based approach to defining the merit order avoids these problems, and is standard practise when analysing a dominant position.

In applying our cost-based approach, we have estimated the fixed and variable costs of alternative sources of flexibility. We then arrange the alternative sources of flexibility into ascending order of cost to form a supply curve or 'merit order'.

Differentiating flexibility sources by cost introduces two new issues. First we must decide whether to base the merit order only on variable costs,[19] or a combination of fixed and variable costs. In essence, this amounts to a question about how the market prices for flexibility might be

[18] Of course the production of any volume of gas will slightly reduce the production capacity of the field. In this sense, production of a volume in the summer will reduce the capacity of the field in the following winter, although the effect will be very small from one summer to the next winter. Moreover, this effect is completely or partially offset by the benefits of producing more gas earlier, which is more valuable since it accelerates revenues.

[19] To determine the expected variable cost of flexibility over the week – in other words how much one would expect to use each unit of flexible capacity over a week – for each week of 2009 we calculated the actual demand less average demand for each hour. We then added up all of these demand numbers, and divided this by the maximum flexibility demand in a week multiplied by the hours in a week to derive a weekly load factor for flexibility.

determined. One alternative is to imagine that the price is determined as in a competitive electricity market, where generators offer power at their marginal or variable cost. The most expensive plant required to satisfy demand sets the price, and infra-marginal plants recover their fixed costs from the difference between the market price and their variable costs.[20] Another option is to imagine that suppliers offer at their average costs, including their fixed costs. For all cases, we imagine the costs are defined over a week, so that the cost is the expected variable cost of flexibility over a week[21], and the annual fixed costs divided by 52.

We think that the use of total costs is more likely to represent the reality of the flexibility market. We observe that actual flexibility offers in the form of storage bundles are based on the total costs of flexibility. The use of total costs would be more common of a market in which flexibility is arranged bilaterally, rather than through a centrally cleared market. Bilateral deal-making seems to be the best characterisation of the Dutch flexibility market. According, we use a supply curve based on total costs.

The second concern related to the discussion on L-gas and H-gas. As we noted in section 2.4, it is free for shippers to convert from H-gas to L-gas, and so in general we do not distinguish between H-gas sources of flexibility and L-gas sources of flexibility. Moreover, in the simple market share analysis in section 3 we subtracted export flexibility demand from sources of GasTerra flexibility, but since we were not differencing sources of flexibility by cost it did not matter which sources of flexibility we deducted exports from, as long as the totals were correct.

However, we know that:

1. GasTerra is the only shipper that exports significant quantities of L-gas;
2. Based on analysis of the data, the demand for L-gas export flexibility is higher than that for H-gas flexibility;
3. The sources of L-gas flexibility include Groningen, one of the lowest cost sources of flexibility.

The facts above mean that a larger proportion of relatively cheap Groningen flexibility is under the control of foreign L-gas buyers than one would assume by ignoring the L-gas/H-gas distinction. As we will explain in more detail below, GasTerra's incentive to exercise market power depends partly on the cost of its flexibility sources. Therefore, mis-estimating the amount of cheap flexibility under the control of foreign gas buyers would over-state GasTerra's incentive to exercise market power.

[20] This is of course a simplification of how electricity markets work – in practise peaking plants also need a mechanism to recover their fixed costs.

[21] To determine the expected variable cost of flexibility over the week – in other words how much one would expect to use each unit of flexible capacity over a week – for each week of 2009 we calculated the actual demand less average demand for each hour. We then added up all of these demand numbers, and divided this by the maximum flexibility demand in a week multiplied by the hours in a week to derive a weekly load factor for flexibility.

To account for this, we calculate separate L-gas and H-gas export flexibility demand for GasTerra and non-GasTerra shippers – see Appendix I.7 for more detailed discussion of this point. We then deduct GasTerra's L-gas export flexibility demand from the three sources of L-gas flexibility – Groningen, Norg and Alkmaar, after allowing that some of this capacity will be used to provide the virtual storage product. This approach ensures that a realistic quantity of cheap Groningen flexibility is actually assumed to be controlled by foreign L-gas buyers.

In practice, the presence of quality conversion facilities mean that H-gas sources of flexibility can provide flexibility for some L-gas flexibility demand.[22] Therefore we assume that only about 80% of L-gas export flexibility demand is served by natural sources of L-gas flexibility, and converted H-gas provides the remaining 20%.

There is also some uncertainty regarding the price of some of the new gas storage facilities. We base the price of storage on the storage auctions carried out on the 26th and 27th April 2011. We also use this price for GasTerra's storages, since this is the opportunity cost of gas storage – that is to say, it is the price that GasTerra is giving up by choosing to use the storage for its own use rather than selling the capacity to third parties. For the new storages for which no market price data exists we use a bottom-up cost estimate. Appendix I shows details of all of the cost estimates used to build the merit order.

[deleted due to confidentiality] NAM and GasTerra are in effect largely vertically integrated, in the sense that GasTerra will make the same profit regardless of the price that it pays to NAM for using storage. Accordingly, one could take the view that the real price of storage for Gas/Terra/NAM is the cost of building the storage, rather than the tariff which GasTerra pays to NAM. To account for this and other uncertainties regarding the pricing of gas storage we have re-run the analysis using a bottom-up estimate of the cost of gas storages for all storages. Appendix III shows these results, and illustrates that the conclusions are not sensitive to the exact assumptions regarding the price of gas storage.

Figure 4 illustrates the merit order for 2012 and Appendix I describes how we estimate fixed and variable costs for the various sources of flexibility supply. Appendix II gives details of the merit order for each year. The 2012 merit order shows that GasTerra controls a large part of the cheapest flexibility sources, mainly the Groningen field, while suppliers other than GasTerra control a large part of the more expensive sources of flexibility (imports, the Epe storages).

Figure 4: Merit order of short-term flexibility supply for 2012, using fixed and variable costs (price is for one week's supply of flexibility)

[deleted due to confidentiality]

The situation changes after 2014 when Bergermeer and Zuidwending gas storages come online and provide additional flexibility at cheaper prices than the GasTerra storages.[23] Another important

[22] The converse is not true – L-gas flexibility sources cannot provide H-gas flexibility. There is no economic way to convert L-gas to H-gas.

[23] Gas storages prices used in the main analysis are reported market prices for the existing gas storages and bottom up costs estimates for the new storages for which no market price data is available. We also perform a sensitivity in which we consider all gas storages prices to be based on bottom up costs estimates. See Appendix III

change relative to the 2009 - 2011 period NMa studied in the previous review is that the supply of cheap 'free-flow' flexibility supplied by the Groningen field has reduced [deleted due to confidentiality].

It is perhaps surprising that LNG seems to be a cheaper source of short-term flexibility than some gas storage, and that interruptible sources of flexibility are cheaper than both storage and LNG. This runs counter to expectations that gas storage in the form of LNG is more expensive than underground gas storage. The reason for this apparent contradiction is that we are looking at the cost of short-term flexibility – that is, the cost of providing flexibility for one week. In this calculation the role of variable costs plays a more important role than when considering the general costs of for example, seasonal gas storage. It is for this reason that we see the results above.

4.3 Varying supply of flexibility over the year

The supply of flexibility also varies over the year. Accordingly we define a separate winter supply curve and a summer supply curve. We acknowledge that supply will also vary within a season, so that our approach will tend to overestimate the supply of flexibility in the height of winter, and underestimate supply in the shoulder periods. But on average it will give an accurate representation of how the potential to exercise market power varies over the year, while keeping the analysis tractable.

To create the seasonal supply curves we calculate winter and summer flexibility for Groningen and gas storages, based on data from 2009. We calculate winter Groningen flexibility supply as again the difference between maximum possible flow and average winter flow. Summer flexibility is similarly the difference between maximum possible flow and average summer flow. We apply the same methodology for gas storages, imports and exports. For gas storages, summer withdrawal capacity is essentially zero, so that the summer flexibility available is essentially simply the withdrawal capacity of the storage. At the same time, we recognise that seasonal storage is normally injecting gas in the summer, and most seasonal storages cannot simultaneously inject and withdraw gas. Therefore seasonal gas storage is not immediately available for providing upward flexibility in the summer. On the other hand, if the price of summer flexibility were to rise sufficiently, seasonal storage could be switched from injection to withdrawal mode, even if only for a short period. But there would be some costs associated with doing this – for example associated with the risk of not being able to fill storage sufficiently during the summer. Therefore we include gas storage in the supply of summer upward flexibility, but at a higher cost than in winter because of the expense and risk of switching from injection to withdrawal mode.[24]

As one would expect, the supply of winter flexibility is much less than the supply of summer flexibility. This makes sense, because we are analysing a short-term flexibility product, and are interested in the ability of sources of gas to increase their output over a short period. If gas storage, imports or the Groningen field is already producing at a relatively high rates, its ability to increase production is more limited compared to the summer months.

[24] Specifically we assume an additional 20% increase in summer storage costs for the seasonal storages (Norg, Alkmaar, Grijpskerk and Bergermeer).

We assume that flexibility from all other sources remains constant throughout the year. While the Gate LNG terminal might offer less flexibility in the winter than in the summer, it is not yet operational. Accordingly we take the case that it will operate as a baseload terminal, rather than a winter peaking terminal, as assumption that will tend to under estimate GasTerra's actual market power. Similarly flexibility supply from small fields remains relatively constant throughout the year. Appendix II gives details of the summer and winter supply curves used.

5 Assessment of dominance by relevant sub-markets

In this section we have developed an assessment of market dominance by estimating market concentration measures (market shares) and pivotality measures (the pivotal supplier index) taking into account the costs incurred to provide the different types of flexibility products. Rather than including all sources of supply, regardless of cost, we only consider a subset of supply which includes products that have a similar cost to the prevailing price – which we define as sub-markets. More specifically, we define the relevant product sub-market to include only flexibility services at costs less than or equal to 1.10 times the market price defined by the intersection of supply and demand at each week of the year.

