MARKET REFORM

International Gas Markets Study

Report to the Australian Energy Market Commission

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AEMC

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1 STUDY OVERVIEW

1.1 Background

In December 2014, the Council of Australian Governments (COAG) Energy Council tasked the Australian Energy Market Commission (AEMC) to review the design, function and roles of Eastern Australia's facilitated gas markets and gas transportation arrangements. The Victorian Government is also seeking to have the AEMC review the Victorian Declared Wholesale Gas Market (DWGM), a review which may closely align with the COAG scope of work. The facilitated gas markets are the DWGM, the Short Term Trading Market (STTM) at the Sydney, Adelaide and Brisbane demand hubs, and the market at the Wallumbilla Gas Supply Hub.

Phase 1 of the COAG work involves identifying issues with the current markets and any immediate recommendations, while Phase 2 will consider medium and longer-term changes to market and transmission pipeline arrangements.

The AEMC commissioned Market Reform to undertake a review and comparative assessment of international wholesale natural gas markets and transmission pipeline arrangements – the International Gas Markets Study – to be performed in parallel with the Phase 1 work. This review is to provide a reference to support the AEMC in its broader review.

1.2 Objective and Scope

The objective of the Study was to gather detailed information by jurisdiction, and conduct comparative analysis, of:

- Market context: including scale, scope and key characteristics
- Industry structure: including the key types of player, relationships between the entities, and principal physical, financial and data flows.
- Transmission arrangements: including the forms of transportation right, transportation access, capacity allocation/auction, capacity release, secondary trading, capacity expansion process and funding, and nomination, scheduling and balancing mechanisms.
- Storage arrangements: including storage access and storage rights, capacity release and secondary trading.
- Trading arrangements: including trading reference points (e.g. physical hubs, virtual hubs, zones, etc.), spot/cash trading and pricing, forward/financial trading and pricing, risk management
- Market information and market transparency.
- Retail competition: including arrangements, and the degree of market openness.
- Regulatory structure: including legal framework, behavioural and economic regulation of pipelines, regulation of trading, and participant regulation.
- Evolution of the current arrangements: including the key drivers for change, transition path to the current state, and the timeframe for change.
- Market development: including issues and concerns with the current arrangements, and potential future developments.

Market profiles examining these topics were developed for:

- Germany
- Great Britain
- The Netherlands
- The United States

In addition, hub profiles, examining a subset of these topics, were developed for the trading hubs of Zeebrugge and the Central European Gas Hub (CEGH).

1.3 Approach

The general approach to the work consisted of:

- Definition of a common template for gathering profile information on each market, covering all features relevant to the broader AEMC review, as well as a comprehensive glossary. As well as the information contained within each profile, this approach provides a basis for 'like against like' comparison, and a common lexicon.
- Profiles were developed for each of the four markets of principal interest – Germany, Great Britain, the Netherlands and the United States – as well as reduced profiles for two hubs – Zeebrugge and CEGH, principally of interest for trading at those points rather than any domestic arrangements. To carry out this work Market Reform utilised its own researchers, as well as a network of subject matter specialists with detailed knowledge and experience of the various markets under study. Each profile was assigned an author and at least one reviewer.
- Preparation of a comparative analysis of key market features, and where applicable, explanation of the rationale for differences between the markets. This includes topics such as: Centralised operators vs. decentralised arrangements; management of cross-border arrangements; market arrangements in a pan-jurisdictional context; virtual vs. physical hubs; zonal entry/exit vs. point-to-point rights, etc.

1.4 Report Outline

The substantive component of this report is structured as follows:

- Section 2 – Context and Comparison: Definition of a common model for gas markets, and comparative analysis across the studied markets.
- Sections 3-8 – Market Profiles: Detailed profiles for each studied gas market.
- Appendix A – Glossary: Glossary of terms utilised across all profiles.

2 CONTEXT AND COMPARISON

In order to describe and compare the key features of multiple international gas markets, it is necessary to define a common model for their description – in terms of their structure, operations, commercial arrangements and regulation. This model is used both as the basis for the gas market profiles contained in later sections of this document, and for the framework of the comparative analysis contained within this section. This comparative analysis, in turn, helps to illustrate, with examples from the various markets studied, and provide context to the various model elements.

2.1 System Characteristics

The four major trading markets chosen for study – Germany, Great Britain, the Netherlands and the United States – were selected because they (a) have active and sizable markets in gas, and (b) all have somewhat different characteristics.

Table 1 below provides some comparative data on market size, both in terms of consumption and overall length of transmission pipeline, and system characteristics.

Table 1 – System Size and Characteristics

	Germany	GB	Netherlands	US	Aust (East)
Total Consumption (million TJ)	3.8	3.0	1.7	28.4	0.66 [i]
Transmission Pipeline (km)	40,000	7,600	11,256	488,000	12,995 [ii]
Primary Source of Supply	Import	Domestic	Domestic	Domestic	Domestic
Largest Category of Demand	Residential/ industrial[1]	Residential	Residential	Power generation	Industrial
Net Import/Export	Import and trans-shipment	Import	Export moving to import	Import moving to export	Net export

The US is, by a large margin, the largest gas market in the world, in terms of both physical and trading volumes. It is presently a small net importer, but with continued ramp-up of shale gas production is predicted to become a sizable net exporter (mainly via LNG) in the next few years. Britain has in recent years moved from being a net-export to a net-import system, and the Netherlands is moving in the same direction. Over the same period, Britain has been supplanted by Germany as the largest gas consumer in Europe.

The physical nature of the transmission systems differs substantially. The US system has principally evolved as a series of independently-operated long-haul pipelines, predominantly from the Gulf of Mexico (and to a lesser extent Western Canada) to major demand sinks in the North-East, Mid-Continent and West. The nature of this system is starting to change, however, with substantial shale gas supplies in the North-East (e.g. Marcellus), leading to increased meshing of the transmission system in that region, and changes in flow direction on a number of key pipeline segments. The increasing prevalence of gas-fired generation is also having significant impacts upon the operational dynamics of the system.

[1] Depending on the year (and the weather) either residential or industrial load can be the major source of gas demand in Germany.

By contrast, the gas transmission systems in Great Britain and the Netherlands are each a single meshed network. Germany for the most part is a meshed network, though receives imports from a number of large long-haul pipelines, and also has substantial long-haul capacity for the purpose of trans-shipment, with around half of all imported gas re-exported into other parts of Europe. Use of gas-fired generation has been dropping in most of Europe, due to higher gas prices. Although there is strong potential for shale gas in Great Britain and the Netherlands, and some potential in Germany, only Britain is actively seeking to exploit this at present.

Figure 1 below compares average gas prices in the four markets studied, as well as Australia, in 2013.

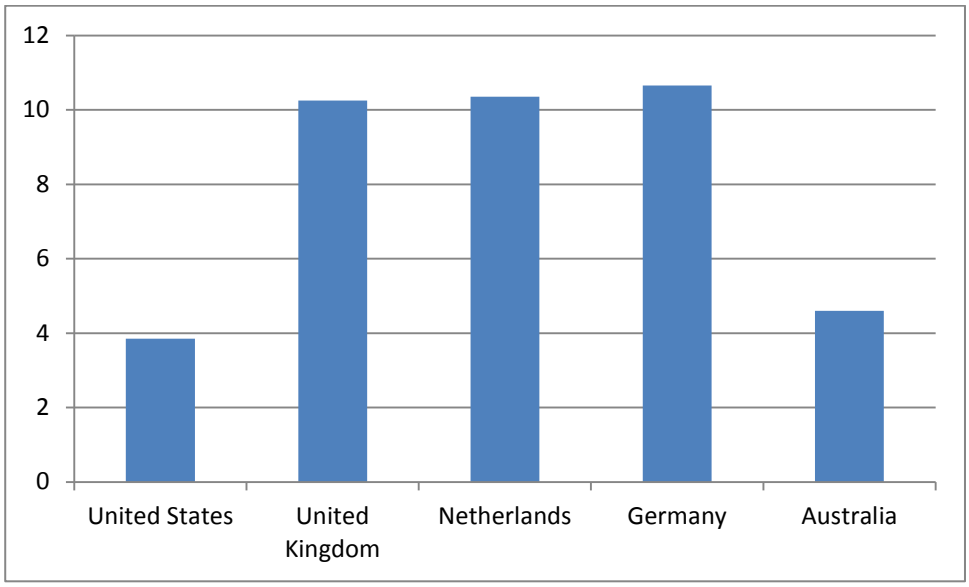


Figure 1 – Wholesale Gas Prices (2013) (US$/MMBtu) [iii]

Figure 2 shows the evolution of wholesale prices in the US, Europe and Japan over the last 25 years. Note particularly the impact of shale gas production on US prices the last 6-7 years.

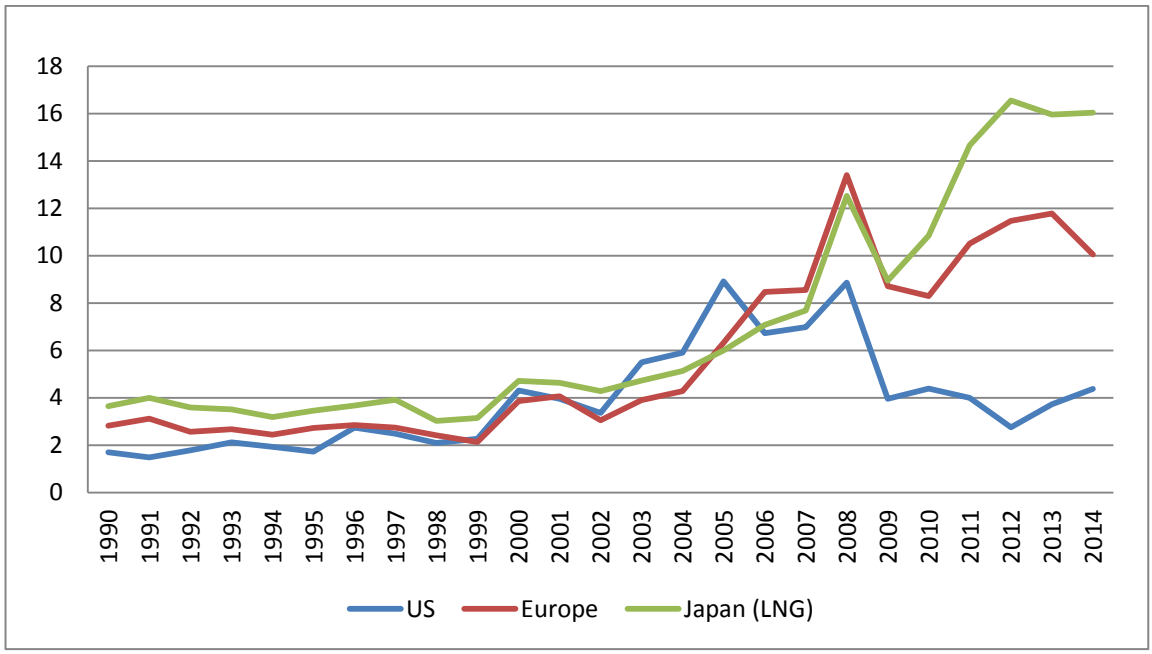


Figure 2 – Nominal Wholesale Gas Prices in the US, Europe and Japan ($/MMBtu) (1990 – 2014) [iv]

Gas storage – which represents the natural physical hedge to short-term price fluctuations – is present in all four countries, though most significant in the US (400 facilities; 35% of annual consumption) and Germany (50 facilities, 57% of annual consumption), driven by economic and security of supply factors, the latter particularly important in Germany, with concerns regarding Russian gas inflows.

2.2 Industry Structure

In all of the studies markets, transmission has been structurally separated from the production, shipping and retailing of natural gas. In none of these markets, however, has system operation been separated from transmission ownership, à la electricity.

The number of transmission system operators (TSOs) varies dramatically. In both Great Britain and the Netherlands the system is operated by a unitary TSO, which also manages a common balancing regime for the market, which in turn functions as the principal trading (virtual) reference point for the market. Germany has 17 separate gas pipeline systems/TSOs. These are grouped into two 'market areas' for the purposes of balancing, and as (virtual) reference points for trading. In the US, each of the approximately 210 pipelines is an independently operated entity, with each having its own balancing regime. With changes in flows, and meshing, some operational complications are beginning to be seen in this model[2]. Trading locations are not based upon balancing, but have evolved at physical and virtual points of commercial convenience.

Table 2 – Industry Structure

	Germany	GB	Netherlands	US
Transmission Separation	Y	Y	Y	Y
System Operator and Owner are Separate	N	N	N	N
# of TSOs	17	1	1	~210
# of Balancing Regimes	2	1	1	~210
# of Major Trading Locations	2	1	1	~24
Full Retail Contestability	Y	Y	Y	Some states
Separation of Retail and Distribution	N	Y	Y[3]	N

Full retail contestability nominally exists in Great Britain, the Netherlands, Germany, and some US states, though the level of actual competition and customer switching differs. A number of US states do not have retail competition, though any entity able to bypass the local distribution system (e.g. industrials, power generators) is also able to access the competitive wholesale market directly.

There is also variation in the degree of unbundling of retail from distribution. In Great Britain retail is fully unbundled, and the Netherlands has the same objective.[3] In the US and Germany there is no retail unbundling requirement.

[2] For example (as discussed in the US profile), Columbia Gas Transmission at times cannot deliver sufficient quantities of gas over its own system from Central Appalachia to Northern Ohio, due to system constraints, and must instead make arrangements for delivery through other pipelines. This is akin to a form of sub-optimal multi-pipeline scheduling.

[3] This has been challenged by some distributors, and is presently before the courts.

2.3 Transmission Arrangements

2.3.1 Transportation Rights

In all of the markets examined, gas transportation is arranged through the purchase of transportation rights. These rights essentially convey to the purchaser – often known as the 'shipper' – an entitlement to a portion of the pipeline's/system's capacity, expressed in terms of a maximum daily quantity. The shipper may nominate daily gas flows within this capacity limit, and other constraints dictated by the transportation agreement with the pipeline. The pipeline operator, in turn, is responsible for ensuring deliveries, including the management of all operational complexities (e.g. within-day events and across-day flows[4]).

Table 3 below provides a summary of transportation rights arrangements in various markets. These topics are discussed further in the sub-sections below.

Table 3 – Transportation Rights Summary

	Germany	GB	Netherlands	US			
				Columbia	El Paso	NGPL	Transco
Locational Form	Entry/Exit	Entry/Exit	Entry/Exit	Entry/Exit	Contract Path	Contract Path	Contract Path
Min. Tenor	Daily	Intra-Day	Intra-Day	Daily			
Maximum Duration	15yrs	16yrs/6yrs (entry/exit)	15yrs	Typically 25-30 years			
Sale of Firm Entry	Auction, Bulletin Board	Auction	Auction, Bulletin Board	Bulletin Board (Regulated Rate) or Negotiated			
Sale of Firm Exit (Retail)	Allocated	Allocated	Allocated				
Sale of Firm Exit (Other)	Auction, Bulletin Board	Auction	Auction, Bulletin Board				
Sale of Interruptible	Bulletin Board	Auction	Bulletin Board	Bulletin Board (Regulated Rate) or Negotiated			
Purchase of New Capacity	Auction, Open Season			Open Season			
Secondary Trading	Y	Y	Y	Y			
Capacity Release Mechanisms[5]	SoC FDA/LT UIOLI	SoC OBB	SoC OBB	Tariff-specific; no general requirements			

[4] Transportation typically involves injection and withdrawal of gas on the same day. However, on a long-haul pipeline the physical movement of injected gas (or more precisely, its associated pressure wave) may take several days. The pipeline operator is responsible for reconciling the commercial service it offers (same day delivery) with the physical realities of the system it operates.

[5] SoC = Surrender of Capacity, FDA UIOLI = Firm Day-Ahead Use-It-Or-Lose-It, LT UIOLI = Lomg-Term Use-It-Or-Lose-It and OBB = Oversell and Buyback. These mechanisms are described in more detail under Capacity Release in the Transportation section of the European gas market profiles (e.g. the German profile).

	Germany	GB	Netherlands	US			
				Columbia	El Paso	NGPL	Transco
Expansion Driven By	10 yr plan Auction	Open season Auction 10 yr plan	Open season Auction 10 yr plan	Open season			

2.3.1.1 Locational Nature

Transportation rights typically conform to one of two different locational systems:

- *Contract Path*: The shipper purchases capacity from a designated point of injection ('source') to point of withdrawal ('sink'), along a designated 'contract path'. Some limited reassignment of source and sink may be allowed by the pipeline operator at its discretion. This model is most commonly used on long-haul pipelines.
- *Entry/Exit*: The shipper purchases 'entry capacity' from a point of entry into a system area (often represented commercially by a virtual point), and separately, purchases exit capacity from the system area to a point of exit (which can be a range of points, such as a distribution system). Delivery throughout the system is managed by the TSO(s). This model is commonly used on meshed transmission networks.

All three of the European systems profiled use a system of entry/exit rights. In Great Britain and the Netherlands, capacity purchases are to/from a single virtual location, the National Balancing Point (NBP) and Title Transfer Facility (TTF) respectively. In Germany, capacity is purchased for nominal deliveries to/from two separate market areas, GasPool and NetConnect Germany (NCG), which collectively cover all 17 TSOs. In all cases, the TSOs are responsible for managing the operational complexities of gas movement to schedule flows nominated on these capacity reservations.

In the US, each gas pipeline manages its own capacity reservation regime, with both the contract path and entry/exit models in use. Of the four pipelines examined in the US profile, Columbia Gas Transmission utilises a single zone entry/exit model, and the others (El Paso, NGPL and Transco) a contract path model, with some providing flexibility around aggregation and/or reassignment of receipt and delivery points within designated zones.

2.3.1.2 Types of Right

The mainstay forms of transportation right are firm capacity and interruptible capacity (defined in the glossary), which all of the profiled markets offered in some form. These are typically based on the presumption of a steady flow rate throughout the day.

In the US, in particular, there are wide variety of variants on these, including 'no notice' service (in which holders, typically local distribution companies, can exceed their schedules), and various forms of 'swing' service (which allow for variations in hourly delivery profile).

2.3.1.3 Tenor and Duration

In Germany, Britain and the Netherlands, firm capacity is typical available for primary (i.e. initial) purchase in annual, quarterly, monthly and daily contracts. Britain and the Netherlands also provide for the sale of intra-day capacity. In the US rights are typically initially sold in multiples of a year, but can be broken down and re-sold in the secondary market for periods as short as a day.

The typical maximum duration of firm transportation contracts in Europe is 15-16 years. In the US the forward commitment period is determined by the open season process. Periods of 25-30 years are common, and it is not uncommon for many open seasons to state that periods less than 15 years will not be accepted.

2.3.1.4 Primary Sales

The way in which a pipeline/system operator sells capacity tends to differ depending on whether the capacity being sold is existing capacity or proposed new capacity.

In the US, each pipeline must maintain a 'bulletin board' where it (amongst other things) posts any existing capacity available for purchase. This capacity may be purchased at a regulated 'recourse' rate, or the parties may agree a negotiated rate – though to ensure transparency, pipelines are required to provide details of all negotiated contracts in their tariffs. By contrast, new capacity is sold by pipelines via an open season process, in which they receive bids to purchase capacity for a specified duration, and select an optimised set (if revenues are sufficient).

In Europe, the processes for the sale of capacity have substantial similarities. All profiled European markets:

- utilised auctions for the sale of firm entry capacity – both existing, and incremental new capacity.
- provided an 'open season' style mechanism to directly contract for new entry capacity where incremental capacity options not applicable (e.g. PARCA in Great Britain).
- provided a form of application/allocation process for exit capacity associated with retail customers.
- utilised auctions for the sale of other exit capacity.

In the Netherlands and Germany all auctions are conducted via the pan-European PRISMA platform[6], which is also utilised for the bulletin board-style sale – at regulated rates – of any interruptible and unsold firm capacity. In Great Britain, auctions are conducted via National Grid's own platform – including for interruptible and unsold firm capacity. By November 2015 all cross-border trading in Europe will migrate to PRISMA, with cross border entry/exit sold as a bundled offering (see profiles for description).

2.3.1.5 Secondary Trading

All of the profiled markets had rules to encourage and facilitate secondary trading of capacity rights.

In the US, FERC requires each pipeline to facilitate secondary trading of capacity via its bulletin board. This provides a mechanism for those looking to sell their capacity to find and trade bilaterally with each other. The holder of the capacity can divided their holdings down into time periods as small as a day and sell these off individually. In the case of capacity using 'contract path', they can also sell of locational segments, provided it is operationally feasible on the pipeline's system. Pipelines will also typically allow some reassignment of injection and/or withdrawal points, subject to operational evaluation, in order to facilitate secondary trading.

In Great Britain, shippers can trade entry capacity back into the capacity auctions operated by the TSOs. As entry/exit rights these cannot be locationally segmented, though they can seek to 'transfer' their capacity to another location, subject to evaluation by the TSO. In the Netherlands and Germany, secondary trading takes place via PRISMA, using a 'bulletin board'-style posting mechanism, with all transfers registered by, and subject to approval of, the relevant TSO.