The intuition behind making this distinction is that sources of supply which are much more expensive that the marginal source of supply do not apply a significant competitive constraint on the dominant supplier. Even large quantities of expensive capacity would not restrict the dominant player from raising prices by 10-20%. So this calculation looks at the shares of ownership of capacity that can keep the current price from rising by more than 10%. The choice of a 10% increase is taken from the standard market definition test quoted on page 2. This type of analysis is similar to the 'Delivered Price Test' analysis which is applied by the Federal Energy Regulatory Commission (FERC) in US electricity markets to establish if electricity rates need to be regulated or if suppliers are free to set their own rates.[25]

For each relevant sub-market we have estimated market shares and pivotality indexes to assess market dominance by GasTerra for each week of the year under analysis. If the analysis by sub-market reveals that GasTerra has a share less than 50 percent and it is not pivotal we then conclude that GasTerra is not dominant.

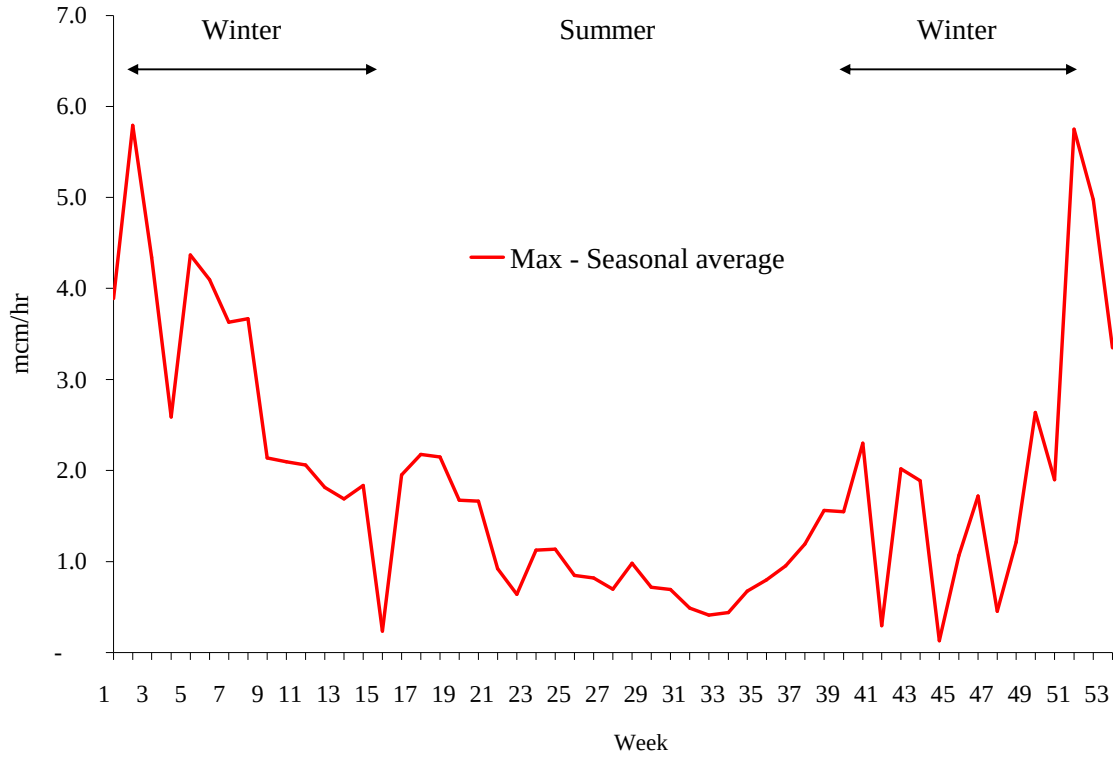
5.1 Demand for flexibility

For the following analyses, it is the balance between supply and demand which drives the results of the analysis. Therefore we consider that the demand for flexibility – defined as actual gas demand less average demand over a given time period – will vary over the year.

[25] In the United States the FERC conducts the so-called 'Delivered Price Test' (DPT Test) to authorize or deny market-based-rate authority and merger proceedings in electricity markets. Applicants who choose to conduct the DPT must estimate the shares of seller capacities that can be physically and economically delivered to an area within 5 % of the market price prevailing during a season and load period. The results of the DPT can be used for calculating market concentration measures (market shares, and the well-known Herfindahl-Hirschman Index, or HHI) as well pivotal supplier analysis. If the DPT reveals that the the analysed firm has a share less than 20 percent and the HHI of the relevant market is less than 2500 FERC concludes that there is rebuttable presumption that the analysed firm does not have significant market power.

We understand that the Dutch gas law requires the NMa to assess the market for flexibility services with a duration of about one week. Therefore instead of applying a seasonal estimate of demand we provide more detail and consider the demand for flexibility over one week periods. That is, we calculate 52 levels of demand over a year, each being the maximum gas demand in a week less the average gas demand for the season.[26] An analysis of weekly flexibility demand – illustrated in Figure 5– shows that flexibility demand in winter has higher peaks than during summer. Note that this is only the demand for flexibility from consumers within the Netherlands. Export flexibility demand has been subtracted from supply so here we are comparing the domestic (Dutch) demand for flexibility with sources of flexibility able to supply in the Netherlands. Since there is little growth expected in Dutch gas demand over the period studied, we do not increase the 2009 demand numbers when estimating demand for flexibility for the period 2012 to 2016 for our base case.[27] However, we do run a sensitivity which we show in Appendix III where we increase demand by 10% above 2009 levels. We find the results are not sensitive to the increase in demand.

Figure 5: Weekly flexibility demand based on 2009 demand data



[26] The seasons are defined based on gas demand variation throughout 2009. We then consider the maximum demand for each week and subtract the seasonal average demand to obtain the demand for flexibility.

[27] For example, Table 1B of GTS's 2010 Report 'The Security of Gas Supply' forecasts that from in 2015 total gas demand will grow only by 3% relative to 2010. However, demand from the distribution companies will actually decrease by 2.5%. Since the distribution companies supply households which have the highest demand for flexibility, it is far from clear that the demand for flexibility will grow over the period studied. We include in Appendix III, nevertheless, a sub-market share analysis sensitivity assuming flexibility demand is 10% higher.

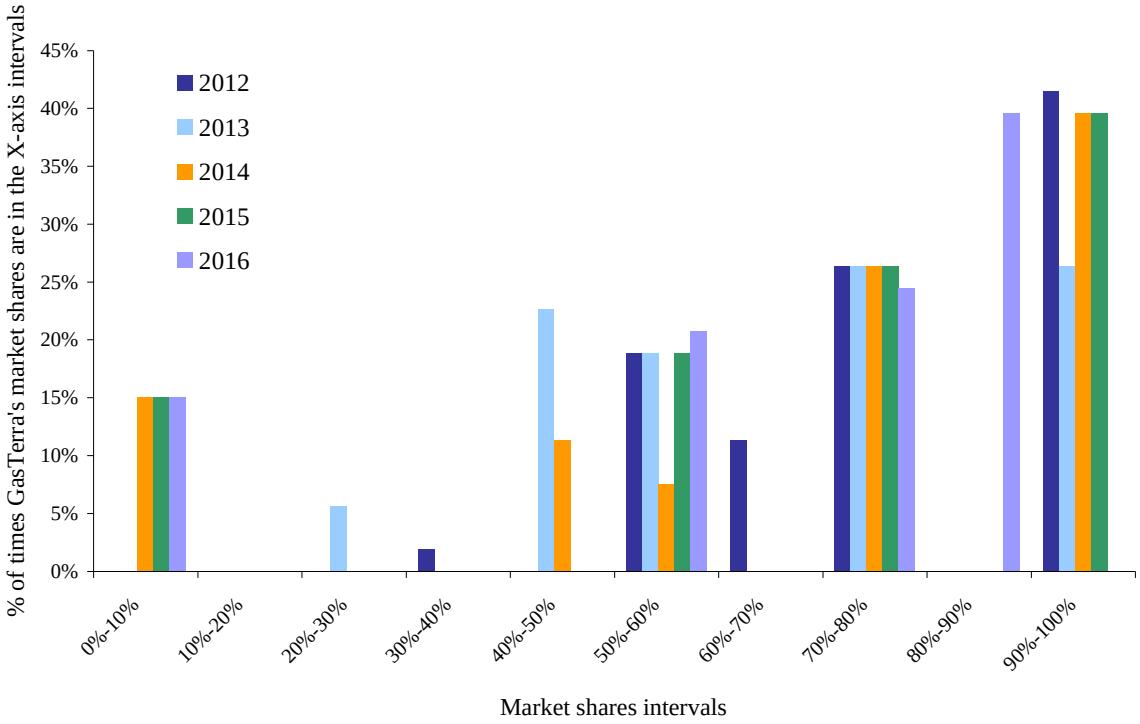
It is worth noting that our definition of demand is based on physical gas demand data from GTS. In reality, the flexibility demands of all shippers' individual portfolios will be more than the net physical demand for flexibility, because some shippers will be long and others will be short at any given time. The GTS data measures the net position. With a perfect market and perfect foresight shippers could trade away offsetting imbalances, so that shippers' aggregate demand for flexibility services equalled physical demand for flexibility. In reality this is probability not possible, so that the demand for flexibility services probably exceeds the physical demand indicated by GTS. Nevertheless we use physical demand for flexibility, while acknowledging that this definition of demand is likely to under estimate actual demand for flexibility services and therefore also under estimate the potential for market power.

5.2 Market share analysis

Having derived merit orders for each year, and defined demand, we carry out an analysis of 'sub-markets' within the flexibility market applying the 110% rule. Specifically, for each weekly level of flexibility demand, we calculate the marginal source of flexibility supply,[28] and the cost of the marginal source of supply. In the market share calculation, we then only include inframarginal sources of supply (that is, supply that is cheaper than the marginal source of supply), and sources of supply that are no more that 10% more expensive that the marginal source of supply. The analysis generates 52 market shares, one for each week of demand. **Figure 6** summarises the results by showing the percentage of time in a year Gas Terra's market share is in a given interval.

[28] The marginal source of flexibility is given by point where the vertical demand curve crosses the supply curve. It is the most expensive form of flexibility required to satisfy demand.

Figure 6: Results of sub-market share analysis



The results show that GasTerra's market share is in the 90% - 100% interval about 40% of the time for 2012 - 2015. Another 25% of the time, Gas Terra has market shares in the 70%-80% interval. Gas Terra's market share is below 50% for only about 15% of time. Starting with 2014 GasTerra's market shares are slightly lower due to the commissioning of gas storages controlled by other market players [deleted due to confidentiality].

GasTerra holds a monopolistic position (that is, it is the only firm that can provide flexibility services at a cost lower or equal than 1.10 times the prevailing price in the market) largely in the summer months where GasTerra has total control of the flexibility from the Groningen field. [deleted due to confidentiality], we calculate that flexibility from Groningen using compression is still one of the cheaper sources of flexibility (see Figure 4). GasTerra's control of a relatively cheap source of flexibility gives it a large share of the flexibility market in the summer months. This may seem counter intuitive – given that we expect the supply of flexibility to be less in the winter while demand is higher, one might expect to see a more severe market power problem in the winter months. But the sub-market share analysis is in essence saying that [deleted due to confidentiality] given GasTerra's actual control of Groningen, it is able to raise the price of flexibility during the summer months especially, to the price of the next most expensive source of flexibility. That is not to say that GasTerra only has a high market share in the summer – GasTerra also has market shares of over 50% in many of the winter weeks.

5.3 Pivotal supplier analysis

A pivotal supplier index (PSI) measures whether demand can be satisfied without any contribution from the market participant being analysed, in this case GasTerra. If demand for

flexibility cannot be satisfied without at least some contribution from GasTerra, then GasTerra is pivotal. The PSI therefore accounts for a situation where they might be a large excess of supply over demand, in which case a firm might be dominant but it would be unable to exercise market power.

For example, consider if GasTerra had a market share of supply of 60%, and that in total there were 100 units of flexibility supply, so that non-GasTerra parties controlled 40 units of flexibility. If demand was only 35 units, then the entire demand could be satisfied by non-GasTerra parties. GasTerra could withdraw all of its capacity from the market, but supply would still be satisfied.

The 2008 report quoted the FERC as noting that:

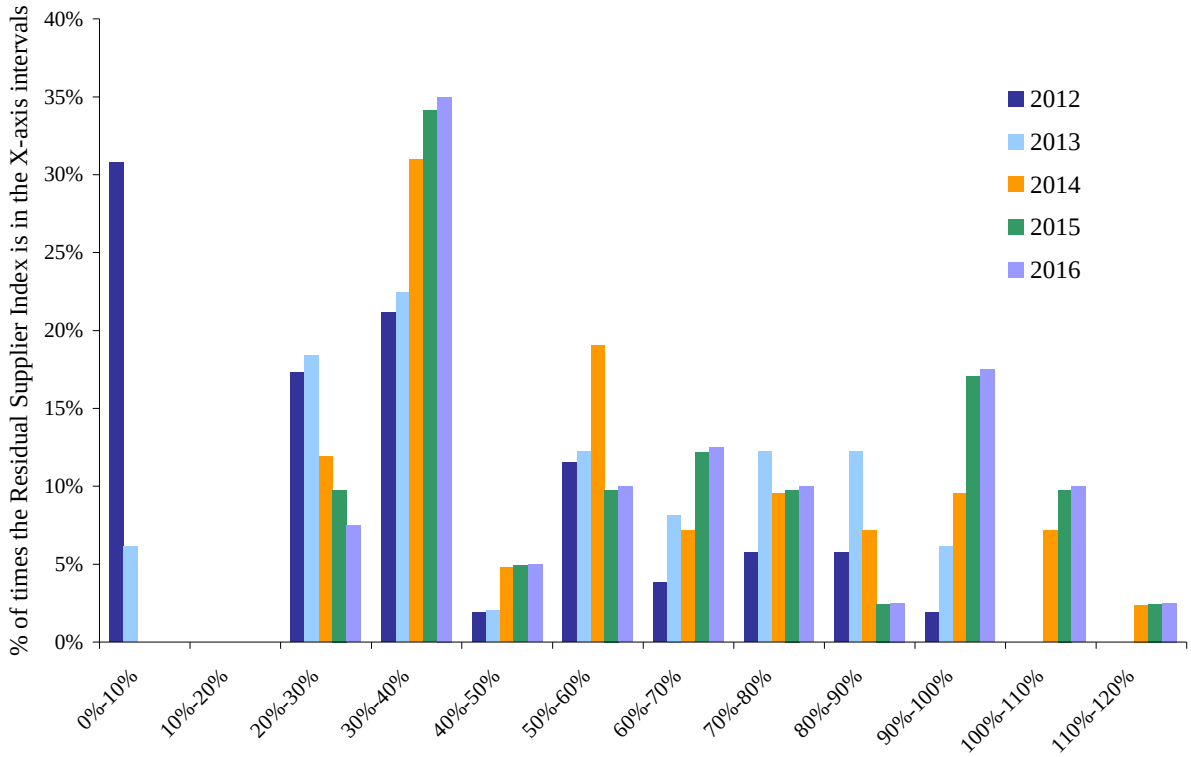
> "The pivotal supplier analysis focuses on the ability to exercise market power unilaterally. It essentially asks whether the market demand can be met absent the applicant during peak times. Thus, the pivotal supplier screen measures market power at peak times, and particularly in spot markets. If demand cannot be met without some contribution of supply by the applicant, the applicant is pivotal. In markets with very little demand elasticity, a pivotal supplier could extract significant monopoly rents during peak periods because customers have few, if any, alternatives."[29]

In common with the sub-market share analysis described above, in the pivotal supplier analysis we now only consider supply that is available at not more than 10% above the marginal price. We also calculate the Residual Supplier Index (RSI), which is simply the supply of the non-dominant players expressed as a percentage of demand. An individual company's RSI of above 100% implies that the company is not pivotal and *vice versa*. Therefore a low RSI is of more concern to the market than a high RSI. The RSI is useful in that it says not only if the dominant supplier is pivotal, but the degree of pivotally – for example can non-dominant players satisfy only 50% of demand? Or 99%?[30] Figure 7 shows the percentage of time in a year the RSI is in a certain interval. GasTerra is almost always pivotal for every year, where an RSI below 100% indicates pivotality. As noted in the sub-market shares analysis the situation changes slightly after 2014.

[29] FERC, Order on Rehearing and Modifying Interim Generation Market Power Analysis and Mitigation Policy, 2004.

[30] The RSI is a variation of the PSI, developed by the California Independent System Operator (CAISO) in the California electricity market as a continuous metric that could better represent the potential for an abuse of market power by a generator. The RSI for a company X measures the percent of supply capacity remaining after subtracting company X's capacity of supply (less contract obligations). An individual company's RSI of above 100 percent implies that the company is not pivotal and *vice versa*. Therefore a low RSI is of more concern to the market than a high RSI. The CAISO presumes that a firm is unlikely to exercise market power if the RSI for the firm under analysis is higher than 110 percent during at least 95 percent of the hours. (See Sheffrin, A. (2002), "Predicting Market Power Using the Residual Supply Index", Presented to FERC Market Monitoring Workshop, December 3-4, 2002.)

Figure 7: Residual Supplier Index



6 Withholding analysis

In our final piece of analysis we perform a 'withholding analysis'. The withholding analysis measures GasTerra's ability and incentive to raise prices by withdrawing capacity from the market.[31] As the dominant player withdraws capacity from the market, the supply curve shifts to the left, which causes prices to increase. The dominant players sells less flexibility services (because it has withdrawn some of it), but it obtains a higher price for its remaining flexibility sales than before. Accordingly, the withdrawal of capacity involves a trade off between selling less but at a higher price. This trade off determines whether withholding is profitably or not. The dominant player may be able to raise prices, but it may have to withdraw so much capacity to do so that the loss of sales volumes outweighs the price increase effect. In economic terms, the withholding analysis determines not only whether the dominant player has the ability to raise prices – which the pivotal supplier test determined – but whether it has the incentives to do so. Accordingly the withholding analysis is the most complete test of the risk of market power abuse, and is commonly used in the analysis of market power in energy markets.[32]

As in the sub-market analysis, we assume that the intersection of the demand and supply curves would set the competitive price of flexibility. We calculate the initial profit that GasTerra makes on flexibility services as the difference between its cost of flexibility and the prevailing price. We then gradually withdraw GasTerra's flexibility from the market – starting with the most expensive capacity first – and calculate both the effect on the price of flexibility and on GasTerra's profits. An ability by GasTerra to profitably raise the price of flexibility services by more than 10% above the competitive level is evidence of a dominant position.

6.1 Results of withholding analysis

The results of the withholding analysis show that in 2012 GasTerra would have the incentive and ability to increase the price of flexibility by more than 10% above the competitive level 83% of the time. While additional sources of flexibility restrain GasTerra's market power later in the period, GasTerra still has the incentive and ability to increase prices by more than 10% about 70% of the time even in 2016.

[31] There are two types of withholding or withdrawal of capacity – economic withholding, where output is reduced because it is bid into the market above competitive prices, and physical withholding, which involves a deliberate reduction of the output that is bid into the market even though such output could still be sold at prices above marginal cost.