2.3.1.6 Capacity Release

The hoarding of capacity – refusing to on-sell unused capacity to others who might be able to use it – is a risk intrinsic to all transportation regimes involving the long-term reservation of system capacity.

This issue seems to have been particularly fraught in Europe, where a number of mechanisms have been defined for addressing it under the common Network Code on Capacity Allocation Mechanisms (NC CAM):

- Surrender of Capacity (SoC): Capacity is voluntarily surrendered back to TSO, with shipper relieved of its payment obligation if the capacity is re-sold.
- Oversubscription & Buy Back (OBB): TSO auctions any firm capacity that has not been nominated, up to the technical limit of the pipeline.
- Firm Day-Ahead Use-It-or-Lose-It (FDA UIOLI): Capacity that is not nominated the day before the flow is made available to others on an interruptible basis.

[6] This platform involves collaboration across 28 major gas TSOs.

- Long-Term Use-It-Or-Lose-It (LT UIOLI): Capacity with less than 80% utilisation in a 12-month period may be forced to be surrendered partially or completely.

Individual countries are able to choose which of these mechanisms they choose to implement (see Table 3).

The US has no formal set of rules (FERC orders) regarding capacity hoarding, though has allowed some pipelines to institute tariff provisions to limit hoarding (e.g. limiting a shipper's receipt point capacity to its firm contract demand). There is various theorising as to why hoarding seems to have been more problematic in Europe, with explanations including regulators with less enforcement authority, grandfathering of rights, less pipeline competition (and thus greater value from hoarding), greater market concentration, etc. Certainly FERC has substantial powers to address abuses, but otherwise there is no definitive answer to why the US has seen less need to address the issue of hoarding.

2.3.1.7 Capacity Expansion Process

The process of planning capacity expansion differs substantially across the markets examined. The process in the US is entirely decentralised, carried out on a pipeline-by-pipeline basis, and driven by customer demand, tested through 'open season' processes where shippers indicate their desire for new capacity.

By contrast, in Germany the process of network expansion is predominantly driven by incremental capacity auctions, and a 10-year Network Development Plan (NDP), prepared annually by the TSOs (as a group). Once agreed to be the regulator, the TSOs are guaranteed cost recovery on any expansion works undertaken.

The Netherlands and Great Britain are both somewhat of a hybrid, with new long-term investment driven by an open season process or similar (known as the PARCA in GB), and incremental capacity auctions, but with centralised planning also occurring through the creation of 10-year plans, which can also lead to other regulator-approved investments being undertaken.

2.3.2 Nominations, Scheduling and Balancing

2.3.2.1 Nominations and Scheduling

The processes for nomination and scheduling of gas are similar for all the markets/pipelines profiled. While timings differ, all:

- operate according to a gas day;
- require the submission of nominations for intended gas flows by a designated cut-off some hours before the gas day;
- schedule based on a priority order, with curtailments made on the basis of interruptible tranches;
- allow re-nomination prior to commencement of the gas day
- allow intra-day nominations during the gas day – though the number of intra-day nominations allowed, and how close to the time of gas flow, may differ by system.

There is some difference in the management of cross-border and inter-pipeline flows. Flows across the US/Canadian border will take place on a designated pipeline, and as such, while injections may be on one side of the border and withdrawals on the other, are essentially managed like all other pipeline flows. Flows from one pipeline into another are not coordinated – it is the shipper's responsibility to ensure they match – but many pipelines offer 'park-and-loan' services to aid in this, and a number of trading hubs offer notional transfer of gas between pipelines.

In Europe, many pipeline systems tend to align with national boundaries rather than cross them. Shippers nominate cross-border (and cross-market area) flows to both relevant TSOs, with the TSOs exchange information to align the nominations according to the 'lesser of rule'.

2.3.2.2 Balancing

Balancing arrangements, by contrast, tended to differ across markets. Historically, balancing has tended to occur through either 'payback' (replacement of the imbalance gas by the shipper) or

'cashout' (the TSO replaces the gas, and is reimbursed by out of balance shippers), either daily or monthly. Many of the systems examined now tend to use some form of hybrid on this model:

- In the US, balancing arrangements can differ by pipeline, though there has been some alignment in recent years, with all four systems profiled having a similar regime – 'cumulative daily, where imbalances are calculated on a daily basis, but allowed to accumulate (including being reduced via 'payback') provided they stay within defined tolerances,, with monthly cashout of net imbalances. FERC requires that pipelines facilitate shipper trading of positive and negative imbalances amongst each other, to reduce their overall imbalance.
- In Great Britain, imbalances are calculated and cashed-out on a daily basis, though shippers can use the On-the-day Commodity Market (OCM) on an intra-day basis to balance their positions. Any residual imbalance is settled at a reference price determined from OCM prices and other determinants.
- In Germany, the Market Area Manager determines imbalance quantities and cashes them out (based on an index derived from trading at a number of reference points, multiplied by a penalty factor) on a daily basis.
- In the Netherlands, imbalance quantities are determined hourly. These can continue to accumulate, and be remedied through payback, unless the System Balancing Signal (SBS), based on aggregate imbalance, moves outside defined tolerance bands, at which point the TSO will act to restore balance, with costs assigned to those out of balance.

Table 4 – Balancing Summary

	Germany	GB	Netherlands	US			
				Columbia	El Paso	NGPL	Transco
Balancing Period	Daily	Daily	Cumulative Hourly	Cumulative Daily			
Settlement Period	Daily	Daily	Daily[7]	Monthly			
Penalty Factors Used	Y	Y[8]	N	Y			

2.4 Storage Arrangements

In all profiled markets there is a requirement to offer third-party access to storage, with limited exceptions/grandfathering (e.g. only FERC-regulated entities in the US are required to provide third-party access). In some cases this involves 'physical' rights to nominated storage facilities, and in other cases 'virtual' access to a set of facilities operated by a storage operator (with the operator deciding physical matters).

Storage may be priced at regulated rates (published in a tariff), market-based rates (determined through open season or auction), or negotiated rates, depending on market. Secondary trading of storage rights is active in all markets, with organised trading markets for storage in Europe (e.g. on ICE-Endex).

[7] Via the Linepack Flexibility Service, shippers can pay to transfer their imbalance to the next day.
[8] Rather than an explicit penalty factor, a different price is used for cashing out positive and negative imbalances.

Table 5 – Storage Access Summary

	Germany	GB	Netherlands	US
Third-Party Access	Most	Y	Most	Interstate connected
Physical/Virtual	Both	Physical	Both	Both
Primary Rights Purchase	Negotiated Rates, Auction	Auction	Negotiated Rates, Auction	Regulated Rates, Open Season
Trading Market	Y	Y	Y	N

2.5 Trading Arrangements

All of the markets and hubs profiled have organised trading markets – a fact that is not coincidental, this being a key reason for their selection for profiling. The US is the most actively traded gas market, in terms of both absolute trading volume and trade velocity (financial volume/physical volume).

Trading in the Great Britain, the Netherlands and Germany is centred around one or two virtual trading locations: NBP (GB), TTF (Netherlands), NCG and GasPool (Germany) – with the exception of some occasional locational trades for balancing. The principal physical hub in Europe is at Zeebrugge in Belgium. NBP has historically been the most actively traded European location, though recently the TTF has drawn level.

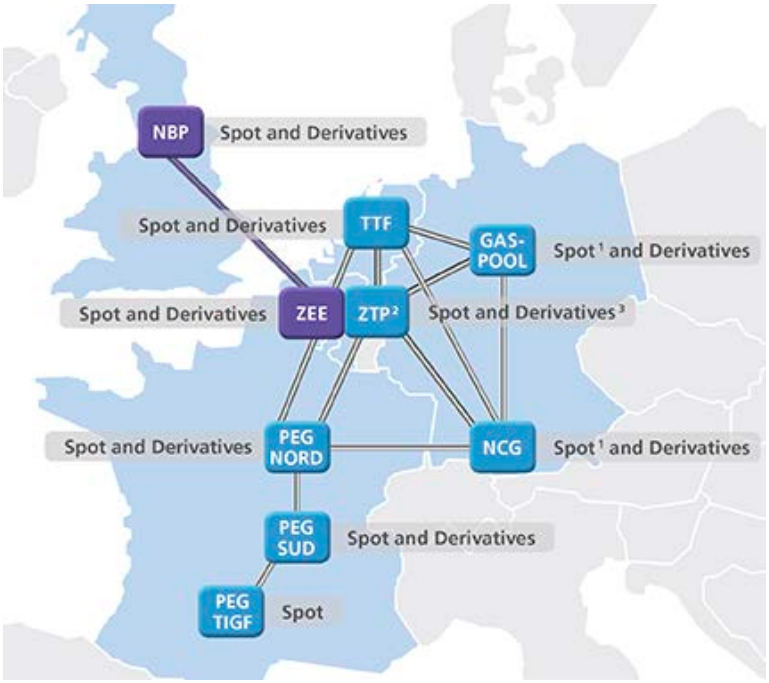


Figure 3 – Key European Trading Points (Source: PEGAS)

By contrast, the US has a wide range of locations at which gas is traded, some physical and some virtual, encompassing key supply points, trans-shipment points, storage locations, city gates and demand zones. Henry Hub, a major supply, storage and trans-shipment point, is the benchmark trading location for gas in North America, with most other products trading as a basis differential to it, rather than as 'outrights' (e.g. the Houston Ship Channel contract trades at the price differential between that location and Henry Hub, rather than representing an 'outright' price for gas at that location).

Depending on the market, trading can take place in a number of timeframes:

- Intra-day market, for gas balancing
- Prompt/short-term forward markets in the day(s)-ahead of delivery
- Forward/futures markets

Table 6 – Trading Arrangement/Market Summary

	Germany	GB	Netherlands	US	Zeebrugge
Trading Locations	NCG GasPool	NBP	TTF	Henry Hub ~ 50 others	ZEE ZTP
Balancing Market Operator	-	ICE-Endex (OCM)	ICE-Endex	-	ICE-Endex
Tenor of Balancing Products	-	Daily Rest-of-day	Hour	-	Hour
Prompt Market Operators	PEGAS CME Europe	ICE CME Europe PEGAS[9]	ICE-Endex PEGAS CME Europe	CME/NYMEX ICE NGX	ICE-Endex PEGAS
Tenor of Key Prompt Products	Within-day Day-ahead Rest-of-week	Daily	Within-day Day-ahead Rest-of-week	Daily	Within-day Day-ahead Rest-of-week
Forward Market Operators	PEGAS ICE-Endex CME Europe	ICE CME Europe PEGAS	ICE-Endex PEGAS CME Europe	CME/NYMEX ICE NGX	ICE-Endex PEGAS
Tenor of Key Forward Products	Months Quarters Seasons Years	Months Quarters Seasons Years	Months Quarters Seasons Years	Months Years	Months Quarters Seasons Years
Forward Listing Period (max)	4 years	7 years	6 years	13 years	2 years
Physical Products	Y	Y	Y	Y	Y
Delivery Integration	Multilateral submission	Multilateral submission	Multilateral submission	Bilateral matching	Multilateral submission
Financial Products	Y	Y	Y	Y	N
Reference Price	ICIS Heren	ICIS Heren	ICIS Heren	Platts	-

Explicit balancing markets exist in Great Britain and the Netherlands, to allow participants to balance their own positions, and for the TSO to procure any balancing gas it requires. In Germany there is no explicit balancing market, though the Market Area Managers (NCG and GasPool) may use the PEGAS cash market, or their own trading platforms, to procure any required balancing gas. The US has no organised market for balancing, with pipelines entering into their own arrangements (using their own or procured gas), and cash-out often based on OTC market indices.

[9] Planned for launch in 2015.

Active prompt/short-term forward markets exist in all of the jurisdictions profiled. In Europe they are often referred to as 'spot' markets, though this is somewhat of a misnomer, as the traded products are not for immediate delivery. Products typically trade in the timeframe of within-day and day-ahead to the next few days-ahead.

Forward trading is steadily growing in all locations, with trading at the NBP and TTF considered quite liquid, and in the US highly liquid (and truly enormous). Anecdotally, this is exceeded by the volume of over-the-counter (OTC) and bilateral trading, though reliable statistics are hard to come by, and in the US many OTC trades use the NYMEX Henry Hub contract as an underlying reference.

Forward products in Europe tend to be offered as months, quarters, seasons and years, whereas similar outcomes tend to be achieved in the US with monthly contracts and strips of months, along with various calendar spread options of different duration. The forward period for which contracts are listed – generally an indicator of market maturity – differs by exchange and product (see profiles). The longest dated contracts in Europe, ICE's NBP contract, list up to seven years out. The NYMEX Henry Hub future lists up to 13 years out, with various basis swaps list from 3-10 years out, 5-6 years being common.

Both physically-delivered and financially-settled products are offered in the markets examined. In Europe the exchanges have entered into agreements with the operators of the various delivery points to allow 'multilateral submission' of a balanced set of one-sided nominations – thus saving their customers the difficulty of arranging bilateral delivery against another party. In the US, deliveries at the main physical trading point, Henry Hub, are bilaterally matched by the clearing house, with matched parties then required to make their own delivery arrangements.

2.6 Market Information

All of the markets examined had substantial market transparency requirements, and robust mechanisms for the provision of market information. This includes:

- The major exchanges publish current and historical pricing, trade volume, open interest and other information. Typically all except real-time ticker feeds are made available to the public free of charge.
- Major price reporting services provide, on a subscription basis, spot and forward gas prices and analysis covering major trading locations. In the US, FERC Order 704-A contains an obligation to report information to price-index publishers.
- In Europe, the London Energy Brokers Association (LEBA) operates a service for the collection, validation and distribution of price and volume indices, and forward price curves.
- TSOs/pipelines provide information on gas flows, operational constraints and utilised and available capacity. In Europe, cross-border capacity availability information is centralised to the PRISMA platform, and information on major flows is published on the Transparency Platform of the European Network of Transmission System Operators for Gas (ENTSO-G). In the US each pipeline maintains its own bulletin board (though some owners use the same platform for all their facilities).
- Storage operators publish information on storage capacity availability, utilisation rates, storage inventory level, and gas injection, with aggregate storage data also published.

2.7 Retail Competition

Full retail competition in gas is mandated in Europe, with all the European markets examined being fully contestable. Great Britain has the longest history of retail competition – well pre-dating any EU directive – and has an extremely vibrant retail market, with annual switching rates of around 15%, and at times as high as 25%. The Netherlands market is also very active, with switching around 12% in 2013. Germany has less activity, with switching rates around 5-6%. In the US, the retail gas market is subject to state jurisdiction, with the level of retail competition determined on a state-by-state basis. About 55% of residential consumers have access to a choice program, though only about 11% have chosen to participate (in total, not annually), clustered in a handful of states.

In the Netherlands and Germany the management of customer switching, and maintenance of the customer registry, is the responsibility of the local distribution company (in Germany this entity is also a competitive retailer, in the Netherlands it is not). This is also the case in most parts of the US. In Great Britain the function has been centralised to Xoserve, a joint venture of all the TSO and distribution companies (4 of the 8 distributors also being owned by National Grid).

2.8 Regulatory Structure

In each profiled market there is a national regulator with responsibility for both the behavioural and economic regulation of the energy market. Ofgem and FERC, in Great Britain and the US respectively, are stand-alone energy regulators. ACM in the Netherlands is the competition regulator, and BNetzA in Germany is responsible for regulating network industries. In the US and Germany, regulation of the retail markets occurs at the state level. The European markets are also subject to harmonisation requirements, stemming from EU directives, and coordinated through the Agency for the Cooperation of Energy Regulators (ACER). In all four markets, regulation of the financial markets in energy is the responsibility of a specialist financial regulator.

Table 7 – Regulatory Structure

	Germany	GB	Netherlands	US
Wholesale Energy Market Regulator	BNetzA	Ofgem	ACM	FERC
Retail Energy Market Regulator	State regulators	Ofgem	ACM	State PUCs
Financial Market Regulator	BaFin	FCA	AFM	CFTC
Competition Regulator	Bundes-kartellamt	CMA	ACM	FTC
Supra-National Regulation	ACER	ACER	ACER	-

2.8.1 Legal Framework

The legal framework governing the gas market, across all markets profiled, follows a relatively common pattern, in priority order, of:

- National legislation
- Regulatory orders and ministerial decrees
- Network, metering, allocation and other codes – in some cases at a national level, and in other cases by system/pipeline
- Market rules, defined by the market operator and authorised by the relevant regulator

In the EU, these are supplemented by EU Directives, which impose obligations for national legislation, and European Network Codes, which set a framework for local network codes.

Table 8 – Legal Framework Comparison

<table>
<tr><th></th><th>Germany</th><th>GB</th><th>Netherlands</th><th>US</th></tr>
<tr><td rowspan="2">Legislation</td><td>Energy Industry Act (EnWG)</td><td>Gas Acts
Utilities Acts</td><td>Gas Act</td><td rowspan="2">Natural Gas Act
NG Policy Act
Energy Policy Act</td></tr>
<tr><td colspan="3">EU Directives</td></tr>
</table>

	Germany	GB	Netherlands	US
Regulation	Gas Ordinances	Regulatory Orders	Ministerial Decrees/Rulings	FERC Orders
Codes	Codes, Protocols and TSO Cooperation Agreement	Codes and Methodologies	National Codes	Pipeline Tariffs
	European Network Codes			
Market Rules	By Exchange	By Exchange	By Exchange	By Exchange Pipeline Tariffs

2.8.2 Licensing

Across the various markets there is some degree of difference in the requirement for those carrying out various functions to be licensed.

Table 9 – Licence Requirements

	Germany	GB	Netherlands	US
Networks/Pipelines	Y	Y	Statutory	Y
Shippers	-	Y	Y	-
Retailers	-	Y	Y	Y
Exchanges	Y	Y	Y	Y
Physical Traders	-[10]	Y[11]	-[10]	Y[12]
Financial Traders	Y	Y	Y	Y

For the most part, network operators, exchanges and financial traders are required to be licenced. Gas retailers – in particular, those servicing domestic customers – must be licenced in most jurisdictions. There is variation in the requirement for shippers to be licensed – in the US, applying for and being granted transportation (with the checks this involves) is sufficient. The other major jurisdictional variation is in the requirement for physical traders to be licensed. Historically, traders classed as purely physical were exempt from most licensing requirements. Substantial change is being seen in this area, with many physical traders presently, or soon to be, required to have some form of registration.

2.8.3 Economic Regulation

In general, monopoly infrastructure, such as transmission and distribution, is subject to economic regulation of its revenues.

In Great Britain and the Netherlands, these charges tend to be revised annually based upon defined methodology set in place for a period of time (the current 'price control' in Britain is for eight years; three years for the current 'method decision' in the Netherlands). By contrast in the US, rates are

[10] Under MIFIDII changes to European financial regulations, physical traders with more than 5% of their working capital used for energy trading will be subject to licensing requirements.
[11] Trading in any 'investments', including those physically delivered, is licensed, but those who trade exclusively in cash markets, such as the OCM, are exempt.
[12] There are certain exceptions for those trading solely for basic physical hedging.

defined in each pipeline's tariff, and stay fixed until the tariff is revised, which occurs upon application to FERC, not a fixed schedule.

Full economic regulation of retail rates continues to occur in those parts of the US with no retail competition. Where competition exists, the retail rate is free to float (the distribution component of LDC charges remains regulated), though some states still have a regulated price for 'default' service, or a 'price to beat'. In the Netherlands, charges for 'protected' customers remain subject to 'reasonable cost' regulation, and all retail offers must conform to a 'model contract' template. In Great Britain and Germany, retail rates are fully deregulated.

2.8.4 Other

All four of the principal markets examined have in place some form of protection for 'at risk' customers. All with retail competition have in place a 'retailer of last resort' mechanism, or similar, to move the retail customers of a failed retailer off to one or more default suppliers.

2.9 Market Evolution

In the case of all of the gas markets studied, the opening of both the wholesale and retail markets was progressive, generally accomplished through a series of legislative and regulatory reforms – in some cases instigated after earlier reforms had failed, or not been as successful as planned.

Figure 4 below provides an approximate timeframe for the opening of the gas wholesale and retail markets in the US, Great Britain, Netherlands and Germany. Further details on specific milestones are provided in the relevant profiles.