[32] This measure was introduced by Joskow and Jahn in 2002 in an analysis of market power in the California electricity market (For more details see Joskow, P. and E. Kahn, (2002), "A Quantitative Analysis of Pricing Behavior in California's Wholesale Electricity Market During Summer 2000" *The Energy Journal*, Vol 23, No. 4). This measure is regularly used by both FERC and the Department of Justice (DOJ) in merger cases in the energy industry in the United States.

Appendix I : Details of flexibility costs, quantity and ownership

In this Appendix for each source of flexibility we describe:

- How we estimate the quantity of flexibility the source provides over the period studied;
- Who controls each source of flexibility. Note that because we are investigating the market position of GasTerra, we only distinguish between GasTerra ownership and non-GasTerra ownership. We do not analyse the composition of the non-GasTerra ownership.
- How we estimate the fixed and variable costs of each flexibility source.

I.1. Production – Groningen

We base our estimate of the quantity of flexibility available from Groningen on the difference between the maximum and average hourly data from 2009. Clearly this means that our estimate of Groningen flexibility is subject to demand conditions in 2009, which may not be representative. However, we felt that basing a flexibility estimate on 2009 data was more accurate than taking an average of the last few years. The latter approach could over estimate available flexibility as the capacity Groningen field, like all producing fields, declines over time. The Groningen field flexibility is under GasTerra's control.

For the purposes of estimating the cost of flexibility, we divide Groningen production into free-flow or natural production and production from well-head compression. [deleted due to confidentiality] We use this figure to compute the flexibility from free flow production. We attributed the rest of the flexibility coming from the Groningen field to production using well-head compressors. We take the fixed and variable cost of free-flow Groningen to be approximately zero, since there are no significant variable costs and the fixed costs of the free-flow facilities have long been depreciated.[33] For compression-based flexibility, we calculate a fixed annual cost based on an installed compressor cost of €100 million for a 20 MW compressor with a capacity of 20 million m3/day and a lifetime of 20 years. The variable costs are simply the cost of electricity. Table 1 shows the details of the calculations. We assume a decline rate of 5% per year from 2009 for Groningen compression flexibility.

Our methodology will likely overestimate the cost of compression-based flexibility, since we use the average compression costs. An alternative approach would be recognise that some compression would be required to deplete the Groningen field at a baseload level (similar to small fields production rates), and calculate the marginal cost of increasing compression to meet peak demands. Due to economies of scale in compression technology, the marginal cost of compression will be lower than the average cost. However, given the uncertainty surrounding compression costs we prefer to err on the side of overestimating the cost of flexibility provided by well-head compression, since this will tend to reduce GasTerra's market shares.

[33] The free flow facilities were constructed in the late sixties and early seventies. Under any reasonable depreciation scheme they should have been fully depreciated by 2011.

Table 1: Volume and costs for Groningen compression-based flexibility

Compressor's power consumption, MW	[1]	Assumed	20
Compressor's production capacity, mcm/day	[2]	Assumed	20
Compressor's production capacity, mcm/hr	[3]	[8]/24	0.8
Capital cost for a compressor, mn €	[4]	Assumed	100
WACC	[5]	Assumed	10%
Compressor lifetime, years	[6]	Assumed	20
Annual capital cost/compressor, mn €	[7]	See note	11.7
Annual capital cost, €/m3/hr	[8]	[7]/[3]	14.1
Electricity comsumption, MWh/m3	[9]	([1]/[3])/10^6	0.00002

Notes:
[7]: Annual payment corresponding to a rate of [5], a lifetime of [6] and a present value of [4]

I.2. Production – small fields

We base our estimate of the quantity of flexibility available from the small fields based on the difference between the maximum and average production based on hourly data from 2009.[34] We take the case that all small fields' flexibility is under GasTerra's control [deleted due to confidentiality].

The cost of flexibility from small fields is the cost of building excess capacity. Since this varies for each individual field it is not practical to develop a bottom up estimate of the cost of flexibility from small fields. However, we reason that small fields flexibility must be more expensive than the cost of flexibility from gas storage. If it was not, there would be no need for gas storage. Developers would simply build production facilities with excess capacity for use in the winter. In reality they do not – the production data shows that small fields produce at the maximum rate possible throughout the year, and gas storages provide flexibility. We therefore take the case that the total costs of small fields flexibility is 20% more than the cost of the most expensive flexibility from gas storage.

[34] We use as the average small fields production for 2012-2016, and the expected supply from developed and not yet developed accumulations from the annual review, 2009, 'Natural Resources and geothermal energy in the Netherlands", p 23. We then assume that the maximum production from 2009 will change with the same ratio as the NLog projections of gas production from small fields.

Similarly variable costs of flexibility will depend on the specific development – some small fields require compression to produce and others do not. We take the variable costs as 50% of the variable costs of Groningen compression flexibility. Table **2** shows the details of these calculations.

Table 2: Volume and costs for small fields flexibility

			2012	2013	2014	2015	2016
Expected Production, m3/hr/yr	[1]	See note	4,261,796	3,995,434	3,729,072	3,462,709	2,929,985
Maximum production, m3/hr/yr	[2]	See note	5,034,600	4,719,937	4,405,275	4,090,612	3,461,287
Available flexibility, m3/hr/yr	[3]	[1]-[2]	772,804	724,504	676,203	627,903	531,303
Fixed Costs, €/m3/hr	[4]	See note	53.3	54.4	55.5	56.6	57.7
Variable costs, €/m3/hr	[5]	See note	0.0006	0.0006	0.0007	0.0007	0.0007
Entry charges	[6]	See note	12.9	13.1	13.4	13.7	13.9

Notes:
[1]: Expected supply from developped and not yet developped accumulations is taken from the annual review, 2009, 'Natural Resources and geothermal energy in the Netherlands, p 23
[2]: We assumed it decreases at the same rate as the expected supply
[4]: We assumed total costs for small fields are 20% more expensive than Gas Terra's most expensive storage.
[5]: Variable costs are assumed to be half of variable costs for Groningen
[6]: From GTS

I.3. Gas storage

We base the quantity of flexibility from gas storage on a mix of data including the websites of storage developers, hourly aggregated flow data from the NMa and data provided by the Gas Storage Europe (GSE) storage map June 2010 edition. The June 2010 edition was the latest edition available at the time of the analysis. Table 3 shows the details of the different gas storages and when the new storages come online. We take the flexibility available as the withdrawal capacity of each gas storage facility.

We have two alternative sources of the cost of flexibility for gas storages:

1. Base case: For the new storages such as Eneco's Epe storage, Zuidwending or Bergermeer, for which no market price information exists we apply a 'bottom-up' estimate of the fixed costs, based on the estimated capital costs of each storage. We convert this capital cost to an annual fixed cost by assuming a required rate of return over a given period. For GasTerra storages and the Nuon and RWE Epe storages we use cost estimates based on storage capacity sold to the market. The main sources of reference are the auction price for the virtual storage product sold by GasTerra and the bundle prices for capacity sold in the Nuon and RWE Epe storages as well as in the Kalle storage. We assume that all GasTerra storages are priced at the same level as the virtual storage product.

2. Sensitivity case: We also calculate results for a case where we compute the bottom up cost for all storages in the analysis to see how the change in price assumptions affects results. The bottom up costs are estimated assuming that similar gas storages have the same cost in €/m3/hr. This means that Grijpskerk, Alkmaar, Bergermeer and Kalle storages all have the same cost as Norg because they are depleted gas fields. All the other storages are salt cavities and share the same cost with Zuidwending (Gasunie). Table 3 and Table 4 provide details.

Table 3 Volume and costs for gas storage flexibility, base case approach

		Alkmaar	Bergermeer	Epe, Eneco	Epe, Nuon	EPE, RWE/Essent	Grijpskerk	Kalle, RWE	Norg	Norg Extension	Zuidwendig (Gasunie)	Zuidwendig (Nuon)
Online date	[1]	-	2014	2013	-	-	-	-	-	2015	2011	2015
Available flexibitity, m3/hr	[2]	1,500,000	2,375,000	400,000	600,000	400,000	2,291,667	450,000	2,083,333	1,250,000	1,600,000	800,000
Fixed costs, €/m3/hr	[3]	44.4	37.2	31.4	99.7	99.7	44.4	62.4	44.4	47.2	30.7	32.6
Variable Costs, €/m3/hr	[4]	0.003	0.004	0.003	0.003	0.003	0.004	0.004	0.003	0.003	0.003	0.0
Transport charges, €/m3/hr/yr	[5]	27.9	34.3	28.9	28.3	28.3	23.8	23.4	24.3	25.8	15.1	16.0
Total fixed costs, €/m3/hr	[6]	72.3	71.4	60.2	127.9	127.9	68.2	85.8	68.8	73.0	45.8	48.6

Notes:
All cost figures are 2012 values except the ones mentioned below
The values for volume of flexibility and the costs for Bergermeer and Zuidwendig (Nuon) refer to 2014 and 2015 respectively.
The values for volume of flexibility and the costs for the extension of Norg refer to 2015
The values for volume of flexibility and the costs for the Epe Eneco storage refer to 2013

Table 4: Volume and costs for gas storage flexibility, sensitivity approach

		Alkmaar	Bergermeer	Epe, Eneco	Epe, Nuon	EPE, RWE/Essent	Grijpskerk	Kalle, RWE	Norg	Norg Extension	Zuidwendig (Gasunie)	Zuidwendig (Nuon)
Online date	[1]	-	2014	2013	-	-	-	-	-	2015	2011	2015
Available flexibitity, m3/hr	[2]	1,500,000	2,375,000	400,000	600,000	400,000	2,291,667	450,000	2,083,333	1,250,000	1,600,000	800,000
Fixed costs, €/m3/hr	[3]	35.7	37.2	31.4	30.7	30.7	35.7	35.7	35.7	37.9	30.7	32.6
Variable Costs, €/m3/hr	[4]	0.003	0.004	0.003	0.003	0.003	0.004	0.004	0.003	0.003	0.003	0.0
Transport charges, €/m3/hr/yr	[5]	27.9	34.3	28.9	28.3	28.3	23.8	23.4	24.3	25.8	15.1	16.0
Total fixed costs, €/m3/hr	[6]	63.6	71.4	60.2	59.0	59.0	59.5	59.1	60.0	63.7	45.8	48.6

Notes:
All cost figures are 2012 values except the ones mentioned below
The values for volume of flexibility and the costs for Bergermeer and Zuidwendig (Nuon) refer to 2014 and 2015 respectively.
The values for volume of flexibility and the costs for the extension of Norg refer to 2015
The values for volume of flexibility and the costs for the Epe Eneco storage refer to 2013

We use as a proxy for variable costs the operating charges for storage bundles for the German storages in Epe and Kalle.

GasTerra controls the capacity of the Alkmaar, Norg and Grijpskerk storages, but GasTerra also uses these storages to provide its virtual storage product, discussed below. All other storages are controlled by non-GasTerra market participants.

I.4. Virtual Storage Product

On 26 and 27 April APX Endex held the Gas Storage Service auctions on behalf of GasTerra The auctions resulted in all 13,249,456 storage bundle units being sold. The weighted average price of the SBUs sold was €4.46 per SBU. The total amount of flexibility that the virtual storage provides is 1.35 million m^3/hour.

We take the case that GasTerra will provide the virtual storage product from flexibility sources that it controls, in proportion to each source of flexibility. Therefore we transfer control of a pro-rata amount of each of GasTerra's flexibility source for use as virtual storage by third parties. To derive a weekly price of flexibility, we assume that the auction price includes both fixed and variable costs. We deduct a variable fee from the virtual storage product to as to estimate the fixed costs. By dividing the virtual storage product into fixed and variable costs we are able to derive a short-term (weekly) virtual storage price for sue in the merit order.

I.5. Interruptible Demand

There was no data available on sources of interruptible demand that could provide flexibility. GTS informed us that it did not have any contracts with interruptible demand, but there could be bilateral deals between shippers and gas users that provide flexibility via interruptions. We believe it would be overly conservative to assume that there are no sources of interruptible demand,

especially looking over the period to 2016. Moreover, the most likely candidates for providing interruptible flexibility are gas-fired power stations, which use relatively large volumes of gas per customer and, when interrupted, can either switch to alternative fuels or their owners can increase production from another source.

We have used our data base of gas-fired power plants in the Netherlands to estimate the hourly gas consumption by power plants. We then assume that 20% of this capacity could be interruptible, providing a bit more than 600,000 m^3/hour of flexibility. Table 5 provides more details. We take the case that GasTerra does not have any contracts for interruptible demand, and so does not control this source of flexibility. We understand from comments received in the consultation that our assumption that 20% of the capacity is interruptible is likely to overestimate the actual level of interpretability. Nevertheless we maintain this assumption on the grounds that the future level of interruptible demand is uncertain and our assumption is likely to lead to an underestimate of GasTerra's dominance, and so is conservative.

For the cost of interruptible flexibility we have used data from the GB gas Transmission System Operator (TSO), National Grid Gas or NGG. NGG holds tenders for interruptible demand services, and publishes the results of these tenders. We use this price – which is entirely variable with no fixed costs – for the price/cost of interruptible demand in the Netherlands. Table 5 provides more details. We have also checked that this price covers at least the spark spread for gas-fired power plants – that is, the payment for being interrupted would at least cover the lost profits from generation.

Table 5: Volume and costs for flexibility from interruptible demand

% of plants assumed interruptible	[1]	Assumed	20%
Total gas consumption, full capacity, m3/hr	[2]	See note	3,122,792
Flexibility available, m3/hr	[3]	[1]x[2]x24	624,558
Interruption price NL, €c/m3/day	[4]	See note	0.01
Cost for flexibility, €/m3/day	[5]	[3]x[4]/100	40.0
Cost for flexibility, €/m3/hr/yr	[6]	[5]/24	1.7

Notes and sources:
[2]: Gas fired plant data from Brattle database of gas fired power plants in the Netherlands. The total gas consumption is computed considering the capacity and efficiency of each plant. We assume the plants run at full capacity
[4]: From http://www.nationalgrid.com, 2009 DN Interruption Tender Results forr the 2012-2017 period.

I.6. LNG Terminals

We assume that the Gate LNG terminal will remain the only LNG terminal active in the Netherlands between until 2016, and that it will not be expanded. We define the flexibility that the LNG terminal can provide as the difference between maximum and average flows. However, since the Gate terminal is not yet active, we do not have any flows on which to base this calculation. Accordingly, we assume that the Gate terminal will have the same load factor as the Zeebrugge terminal. This assumptions seems reasonable, as TTF and Zeebrugge gas prices are, for most of the time, very similar, and so we would expect import flows through Gate to be similar to Zeebrugge

flows. This assumption, detailed in Table 6, means that the Gate terminal will provide about 380,000 m^3/hour of flexibility. GasTerra does not control any flexibility in the Gate terminal.

We base the fixed costs of the Gate terminal flexibility on an estimate of the terminals capital costs, again assuming a required rate of return over a given period. The variable costs of flexibility from the LNG terminal is the cost of the gas used to re-gasify the LNG – we take the case that 0.5% of the gas must be used for re-gasification. Table 6 provides details.

Table 6: Volume and costs for LNG flexibility, 2012 values

Zeebrugge			
Technical capacity, bcm/yr	[1]	See note	9
LNG imports, bcm/yr	[2]	See note	6.5
Tarif for additional regazification capacity, €/m3/hr/year	[3]	See note	19.05
Gate terminal			
Technical capacity, bcm/yr	[4]	See note	12
Estimated cost, € mn	[5]	See note	800
Useful lifetime, yrs	[6]	See note	20
WACC	[7]	Assumed	10%
% Gas used for regassification	[8]	Assumed	0.5%
Assumed LNG imports, bcm/yr	[9]	[3]/[1]*[2]	8.7
Flexibility available, m3/hr	[10]	See note	380,518
Costs			
GATE terminal cost, mn €	[11]	See note	85.4
Fixed cost, €/m3/hr	[12]	[11]/[4]x10^6	62.36
Gas prices, €/MWh	[13]	See note	19.1
Variable costs, €/m3/hr	[14]	See note	0.1870
Entry cost, €/m3/hr	[15]	See note	11.1

Notes and sources:
[1]: Zeebrugge's capacity is 9 bcm/yr. Source: LNG Map, http://www.gie.eu.com/
[2]: Data from BP Statistical Review of World Energy. The figure refers to 2009 imports, we assume the same volume of imports for 2012-2016
[4]: The initial capacity of the Gate is 12 bcm/yr. Source: http://www.gate.nl
[5]: The costs for building Gate are estimated at 800 million Eur. Source: http://www.gate.nl
[6]: In the Fluxys 2009 Annual Report they assume a useful lifetime of 20 years for the terminal's expansion. Assumed the same for the GATE Terminal
[10]: ([3]-[9])/8760x10^9
[11]: Annuitised cost of building the terminal, assuming a rate of return of [7] and a lifetime of [6] and no expansion
[13]: Price data from Platts PowerVision.
[14]: Prices converted to Eur/m3 using a conversion rate of 9.77 kWh/m3
[15]: From GTS

I.7. Imports and Exports

Imports are a source of flexibility, whereas exports are a demand for flexibility. Nevertheless the way we estimate both are very similar.

We estimate the flexibility supply and demand of imports and exports respectively based on the maximum less average flow using 2009 hourly flow data supplied by GTS. We allocate both import and export flexibility using data on the monthly import and export volumes for GasTerra and other shippers. We allocate flexibility in proportion to the import and export volumes. Since we do not

have detailed data on the flexibility in each contract, we take the case that all import contracts have the same flexibility and all export contracts have the same flexibility.

As discussed in the main body of the report, we need to differentiate between L-gas and H-gas exports, so that we can deduct L-gas export flexibility demand from GasTerra's L-gas supply sources. NMa has supplied us with hourly flow data on both H-gas and L-gas exports, so that we can calculate the export flexibility demand of each type of gas. We also need to deduct GasTerra's H-gas export flexibility demand from sources of H-gas flexibility GasTerra controls. To estimate GasTerra's H-gas export flexibility demand, we subtract L-gas volumes (which are assumed to be all GasTerra's) from GasTerra's total exports. This gives us the volume of GasTerra's H-gas exports.

All the above calculations are performed for 2009. To estimate how import and export flexibility supply and demand will develop over the period 2012 to 2016, we have used data on capacity booking provided by GTS as well as data on the increases in available import and export capacity over the period.

For both future imports and exports, we assume that the load factor of any new gas flows will be the same as in 2009 – in other words, that there will be a constant ratio between gas volumes imported or exported and flexibility demand. During the period 2012 to 2016 we treat imports and exports slightly differently. We calculate the potential for more import flexibility, based on increases in import capacity built by GTS. [deleted due to confidentiality] Because of the GTS 'open season' and increases in import capacity, import flexibility supply more than doubles by 2016 relative to 2009. We look at the potential for imports, because this is the relevant consideration when considering the ability of third parties to constraint market power of a dominant player.

We take the case that export flexibility demand changes in line with changes in booked capacity over the period. [deleted due to confidentiality] This approach means that we only increase export flexibility demand if there are capacity bookings to indicate a change in export flexibility demand. We are not simply looking at the capacity of the pipeline system to support more exports. This is because exports are on the demand side of the flexibility market.