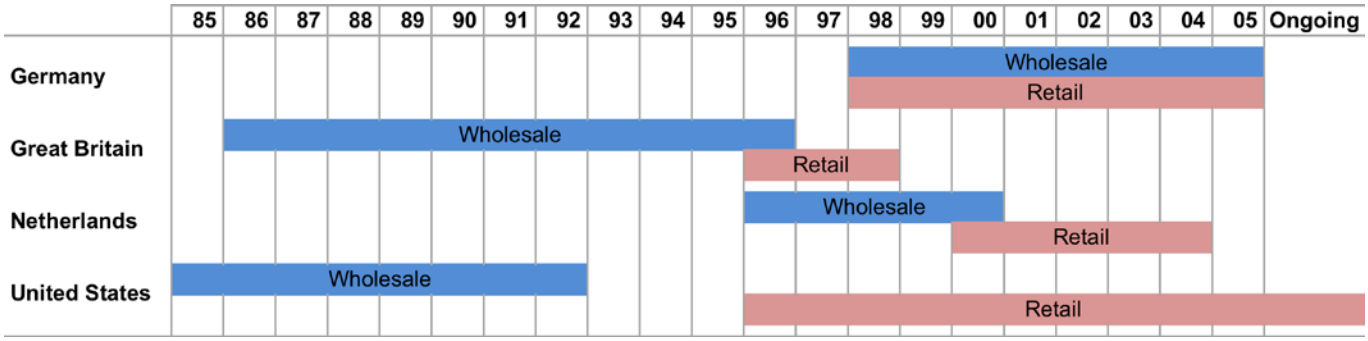


Figure 4 – Market Evolution Timeline

2.10 Market Development

The principal challenges being faced by each market were diverse and relatively distinct. Some of these are listed below; details are available in the market profiles.

Germany:

- Distribution cross-subsidies of municipal services
- Competitiveness of mid-stream energy trading companies
- Hub pricing vs. oil-indexed pricing of imports

Great Britain:

- Harmonisation with EU network codes
- Exploitation of shale gas

Netherlands:

- The method of allocation of costs for small consumer arrangements
- Gas balancing period: mismatch between current practice and EU network codes
- Risk of variance between tariff setting and open season process

- Barriers to effective movement between H-gas and L-gas systems

United States:

- Misalignment of Gas and Electricity Days
- Future of the Henry Hub Benchmark
- Incentives for Construction of Sufficient Pipeline Capacity

3 MARKET PROFILE – GERMANY

3.1 Context

3.1.1 Location and Physical Reach

The German gas network stands at the crossroads of Europe, serving both a significant local demand as well as trans-shipment of gas, in both an East-West and North-South direction.

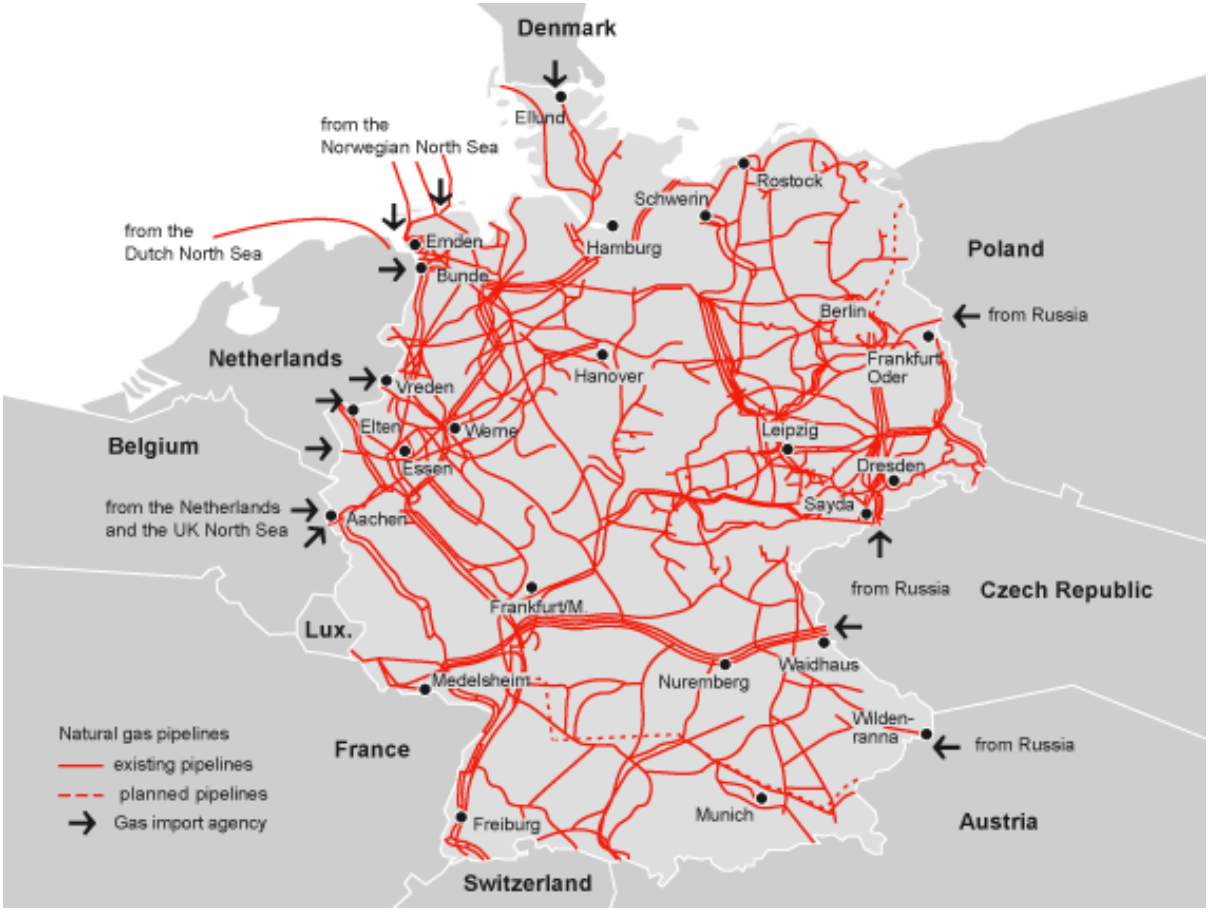


Figure 5 – German Gas Pipeline System [v]

Natural gas imports come from Russia via multiple pipelines including the recently commissioned Nord Stream system, Norway via Norpipe and Europipe systems, and the Netherlands via four main pipelines, directly and via Belgium. The system has substantial internal demand, as well as exporting off to other locations, principally France and Switzerland. The market is divided into two principal 'market areas' – Gaspool and NetConnect Germany (NCG).

3.1.2 Key Statistics

Total Consumption (TJ)	~ 3.8 million TJ in 2013 – 98 billion cubic meters (bcm), up from 88 bcm in 2012. [vi]
Total Production (TJ)	~ 336,000 TJ in 2013 – a total of 10.68 bcm of gas (field quality), produced through 78 natural gas fields.[vii]
Peak Daily Consumption (TJ)	~ 15,400 TJ in 2012 (0.4 bcm[viii])
Total Length of Pipeline (km)	The length of the long-distance pipelines in Germany is about

	40,000 km. This forms the backbone of the gas pipeline system. The total length of the German natural gas pipeline system (including distribution) is in excess of 530,000 km.
Import/Export (TJ)	In 2013, imports totalled 6.4 million TJ (1,778 TWh), and exports 2.6 million TJ (726 TWh).[ix]
Storage Capacity (TJ)	~ 2.18 million TJ (23.8 bcm), in 51 underground storage facilities

Note: Many original statistics are in bcm. The conversion to TJ is approximate as there are various gas qualities used within Germany, and a number of differing factors for conversion, based upon source. Two sources examined for this profile were:

- Source 1[x]: Low calorific value gas (L-gas) varies between 8.2 – 8.9 kWh/m^3, and high-calorific value gas (H-gas) between 10.0 – 11.1 kWh/m^3.
- Source 2[xi]: L-gas varies between 8.2 – 11.1 kWh/m^3, and H-gas between 10.0 – 14.0 kWh/m^3.

This report has used a calorific value for L-gas of 8.75 kWh/m^3 (31.5 MJ/m^3) and H-gas of 11.5 kWh/m^3 (41.5 MJ/m^3).

The share of L-gas in Germany is 30% [2009][xii], thus giving a blended calorific value of 38.5 MJ/m^3. The blended factor has been used in deriving consumption and storage amounts in TJ above. The L-gas figure was used in determining production amounts.

3.1.3 Key System Characteristics and Considerations

Germany is the largest gas consumer in the European Union. Between 2003 and 2012 natural gas consumption declined in Germany, largely because of energy efficiency improvements. This trend reversed since 2012. Domestic production is about 10% of total domestic consumption.

Figure 6 below gives an overview of the breakdown of gas usage between domestic customers, commercial and industrial and power generation.

Figure 6 – Historical Production and Demand Breakdown[xiii]

	1985	1990	1995	2000	2005	2009	2010	2011 *
Production (mcm/y)	22 021	18 919	21 069	22 049	19 850	14 953	13 042	11 905
Demand (mcm/y)	64 042	69 723	83 378	87 728	98 176	93 508	90 069	78 992
Transformation	*12 036*	*15 872*	*15 991*	*15 679*	*22 550*	*20 826*	*24 006*	-
Industry	*25 152*	*25 123*	*25 555*	*27 227*	*24 433*	*21 183*	*26 174*	-
Residential	*16 513*	*17 455*	*27 408*	*29 802*	*36 558*	*36 073*	*27 894*	-
Others	*10 341*	*11 273*	*14 424*	*15 020*	*14 635*	*15 426*	*11 995*	-
Net imports (mcm/y)	42 021	50 804	62 309	65 679	78 326	78 555	77 027	67 087
Import dependency	*65.6%*	*72.9%*	*74.7%*	*74.9%*	*79.8%*	*84.0%*	*85.5%*	*84.9%*
Natural Gas in TPES	*13.7%*	*15.7%*	*20.0%*	*21.4%*	*23.9%*	*24.1%*	*22.3%*	-

** based on monthly data submissions to the IEA.*

Natural gas consumption is shared relatively evenly between the industrial sector (30.6%), residential sector (28.9%), and power generation (26.4%). The share of the commercial (13.2%), and transport sectors (0.9%) are relatively small.[xiv] The residential sector's consumption is highly dependent on winter temperatures as natural gas is a key source of heating. Gas demand in the winter period is more than double that of summer periods. Projections for the next 20 years indicate that power generation from natural gas will increase while residential and commercial usage will fall.[xv]

Demand (and trans-shipment export) is met by imports from Russia (38%), Netherlands (26%), Norway (20%), and Denmark/UK (6%).[xvi] Nord Stream, a direct 1200km pipeline between Russia and Germany via the Baltic Sea, is of particular importance. This link, which opened in 2012, is capable of carrying 55bcm/yr. Germany has no LNG terminals.

Germany has extensive natural gas storage – the most extensive in Europe. This has importance for both economic reasons, smoothing between peaks and seasons, and security of supply reasons, in case of interruption of gas, from Russia in particular. Legislation states that the storage volume in Germany should sustain operations for 80 days, but there are no mandatory storage volume

requirements. Additionally, both storage prices and financial spreads between hubs are low, impacting the economics of storage. As a result, there is no economic signal for new storage capacity and existing storage may be decommissioned.

About half of the underground storage facilities are based on porous structures such as depleted fields and aquifer structures, and half are based on salt caverns. The ratio of salt cavern based underground storage is significantly higher than anywhere else in the European Union, due to geological conditions. Salt cavern storages can be run more efficiently as the ratio of cushion gas to working gas is typically lower than in porous structures. In Germany, the ratio of cushion gas to active gas is 47:53 in porous structures whereas it is 22:78 in salt caverns.[xvii] This means that high withdrawal rates can be maintained even if the working gas volume in the storage is low.

Due to its geographical position, extensive cross-border and domestic pipeline infrastructure and large gas storage capacities, Germany is a key hub for transit of natural gas in both the North-South and East-West directions. The German gas transmission system is a meshed network, but heavily dependent on a number of large capacity, long-haul pipelines running from the East. For the purposes of balancing, the various transmission systems are grouped into two market areas – Net Connect Germany (NCG) and Gaspool – each of which represents a virtual trading point.

There are two different gas qualities in Germany: domestic production and imports from the Netherlands are low-calorific gas (L-gas); imports from Russia, Norway and Denmark are high-calorific gas (H-gas). L-Gas has a lower market share (~30%) and is used mainly in north-west Germany. Transport of L-Gas takes place in a separate network. However, there is some blending between the two systems. Trading takes place across the two systems, as well as in quality specific products. Due to decreasing domestic production and imports of L-Gas, a large-scale changeover of L-Gas networks and appliances of consumers to H-Gas is expected in the coming years.

3.2 Industry Structure

The largest domestic producers are:

- Wintershall Holding Gmbh (BASF Group)
- BAB Erdgas und Erdol Gmbh (joint venture Shell/Exxon Mobil)
- Exxon Mobile Deutschland
- GdF Suez E&P Deutschland

Gazprom (the Russian natural gas monopoly) is the most important external producer supplying gas to the German market.

The midstream energy companies, such as E.On, are both shippers and suppliers (retailers). Many of these companies retain long-term ‘take or pay’ supply contracts with upstream producers, as well as long-term ‘ship or pay’ contracts for transportation capacity.

Germany’s natural gas storage facilities are well dispersed geographically and are owned and operated by approximately 25 private companies. The largest storage providers in the market are E.ON Gas Storage, Wingas, VNG-Verbundnetz Gas, RWE Dea, BEB, and GdF.

The German Energy Industry Act (EnWG) requires network operators to be unbundled from electricity and gas production and supply. Vertically integrated entities were allowed to opt for ‘ownership unbundling’ – effectively a spin-off of their network operations – or ‘structural unbundling’, in which the network must be setup under an independent transmission system operator (TSO), but may remain part of the corporate group. This unbundling must be certified by the regulator. In all cases, TSOs must provide non-discriminatory access to their pipeline. Distribution system operations must also be operated independently from other energy activities, though unbundling requirements for distribution are less formal and require no certification.

3.2.1 Key Roles

Key market roles are identified below. Unless otherwise noted, these roles are as described in the glossary.

- shippers

- producers: these include domestic producers, as well as foreign exporters; may compete for non-residential customers
- transmission system operators (TSOs): typically also serve as pipeline owners
- pipeline owner
- market area managers: manage collective arrangements for balancing and data provision (e.g. to support settlement) across a group of TSOs, and operate a virtual trading point for the common market area it encompasses. NetConnect Germany (NCG) and Gaspool are the two 'market area managers'.
- neighbouring network owners: owners of adjacent pipeline networks
- market operators
- storage system operators (storage providers): manage storage facilities as a third-party service, and also trade gas for their own account.[13] [xviii]
- downstream network operators (distribution companies): many distribution companies continue to also serve as suppliers (retailers) in the retail market in their respective service areas.
- suppliers (retailers): there are also competitive suppliers not associated with a DSO.
- transmission connected users

3.2.2 Infrastructure Providers

Pipeline/Transmission System Operator(s)	There are currently 17 TSOs in Germany (stars mark the largest TSOs). • Bayernets (NCG) • Fluxys NEL • Fluxys Tenp (NCG) • GASCADE Gastransport (Gaspool) • Gastrantsport Nord (Gaspool) • Gasunie Deutschland Transport Services (Gaspool) • Gasunie Ostseeanbindungsleitung (Gaspool) • GRTgaz Deutschland (NCG) • jordgasTransport (Gaspool) • terranets bw (NCG) • Thyssengas (NCG)*** • NEL Gastransport (Gaspool) • Nowega (Gaspool) • Ontras - VNG Gastransport (Gaspool)*** • OPAL Gastransport (Gaspool) • Open Grid Europe (NCG)*** There are two 'market area managers', NetConnect Germany (NCG) and GasPool. Within each market area, gas can nominally be traded without restriction, at a virtual trading point, and a common balancing mechanism is utilised within each. Transportation, though, is sold by each TSO.

[13] "Some gas storage operators even withdraw and market volumes being part of the cushion gas in times of high gas demand or when gas prices are high and re-fill the withdrawn cushion gas in times of lower purchase costs."

Figure 7 – Market Area Manager Footprint[xix]

Pipeline Owner(s)	The TSOs also own and maintain their respective pipelines.
Spot Market/Balancing Operator(s)	Balancing is the responsibility of the market area manager in each market area – NCG and Gaspool. Each operates its own platform for balancing management.
Prompt/Short-Term Forward Market Operator(s)	ICE-Endex, PEGAS[14] and CME Europe offer 'spot' (in actuality, day-ahead) and short-term forward trading of NCG and Gaspool products.
Forward/Futures Market Operator(s)	ICE-Endex, PEGAS and CME Europe offer financial futures trading and clearing, as well as OTC clearing, of NCG and Gaspool products.

3.2.3 Regulators

Energy Regulator – National	Bundesnetzagentur (BNetzA) is the Federal Network Agency of the German Federal Ministry of Economics and Energy (BMWi). It is the regulator for electricity, gas, telecommunications, post and railway markets. BNetzA is responsible for ensuring non-discriminatory third-party access to gas transmission and distribution networks, and regulating the fees. BMWi remains responsible for the regulation of safety.
Energy Regulator – Regional	Each of the 16 Bundesländer (states) may establish its own regulatory authority. This requires, though, that the regulated networks do not cross a federal boundary, or that fewer than 100,000 customers are connected, either directly or indirectly. Each state is also responsible for licencing of gas suppliers (retailers) and distribution companies. Construction of distribution pipelines exceeding 300mm in diameter also requires approval from state authorities, as do related activities such as permitting procedures, construction, and land-use planning.

[14] PEGAS is the gas market joint venture between the European Energy Exchange (EEX) and Powernext (which is itself majority owned by EEX).

Financial Market Regulator	Financial markets are regulated by the Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), also known as BaFin.
Competition Regulation	The German Cartel Office (Bundeskartellamt) is responsible for ensuring market competition.
Other	The regulation of gas transportation and distribution and the associated infrastructure is, to a great extent, harmonised within the European Union (EU). This is achived through the Agency for the Cooperation of Energy Regulators (ACER). While ACER principally monitors, reports, complements and coordinates the work of national agencies, it can take, under certain conditions, binding individual decisions on terms and conditions for access and operational security for cross border infrastructure.

3.3 Transmission Arrangements

3.3.1 Transportation Rights

Form of Transportation Rights	Shippers must hold transportation rights to ship on the system. This is purchased from the TSOs. For gas entering or leaving across a border point, this includes a requirement to hold cross-border capacity.
Type	The principal forms of transportation right are firm and interruptible contracts.
Locational Nature	Germany uses an entry/exit model for each market area. • Entry rights convey a right to inject into a market area. i.e. they represent transportation from a point of entry to the 'virtual trading point'. • Exit rights convey a right to withdraw gas from the market area. i.e. from the 'virtual trading point' to a point of exit. Capacity can be freely and independently used and traded within a market area. As capacity is to/from the virtual trading point of the market area, there is no requirement to have capacity from one TSO's system to another's within the market area. i.e. if a shipper purchases entry capacity from TSO 'A', and exit capacity from TSO 'B', it does not need to purchase any capacity for the path from A to B, even if those systems are not contiguous, provided they are within the same market area. Net inter-TSO physical flows are managed between the TSOs as an operational matter. For cross-border and inter-market-area transport, the NC CAM requires neighbouring TSOs to offer bundled services, meaning entry into one system must be sold together with exit from the connecting system. This is facilitated through the PRISMA system, which combines such points as a single 'bundled' exit/entry offering.
Tenor and Duration	Transportation contracts are available as annual, quarterly, monthly and daily contracts. Annual contracts can be sold up to 15 years in advance.
Primary Sales – Existing Capacity	Capacity sales occur via PRISMA, the joint capacity booking platform of 28 major European TSOs. This platform implements the requirements of the Network Code on Capacity Allocation Mechanisms (NC CAM), the future European market rules for

	allocating natural gas transport capacity. NC CAM obliges gas grid operators to conduct harmonised auctions and to provide third-party access to the grid in a transparent and non-discriminatory way. Thus, these auctions are held at the same time, are governed by the same rules, and sell standardised products across the EU. Since 2014, the use of PRISMA has been mandatory in Germany for trading of primary and secondary gas pipeline capacity. The use of the standardised platform will be required in all EU jurisdictions from November 2015. In order to book capacity on PRISMA, a party must be registered as a shipper and accredited by one of the member TSOs. The aim of this regime is to allow shippers, through a single registration, non-discriminatory access to the transmission grids of all the participating TSOs. Firm capacity at market area and cross-border interconnection points must be offered by TSOs using an auction procedure. • Annual Products: annual auctions of Y1-Y15 • Quarterly Products: quarterly auctions of Q1-Q4 • Monthly Products: monthly auctions of M • Daily Products: daily auctions of D BNetzA requires (per BK7-10-001) that capacity at cross-border and market area interconnection points be sold in a bundled fashion with capacity from the neighbouring TSO, though exceptions may occur for legacy transportation agreements, and agreements with neighbouring TSOs not participating in the pan-EU arrangements.[xx] There are two different algorithms for auctions: the multi-round ascending clock auction algorithm for yearly, quarterly, and monthly products and the single-round uniform-price algorithm for within-day firm and day-ahead products. The reserve price for the auction is based upon each TSO's allowed revenues. Per the CAM, the revenues for cross-border and cross-market-area capacity sales are split between the TSOs. Each TSO receives its reserve price, with the difference between the auction clearing price and the sum of reserve prices – known as the 'auction premium' – divided between the TSOs based on bilateral agreements between them, or in the absence of such agreement, on a 50/50 basis. Capacity for internal entry/exit points (i.e. points of consumption, storage or production within Germany) and interruptible capacity[15] is sold on a first-come-first-served basis.[xxi] Downstream network operators (distribution companies) order capacity on an annual basis to cover their maximum fixed exit capacity at the network interconnection points or exit points they are connected to. This capacity is ordered directly from the TSOs (i.e. not via PRISMA), in a process referred to as internal ordering (Interne Bestellung).
Secondary Market	Capacity holders can resell their capacity, or the right to use that capacity. This occurs via the PRISMA system. Shippers can post bids and offers, request others to place bids/offers, and respond to these offers. Bilateral/OTC trading of capacity can also be registered via this