To estimate the cost of import flexibility, we take the case that the ultimate source of the flexibility is from gas storages outside of the Netherlands. Since we do not know from which country the import flexibility originates, we take the case that the cost of foreign storage is the same as the average cost of Dutch storage. We then add on the main additional cost which import flexibility faces, which is the cost of buying entry capacity at the Dutch border.

Figure 8: Changes in import flexibility supply and export flexibility demand 2012 to 2016

[deleted due to confidentiality]

Appendix II : Detailed results

All results presented in this Appendix refer to the base case.

Table 7: Overall flexibility supply curve, volumes

	Overall flexibility, m3/hr				
	2012	2013	2014	2015	2016
Overall domestic supply of flexibility					
From Production					
Groningen (L-gas) Free flow	[redacted]				
Groningen (L-gas) Compression					
Small Fields (H-gas)	142,292	106,576	80,698	62,162	38,287
From Storage					
Grijpskerk (H-gas)	421,953	337,109	273,486	226,873	165,142
Alkmaar (L-gas)	911,617	893,029	874,310	926,817	911,256
Norg (L-gas)	1,392,749	1,364,349	1,335,752	1,415,970	1,392,197
Norg (L-gas) extension	-	-	-	772,347	759,380
Epe, Nuon (L-gas)	570,467	571,560	575,751	577,408	576,802
EPE, RWE/Essent, (L-gas)	380,311	381,040	383,834	384,938	384,535
Kalle, RWE (H-gas)	427,850	428,670	431,813	433,056	432,601
From New storages					
Bergermeer (H-gas)	-	-	1,535,335	1,539,754	1,538,139
Zuidwending, Gasunie (L-gas)	1,521,245	1,524,159	1,535,335	1,539,754	1,538,139
Zuidwending, Nuon (H-gas)	-	-	-	769,877	769,069
Epe, Eneco (L -gas)	-	381,040	383,834	384,938	384,535
New storage (H-gas)	-	-	-	-	-
From LNG	361,788	362,481	365,139	366,190	365,805
From Interruptible demand	593,816	594,954	633,661	635,485	634,818
From imports, H-gas	[redacted]				
From backhaul	780,548	780,548	780,548	780,548	780,548
From virtual storage	1,283,550	1,286,009	1,295,439	1,299,167	1,297,804
Gas Terra's domestic supply of flexibility	6,894,215	6,436,418	6,031,569	6,887,601	6,511,925
From Production					
Groningen (L-gas) Free flow	[redacted]				
Groningen (L-gas) Compression					
Small Fields (H-gas)	142,292	106,576	80,698	62,162	38,287
From Storage					
Grijpskerk (H-gas)	421,953	337,109	273,486	226,873	165,142
Alkmaar (L-gas)	911,617	893,029	874,310	926,817	911,256
Norg (L-gas)	1,392,749	1,364,349	1,335,752	1,415,970	1,392,197
Norg (L-gas) extension	-	-	-	772,347	759,380
From imports	[redacted]				
Others' domestic supply of flexibility	8,051,274	8,677,243	10,356,275	11,378,528	11,092,884
Epe, Nuon (L-gas)	570,467	571,560	575,751	577,408	576,802
Epe, RWE/Essent, (L-gas)	380,311	381,040	383,834	384,938	384,535
Kalle, RWE (H-gas)	427,850	428,670	431,813	433,056	432,601
From New storages					
Bergermeer (H-gas)	-	-	1,535,335	1,539,754	1,538,139
Zuidwending, Gasunie (L-gas)	1,521,245	1,524,159	1,535,335	1,539,754	1,538,139
Zuidwending, Nuon (H-gas)	-	-	-	769,877	769,069
Epe, Eneco (L -gas)	-	381,040	383,834	384,938	384,535
New storage (H-gas)	-	-	-	-	-
From LNG	361,788	362,481	365,139	366,190	365,805
From Interruptible demand	593,816	594,954	633,661	635,485	634,818
From imports	2,131,699	2,366,784	2,435,586	2,667,414	2,390,088
From backhaul	780,548	780,548	780,548	780,548	780,548
Virtual storage	1,283,550	1,286,009	1,295,439	1,299,167	1,297,804

As described on page 18, the supply curve consists of the weekly fixed costs, so annual fixed costs divided by 52, plus the variable costs. Accordingly these costs will be different from the annual costs shown in the previous appendix

Table 8 Overall flexibility supply curve, Fixed + Variable costs

	Total Costs, €/m3/hr				
	2012	2013	2014	2015	2016
Overall domestic supply of flexibility					
From Production					
Groningen (L-gas) Free flow	-	-	-	-	-
Groningen (L-gas) Compression	0.48	0.48	0.49	0.49	0.50
Small Fields (H-gas)	1.27	1.30	1.32	1.35	1.38
From Storage					
Grijpskerk (H-gas)	0.86	0.87	0.89	0.91	0.93
Alkmaar (L-gas)	0.86	0.87	0.89	0.91	0.93
Norg (L-gas)	0.86	0.87	0.89	0.91	0.93
Norg (L-gas) extension	-	-	-	1.40	1.43
Epe, Nuon (L-gas)	2.46	2.51	2.56	2.61	2.66
EPE, RWE/Essent, (L-gas)	2.46	2.51	2.56	2.61	2.66
Kalle, RWE (H-gas)	1.65	1.68	1.72	1.75	1.79
From New storages					
Bergermeer (H-gas)	-	-	1.37	1.40	1.43
Zuidwending, Gasunie (L-gas)	0.88	0.89	0.91	0.93	0.94
Zuidwending, Nuon (H-gas)	-	-	-	0.94	0.95
Epe, Eneco (L -gas)	-	1.16	1.18	1.21	1.23
New storage (H-gas)	-	-	-	-	-
From LNG	1.46	1.46	1.47	1.47	1.48
From Interruptible demand	0.39	0.39	0.41	0.41	0.41
From imports, H-gas	1.09	1.11	1.10	1.23	1.26
From backhaul	1.27	1.30	1.33	1.35	1.38
From virtual storage	0.86	0.87	0.89	0.91	0.93
Gas Terra's domestic supply of flexibility					
From Production					
Groningen (L-gas) Free flow	-	-	-	-	-
Groningen (L-gas) Compression	0.48	0.48	0.49	0.49	0.50
Small Fields (H-gas)	1.27	1.30	1.32	1.35	1.38
From Storage					
Grijpskerk (H-gas)	0.86	0.87	0.89	0.91	0.93
Alkmaar (L-gas)	0.86	0.87	0.89	0.91	0.93
Norg (L-gas)	0.86	0.87	0.89	0.91	0.93
Norg (L-gas) extension	0.86	0.87	0.89	0.91	0.93
From imports	1.09	1.11	1.10	1.23	1.26
Others' domestic supply of flexibility					
Epe, Nuon (L-gas)	2.46	2.51	2.56	2.61	2.66
Epe, RWE/Essent, (L-gas)	2.46	2.51	2.56	2.61	2.66
Kalle, RWE (H-gas)	1.65	1.68	1.72	1.75	1.79
From New storages					
Bergermeer (H-gas)	-	-	1.37	1.40	1.43
Zuidwending, Gasunie (L-gas)	0.88	0.89	0.91	0.93	0.94
Zuidwending, Nuon (H-gas)	-	-	-	0.94	0.95
Epe, Eneco (L -gas)	-	1.16	1.18	1.21	1.23
New storage (H-gas)	-	-	-	-	-
From LNG	1.46	1.46	1.47	1.47	1.48
From Interruptible demand	0.39	0.39	0.41	0.41	0.41
From imports	n/a	n/a	n/a	n/a	n/a
From backhaul	1.09	1.11	1.10	1.23	1.26
Virtual storage	1.27	1.30	1.33	1.35	1.38

Table 9 Winter flexibility supply curve, volumes

	Overall flexibility, m3/hr				
	2012	2013	2014	2015	2016
Overall domestic supply of flexibility	12,913,248	13,168,892	14,338,855	16,043,370	15,482,741
From Production					
Groningen (L-gas) Free flow	[redacted]				
Groningen (L-gas) Compression					
Small Fields (H-gas)	231,580	194,461	165,335	145,936	110,269
From Storage					
Grijpskerk (H-gas)	586,473	525,300	478,525	454,868	406,188
Alkmaar (L-gas)	719,950	704,242	688,576	748,757	735,976
Norg (L-gas)	1,099,924	1,075,925	1,051,991	1,143,934	1,124,408
Norg (L-gas) extension	-	-	-	623,964	613,313
Epe, Nuon (L-gas)	495,500	496,082	498,291	499,203	498,818
EPE, RWE/Essent, (L-gas)	330,333	330,721	332,194	332,802	332,546
Kalle, RWE (H-gas)	371,625	372,061	373,718	374,402	374,114
From New storages					
Bergermeer (H-gas)	-	-	1,328,775	1,331,208	1,330,182
Zuidwending , Gasunie (L-gas)	1,321,333	1,322,884	1,328,775	1,331,208	1,330,182
Zuidwending , Nuon (H-gas)	-	-	-	665,604	665,091
Epe, Eneco (L -gas)	-	330,721	332,194	332,802	332,546
New storage (H-gas)	-	-	-	-	-
From LNG	367,961	368,393	370,033	370,711	370,425
From Interruptible demand	603,949	604,658	642,155	643,331	642,836
From imports, H-gas	[redacted]				
From backhaul	854,748	854,748	854,748	854,748	854,748
From virtual storage	1,305,452	1,306,984	1,312,804	1,315,207	1,314,195
Gas Terra's domestic supply of flexibility	5,094,276	4,776,251	4,496,936	5,291,798	5,016,785
From Production					
Groningen (L-gas) Free flow	[redacted]				
Groningen (L-gas) Compression					
Small Fields (H-gas)	231,580	194,461	165,335	145,936	110,269
From Storage					
Grijpskerk (H-gas)	586,473	525,300	478,525	454,868	406,188
Alkmaar (L-gas)	719,950	704,242	688,576	748,757	735,976
Norg (L-gas)	1,099,924	1,075,925	1,051,991	1,143,934	1,124,408
Norg (L-gas) extension	-	-	-	623,964	613,313
From imports	[redacted]				
Others' domestic supply of flexibility	7,818,973	8,392,641	9,841,919	10,751,572	10,465,956
Epe, Nuon (L-gas)	495,500	496,082	498,291	499,203	498,818
Epe, RWE/Essent, (L-gas)	330,333	330,721	332,194	332,802	332,546
Kalle, RWE (H-gas)	371,625	372,061	373,718	374,402	374,114
From New storages					
Bergermeer (H-gas)	-	-	1,328,775	1,331,208	1,330,182
Zuidwending , Gasunie (L-gas)	1,321,333	1,322,884	1,328,775	1,331,208	1,330,182
Zuidwending , Nuon (H-gas)	-	-	-	665,604	665,091
Epe, Eneco (L -gas)	-	330,721	332,194	332,802	332,546
New storage (H-gas)	-	-	-	-	-
From LNG	367,961	368,393	370,033	370,711	370,425
From Interruptible demand	603,949	604,658	642,155	643,331	642,836
From imports	2,168,072	2,405,388	2,468,233	2,700,347	2,420,272
From backhaul	854,748	854,748	854,748	854,748	854,748
Virtual storage	1,305,452	1,306,984	1,312,804	1,315,207	1,314,195