[15] The PRISMA platform provides for auctioning of interruptible capacity, but at present German TSOs continue to sell this capacity on a first-come-first-served basis only.

	system. Transfers are subject to acceptance by the TSO. Breaking up longer-term capacity contracts into smaller tenor contracts is allowed.
Capacity Release	The new EU Congestion Management Procedure (CMP) specifies four mechanisms for capacity release: • Surrender of Capacity (SoC): Capacity is voluntarily surrendered back to TSO, with shipper relieved of its payment obligation if the capacity is re-sold. • Oversubscription & Buy Back (OBB): TSO will auction any firm capacity that has not been nominated, up to the technical limit of the pipeline. Should the original holder then nominate, TSO will enter the market to buy back capacity, to get back within technical limits. OBB capacity will be made available on a monthly and daily basis, initially at cross-border interconnection points with contractual congestion. • Firm Day-Ahead Use-It-Or-Lose-It (FDA UIOLI): Requires capacity that is not nominated the day before the flow to be made available to others on an interruptible basis – and due to limits on renominations, a portion of which may become firm. To prevent quasi-withholding through nominations[16], limits are placed on renomination rights at congested points for users that have held more than 10% of capacity at that point over the last year. • Long-Term Use-It-Or-Lose-It (LT UIOLI): If a capacity holder sytemically under-uses their capacity – defined as under 80% average utilisation in a 12-month period, or habitual nomination downward close to delivery – they may be forced to surrender their capacity partially or completely. Germany has implemented the FDA UIOLI, LT UIOLI and SoC mechanisms, and has chosen not to implement the OBB mechanism.[xxii] It has, so far, not yet applied the LT UIOLI mechanism. [xxiii]
Capacity Expansion Process	Gas network operators are legally obliged to maintain and develop the network, meeting demand to the extent that this is economically reasonable (EnWG, Sec. 11§.1). This includes the obligation to expand the network, for example, to connect new gas-fired power plants. Capacity demand in transmission networks is implemented through a national Gas Network Development Plan (NDP), prepared annually[17] by the TSOs as a group[18], which stipulates mandatory network expansion measures. Costs are, in general, socialised through network fees. As a means of last resort, the BNetzA can enforce these investments through tender proceedings. Newly built gas transit pipelines, LNG and storage facilities can be exempted from regulated third-party access (including network access regulation) and unbundling provisions for a limited period of time if the investment would not have been made but for the exemption

[16] A common strategic withholding game to avoid use-it-or-lose-it provisions was to nominate all capacity, only to re-nominate down at the last possible moment, preventing anyone else from usefully acquiring it.
[17] There are proposals to move this to a biennial process.
[18] The joint nature of this activity by necessity involves coordination between the parties, consistent with the obligations in the EU Directive that the plan "contain efficient measures…"

	(EnWG, Sec. 28a). New assets are also required to submit a 10 year network development plan for approval by regulators. The tariffs which they are allowed to charge, and the rates of return they are allowed to earn, are determined by regulators based on an agreed methodology. Capacity investment decisions are made within the German regulatory framework. Each EU member state is naturally keen to limit investments to those needed to meet national requirements, in order to keep tariffs as low as possible. However, this may result in underinvestment in infrastructure beneficial to the broader pan-European market (e.g. transit to other member states). The EU has recently amended the NC CAM with rules relating to the development and economic testing of new and incremental capacity when this relates to two or more member states. By preference, per the NC CAM, the offering of incremental capacity is integrated with the sale of existing capacity. An open season procedure may be used by the TSO as an alternative when there is no straight-forward hub-to-hub setting, or project complexities would make the integrated approach impractical, or there is no pre-existing connection between two hubs.[xxiv] The identified triggers for TSOs to offer new or incremental capacity are when any one of the following conditions are satisfied: • "The ENTSOG Ten Year Network Development Plan (TYNDP) identifies a physical capacity gap …; or a national network development plan identifies a concrete and sustained physical transport requirement; • No yearly capacity product based on existing capacity will be on offer (as the yearly product is fully booked) in the year when incremental capacity could be offered first and in the three subsequent years…; • Network users indicate in a non-binding manner to TSOs their need for and their willingness to underwrite incremental or new capacity for a sustained number of years and this transport need leads to physical constraints after exhausting all other mechanisms to maximise the availability of existing capacity." These tests should "not preclude more frequent or regular testing of demand."[xxv]
Primary Sales – Capacity Expansion	See above.
Load Flow Commitments	Flow commitments are contractual arrangements between shippers and TSOs concerning the provision of gas flows at one or more entry or exit points to enhance the supply of freely allocable entry or exit capacity. Maintenance activities may also require flow commitments from shippers. Pre-qualified customers offer load flow commitments to TSOs through a tendering process.

3.3.2 Nominations, Scheduling and Balancing

Nominations	Nominations to/from the virtual hub are made at each entry/exit point. These are submitted to the TSO, which schedules its system, in coordination with neighbouring TSOs as required. If not all

	nominations can be scheduled, curtailments are made by the TSO on the basis of interruptible tranches.
Scheduling Period	Nominations are made on a daily basis. They contain flows for each hour of the gas day (6:00 D – 6:00 D+1) at the nominated entry/exit point. Nominations must be submitted by 14:00 D-1.
Changes to Nominations	Renominations are allowed, up until two hours before the start of the gas day.[xxvi] Intra-day nominations are also allowed, but must also be received at least two hours before the gas in question flows.
Multiple Pipelines	Cross-border and other inter-pipeline nominations are matched by each TSO with the 'adjacent network operator'. If quantities do not match, the Lesser Of Rule (LOR) is followed, where the lower quantity is scheduled and confirmed by both TSOs to their own shippers.
Balancing	Balancing occurs at the aggregate level of 'market area' – NCG and Gaspool. These are each divided into various 'balancing zones'. Those for NCG, for example, are: H-Gas North, H-Gas Central, H-Gas South, L-Gas East, and L-Gas West.
Balancing Period	The balancing period, for the purpose of determining participant imbalances, is daily. However, the Market Area Manager may take within-day balancing actions to maintain overall system security.
Balancing Gas	The Market Area Manager (MAM) procures (buys or sells) balancing gas to physically balance any imbalances in its market area. The balancing requirements stipulated by the TSOs, and procured by the MAM, may be 'global' (no quality specified; location = virtual trading point), or specify a gas quality and/or location(s).[xxvii] Within these constraints, gas procurement is based upon an economic merit order. Both MAM's purchase balancing gas according to a mutually agreed preference order[xxviii]: • Standardised short-term products, such as day-ahead and rest-of-day. ⇒ Exchange traded (typically PEGAS), based on MAM's own market area ⇒ Exchange traded, based on adjacent market area ⇒ Utilising MAM's bilateral platform • Standardised long-term products: option products traded via MAM's bilateral platform, for period from a week to a year. • Non-standardised long-term products: such as intra-day flexibility, traded via MAM's bilateral platform for a quarter, half-year or year. Shippers wishing to participate in the market for provision of balancing gas and services must complete a prequalification procedure and enter into balancing product agreements with the MAM.
Participant Balancing	Participant nominations (including renominations) must consist of balanced injections and withdrawals. The exception to this rule is nominations submitted via exchange operators. These may be one-sided for any individual shipper, but the overall set must be in balance (i.e. net long = net short).

Quantity Measurement	Nominated quantities are balanced for all entry and exit points at market area borders, cross-border points, storage facilities, domestic gas production facilities, and for transferring quantities at virtual points. If points are run by TSOs then they are 'allocated as nominated'. For non-metered customers, standard load profiles (SLP) are used and the relevant volume is determined with a time-lag of 48 hours.
Recompense for Participant Imbalances	Participants make recompense for any imbalances through cash payment.
Balancing Payment	Balancing payments/charges are calculated based on a shipper's[19] imbalance quantity multiplied by the imbalance price. Imbalance prices are determined according to the GaBi gas balancing rules stipulated by the regulator, BNetzA. Under the current rule (GaBi v1.0), imbalances pricing utilises a set of hub reference prices, for NCG, Gaspool, TTF and Zeebrugge. • Positive energy imbalance price = second highest reference price x 1.2.[xxix] This is paid by those 'buying' their imbalances. • Negative energy imbalance price = second lowest reference price x 0.9. This is paid to those 'selling' their imbalances. New rules (GaBi v2.0) will apply when the EU Network Code for Balancing (NC BAL) comes into force (est. Oct 2015).[xxx] • When 'external' balancing actions are required (i.e. purchase of balancing gas), imbalance price = highest price of 'buy' transaction or lowest price of 'sell' transactions for buy/sell respectively. • When 'external' balancing actions are not required, imbalance price = volume-weighted average of exchange trades ± an adder (≤2%) for buy/sell respectively.

3.4 Storage Arrangements

Storage Access	Around 95% of storage capacity is available to third-party access. Storage System Operators (SSOs) must ensure non-discriminatory access to storage capacity. The EU Directive on the Internal Gas Market (2003/55/EC) leaves to member States the decision on whether to require a negotiated or regulated access regime for storage facilities. The German government opted for negotiated rather than regulated access to gas storage. Compared to the EU average, Germany's storage market is highly diversified in terms of the number of SSOs.
Storage Rights	As access is negotiated, the precise form acess rights take is a matter to be negotiated between the SSO and the shipper storing gas. Each SSO may have its own arrangements. The Guidelines of Good Third-Party Access Practice for Storage System Operators (GGPSSO) provides a guide for SSOs.
Primary Sales – Storage Rights	Most SSOs offer multiple storage products, differentiated by service quality (firm or interruptible, bundled/unbundled), service duration,

[19] To be precise, nominations and balancing are the responsibility of a 'balancing group manager', a shipper with designated responsibility for balancing at the connection points within a designated 'balancing group'.

	working capacity/deliverability rate requirements, etc. Many storage facilities are fully booked for long periods, with several SSOs stating they have little or no available capacity.
Secondary Market	Secondary trading of storage rights is active in Germany. One available method is the Store-x internet platform, which covers 15 SSOs. Store-x offers various trading methods, including auctions, on-line offers and requests for proposal. Unbundled storage services are available, allowing injection and withdrawal capacity to be booked separately from each other.
Capacity Release	As access is negotiated, any mechanism for release of unused capacity is a matter addressed in the agreement between the SSO and the shipper storing gas.

3.5 Trading Arrangements

3.5.1 Trading Reference Points

The major gas trading hubs for Germany are:

NAME	TYPE	DESCRIPTION
Gaspool	Virtual hub	Virtual trading location based on the Gaspool market area.
NCG	Virtual hub	Virtual trading location based on the NetConnect Germany (NCG) market area.

In addition, some facilities in the North-West of Germany are directly connected into the Dutch network and utilise the Dutch Title Transfer Facility (TTF) for trading.

3.5.2 Balancing Market

There is no formal balancing market, though both NCG and Gaspool utilise exchange-based markets (discussed under Cash Market below) as one of their available mechanisms for procuring (and pricing) balancing gas, as well as their own platforms.

3.5.3 Prompt/Short-Term Forward Market

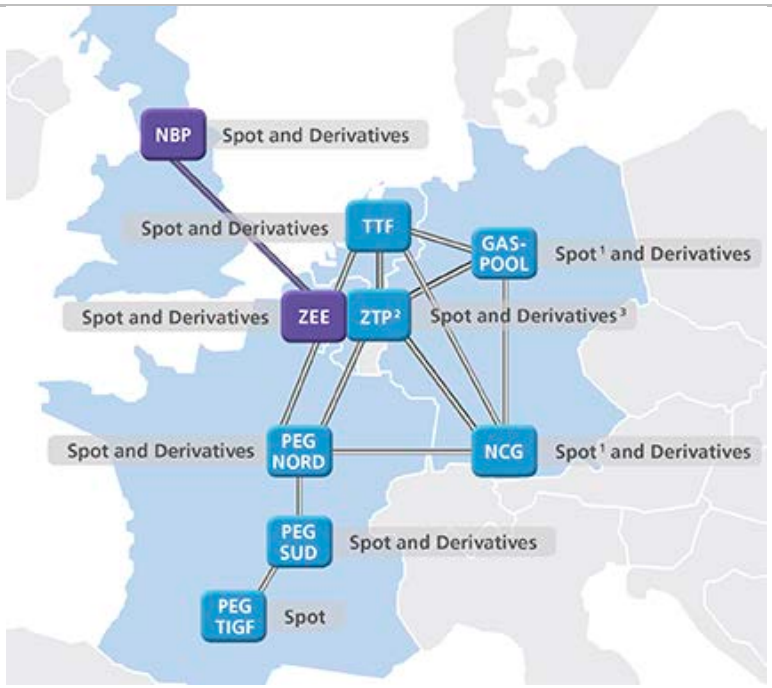
OTC Trading	Although the trading volume on exchanges has increased over recent years, most natural gas is still traded 'over the counter' (OTC).
Exchange Trading	Trading of physically delivered prompt/short-term forward products, for both H-Gas and L-Gas at both hubs, occurs on PEGAS. PEGAS is also used by the Market Area Managers for the purpose of procuring balancing gas. CME Europe also has financially-settled daily products based on both the NCG and Gaspool hubs.
Trading Mechanism	The market transacts via a continuous automated auction.
Locational Basis	Trading is based around the NetConnect Germany and Gaspool virtual hubs.
Product Tenor	PEGAS lists cash products covering within-day, day-ahead, Saturday and Sunday (tradable separately or as a weekend block) and individual days (for bank holidays). ICE-Endex also lists working-days-next-week and balance-of-week products. CME Europe offers trading in a daily future, and strips of dailies.

Participation	Traders in 'spot' products resulting in physical delivery must be capable of making or taking delivery of gas. If offering balancing gas, they must be accredited to do so. Trading in financially-settled products is open to all traders (satisfying the general participation requirements of the exchange).
Settlement and Credit Risk	Trading on PEGAS is cleared through European Commodity Clearing (ECC), a subsidiary of EEX. Trading on CME Europe is cleared through the CME Clearing House. Both clearing houses offer OTC clearing.
Delivery Method	PEGAS 'spot' contracts are physically delivered. CME Europe's daily product is financially-settled against indices published by ICIS Heren.
Delivery Integration	ECC carry out "single sided nominations without (the) requirement to counter nominate." i.e. they support *multilateral submission* of a balanced delivery file to the TSOs.

3.5.4 Forward Market

Note: This section refers to both physical and financial forward markets in gas that result in an exitable forward position.

OTC Trading	Although the trading volume on exchanges has increased over recent years, most natural gas is still traded 'over the counter' (OTC). The major brokers participating in the survey conducted by the London Energy Brokers' Association (LEBA) are GFI, Griffin Markets, ICAP Energy, Marex Spectron, Tradition and Tullett Prebon. The Das Gas website is run by Germany's energy-intensive industry association (VIK) to facilitate OTC gas market trading. Energy suppliers are able to upload individual selling profiles providing information on preferred customers, products and market areas within the German gas market. The platform provides contact details of possible matches, but no transactions are completed through the website. There are also a number of significant, long-term take-or-pay contracts with Gazprom for Russian gas. These are bilaterally-negotiated.
Exchange Trading	Trading of futures products occurs on PEGAS, ICE-Endex and CME Europe. PEGAS is the most widely traded of these markets for NCG and Gaspool futures. PEGAS (via the EEX website) also lists EGIX gas market index futures.
Trading Mechanism	The market transacts via a continuous automated auction.
Locational Basis	German trading is based around the NCG and Gaspool virtual hubs. Locational spreads are also available between NCG and Gaspool, and between each of these hubs and a number of other trading points, including TTF in the Netherlands, Zeebrugge Trading Point (ZTP) in Belgium and PEG Nord (PEGAS only) in France.

	 ***Figure 8 – PEGAS Trading Hubs and Spreads***[xxxi]
Product Tenor	PEGAS: lists futures contracts for: months (next 3), quarters (next 4), seasons (next 3), calendar years (next 3). ICE-Endex: lists German gas futures contracts for months (next 59), quarters (next 7), seasons (next 7), calendar years (next 4). CME Europe: lists its financially-settled contract spanning the balance of the current year and the next two calendar years.
Participation	Trading is open to all traders (satisfying the general participation requirements of the exchange). For physically delivered contracts, as the time of delivery approaches restrictions may be placed upon positions held by traders unable to make/take delivery.
Settlement and Credit Risk	Trading on PEGAS is cleared through European Commodity Clearing (ECC), a subsidiary of EEX. Futures trades on ICE-Endex are cleared through ICE Clear Europe. Trading on CME Europe is cleared through the CME Clearing House. All three clearing houses offer OTC clearing.
Delivery Method	The futures contracts of both ICE-Endex and PEGAS are physically delivered at the TTF hub. CME Europe's contracts are financially-settled against indices published by ICIS Heren.
Delivery Integration	ICE-Endex and ECC carry out "single sided nominations without (the) requirement to counter nominate." i.e. they support *multilateral submission* of a balanced delivery file to the TSO.

3.6 Market Information

Market Information	The major exchanges publish current and historical pricing, trade volume, open interest and other information. Basic end-of-day information, such as end-of-day settlement prices, must be made available to the public free of charge. Brokers also publish information about trade on their own

	platforms to their customers. TSOs are required to publish information on historical gas pipeline flows and contracted and available capacities, among other data. Some of this information is published via ENTSO-G (see Publication Platform below). SSOs publish information on storage capacity availability, utilisation rates, storage inventory level, and gas injection on a daily basis. A storage investment database with information on planned, committed, and under construction storage projects around Europe is also proposed.
Publication Platform	Exchanges publish information through their own platforms and via third-party data resellers (e.g. Reuters). The European Network of Transmission System Operators for Gas (ENTSO-G) operates the ENTSO-G Transparency Platform, which publishes information on European gas capacity and flows, with a particular focus on cross-border points.
Third-Party Services	The London Energy Brokers Association (LEBA) operates a service for the collection, validation and distribution of price and volume indices, and forward price curves, based on 100% of members' daily market transactions. These indices are widely used in pricing shorter-term (up to a year out) contracts with retailers and transmission connected users. Tankard provides a similar service for trading facilitated by ICAP, Marex Spectron and Tullett Prebon Major price reporting services – such as ICIS Heren, Argus and Platts – provide spot and forward gas prices and analysis covering major European hubs including TTF. The ICIS Heren European Spot Gas Market Report is used as a reference for CME Europe's financially-settled futures contract. Aggregate storage capacity data is posted weekly (and soon, potentially daily) by Gas Storage Europe (GSE)[20].

3.7 Retail Competition

Retail Contestability	The German retail gas market is fully contestable. Switching rates in the period 2008-2013 averaged around 5-6%.[xxxii]
Retail Opening	The German gas market was deemed to be 100% open from the commencement of liberalisation. However, this was essentially in name only. Little effort was made to out in place adequate market infrastructure and institutional arrangements to allow competition to take hold. Various changes to market structure and design over the years, especially in 2005, improved these arrangements, such that Germany now has meaningful levels of retail competition in gas.
Customer Switching	The distribution system operators are responsible for the operation of the system for customer switching, with each serving as a hub in the data communication process[xxxiii]. Switching is carried out in accordace with GeLi Gas (German business processes for gas supplier switching).

[20] Gas Storage Europe (GSE) is an industry association representing gas transmission companies, storage system operators and LNG terminal operators in Europe.

3.8 Regulatory Structure

3.8.1 Legal Framework

National Legislation	The Energy Industry Act (EnWG) is the backbone of German national gas sector regulation. The construction and operation of underground storage facilities for natural gas are subject to the Federal Mining Act (Bundesberggesetz, BBergG). The German Exchange Act governs exchanges, such as EEX.
International Agreements	The EU has been a key driving force behind liberalisation of the gas market. Key instruments include: • Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas. • Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009, on conditions for access to the natural gas transmission networks. • Regulation on wholesale Energy Market Integrity and Transparency (REMIT), No 1227/201, of 25 October 2011, which addressed market manipulation and market monitoring. The EU is moving gradually towards a more integrated European gas market. Many pan-EU arrangements, however, leave room for member states to incorporate local variations. The EU rulemaking process can be quite complicated, with elaborate 'comitology' processes involving the Agency for the Cooperation of European Regulators (ACER), and ENTSO-G. Financial/derivative markets in energy (including products resulting in physical delivery) are also subject to various EU regulations, including: • European Market Infrastructure Regulation (EMIR), No 648/2012, of 16 August 2012, requiring standardised OTC trades to be cleared, higher capital requirements for non-cleared trade, and requirement for establishment of trade repositories. • Market in Financial Instruments Directive (MiFID), 2004/39/EC, of 30 April 2004, which addresses harmonised financial market regulation, and various specific requirements. In 2017, MiFID II is supposed to take effect. The interaction between these various regulations has required increased cooperation between energy financial regulatory authorities.
Regulations	The Energy Industry Act is supplemented by key ordinances such as , the • Gas Network Access Ordinance (GasNZV) • Gas Network Charge Ordinance (GasNEV) • Incentive Regulation Ordinance (ARegV) • Low Pressure Connection Ordinance (NDAV), and Ordinance on General Terms Regulating the Operation of Meter Points and the Measurement in Connection with the Electricity and Gas Supply via Networks (MessZV) • Ordinance on General Terms Regulating Universal Service for

	Household Customers and Replacement Supply with Gas from the Low-Pressure Network (GasGVV) • Ordinance Regulating Concession Fees for Electricity and Gas (KAV) Underground storage is subject to various mining ordinances.
Codes	In 2002, four industry associations agreed on a third-party access code for the German gas network (Associations Agreement, Verbändevereinbarung II). For storage access, the Guidelines of Good Third Party Access Practice for Storage System Operators (GGPSSO) has been in force since 1 April 2005. The relationship between network operators is governed by a nationwide Cooperation Agreement, most recently changed in June 2014 (Kooperationsvereinbarung Gas, KoV). This is similar to a 'grid code'. There are also a number of agreed protocols, such as GeLi Gas (for customer switching) that are approved by the regulator and thus form part of the market's legal framework. The market is also subject to 'network codes' at the EU-level, promulgated via ENTSO-G, which are then interpreted into codes (new, or changes to existing), and potentially other instruments, at the national level. The European Network Code on Capacity Allocation Mechanisms (NC CAM) is already active, the Congestion Management Procedures (CMP) are expected to be fully implemented by November 2015, and the Balancing Code (NC BAL) in late 2015 (though this may be deferred until late 2016). Further planned EU-level codes include the Harmonization of Tariff Structures, Interoperability Rules, Rules for Trading, Third Party Access, and Security and Reliability codes.
Market Rules	Each exchange is responsible for development and maintenance of its own rule book. These rules, and any changes to them, are subject to authorisation by BaFin, the financial regulator.

3.8.2 Licensing

Wholesale Market	No trading licenses are required in Germany, for either financial or physical wholesale trading. Prior to 2002 the German regions issued licenses to energy traders. Following regulatory review of licenses, it was felt that many of the intended functions of the licenses were either ineffective, or best carried out by other contracts and institutions. Since 2002 it has not been necessary to hold a license for wholesale energy trading. In 2005, the requirement that notification be given upon the commencement of trading or supplying was rescinded. The operation of a gas transmission or distribution network requires a network operating permit (EnWG, Sec. 4). The competent authority at state level must issue the permit if the operator has at its disposal the necessary staff, and the technical and financial resources for safe and (cost-)effective operation of the network. Per the EnWG, the construction of gas transmission pipelines and gas distribution pipelines greater than 300mm in diameter is subject to plan approval by the relevant state agency.

Retail Market	The supply of gas to retail customers – industrial, commercial and residential – does not require a licence, but an entity's intent to function as a supplier (retailer) must be notified to the regulatory authority (EnWG, Sec. 5).
Financial Market	Under MiFID, a financial market licence is required in order to conduct trading considered to be a 'financial service'. In order to avoid this, some participants will trade only products classed as physical. Under the proposed MiFID II extensions, exemptions for physical trading will be limited to those using less than 5% of their working capital for energy trading. This would subject many currently exempt to financial market licensing requirements. Trading on a registered futures exchange, such as EEX/PEGAS, requires a licence from BaFin, and for individual traders to meet qualification criteria, including passing an exam. German-domiciled exchanges (i.e. EEX) must hold an exchange licence from the financial regulator. Under the 'EU Passport' arrangements, exchanges properly accredited in other EU countries can offer services to participants in Germany (e.g. ICE-Endex can allow trading from German participants without having to obtain a German exchange licence). Conversely, accredited participants from other EU jurisdictions can trade on EEX without having to obtain local licensing.

3.8.3 Behavioural/Market Conduct Regulation

Open Access	The German gas market requires non-discriminatory third-party access to both transmission and distribution. This is regulated by BNetzA and the German Cartel Office.
Rules Compliance	The financial market regulator, BaFin, oversees compliance with forward market rules. BNetzA oversees activity in the cash market, as well as compliance with industry codes. Under REMIT, the Agency for the Cooperation of Energy Regulators (ACER) has overarching responsibility for the supervision of EU energy markets.

3.8.4 Economic Regulation

Transmission	Fees for access to transmission networks are regulated by the EnWG, GasNEV and the ARegV. Fees are based upon the costs of network operation and are subject to 'maximum income limits'. Costs are reviewed and, if regarded as inefficient, curtailed by the regulator. Incentive elements are applied to the cost base. Per the GasNZV, any auction premium collected in the auction of cross-border and cross-market-area capacity must be used "immediately for measures to eliminate or defer persistent bottlenecks." If the auction premium relates to a temporary rather than a persistent bottleneck, then the revenues must be used for measures that defer further capacity shortages, or to offset future tariff charges. Auction proceeds and their usage must be documented by TSOs and submitted to the regulatory authority.
Distribution	Fees for access to distribution networks are regulated by the EnWG, GasNEV and the ARegV.

	Fees are based upon the costs of network operation and are subject to 'maximum income limits'. Costs are reviewed and, if regarded as inefficient, curtailed by the regulator. Incentive elements are applied to the cost base.
Retail	There is no regulation of retail gas prices in Germany for any customer class.[xxxiv]

3.8.5 Other

Obligation to Serve	Under EU regulations there is no universal service obligation for gas. However, Germany does have a Supplier of Last Resort (SoLR) mechanism for gas, to step in and supply the customer in the event of their existing supplier's failure.[xxxv]
Safety	The Ministry of Economic Affairs and Energy (BMWi) is responsible for the regulation of safety, including the development of the Emergency Plan and Preventative Action Plan for gas. The Preventative Action Plan contains specific measures for preventing supply crises, recognising them at an early stage, and mitigating them. The Emergency Plan describes the explicit steps to be taken in the event of a crisis. The actions to be taken depend upon the crisis level – early warning, alert or emergency – which are determined based upon degree of disruption, anticipated economic and technical impact, and urgency of rectification.

3.9 Market Evolution and Future Development

3.9.1 Market Evolution

Establishment - Wholesale	Competition was first introduced at the wholesale level with the German Energy Industry Law of April 1998. However, this law declared the market to be open without establishing market infrastructure or requiring structural separation, and third-party access to the regional transmission networks was to be via negotiation. The result was ineffective competition, with preference behaviour from the incumbents, high network charges for the transactions of most interest to new entrants.[xxxvi] Deutsche Bank at the time observed that "the opening of the natural gas market in Germany has … only taken place on paper."[xxxvii] In 2005, a fundamental change of the regulatory framework was enacted through a revision of the EnWG. These legislative amendments, as well as a series of new ordinances, were designed to transpose the requirements of the Second EU Internal Energy Market Package (Directives 2003/54/EC and 2003/55/EC). At the heart of the new legislation was the establishment of a regulatory authority for the electricity and gas networks (BNetzA).
Establishment - Retail	The Energy Industry Act (EnWG) of April 1998 also opened the retail market, nominally to full competition. However, as with the wholesale market, little was done to establish the necessary infrastructure or otherwise give the reform meaning. As a result, competition languished until the revision of the EnWG in 2005. The effective level of competition has progressively increased since then.
Evolutionary Path	Some of the key milestones on the project's evolutionary path are:

	• 1998: First Energy Industry Act • 2002: Federal Cartel Office raises concerns with effectiveness of market arrangements in electricity and gas • 2003: E.On Ruhrgas merger (over objections of Federal Cartel Office) • 2003: Second EU Gas Directive • 2005: Amendment of Energy Industry Act • 2005: Establishment of BNetzA; requirement for structural unbundling • 2007: EEX commences natural gas spot and derivatives trading • 2013: PEGAS (EEX/Powernext joint venture) launched

3.9.2 Market Development

Areas of the current arrangements that are presently sources of concern, under debate or changing include:

- *Distribution cross-subsidies*: In Germany distribution companies have typically cross-subsidised municipal services using profits made from their gas (and power) business. As these profits have reduced due to competition, many DSOs cannot sustain these subsidies, or are incurring ongoing losses to do so. A new regulatory arrangement for provision of these services is likely to be required.
- *Competitiveness of mid-stream energy trading companies:* During the restructuring of the energy utility market, the former merchant gas transmission companies were stripped of their networks and their monopoly positions were abolished. They now have to compete with a large number of companies to retain their previously captive customer base. At the same time they retained legacy 'take or pay' supply contracts 'ship or pay' obligations with pipelines. Some of these contracts extend for 10-20 years into the future. However, competition dicates that they sell at the prevailing market price – which may be lower than for these legacy arrangements – or risk losing their customer base, or competition increases the risk associated with these obligations. The midstream companies are thus exposed to both volume risk and price risk, though this risk is offset by various negotiated concessions and rebates.
- *Hub pricing vs. oil-indexed pricing:* Natural gas and oil are substitutes in both short and long term. In order to encourage customers to switch to natural gas and to remain with natural gas (even if they retained the ability to switch back) price formulae were designed such that natural gas prices followed that of oil. This was done primarily to avoid gas importers having to pay 'take-or-pay' penalties in their contracts with exporters if they lose large number of customers. The rationale for pricing gas in relation to oil had become increasingly questionable as gas had displaced oil in the domestic and power generation sectors. However, familiarity with, and profitability of, the oil-indexed pricing system created inertia and the oil-based pricing remained for a long time. In the meantime, natural gas demand had fallen and availability increased but due to oil price increases the long-term contract prices for gas kept rising. As North West European hubs prices became more transparent, customers demanded hub-based prices. This was facilitated by the ruling that freed customers from multi-year purchase agreements. For several utilities, their commercial position was rapidly becoming unsustainable. Starting from 2010 a series of renegotiations of long term contract prices took place – many of which required international arbitration proceedings to resolve. There are still several ongoing negotiations to move long-term contracts to hub prices.

4 MARKET PROFILE – GREAT BRITAIN

4.1 Context

4.1.1 Location and Physical Reach

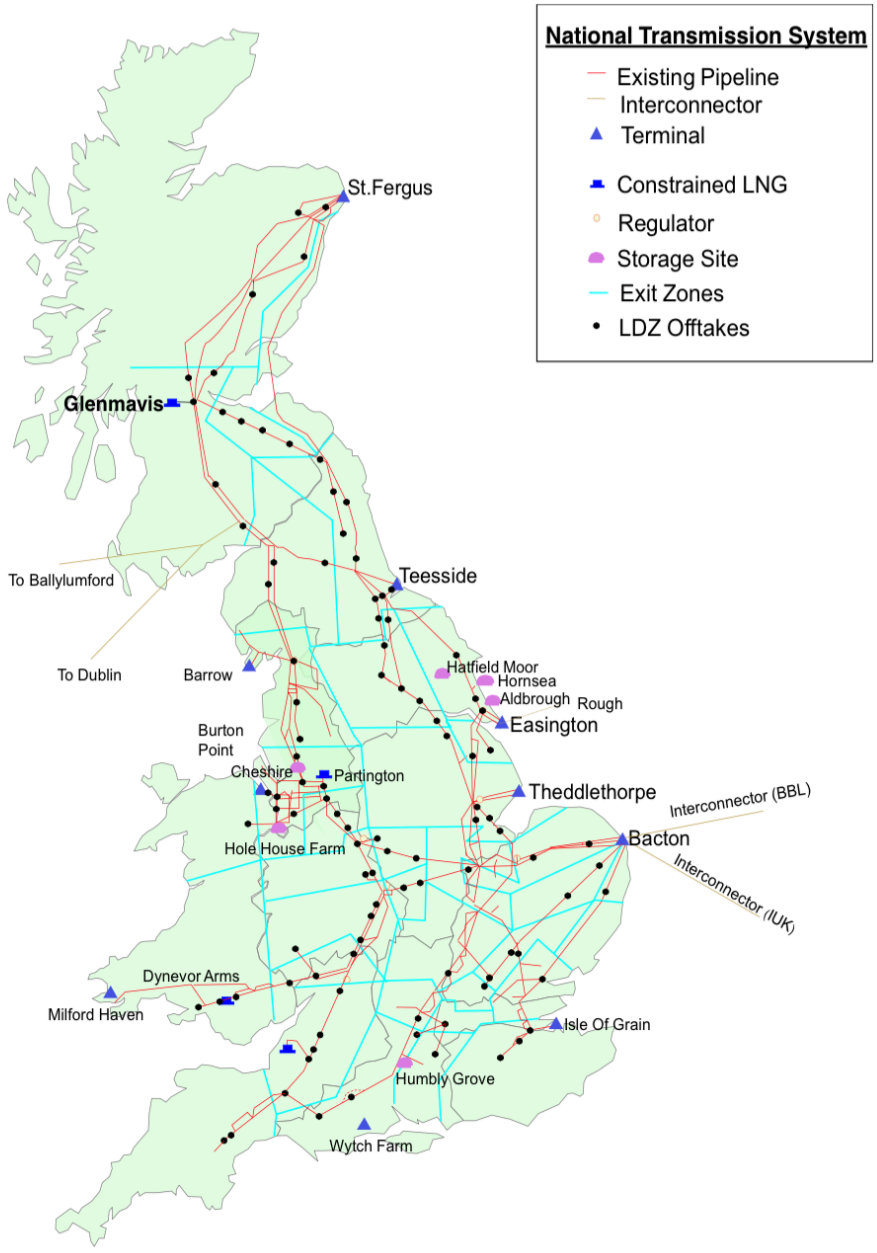


Figure 9 – Map of the GB NTS. Source: National Grid[xxxviii]

The gas market in Great Britain operates as a single interconnected system – the National Transmission System (NTS).

Domestic production is principally offshore, in the North Sea and Irish Sea. Imports occur from Norwegian offshore fields directly to Great Britain via four pipeline routes:

- Langeled (Norway) - Easington[xxxix]
- Versterled (Norway) - St. Fergus

- Tampen (Norway) - St. Fergus[xl]
- Gjøa (Norway) - St. Fergus

There are also four principal interconnectors:

- Belgium: Interconnector United Kingdom (IUK); Bacton(GB)-Zeebrugge (Belgium); operational from October 1998[xli]
- Netherlands: Bacton-Balgzand Line (BBL); Bacton (GB)-Balgzand (Netherlands); operational from 2004[xlii]
- Ireland: Moffat (GB)-Dublin (Ireland). Operational from 1993[xliii]
- Northern Ireland: Scotland-Northern Ireland Pipeline (SNIP); Twynholm (GB) – Ballylumford (NI)

The interconnectors to Belgium and Netherlands are used for both import and export, whereas the interconnectors to Ireland and Northern Ireland are used almost exclusively for export.

There are also a number of LNG import terminals, with imports originating from Algeria, Norway, Qatar, Trinidad & Tobago, Australia, Egypt, Nigeria, USA and Yemen.[xliv]

Table 10 – Great Britain LNG Import Terminals

Terminal	Operator	Location
Isle Of Grain 1 – 3	National Grid Grain LNG	Kent
GasPort	Excelerate Energy	Teesside
Dragon 1	Qatar Petroleum and ExxonMobil	Milford Haven
South Hook 1 – 2	BG Group / Petronas	Milford Haven

There are three types of storage facility:

- *Long Range*: there is one long-range storage site on the NTS: Rough, situated off the Yorkshire coast. Rough is owned by Centrica and operates on a seasonal basis.
- *Medium Range*: these commercially operated sites have shorter injection/withdrawal times so can react more quickly to demand and prices.
- *Short Range*: the only short range storage site on the NTS is at Avonmouth near Bristol. This onshore site stores LNG gas that has been condensed from the NTS. When needed, the liquid gas is re-vaporised and delivered to the NTS. This facility can respond quickly, but has limited stock.[xlv]

Table 11 – Major Storage Sites

Storage Site	Type	Operator	Space (billion m^3)
Avonmouth LNG	Short range	National Grid LNG Storage	0.08
Hill Top Farm (under construction; due 2017)	Medium range	EDF energy	0.10
Holford	Medium range	E.ON	0.20
Hatfield Moor	Medium range	Scottish Power UK plc	0.07
Hornsea	Medium range	SSE Ltd	0.30
Hole House Farm	Medium range	EDF Trading Gas Storage Ltd	0.05

Storage Site	Type	Operator	Space (billion m^3)
Humbly Grove	Medium range	Petronas Energy Trading Ltd	0.30
Aldborough	Medium range	SSE Ltd	0.30
Stublach	Medium range	Storengy UK	0.20
Rough	Long range	Centrica Storage	3.30
		Total [xlvi]	4.90

Figure 10 – GB NTS Storage Sites [xlvii]

In total, the NTS has 30 entry points and in excess of 200 exit points, of which approximately two thirds are distribution network transfer points and the remainder are connections to transmission connected customers (TCCs), interconnectors and others.

Trading occurs at the National Balancing Point (NBP), a virtual hub.

4.1.2 Key Statistics

Total Consumption (TJ)	3,074,400 TJ (854 TWh) [xlviii] [2013]	
Total Production (TJ)	1,527,000 TJ (424 TWh) [2013]	
Peak Daily Consumption (TJ)	19,764 TJ (5,490 GWh) [xlix]	
Total Length of Pipeline (km)	7,600 km in the NTS (122,000km in the distribution networks)	
Import/Export (TJ)	Import [2013]	Export [2013]
Belgium [21]	127,400 (35.4 TWh)	99,000 (27.5 TWh)
Netherlands	293,400 (81.5 TWh) [22]	67,000 (18.6 TWh) [23]

[21] Physical flows of gas through the Bacton-Zeebrugge Interconnector.
[22] Physical flows via the BBL pipeline.

Ireland	-	192,600 (53.5 TWh)
LNG[24]	369,400 (102.6 TWh)	-
Norway (unprocessed)[25]	1,099,800 (305.5 TWh)	72 (20 GWh)[26]
Total Import/Export	1,890,000 (525.0 TWh)	358,672 (99.6 TWh)
Storage Capacity (TJ)[l]	197,225[li] (4.90 bcm)	

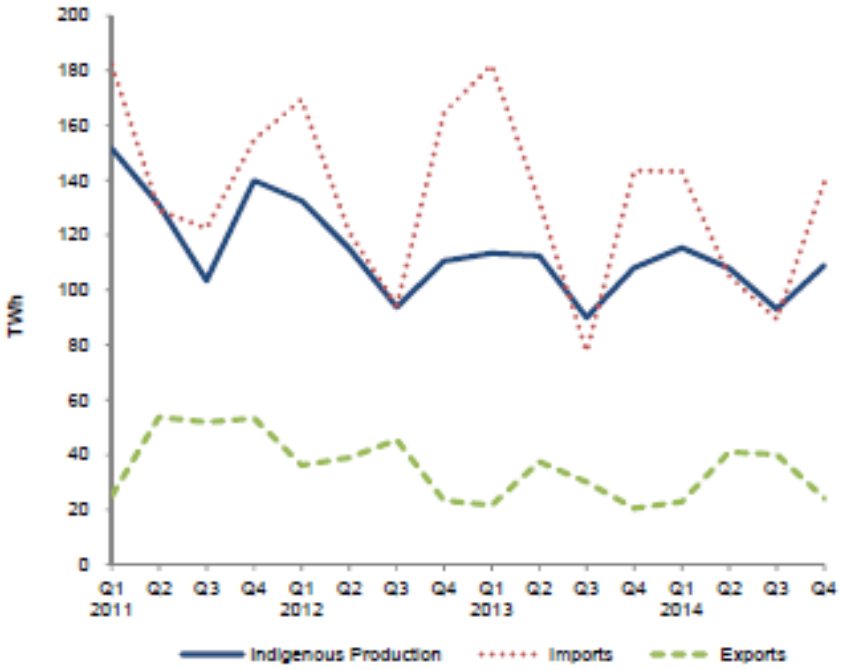


Figure 11 – UK Natural Gas Production, Imports & Exports (Source: UK Government Gas Statistics)

4.1.3 Key System Characteristics and Considerations

The system in great Britain is essentially a meshed grid. Sitting at the edge of the European gas market, there are only small amounts of transit, to Ireland and Northern Ireland, with the remainder serving domestic consumption. While a net importer, depending on the economics on any particular day there may also be exports to Belgium and/or the Netherlands.

The principal transmission system – the National Transmission System (NTS) – is operated by National Grid under transparent capacity and market arrangements. The four interconnectors each have their own arrangements and capacity booking mechanisms, though these are also fairly transparent and accessible for all gas trading parties. The other connections are upstream pipelines to the gas wells in the North Sea (UK and Norway) and Irish Sea, most of them being principally accessible only to the upstream parties involved.