Table 10 Summer flexibility supply curve, volumes

	Overall flexibility, m3/hr				
	2012	2013	2014	2015	2016
Overall domestic supply of flexibility	20,036,872	20,147,132	21,351,881	23,168,289	22,419,188
From Production					
Groningen (L-gas) Free flow					
Groningen (L-gas) Compression					
Small Fields (H-gas)	458,400	415,847	378,221	346,013	285,570
From Storage					
Grijpskerk (H-gas)	1,359,335	1,315,359	1,281,799	1,262,847	1,231,750
Alkmaar (L-gas)	1,251,121	1,242,738	1,234,283	1,250,407	1,242,799
Norg (L-gas)	1,911,435	1,898,628	1,885,710	1,910,343	1,898,720
Norg (L-gas) extension	-	-	-	1,042,005	1,035,666
Epe, Nuon (L-gas)	582,447	583,096	585,588	586,572	586,212
EPE, RWE/Essent, (L-gas)	388,298	388,731	390,392	391,048	390,808
Kalle, RWE (H-gas)	436,835	437,322	439,191	439,929	439,659
From New storages					
Bergermeer (H-gas)	-	-	1,561,567	1,564,193	1,563,233
Zuidwending , Gasunie (L-gas)	1,553,192	1,554,924	1,561,567	1,564,193	1,563,233
Zuidwending , Nuon (H-gas)	-	-	-	782,096	781,616
Epe, Eneco (L -gas)	-	388,731	390,392	391,048	390,808
New storage (H-gas)	-	-	-	-	-
From LNG	369,385	369,797	371,377	372,002	371,773
From Interruptible demand	606,287	606,963	644,488	645,571	645,175
From imports					
From backhaul	259,551	259,551	259,551	259,551	259,551
From virtual storage	1,310,506	1,311,967	1,317,572	1,319,788	1,318,978
Gas Terra's domestic supply of flexibility	12,353,904	11,831,490	11,353,001	12,142,547	11,679,059
From Production					
Groningen (L-gas) Free flow					
Groningen (L-gas) Compression					
Small Fields (H-gas)	458,400	415,847	378,221	346,013	285,570
From Storage					
Grijpskerk (H-gas)	1,359,335	1,315,359	1,281,799	1,262,847	1,231,750
Alkmaar (L-gas)	1,251,121	1,242,738	1,234,283	1,250,407	1,242,799
Norg (L-gas)	1,911,435	1,898,628	1,885,710	1,910,343	1,898,720
Norg (L-gas) extension	-	-	-	1,042,005	1,035,666
From imports					
Others' domestic supply of flexibility	7,423,416	8,056,090	9,739,329	10,766,191	10,480,578
Epe, Nuon (L-gas)	582,447	583,096	585,588	586,572	586,212
Epe, RWE/Essent, (L-gas)	388,298	388,731	390,392	391,048	390,808
Kalle, RWE (H-gas)	436,835	437,322	439,191	439,929	439,659
From New storages					
Bergermeer (H-gas)	-	-	1,561,567	1,564,193	1,563,233
Zuidwending , Gasunie (L-gas)	1,553,192	1,554,924	1,561,567	1,564,193	1,563,233
Zuidwending , Nuon (H-gas)	-	-	-	782,096	781,616
Epe, Eneco (L -gas)	-	388,731	390,392	391,048	390,808
New storage (H-gas)	-	-	-	-	-
From LNG	369,385	369,797	371,377	372,002	371,773
From Interruptible demand	606,287	606,963	644,488	645,571	645,175
From imports	2,176,466	2,414,558	2,477,198	2,709,751	2,429,081
From backhaul	259,551	259,551	259,551	259,551	259,551
Virtual storage	1,310,506	1,311,967	1,317,572	1,319,788	1,318,978

Table 11 Sub-market shares analysis results, total costs

	GasTerra				
Week	2012	2013	2014	2015	2016
% of weeks GasTerra has a market share higher or equal to 50%					
	98%	72%	74%	85%	85%
1	59.5%	58.1%	50.6%	52.8%	51.6%
2	59.5%	58.1%	47.9%	52.8%	51.6%
3	59.5%	58.1%	47.9%	52.8%	51.6%
4	79.5%	78.2%	75.8%	76.4%	75.2%
5	59.5%	58.1%	47.9%	52.8%	51.6%
6	59.5%	58.1%	47.9%	52.8%	51.6%
7	59.5%	58.1%	50.6%	52.8%	51.6%
8	59.5%	58.1%	50.6%	52.8%	51.6%
9	79.5%	78.2%	75.8%	76.4%	75.2%
10	79.5%	78.2%	75.8%	76.4%	75.2%
11	79.5%	78.2%	75.8%	76.4%	75.2%
12	79.5%	78.2%	75.8%	76.4%	75.2%
13	79.5%	78.2%	75.8%	76.4%	75.2%
14	79.5%	78.2%	75.8%	76.4%	75.2%
15	100.0%	23.9%	0.0%	0.0%	0.0%
16	92.2%	91.7%	90.8%	90.4%	89.9%
17	92.2%	91.7%	90.8%	90.4%	89.9%
18	92.2%	91.7%	90.8%	90.4%	89.9%
19	92.2%	91.7%	90.8%	90.4%	89.9%
20	92.2%	91.7%	90.8%	90.4%	89.9%
21	100.0%	44.1%	90.8%	90.4%	89.9%
22	100.0%	44.1%	0.0%	0.0%	0.0%
23	61.2%	91.7%	90.8%	90.4%	89.9%
24	61.2%	91.7%	90.8%	90.4%	89.9%
25	100.0%	44.1%	90.8%	90.4%	89.9%
26	100.0%	44.1%	90.8%	90.4%	89.9%
27	100.0%	44.1%	90.8%	90.4%	89.9%
28	61.2%	44.1%	90.8%	90.4%	89.9%
29	100.0%	44.1%	90.8%	90.4%	89.9%
30	100.0%	44.1%	90.8%	90.4%	89.9%
31	100.0%	44.1%	0.0%	0.0%	0.0%
32	100.0%	100.0%	0.0%	0.0%	0.0%
33	100.0%	100.0%	0.0%	0.0%	0.0%
34	100.0%	44.1%	90.8%	90.4%	89.9%
35	100.0%	44.1%	90.8%	90.4%	89.9%
36	100.0%	44.1%	90.8%	90.4%	89.9%
37	61.2%	91.7%	90.8%	90.4%	89.9%
38	61.2%	91.7%	90.8%	90.4%	89.9%
39	61.2%	91.7%	90.8%	90.4%	89.9%
40	92.2%	91.7%	90.8%	90.4%	89.9%
41	100.0%	23.9%	0.0%	0.0%	0.0%
42	79.5%	78.2%	75.8%	76.4%	75.2%
43	79.5%	78.2%	75.8%	76.4%	75.2%
44	100.0%	100.0%	0.0%	0.0%	0.0%
45	79.5%	78.2%	75.8%	76.4%	75.2%
46	79.5%	78.2%	75.8%	76.4%	75.2%
47	37.9%	23.9%	0.0%	0.0%	0.0%
48	79.5%	78.2%	75.8%	76.4%	75.2%
49	79.5%	78.2%	75.8%	76.4%	51.6%
50	79.5%	78.2%	75.8%	76.4%	75.2%
51	59.5%	58.1%	47.9%	52.8%	51.6%
52	59.5%	58.1%	47.9%	52.8%	51.6%
53	59.5%	58.1%	50.6%	52.8%	51.6%