Residential consumption is the largest use of gas in Great Britain, accounting for around 40% of demand, followed by power generation (~27%), commercial (~14%) and industrial (~11%), with various other uses making up the remainder.[lii]

[23] Direct exports from Chiswick, Grove, Markham, Minke Stamford, Windermere, Wingate offshore gas fields.
[24] From various sources to Milford Haven (South Hook and Dragon), Isle of Grain and Gasport Teesside
[25] Via the Langeled and Vesterled pipelines, and the Tampen Link (from Statfjord to FLAGS).
[26] Injection into the Norwegian Ula field.

The system was originally designed to utilise Britain's (originally) large gas reserves to serve domestic demand, as well as export to the Continent. For heating purposes, natural gas replaced other fuels such as coal and heating oil.

The large gas production capacity at that time also led to a "dash for gas" in electricity generation. Consequently, Britain built a significant amount of gas-fired generation compared to many other European countries. In 2005, gas-fired plant generated 35% of all electricity. By 2013, this had decreased to 23%[liii]. The declined share of gas in power generation has been due to several reasons:

- Decline of domestic gas production, with the transition from a gas-exporting country into a gas-importing one.[liv]
- The drop in coal prices and CO2 prices in the EU Emissions Trading Scheme (ETS), and relatively high gas prices[27]. As such, gas generation has become economically much less attractive than coal-fired generation.[lv]

In recent years, Britain has embarked on development of shale gas resources in order to replace the declining production from existing gas fields – one of the few EU countries to do so. This is driven, at least in part, by a desire to maintain a diversity of gas supply sources.

The gas market in Great Britain is based around the National Balancing Point (NBP), a virtual hub. This was the first competitive gas market in Europe, and until very recently the most liquid (it is now rivalled by the Dutch TTF market).

4.2 Industry Structure

Figure 12 below shows key gas flows and cash flows in the British gas market.

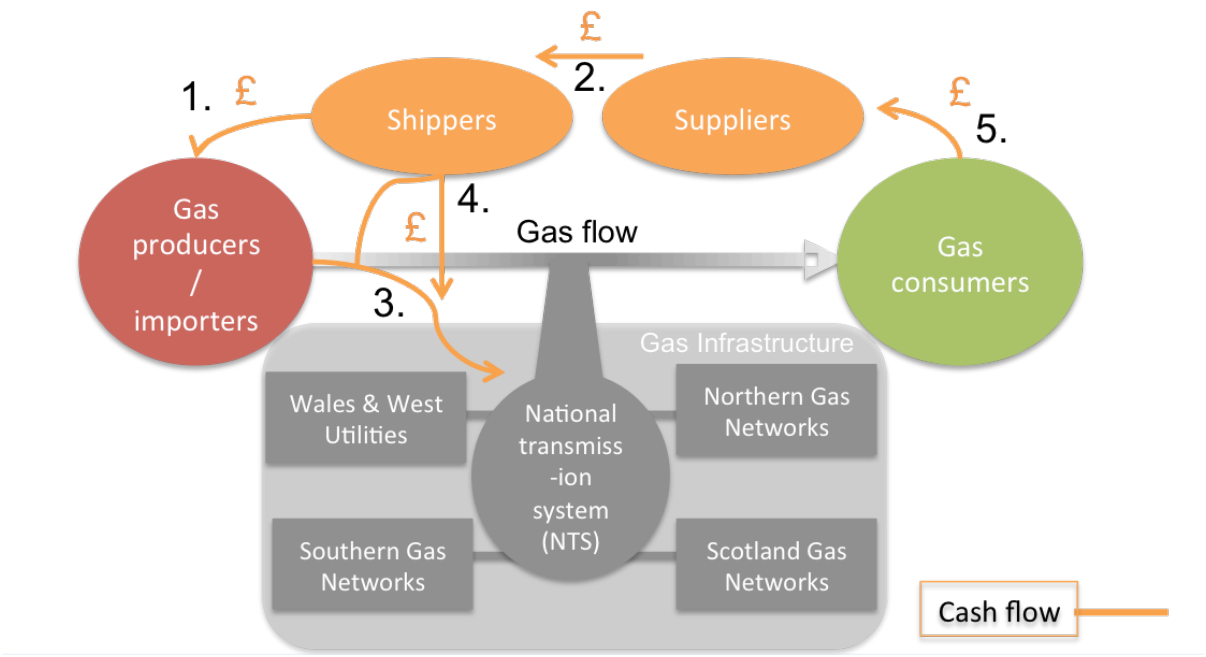


Figure 12 – Key Gas and Cash Flows for Gas Market in Great Britain

Key elements include:

- Gas producer and importers sell gas to shippers, who own the gas as it travels through the transmission and distributions systems.
- Shippers buy transportation on the National Transmission System by purchasing capacity at entry points, and then arranging for it to be conveyed to various supply points.

[27] Far above US Henry Hub prices, albeit lower than Asian gas prices (based on delivered LNG).

- Gas is sold by shippers to suppliers (retailers), who then sell the gas to end consumers. Some suppliers serve as their own shipper.
- Additionally, some major consumers (in particular, transmission connected) may buy directly from shippers.

4.2.1 Key Roles

Key roles in the Great Britain market include:

- shippers
- transmission system operator
- transmission network (pipeline owner)
- market operator(s)
- gas producers/importers
- storage managers (storage providers)
- gas distribution networks (distribution companies)
- supplier (retailer)
- transmission connected customers
- allocation agents: calculate how much of the gas injected at a terminal belongs to each shipper

Ownership separation exists between gas pipelines and shippers. Similarly, there is ownership separation between the gas distribution networks (GDNs) and suppliers.

4.2.2 Infrastructure Providers

In the UK, gas leaves the transmission system and enters the distribution networks at high pressure. It is then transported through a number of reducing pressure tiers until it is finally delivered to consumers. There are eight regional distribution networks, four of which are owned by National Grid[lvi].

Pipeline/Transmission System Operator(s)	National Grid Gas plc is Britain's System Operator. Among other duties, it is in charge of making sure that gas supply matches gas demand on a daily basis.
Pipeline Owner(s)	National Grid owns the high-pressure gas transmission system in Great Britain.
Spot Market/Balancing Operator(s)	Balancing occurs via the On-the-day Commodity Market (OCM) operated by ICE-Endex.
Prompt/Short-Term Forward Market Operator(s)	ICE Futures Europe (an affiliate of ICE-Endex) operates the principal short-term market for gas in Great Britain, based on trading around the NBP. CME Europe offers daily contracts based around the NBP, and PEGAS, the gas joint venture between EEX and Powernext, plans to launch 'spot' trading around the NBP in 2015.
Forward/Futures Market Operator(s)	ICE Futures Europe operates the principal futures market for gas in Great Britain. CME Europe offers futures contracts based around the NBP, and PEGAS, the gas joint venture between EEX and Powernext, plans to launch futures trading around the NBP in 2015.

4.2.3 Regulators

Energy Regulator – National	The Office of Gas and Electricity Markets (Ofgem) is the national energy regulator for Great Britain. It is responsible for • the supervision and development of markets and competition • regulation and the delivery of Government schemes The Department of Energy & Climate Change (DECC) creates policies regarding the energy sector. EU regulations are translated into UK legislation.
Energy Regulator – Regional	Not applicable.
Financial Market Regulator	The Financial Conduct Authority (FCA) regulates conduct in the financial markets, including overseeing the operation of all derivatives markets and clearing houses – including for energy. The Prudential Regulation Authority (a division of the Bank of England) is responsible for prudential risk regulation, which includes some oversight of clearing houses.
Competition Regulation	The Competition and Markets authority (CMA) oversees fair competition for all trade practices in the UK.
Other	-

4.3 Transmission Arrangements

4.3.1 Transportation Rights

Form of Transportation Rights	Transportation takes place through the purchase of transportation rights with a specified maximum daily quantity.
Locational Nature	Shippers buy entry rights and exit rights, which provide the right to inject gas into and withdraw gas from the system at the specified connection point(s) to/from the virtual location of the National Balancing Point (NBP). Delivery throughout the system is facilitated by National Grid.
Type	Entry rights are available as: • Firm capacity • Interruptible capacity Exit rights are available as: • Firm capacity • Off-peak capacity (made available when firm capacity is not being fully utilised, and curtailable without compensation)
Duration	Entry capacity ranges from within-day sales of the balance of the current day, through to 16 years out (Y+16). Exit capacity ranges from within-day sales of the balance of the current day, through to 6 years out (Y+6).
Primary Sales – Existing Capacity	Transportation rights are sold principally via auction. A number of different auctions are run. For firm entry: • Quarterly strips, sold annually, from Y+2 to Y+16 (QSEC)

	• Monthly strips, sold annually, for Y+1 and Y+2 (MSEC) • Monthly, sold month-ahead (RMTnTSEC) • Daily, sold day-ahead (DADSEC) • Within-day (WDDSEC) • Discretionary release: 1 month to 1 year (DRSEC); held based upon evaluation of request to hold For interruptible entry: • Daily, sold day-ahead (DISEC) Long-term firm exit capacity is obtained through an application process, with three separate application windows: • Annual enduring exit increase, from Y+4 to Y+6, sold annually (EAFLEC) • Annual enduring exit decrease, for Y+1, sold annually (EAFLEC) • Annual NTS exit, sold annually (AFLEC) Short-term firm exit capacity is made available via auction: • Day-ahead NTS exit, sold day-ahead (DADNEC) • Within-day NTS exit (WDDNEC) Off-peak exit capacity is also made available via auction: • Daily, off-peak NTS exit, sold day-ahead (DONEX) National Grid uses its own auction platform. It intends to move the trading of cross-border capacity to the pan-European PRISMA platform in November 2015, but to keep the auctioning of other capacity on its own platform.
Secondary Market	Shippers can trade excess entry capacity back into the capacity auctions. If shippers wish to 'trade' or 'transfer' their entry capacity from one aggregated system entry point (ASEP) to another, this must be evaluated by the TSO subject to the Entry Capacity Trade & Transfer (ECT&T) Methodology.[lvii] This methodology aims to ensure that transfers and trades do not result in congestion, and "maximise the availability of firm NTS Entry Capacity at ASEPs of higher value as demonstrated by shipper bids."[28] As such, a derived "exchange rate" is applied in converting from one ASEP to another.
Capacity Release	National Grid allows shippers to offer firm available NTS Entry Capacity for surrender into its annual QSEC and AMSEC auctions, and monthly RMTnTSEC auction. If the capacity is sold, the shipper is relieved of their obligation.[lviii] Shippers may also surrender Annual NTS Exit Capacity through the AFLEC application process, and can offer to reduce their Annual Enduring NTS Exit Capacity via the EAFLEC application process. National Grid also utilises and Oversubscription & Buy Back (OBB) scheme, whereby it auctions firm capacity in excess of the physical capability of the system – in the expectation that not all of this will be nominated. Should nominations exceed the systems physical

[28] This would appear to be a crude analogue to the 'FTR reconfiguration' process that occurs with Financial Transmission Rights (FTRs) re-sold into the FTR auctions in electricity.

	capability, National Grid will buyback capacity, to get back within technical limits. This may take place through the on-the-day market, or additionally National Grid may enter into forward agreements (e.g. options).[lix] Ofgen has recently published a vision paper, in conjunction with the regulators in the Netherlands and Belgium, on how they might joint apply 'long-term use-it-or-lose-it' (UIOLI) at cross-border congestion points with contractual congestion.[lx] The decision to remove capacity from a shipper would be made by the regulator, with and actioned by the TSO.
Capacity Expansion Process	System augmentation can take place based on shipper purchases of firm entry capacity, secured through a Planning and Advanced Reservation of Capacity Agreement (PARCA), which gives the shipper capacity rights associated with the investment. Revision of the systems's exit capacity generally occurs in conjunction with investment in new entry capacity.[lxi] National Grid may also undertake investments based upon its Gas Ten Year Statement (GTYS) – a planning document produced on an annual basis, outlining its investment plans and potential future developments over a 10-year planning horizon. This takes account of capacity reserved or allocated via a PARCA, long-term QSEC auction results for entry capacity, long-term exit capacity bookings made by distribution network operators, and exit capacity requirements indicated by shippers.
Primary Sales – Capacity Expansion	Shippers can contract directly with National Grid for entry capacity via a PARCA. They can also offer to buy additional capacity via the long-term auction process (QSEC), and if successful, would receive binding obligations. The desire for additional exit capacity is indicated via the application windows for long-term exit capacity, described in the NTS Exit Capacity Release Methodology Statement[lxii], and contracted via a PARCA[lxiii].

4.3.2 Nominations, Scheduling and Balancing

Nominations	Under the Uniform Network Code (UNC), shippers are required to submit balanced nominations, and are incented to balance their system inputs and outputs. The Gemini system, operated by Xoserve, is used for nominations.
Scheduling Period	Nominations are made on a daily basis. At this point in time (April 2015), the gas day is from 6.00 am to 6.00 am next day. This is about to change. Due to alignment with Central European arrangements, the gas day will be changed to 5.00 am to 5.00 am. This change will be effective as of the starting date of new gas year, 1 October 2015.[lxiv] Nominations can be entered from 30 days to 1 day in advance[lxv].
Changes to Nominations	Renominations and intra-day nominations are allowed.
Multiple Pipelines	Cross-border and other inter-pipeline flows are nominated to both National Grid and the Neighbouring Network Operator (NNO) by the relevant shipper on each TSO's system. National Grid and the NNO exchange matching messages to align the nominations. If quantities do not match, the Lesser Of Rule (LOR) is followed, where the lower

	quantity is scheduled and confirmed by both TSOs to their own shippers.
Balancing	
Balancing Period	The balancing period is daily.
Balancing Gas	Gas for physical balancing can be obtained from existing stocks managed by National Grid – including linepack, and gas storage – as well as procured through the On-the-day Commodity Market (OCM) operated by ICE-Endex.
Participant Balancing	There is a requirement for shipper injections and withdrawals to be balanced. The OCM also provides a liquid venue to facilitate participant within-day gas trading to balance their positions. The minimum amount of gas that may be traded on the OCM is 4,000 therms. If a shipper's position is long or short by a volume less than this they may be forced to leave their balance to cash out.[lxvi]
Quantity Measurement	Xoserve performs gas allocations for all market entry and exit points, as an agent for the shippers and gas transporters (including National Grid).
Recompense for Participant Imbalances	All participant imbalances are 'cashed out'. Unlike some other schemes in Europe, though, these imbalance charges are not considered to be punitive, and as a result it is not unusual for participants to leave an imbalance position to be cashed out. In addition to imbalance charges, shippers are also subject to 'scheduling charges; if either their input or offtake flows are not equal to nominations (even if input = offtake).
Balancing Payment	Under or over-delivered gas is deemed to have been sold/bought by National Grid, with shippers charged for their imbalances. • Inputs > Offtakes: 'positive imbalance' • Offtakes > Inputs: 'negative imbalance' Positive imbalance receives System Marginal Sell Price (SMPs). SMPs = minimum of: • TSO's lowest price balancing trade on the OCM. • System Average Price – system flexibility premium of 0.0324 pence/KWh. Negative imbalance receives System Marginal Buy Price (SMPb). SMPb = maximum of: • TSO's highest price balancing trade on the OCM • System Average Price + system flexibility premium of 0.0287 pence/KWh. [lxvii] See the example OCM weekly price and volume chart in Figure 13.

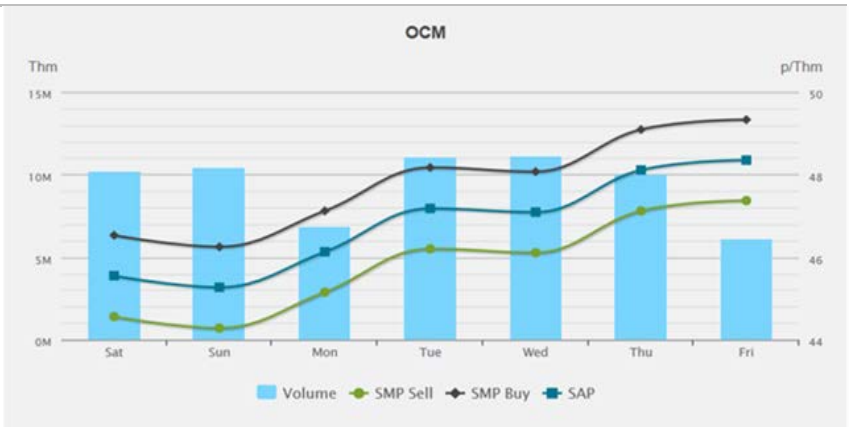


Figure 13 – OCM Weekly Price and Volume Example (Source: ICE-Endex)

These charges are invoiced by Xoserve, as the gas transporters' agent.

4.4 Storage Arrangements

Storage Access	Storage in Great Britain is subject to third-party access.
Storage Rights	Storage operators auction a variety of gas storage capacity and associated rights. Storage rights can take several forms. For instance, on the most important storage field, the "Rough" field operated by Centrica, rights include: • Firm injection rights • Firm withdrawal rights • Firm space • Gas in store
Primary Sales – Storage Rights	Storage rights are obtained through participation in auctions. There is no grandfathering.
Secondary Market	ICE-Endex facilitates a secondary market in storage rights, and gas in storage, for the Rough gas storage, in co-operation with the field's owner, Centrica Storage Ltd (CSL). Products traded are: • Firm injection rights: day-ahead and within-day • Firm withdrawal rights: day-ahead and within-day • Firm space: day-ahead and within-day • Gas in store: within-day This market is available to all members of the On-the-day Commodity Market (OCM), provided that they are signatories of CSL's Storage Services Contract and the associated Credit Agreement, and using the same trading and clearing mechanisms (see Trading Arrangements). All trades are notified to CSL, and the transfer of commodity or capacity is made on behalf of members via StorIT, Centrica's online customer services system[lxviii]. Secondary trading is possible for storage rights for other gas storage facilities. This trade is bilateral and OTC.
Capacity Release	There appears to be no mechanism for mandatory capacity release for storage.

4.5 Trading Arrangements

4.5.1 Trading Reference Points

NAME	TYPE	DESCRIPTION
National Balancing Point (NBP)	Virtual hub	The NBP is a virtual location representing the entire NTS.
St. Fergus, Bacton and others	Physical supply point	Some trading occurs based on physical entry points to the syste, including the potential for the TSO to purchase location specific balancing gas.

4.5.2 Balancing Market

Market Operator	The organized balancing market is the On-the-day Commodity Market (OCM). ICE-Endex is the assigned market operator for the OCM. The OCM is the most liquid balancing market in Europe and probably the world. The traded volume in 2011 was 333 TWh[lxix], or ~1.2 Million TJ. This volume has remained more or less stable over the years.
Trading Mechanism	The OCM utilises a continuously-traded, anonymous, order matching process. Products consist of: [lxx] • Title: an exchange of title for gas at the NBP. This trade is a transfer of gas between market participants at the NBP virtual balancing point. No physical delivery included. • Physical: physical delivery to/from the NBP. Post-trade, the bid originator shall identify the location(s) at which the gas will be delivered, or off-taken. • Locational: physical delivery at a specified system entry or exit point. Contains single entry or exit point at which gas is bid/offered. The Title product is by far the most liquid.
Locational Basis	Most trading is based around the National Balancing Point. Location-specific products are also available. When needed, National Grid submits bids for these products to meet specific balancing requirements.
Trading Interval	The trading interval is daily, prior to commencement of the gas day, or balance-of-day, once the gas day has commenced There is a maximum of two days tradable at any one time: Within-Day and Day-Ahead, according to the time of day. Trading is available from 08:00 day-ahead until 03:35 within-day on the gas day. For example, the OCM Title Day Product 'OCM TITLE TUE 11-FEB-13' delivers between 06:00 on 11 February 2013 and 06:00 on 12 February 2013; it opens for trading as a Day-Ahead Product at 08:00 on 10 February 2013, and becomes a Within-Day Product at 06:00 on 11 February. The product closes for trading at 03:35 on 12 February 2013.
Participation	All shippers allowed to nominate at the NBP can participate, if they sign the membership agreement of ICE-ENDEX and adhere to the market rules of the exchange and the clearing house.

Measurement	The OCM settles based upon transacted quantity.
Settlement and Credit Risk	Financial settlement and credit risk management is performed by the clearing house designated by ICE-Endex. Settlement is carried out by APX Clearing BV at present, but is due to move to ICE Clear Europe later in 2015. Billing period is weekly, but will likely move to business day once migrated to ICE Clear Europe. Credit management will also move from the relatively simple 'cash clearing' arrangements of APX, to the full set of clearing arrangements in place at a regulated commodities clearing house at ICE, including portfolio margining across positions in other products.

4.5.3 Prompt/Short-Term Forward Market

OTC Trading	A significant portion of the trading volume in the market continues to take place bilaterally between principals, or OTC, facilitated by a range of brokers. The London Energy Brokers' Association (LEBA) has been active in establishing standards for the market. The "Short Term Flat NBP Trading Terms & Conditions" is the commonly used master agreement for OTC trading at NBP.
Exchange Trading	The bulk of prompt exchange-based trading at NBP is conducted on the ICE Futures Europe (ICE). CME Europe (CME) also lists prompt products. PEGAS plans to launch trading of prompt NBP products in 2015.
Trading Mechanism	Both the ICE and CME markets transact anonymously via continuous screen trading (via the WebICE and Globex system's respectively).
Locational Basis	The locational basis for all products is the NBP.
Product Tenor	Both ICE and CME offer trading in daily products, and strips of dailies. The ICE daily products list out to 42 days out from delivery. Various trip combinations are also available, including 'balance of week', 'weekends', 'working days next week' and 'balance of month'.
Participation	All participants on the exchange are eligible to trade, though only shippers able to nominate on the NBP can hold physical products through to delivery.[29]
Settlement and Credit Risk	Trading on ICE is cleared through ICE Clear Europe. Trading on CME is cleared through the CME Europe Clearing. Both clearing houses offer OTC clearing.
Delivery Method	ICE offers both a physically-delivered daily product, and a daily cash-settled against the System Average Price. CME offers both a physically delivered daily product, and a daily product financially-settled against the index published by ICIS Heren.
Delivery Integration	Both ICE Clear Europe and CME Clearing Europe facilitate the delivery process through multilateral submission of a balanced set of

[29] These restrictions are often enforced through position limits and 'proof of ability to make/take delivery' requirements approaching the time the product ceases trading prior to delivery.

	nominations. Each delivery party submits a nomination – with the clearing house on the other side (i.e. buyer from clearing house, and seller to clearing house) – to National Grid's Gemini system. [lxxi]

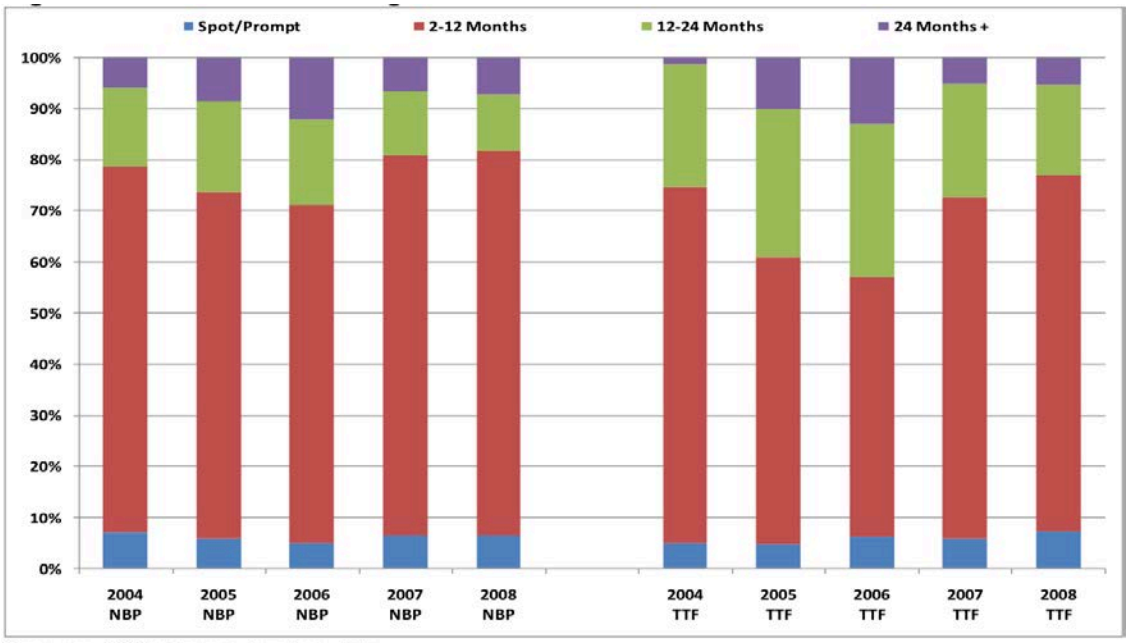
4.5.4 Forward Market

OTC Trading	A significant portion of the trading volume in the market continues to take place bilaterally between principals, or OTC, facilitated by a range of brokers. The London Energy Brokers' Association (LEBA) has been active in establishing standards for the market. The "Short Term Flat NBP Trading Terms & Conditions" is the commonly used master agreement for OTC trading at NBP.
Exchange Trading	The bulk of exchange-based trading at NBP is conducted on ICE. CME also lists prompt products. PEGAS plans to launch trading of prompt NBP products in 2015. The market is very liquid. Recently. ICE announced daily volume in the NBP Natural Gas futures contracts on February 10, 2015, with 137,495 (120.9 TWhs) contracts traded. Year-to-date average daily volume is 61,898 contracts; and open interest was 344,267 contracts (302.7TWh) as of February 10, 2015[30].
Trading Mechanism	Both the ICE and CME markets transact anonymously via continuous screen trading (via the WebICE and Globex system's respectively).
Locational Basis	The locational basis for all products is the NBP. Various spreads between NBP and other hubs are also provided by both ICE and CME.
Product Tenor	ICE: lists futures contracts for months (next 78-83), quarters (next 11-13), seasons (next 13-14), calendar years (next 6). CME: lists a monthly physical contract spanning the balance of the current year and the next five calendar years, and a financially-settled contract spanning the balance of the current year and the next two calendar years. On ICE, market participants can generally obtain quotes for around four years out allowing them to hedge positions over this time horizon. Liquidity is significantly lower further out along the forward curve, i.e. for products for delivery further into the future[lxxii]. Figure 14 provides an indication of relative trade volumes as the forward curve goes out.
Participation	All participants on the exchange are eligible to trade, though only shippers able to nominate on the NBP can hold physical products through to delivery.[31]
Settlement and Credit Risk	Trading on ICE is cleared through ICE Clear Europe. Trading on CME is cleared through the CME Europe Clearing. Both clearing houses offer OTC clearing.

[30] Press release ICE-ENDEX, http://ir.theice.com/press-and-publications/press-releases/all-categories/2015/02-11-2015a.aspx

[31] These restrictions are often enforced through position limits and 'proof of ability to make/take delivery' requirements approaching the time the product ceases trading prior to delivery.

Delivery Method	ICE offers a physically-delivered product. CME offers both a physically delivered product, which cascades into a strip of physical dailies upon 'delivery', and a daily product financially-settled against the index published by ICIS Heren.
Delivery Integration	ICE Clear Europe facilitates the delivery process through multilateral submission of a balanced set of nominations. Each delivery party submits a nomination – with the clearing house on the other side (i.e. buyer from clearing house, and seller to clearing house) – to National Grid's Gemini system. CME Clearing Europe: physicals become a strip of physical dailies, rather than being delivered themselves. Delivery Integration is described in the Prompt Market of this profile.



Source: ICIS Heren, broker data

Figure 14 – Relative Breakdown of Trading Depth
(Blue: <1 month; Red: 1-12 months; Green: 1-2 years; Purple: longer-dated)

4.6 Market Information

Market Information	The major exchanges publish current and historical pricing, trade volume, open interest and other information. Basic end-of-day information, such as end-of-day settlement prices, must be made available to the public free of charge. Brokers also publish information about trade on their own platforms to their customers.
Publication Platform	Exchanges publish information through their own platforms and via third-party data resellers (e.g. Reuters). The European Network of Transmission System Operators for Gas (ENTSO-G) operates the ENTSO-G Transparency Platform, which publishes information on European gas capacity and flows, with a particular focus on cross-border points.

Third-Party Services	The London Energy Brokers Association (LEBA) operates a service for the collection, validation and distribution of price and volume indices, and forward price curves, based on 100% of members' daily market transactions. These indices are widely used in pricing shorter-term (up to a year out) contracts with retailers and transmission connected users. Major price reporting services – such as ICIS Heren, Argus and Platts – provide spot and forward gas prices and analysis covering major European hubs including NBP. The ICIS Heren European Spot Gas Market Report is used as a reference for CME Europe's financially-settled futures contract.

4.7 Retail Competition

Retail Contestability	All segments of the retail market have been contestable since 1996. The market is highly competitive, with switching rates of around 15% in the last few years[lxxiii], and running around 20-25% in the first years of the market.
Retail Opening	The first steps towards retail competition were taken in the Gas Act of 1986[lxxiv], sanctioning the privatisation of British Gas (BG) and removing BG's monopoly for very large customers above 25,000 therms (732,678 kWh) annual demand, with the obligation to offer third-party access for competitors. Development of competition developed relatively slow however.[lxxv] Further steps were taken in the early nineties after a review by the Office of Fair Trading. In 1992, the consumer threshold was reduced to 2500 therms (73,268 kWh) annual demand. The 1995 Gas Act[lxxvi] mandated a fully liberalised gas market including competition in the residential market, a timetable for full competition (see section on Market Evolution) and a new licensing system for pipeline operators, shippers and retailers. The retail market opened for most customers progressively between April 1996 and May 1998.
Customer Switching	The central registry for switching is operated by Xoserve. Xoserve is a joint venture of the gas transporters (transmission and distribution) in Great Britain.

4.8 Regulatory Structure

4.8.1 Legal Framework

National Legislation	The principal laws governing, or impacting upon, the gas market are: • Competition and Service (Utilities) Act 1992 • Gas Act 1986 • Electricity Act 1989 • Utilities Act 2000 • Gas Act 1995 • Financial Services and Markets Act 2000
International Agreements	There is extensive supra-national legislation, mainly from EU directives: Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal

	market in natural gas and repealing Directive 2003/55/EC[lxxvii]. Financial/derivative markets in energy (including products resulting in physical delivery) are also subject to various EU regulations, including: • European Market Infrastructure Regulation (EMIR), No 648/2012, of 16 August 2012, requiring standardised OTC trades to be cleared, higher capital requirements for non-cleared trade, and requirement for establishment of trade repositories. • Market in Financial Instruments Directive (MiFID), 2004/39/EC, of 30 April 2004, which addresses harmonised financial market regulation, and various specific requirements. In 2017, MiFID II is supposed to take effect. The interaction between these various regulations has required increased cooperation between energy financial regulatory authorities.
Regulations	Ofgem issues regulatory orders based on legislative requirements, and policy determined by the responsible Minister, via the Department of Energy and Climate Change (DECC).
Codes	The gas market in Britain is governed by a number of detailed codes. These include the Uniform Network Code (which replaced the old Transco Network Code, first published 1996), Storage Code and Metering Code. These codes, and in some cases, the specific 'methodologies' that sit beneath them, are subject to approval by Ofgem.[lxxviii] The market is also subject to 'network codes' at the EU-level, promulgated via ENTSO-G, which are then interpreted into codes (new, or changes to existing), and potentially other instruments, at the national level. The European Network Code on Capacity Allocation Mechanisms (NC CAM) is already active, the Congestion Management Procedures (CMP) are expected to be fully implemented by November 2015, and the Balancing Code (NC BAL) in late 2015 (though this may be deferred until late 2016).
Market Rules	Each exchange is responsible for development and maintenance of its own rule book. For financial exchanges, these rules are subject to regulatory approval by the Financial Conduct Authority (FCA). Balancing market rules are subject to approval by Ofgem. Day-ahead markets are a grey area – these markets are essentially financial, but have a close relationship to physical scheduling, potentially exposing the, to both regulatory regimes.

4.8.2 Licensing

Wholesale Market	ICE-Endex is designated by Ofgem, and appointed by National Grid Gas, as the market operator of the independent market for balancing (On-the-day Commodity market or OCM)[lxxix]. National Grid, as a gas transporter, is required to be licenced by Ofgem for its role as TSO. Shippers are also licenced. The conditions imposed upon licences include, amongst other things, compliance with the various codes.
Retail Market	Gas Distribution Networks, as gas transporters, are required to be licenced by Ofgem.

	Suppliers to end consumers must also be licenced by Ofgem.
Financial Market	Operators of derivatives markets must be licenced by the Financial Conduct Authority (FCA), typically as a Registered Investment Exchange. Operators of clearing houses must be authorised by the Bank of England. CME Clearing Europe is authorised as a 'Recognised Counterparty', and ICE Clear Europe is authorised as a "Recognised Clearing House which is not a Recognised Counterparty'. Under the 'EU Passport' arrangements in MiFID, exchanges properly accredited in other EU countries can offer services to participants in the UK (e.g. PEGAS can allow trading from UK participants without having to obtain a UK exchange licence). Conversely, accredited participants from other EU jurisdictions can trade on UK-domiciled markets (ICE Futures Europe and CME Europe) without those exchanges having to obtain local licensing. Those classified as 'dealing in investments (as principal or agent) require authorisation from the FCA. This includes all trading on a Registered Investment Exchange (i.e. there is no physical trading exclusion from the FSMA as there is in MiFID), as well as OTC trading of cash-settled derivatives.[lxxx] Trading in (and operation of) purely cash markets, such as the OCM, is exempt from financial market licencing requirements.

4.8.3 Behavioural/Market Conduct Regulation

Open Access	Third-party access to both the transmission and distribution system is on a non-discriminatory basis. This access is regulated. There is full ownership separation of the TSO and gas distribution networks from shippers, producers, etc.
Rules Compliance	Compliance with the various codes, as well as the rules of the OCM, is enforced by Ofgem. Under REMIT, the Agency for the Cooperation of Energy Regulators (ACER) has overarching responsibility for the supervision of EU energy markets. The monitoring of compliance with financial market rules is typically carried out by the exchange/clearing house in the first incidence, with more serious matters referred to the FCA.

4.8.4 Economic Regulation

Wholesale	The gas infrastructure of National Grid, as a monopoly function, is heavily price-regulated by Ofgem through a mix of cost controls. Ofgem utilises the RIIO model (Revenue = Incentives + Innovation + Outputs) for network price controls. RIIO places particular emphasis on incentives to drive the innovation needed to deliver a sustainable energy network at value for money to existing and future consumers. The current price control (TPCR5) is active for a period of eight years.[lxxxi] There are no price controls on the principal wholesale market participant entities, including shippers, storage, etc.
Retail	The regional Gas Distribution Networks (GDNs), as monopoly functions, are also subject to price control by Ofgem using the RIIO

	methodology. The current price control (RIIO-GD1) is active for a period of eight years. Suppliers are not subject to any price controls – price competition and the ability to efficiently change supplier are relied upon to ensure reasonability of prices.

4.8.5 Other – Retail Market

Obligation to Serve	There is the equivalent of an obligation to serve. Various protections are in place for vulnerable customers (elderly, disabled, etc.). If a supplier's business fails, a 'supplier of last resort' regime exists to step in and serve the customer.[lxxxii]

4.9 Market Evolution and Future Development

4.9.1 Market Evolution

Establishment - Wholesale	Wholesale competition developed slowly in a series of steps between 1986 and 1996. The launch of the current wholesale market dates from 1996 based on the introduction of regulated third-party access and balancing arrangements as mandated in the 1996 Network Code. A revised set of markets arrangements, the New Gas Trading Arrangements (NGTA) came into force in 1999. This introduced the On-the-day Commodity Market, and auctions of entry capacity, amongst other things.
Establishment - Retail	Opening of the retail market took place from 1996 to 1998: • 1996 (Apr): Competition opened to first 0.5 million customers (of 19 million in total) in South-West England. • 1997 (Feb/Mar): Competition extended to 2.1 million in total, in South-East and South-West England • 1997 (Nov): Competition extended to 4.5 million in total, adding Scotland, North-East England, and two initial Trial Areas.[lxxxiii] • 1998 (May): Competition opened to all 19 million gas customers in Great Britain.[lxxxiv]
Evolutionary Path	Some key milestones in the development of the gas market in Great Britain include: • 1992: Competition and Service (Utilities) Act removed the gas supply tariff monopoly, and lowered the tariff threshold to 2,500 therms. • 1996: First Network Code published by Transco • 1997: Centrica demerged from British Gas • 1997: IPE (now ICE) launch first futures product at NBP[lxxxv] • 1998: Opening of Bacton-Zeebrugge Interconnector • 1998: First EU gas directive 98/30/EC • 1999: Transco demerged from BG plc • 1999: BG plc gas trading operations moved to Centrica • 1999: Ofgas and Offer merged to become Ofgem • 1999: New Gas Trading Arrangements (NGTA) introduced

	• 1999: On-the-day Commodity Market (OCM) and capacity auctions • 2002: Transco merges with National Grid • 2003: Second EU gas directive 2003/55/EC • 2006: Balgzand-Bacton Line (BBL) becomes operational • 2008: Transitional exit capacity arrangements introduced • 2009: Third EU gas directive 2009/73/EC • 2012: Enduring exit capacity arrangements introduced

4.9.2 Market Development

The UK gas market is seen as one of the more mature and better organised gas markets in the world. Although there may be issues from time to time, the market has been able to address these and maintain liquidity even through times of profound changes. For example:

- In 2001-2002 a severe drop in liquidity occurred after the demise of Enron and a number of other energy merchants/traders. For four years thereafter, the market suffered from lower liquidity and a drop in trade multiples ('churn'). By 2006-2007, the problems were overcome and the liquidity returned to its pre-Enron level. Over that whole period, nomination and balancing arrangements remained stable and continued to perform their function.
- The financial crisis in 2008 had remarkably little effect on the development of the market. Liquidity kept developing further over the years 2008-2010.
- Over the last decade or so Great Britain has moved from being a significant gas exporting country, to a sizable gas importer. The market has remained steady throughout these changes, and the system has evolved as necessary to accommodate changing flows.
- In the last years, Great Britain has become increasingly interconnected with Continental European gas markets (via Zeebrugge, Netherland and Norwegian offshore gas). On the one hand, this has brought new liquidity to the NBP; on the other hand, it has enabled other hubs in Continental Europe to develop (like Zeebrugge, TTF and NCG) and potentially challenge NBP. Interestingly enough, the growth of these other hubs has, so far, not been detrimental to the NBP gas market, which remains strong in its own right.

Key potential market development challenges in the next few years include:

- *Ongoing harmonisation with the European Network Codes*: Britain is set to align with the NC CAM arrangements in November 2015. Other EU network codes are also under development.
- *Shale gas*: Britain is also actively seeking to exploit shale gas. Should significant new supply sources come online, flow dynamics may reverse moves towards imports and change it back into an export system.

5 MARKET PROFILE – THE NETHERLANDS

5.1 Context

5.1.1 Location and Physical Reach

In the North East of the Netherlands, the gigantic Groningen field is the main source of gas. While the Netherlands exports significant volumes, its own reserves are in decline. The Netherlands serves as a focal point of the North West European gas market, with the Groningen field acting as a swing provider, importing gas in base load periods and exporting in the high demand winter months.

Russian and Norwegian gas enters the system in the North East border connections. Norwegian pipe lines land in Emden, Germany, just a few kilometres from the Dutch border. Most other border points are for export only. Import via such points is either impossible or only possible as an administrative service via virtual back haul. Besides the North East border points, only Zelzate in the South West supports physical import. Zelzate is close to Zeebrugge hub, the Belgian landing point of Norwegian and British pipelines as well as a major LNG terminal.

Besides the regular gas transport system, there is one high pressure pipeline, ZeBra pipe, which is not connected to the transmission grid (although some of the large consumers connected to this system also have a connection to the regular grid). This specific 'isolated' pipe connects the Belgian system to several large consumers in the Netherlands. The regulator treats this pipe as a regional grid.

Figure 15 – Major Netherlands Gas Pipelines (Source: Gasunie)

The Netherlands also produces offshore gas but the fields are in fast decline. Landing points are Rotterdam, Den Helder (close to land fall of BBL, the pipe between Netherlands and UK), as well as Eemshaven in the very North East of the country. One of these pipes, Nogat, is also capable of transporting gas from the Danish North Sea sector. The operator of the Danish fields thus has the choice of transporting gas to Denmark or to the Netherlands.

Rotterdam, the main harbour and industrial area in the west of the Netherlands, hosts the Gate LNG terminal.