Table 12: Residual supplier index, considering the relevant market

Week	2012	2013	2014	2015	2016
1	83.1%	83.2%	50.7%	101.8%	101.7%
2	55.8%	55.8%	79.6%	68.3%	68.2%
3	74.4%	74.5%	106.2%	91.1%	91.0%
4	23.4%	23.4%	24.8%	24.9%	24.9%
5	74.0%	74.1%	105.6%	90.6%	90.5%
6	78.9%	79.0%	112.6%	96.6%	96.5%
7	89.0%	89.1%	54.3%	109.0%	108.9%
8	88.1%	88.2%	53.7%	107.9%	107.8%
9	28.3%	28.3%	30.0%	30.1%	30.1%
10	28.8%	28.9%	30.7%	30.7%	30.7%
11	29.3%	29.4%	31.2%	31.3%	31.2%
12	33.3%	33.3%	35.4%	35.5%	35.4%
13	35.8%	35.8%	38.1%	38.1%	38.1%
14	32.9%	33.0%	35.0%	35.1%	35.0%
15	0.0%	258.1%	274.1%	274.6%	274.4%
16	31.1%	31.1%	33.0%	33.1%	33.1%
17	27.9%	27.9%	29.6%	29.7%	29.7%
18	28.2%	28.2%	30.0%	30.0%	30.0%
19	36.3%	36.3%	38.5%	38.6%	38.6%
20	36.5%	36.5%	38.8%	38.8%	38.8%
21	0.0%	66.0%	70.1%	70.3%	70.2%
22	0.0%	95.0%	100.9%	101.1%	101.0%
23	53.9%	54.0%	57.3%	57.4%	57.4%
24	53.4%	53.4%	56.7%	56.8%	56.8%
25	0.0%	71.7%	76.2%	76.3%	76.2%
26	0.0%	74.1%	78.7%	78.9%	78.8%
27	0.0%	87.4%	92.9%	93.0%	93.0%
28	61.9%	62.0%	65.8%	65.9%	65.9%
29	0.0%	84.8%	90.0%	90.2%	90.1%
30	0.0%	87.8%	93.3%	93.4%	93.4%
31	0.0%	124.3%	131.9%	132.2%	132.1%
32	0.0%	0.0%	158.0%	158.2%	158.1%
33	0.0%	0.0%	146.9%	147.1%	147.1%
34	0.0%	90.1%	95.7%	95.9%	95.8%
35	0.0%	76.0%	80.7%	80.8%	80.7%
36	0.0%	63.7%	67.7%	67.8%	67.8%
37	50.9%	51.0%	54.1%	54.2%	54.2%
38	38.8%	38.9%	41.3%	41.3%	41.3%
39	39.3%	39.3%	41.7%	41.8%	41.8%
40	26.4%	26.4%	28.0%	28.1%	28.1%
41	0.0%	204.1%	216.8%	217.2%	217.0%
42	29.9%	30.0%	31.8%	31.9%	31.9%
43	32.0%	32.0%	34.0%	34.1%	34.1%
44	0.0%	0.0%	505.1%	506.0%	505.7%
45	56.8%	56.9%	60.4%	60.5%	60.5%
46	35.1%	35.2%	37.3%	37.4%	37.4%
47	133.4%	133.6%	141.8%	142.1%	142.0%
48	49.8%	49.9%	53.0%	53.1%	53.0%
49	22.9%	22.9%	24.3%	24.4%	149.8%
50	31.8%	31.8%	33.8%	33.9%	33.9%
51	56.2%	56.2%	80.2%	68.8%	68.7%
52	64.9%	65.0%	92.7%	79.5%	79.4%
53	96.5%	96.6%	58.9%	118.2%	118.1%

Appendix III : Results of scenarios

In our main analysis, we based the price of storage on the published bundle price for existing storages and on a bottom up cost estimate for the new storages for which no market price data exists. However, it is unlikely that GasTerra actually pays this price to NAM for using gas storage. In any case, NAM and GasTerra are in effect vertically integrated, and so the real price of storage is the cost of storage. To account for this we have re-run the analysis using a bottom-up estimate of the cost of gas storages, rather than the bundle price.

We have also run a sensitivity considering how an increase of 10% of the demand for flexibility will affect our results. For our base case we consider the demand for flexibility is unlikely to suffer significant changes for the following years. The scenarios we consider are thus:

- Base case: market prices used for gas storages and demand for flexibility at the 2009 level;
- Scenario 1: market prices used for gas storages and demand for flexibility at the 2009 level + 10%;
- Scenario 2: bottom up cost estimates used for gas storages and demand for flexibility at the 2009 level;
- Scenario 3: bottom up cost estimates used for gas storages and demand for flexibility at the 2009 level + 10%.

The charts below illustrate the results in terms of sub-market shares, and illustrate that the results of the scenarios do not differ significantly from the base case. In all the scenarios GasTerra has a market share of at least 50% for about 80% of the time.

Figure 9: Scenario 1: Sub-market shares

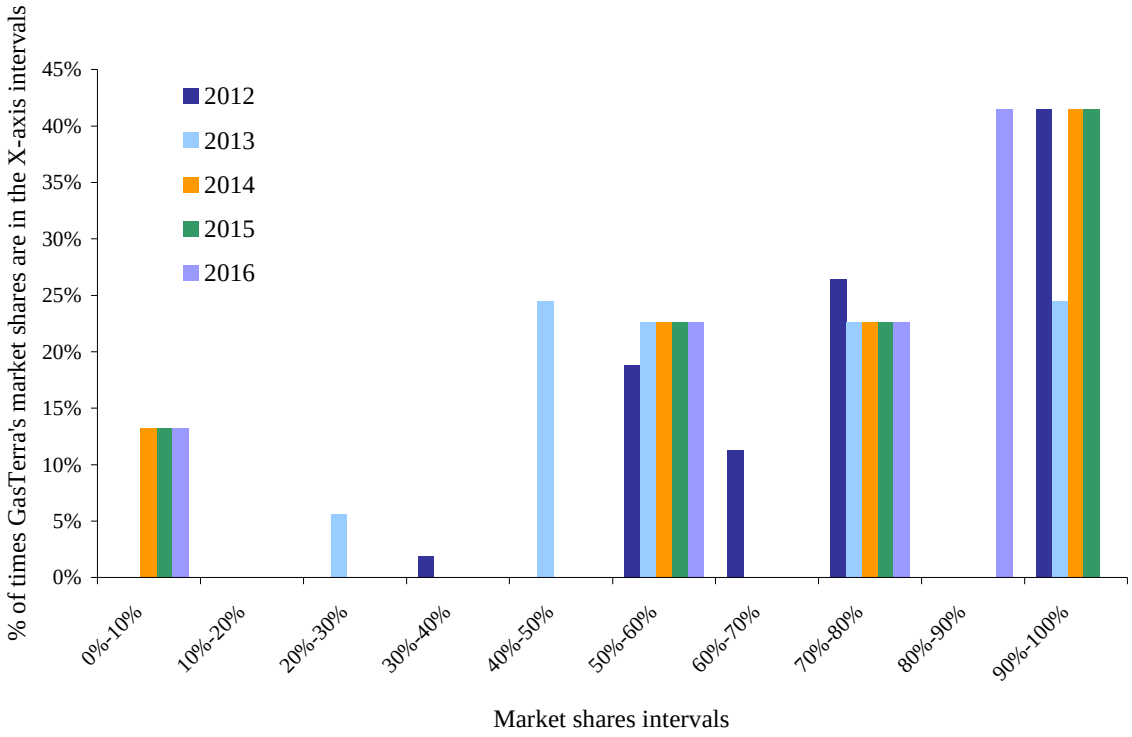


Figure 10: Scenario 2: Sub-market shares

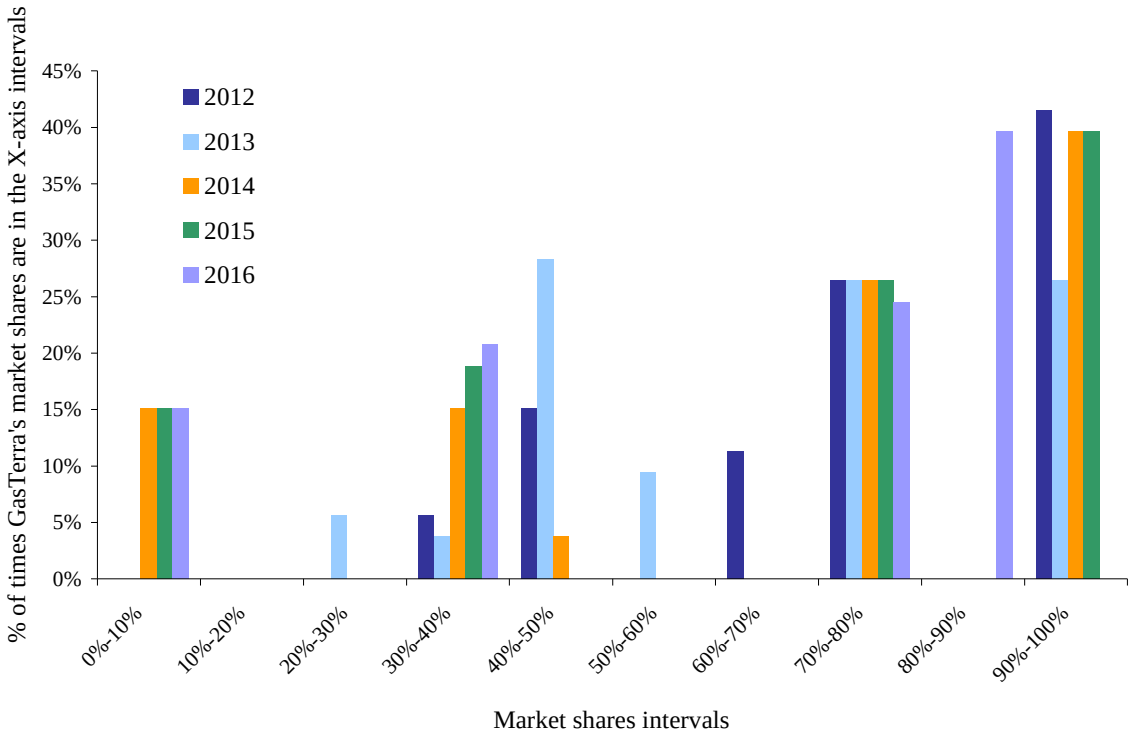


Figure 11: Scenario 3: Sub-market shares