5.1.2 Key Statistics

Total Consumption (TJ)	1.4 - 1.7 million TJ/yr
Total Production (TJ)	2.8 million TJ/yr, but 2015 will show lower production due to seismic issues
Peak Daily Consumption (TJ)	8152 TJ (16 January 2013)
Total Length of Pipeline (km)	Main onshore system: 11256 km 65-80 bar system: 5330 km 40 bar (regional) system 5926 km 1100 gas receiving stations which transfer gas to regional 8 bar distribution systems or directly to main grid connected end users Regional grids (distribution) which are operated at 8 bar or lower:

	appr. 120 000 km. # connections: ~ 6.4 million
Import/Export (TJ)	Record transport through GTS grid 19,167 TJ/day (7 Feb 2012), for domestic and foreign use.
Storage Capacity (TJ)[lxxxvi]	

Field	Type	Quality	Volume 10^6 m^3
Norg	depleted	L	3,000
Grijpskerk	depleted	H	1,500
PGI Alkmaar	depleted	L	500
Bergermeer	depleted	H	4,100
Zuidwending L	cavern	L	200
Zuidwending H	cavern	H	200
Epe (G)	cavern	L & H	620

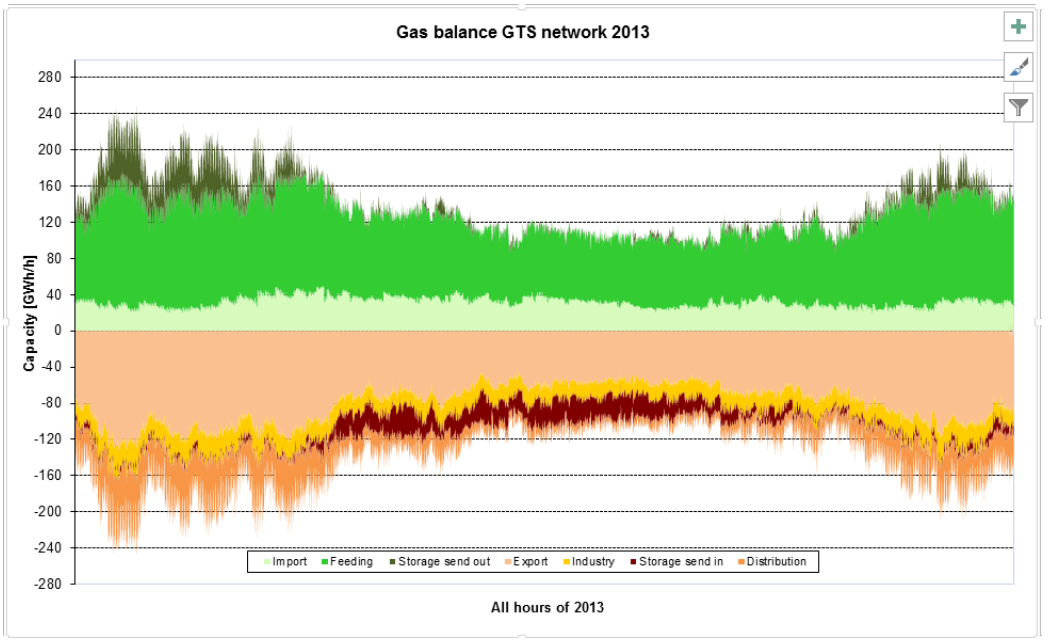


Figure 16 – GTS Network Gas Balance (Source: Gasunie)

5.1.3 Key System Characteristics and Considerations

Gasunie Transport Services (GTS) operates two distinct transport systems:

- high calorific value gas (H-gas) system (>40 MJ/m^3 gross calorific value)
- low calorific value gas (L-gas) system.

Most gas users, and all distributions systems, are connected to the L-gas system. The original Groningen gas, which kicked off the gas market, is low calorific value gas (around 35.17 MJ/m^3).

The two systems are linked via blending stations and/or nitrogen injection stations (to dilute the energy density and turn H-gas into L-gas). For commercial/trading purposes, these are treated as a single market – with free (i.e. socialised cost) conversion between the two. Shippers do not need to

worry about quality issues as long as injected gas fits within the quality range determined for each injection point.

The Netherlands acts as swing provider for neighbouring markets, producing roughly 80 billion m^3/yr and exporting roughly half of that. However, the Netherlands is gradually turning from an exporter of gas into an importer. This recently accelerated due to political unrest caused by increasing level of earthquakes in Groningen, which will likely reduce production levels from that field. Because most Dutch gas equipment is based on a low calorific value, switching to increased import levels is complicated.

The Netherlands is a very mature gas market with almost all houses connected to the natural gas grid. (95% penetration). Until recently, some 30% of gas consumption was used for production of power[32], with some 65% of power production gas-based. Due to the move towards sustainable energy as well as new coal power plants coming into operation, the dominant position of gas in power production is shifting, resulting in several modern power plants being mothballed.

For the gas market as a whole, the official policy is 'Netherlands as a gas hub', meaning the Netherlands wants to be at the centre of gas transport and trade. For this reason, the government supported the construction of the large Bergermeer storage. The transportation system is a meshed network with multiple entry points, several storage facilities, and exit points into both local distribution systems ('regional grids') and transmission connected users. The system is extensively connected to the broader European system, including a network owned by Gasunie (the owner of the main Dutch pipeline network) in Northern Germany, the BBL connection to Great Britain, and the Gate LNG terminal. Gasunie has invested considerable money in expanding the Dutch onshore transport system in order to provide greater transit capacity.

5.2 Industry Structure

The main producer is NAM, a 50/50 JV of Shell and ExxonMobil, which operates the major onshore gas field at Groningen. However, with fields in rapid decline, the oil majors are pulling out and small entrepreneurial companies are taking over. The Dutch State participates in production, up to 40% in each producing well, via Energie Beheer Nederland (EBN), to which producers must offer 40%, which is always accepted, in return for paying 40% of the investments (of successful drilling only).

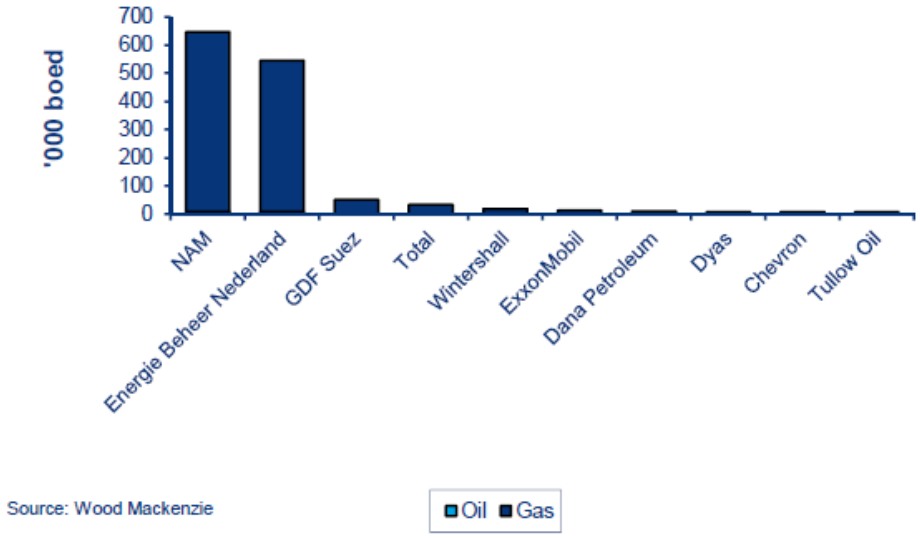
Historically, NAM constructed gas storage in depleted gas fields, with Gasterra and its predecessors as the exclusive user. There was also a relatively small DGF storage constructed by Amoco (later BP, now TAQA). Since liberalisation, Gasunie constructed salt cavern storage, driven by the wish to secure pressure in the transport system, and TAQA constructed the large Bergermeer DGF storage aiming at selling the storage services to market parties. Gazprom cooperates with TAQA by making 'cushion' gas available.

Offshore transport of unprocessed gas utilises pipes owned by special purpose vehicles, that originally represented the parties producing gas. Processing is done at the beachhead by NAM.

Onshore transport of gas is managed by Gasunie, as pipeline owner and its affiliate Gasunie Transport Services (GTS) as TSO. The Dutch State is 100% owner of Gasunie.

The three large distribution companies ('regional grid operators') are Enexis, Liander and Stedin. Smaller operators include Cogas, Rendo Delta, Edinet and Westland. Parties can only own pipes if either an exemption for a 'closed distribution system' is granted, or an official grid operator is appointed.

[32] CHP used to be very attractive. Therefore, Netherlands has a high level of embedded generation. That results in uncertainty about amount of gas used for power generation.



Gas produced by NAM is sold exclusively by Gasterra – owned 50% Dutch State, 25% Shell and 25% Exxon Mobil. Gasterra does sell directly to large end consumers, but is not particularly eager to achieve direct sales, selling mainly to other suppliers (retailers) and for export. In the retail market, over 20 suppliers (retailers) are active, though with consolidation in recent years Nuon (Vattenfall), Essent (RWE) and Eneco have a market share of 81% (2012)[lxxxvii]. The main suppliers are also the main shippers, though the list of shippers is more extensive, also incorporating entities trading only wholesale.

A number of entities, including large banks, oil majors, and foreign trading companies, are also active solely as traders at the Title Transfer Facility (TTF). The TTF has recently overtaken the UK NBP as the most liquid gas hub in Europe.

5.2.1 Key Roles

Key market roles are identified below. Unless otherwise noted, these roles are as described in the glossary.

- suppliers (retailers): supply gas to consumers <40 m^3/h connections; also called 'permit holders' – also the major shippers
- transmission connected users: also known as 'end users'. Must consume greater than 40 m^3/h
- shippers
- traders: non-physical trader
- transmission system operator
- pipeline owners
- neighbouring network owners: owners of adjacent pipeline networks
- within-day market operator
- market operators
- storage providers
- regional grids (distribution networks): by Government mandate these should be separate from suppliers (retailers), though some are resisting the change, and a court case is currently playing out to resolve the matter.

5.2.2 Infrastructure Providers

Pipeline/Transmission System Operator(s)	Gasunie Transport Services (GTS) is the TSO of the onshore transmission system

	Zebra Gasnetwerk is a dedicated 235 km onshore pipeline connecting the Belgian system to a limited group of large consumers in the Netherlands (2.24 billion m^3/year in 2010). This is treated as a regional system (distribution network) by the regulator. BBL Company is TSO of the connection between the Netherlands and Great Britain. Offshore production pipelines are not regulated because they transport unprocessed gas. NGT and Nogas are operated by GdF Suez, and WGT by Winterhall.
Pipeline Owner(s)	The onshore transmission system is owned by Gasunie, GTS's parent company. Gasunie is a 100% Dutch State-owned company. Offshore production pipelines are owned predominantly by the oil and gas producers, pro rata based on capacity usage, but with the decline in offshore production other investors (e.g. pension funds) have bought shares in the NGT and Nogat offshorsystems.
Spot Market/Balancing Operator(s)	The TSO (=GTS) is formally the operator of the balancing market. Until June 2014, GTS operated a so-called 'bid ladder', containing bids and offers for balancing gas. Since 3 June 2014, this bid ladder has been replaced by the within-day market, operated by ICE-Endex (formerly APX-Endex).
Prompt/Short-Term Forward Market Operator(s)	ICE-Endex, PEGAS[33] and CME Europe offer 'spot' (in actuality, day-ahead) and short-term forward trading of Dutch (TTF) products.
Forward/Futures Market Operator(s)	ICE-Endex, PEGAS and CME Europe offer futures trading and clearing, as well as OTC clearing, of Dutch (TTF) products.

5.2.3 Regulators

Energy Regulator – National	The Autoriteit Consument en Markt (ACM) is the designated National Regulatory Authority (NRA) for energy. According to EU regulation, the NRA must be independent from the government. ACM has a broad set of responsibilities: • regulating transport tariffs • anti-cartel authority • rule maker for the market • regulating the interaction between grid operators and other market parties such as shippers, suppliers and metering companies. ACM is also jointly responsible for supervising the safety of the gas transport system, in conjunction with the State Supervision of Mines (which regulates the safety of gas production).
Energy Regulator – Regional	ACM cooperates with the EU regulator ACER. The EU's Regulation on Energy Market Integrity and Transparency (REMIT) requires reporting of all transactions to ACER, via the national regulators, to ensure cooperation in preventing market manipulation

[33] PEGAS is the gas market joint venture between the European Energy Exchange (EEX) and Powernext (which is itself majority owned by EEX).

Financial Market Regulator	The Autoriteit Financiele Markten (AFM) is responsible for regulating financial markets in the Netherlands. ACM works in close cooperation with AFM for regulation of energy financial markets. The futures trading and clearing activities of ICE-ENDEX are subject to the supervision of the AFM. The 'prompt' market, being physical, is under the 'control' of the Ministry of Economic Affairs, partly delegated to ACM.
Competition Regulation	The energy regulator is a 'department' of the competition authorities.
Other	Nederlandse Energie Data Uitwisseling (Nedu), is the association through which grid operators, shippers, suppliers and metering companies establish the detailed 'sector arrangements' for the exchange of energy data. The main aspects of the arrangements must be authorised by the ACM in the so called ACM Codes, but details are left to the cooperating market participants.

5.3 Transmission Arrangements

5.3.1 Transportation Rights

Form of Transportation Rights	Shippers must hold transportation rights to ship on the system. For gas entering or leaving across a border point, this includes a requirement to hold cross-border capacity.
Type	The principal forms of transportation right are: • Firm • Non-firm: available for only some cross-border points. The discount applied depends on the risk of interruption. If firm capacity becomes available, non-firm is automatically transferred into firm. • Interruptible: Under the EU Gas Network Code Capacity Allocation Mechanism (CAM), the calling of interruption will be limited to day-ahead. Rights can be for both 'forward haul' and 'backhaul'.
Locational Nature	The Dutch system is managed as a single zone with a single virtual point of transfer, known as the VPPV, which incorporates the Dutch Title Transfer Facility (TTF). Shippers must hold entry and exit rights, though the TSO often refers to the system as a 'connected entry-exit' system, as there is a physical limit to the extent to which a shipper can change their nominal flows of gas if they wish to. For cross-border trade, the CAM requires neighbouring TSOs to offer bundled services, meaning entry into one system must be sold together with exit from the connecting system. This is facilitated through the PRISMA system.
Duration	The minimum duration of a capacity booking is a Gas Day (06:00 day N – 06:00 Day N+1). A long-term booking is for a Gas Year, and can be done up to 15 years in advance, though tariffs are set annually by the regulator.
Primary Sales – Existing Capacity	For cross-border capacity sales, the TSO operates a 'click and book' system using the pan-European PRISMA system. For key cross-border

	points an auction is conducted for day-ahead allocation – with standard tariff rates serving as the 'reserve price' (i.e. price floor). Under the CAM all cross-border capacity will transition to this mechanism. Per the CAM, the revenues for cross-border capacity sales are split between the TSOs. Each TSO receives its reserve price, with the difference between the auction clearing price and the sum of reserve prices – known as the 'auction premium' – divided between the TSOs based on bilateral agreements between them (which must be approved by the NRA in each jurisdiction), or in the absence of such agreement, on a 50/50 basis.[lxxxviii] Exit capacity for the regional grids (distribution systems) is allocated automatically to shippers who supply end customers on the distribution network – based on the peak hourly consumption in the last three winter months (Dec, Jan, Feb). Capacity for other domestic entry and exit points (e.g. transmission connected users) is booked on a first-come-first-served basis, using the PRISMA system. In both cases shippers are charged the regulated tariff. Penalties are applied if usage in any hour exceeds capacity reservations. The lower the temperature the higher the penalty.
Secondary Market	Capacity holders can resell capacity, or just the rights to use the capacity. Secondary trading is facilitated through the PRISMA system. Shippers can post bids and offers, request others to place bids/offers, and respond to these offers. Bilateral/OTC trading of capacity can also be registered via this system. All transfers are subject to acceptance by the TSO. Breaking up longer-term capacity contracts into smaller tenor contracts is allowed, down to individual days.
Capacity Release	There are currently no mechanisms to force capacity release, though un-nominated capacity is sold as interruptible day-ahead, serving as a form of anti-hoarding measure. Under the new EU Congestion Management Procedure (CMP), GTS will implement two of the four possible measures allowed in the procedure for forcing more effective usage of capacity: • Surrender of Capacity (SoC): Capacity is voluntarily surrendered back to GTS, with shipper relieved of its payment obligation if the capacity is re-sold. • Oversubscription & Buy Back (OBB): GTS will auction any firm capacity that has not been nominated, up to the technical limit of the pipeline. Should the original holder then nominate, GTS will enter the market to buy back capacity, to get back within technical limits. OBB capacity will be made available on a monthly and daily basis, initially at cross-border interconnection points with contractual congestion. GTS has agreed with ACM not to implement the 'day-ahead use-it-or-lose-it' measure, and is further investigating the 'long-term use-it-or-lose-it' (LT UIOLI) measure in cooperation with ACM. ACM has recently published a vision paper, in conjunction with the regulators in the United Kingdom and Belgium, on how they might joint apply LT UIOLI at cross-border congestion points with contractual congestion.[lxxxix]

Capacity Expansion Process	New capacity is funded through the sale of additional transportation rights.
Primary Sales – Capacity Expansion	New long-term capacity is sold via an 'open season' process, through which GTS gathers information about potential interest in additional capacity, followed by non-binding, and subsequently, binding commitments from shippers. Yearly and monthly auctions of unallocated (and released) capacity are also conducted. For regional grid operators, and their incremental demand growth, GTS decides how much exit capacity is required by each shipper serving customers connected to the distribution network, and automatically assigns that capacity. If necessary, projects should be developed to expand the city gate. This planned capacity divided by the sum of present capacities of each individual connected party (based on the last three winter months) at the distribution network exit points is referred to as the 'fit factor'. Economically, tariffs for reserved capacity are multiplied by the fit factor to determine the amount invoiced.

5.3.2 Nominations, Scheduling and Balancing

Nominations	Shippers nominate 'entry programmes' from points of entry to the VPPV, and 'exit programmes' from the VPPV to points of exit. Non-physical traders at the TTF (which forms part of the VPPV) must submit a 'trade programme', which does not involve entry or exit. GTS schedules the system based on submitted nominations and the physical constraints of the system. If not all nominations can be scheduled, curtailments are made on the basis of interruptible tranches, and within these, on the basis of the time stamp of the booking. Firm capacity is interrupted only under extreme or emergency conditions. Confirmations are issued to all scheduled flows.
Scheduling Period	Nominations are made on a daily basis. They contain flows for each hour of the gas day at the nominated entry/exit point. Nominations must be submitted by 14:00 day N-1, with final confirmations issued by 18:00 N-1; for any nominations submitted after 14:00, confirmation will be after 18:00. Daily nominations can be submitted up to 179 days in advance.
Changes to Nominations	Renominations are allowed from the time of nomination closure (14:00) up to two hours before the start of the hour or hours that are changed, or half an hour prior for approved connection points, if the change is less than 25% of booked capacity at that point.
Multiple Pipelines	Cross-border and other inter-pipeline flows are nominated to both GTS and the Neighbouring Network Operator (NNO) by the relevant shipper on each TSO's system. GST and the NNO exchange matching messages to align the nominations. If quantities do not match, the Lesser Of Rule (LOR) is followed, where the lower quantity is scheduled and confirmed by both TSOs to their own shippers.
Balancing	
Balancing Period	The balancing period is hourly. However, in actuality the balancing system is a 'cumulative hourly balancing system'. Shippers accrue imbalances on an hourly basis,

	known as their portfolio imbalance signal, or POS. When aggregated across all shippers, this is known as the System Balancing Signal (SBS). Balancing action is only taken by GTS when the SBS is outside defined tolerance bands (referred to as 'zones' – not to be confused with locational zones). Shippers should be in balance at the end of the gas day, but if the SBS is within tolerance, imbalances will be transferred to the following day, for a set fee (see later), using the Linepack Flexibility Service.
Balancing Gas	GTS contracts a limited amount of gas for linepack, plus some limited storage capacity. Outside of this, balancing gas is procured from market parties utilising the within-day market operated by ICE-Endex. In case of emergency, the TSO may also order curtailments outside of the regular balancing mechanism.
Participant Balancing	Participant nominations (including renominations) must consist of balanced injections and withdrawals. Participants are permitted to run a cumulative imbalance from hour-to-hour, and in some circumstances, from one day to the next. However, in the event the SBS is outside established tolerances, GTS may buy or sell gas through the within-day market operated by ICE-Endex to bring the system back into balance. The 'zones' are: • Dark green: no action • Light green: may take action; potentially buy/sell products with a longer response • Orange: will take action; buy sell products with one-hour response • Red: will take action; buy sell products with one-hour response, and may take other action. The cost of such action is assigned to those designated as 'causers'.
Quantity Measurement	Near-real-time (~ 5 minute lag) imbalances are calculated for each hour using near-real-time allocations (determined in different ways depending on the type of entry/exit point). These are used to determine the POS and SBS for the previous hour (within 20 minutes), as well as a forecast of the probable position at the end of the current hour, on a 24x7 basis. 'Offline allocations' are determined after-the-fact. GTS determines quantities based on: • Hourly-metered data for large consumers: connection that withdraw more than. Connections that withdraw more than 170,000 m^3/yr must be read daily or hourly, and those more than 1,000,000 m^3/yr must be read hourly. • Allocation of standard profiles for small and mid-size consumers.
Recompense for Participant Imbalances	Within established bands, participants may run a cumulative imbalance, which they could seek to offset through corrective physical action (essentially 'payback'). Once the SBS moves outside defined tolerances, if the GTS takes corrective action, the cost of such action is assigned to 'causers' (essentially 'cashout').
Balancing Payment	In situations where GTS needs to take balancing action, balancing gas is bought/sold through the ICE-Endex market. If the system is short,

	the net cost of all balancing gas purchases is assigned pro-rata to those with a short POS (i.e. 'causers', who contributed to the situation). Conversely, if the system is long the net proceeds from gas sales are assigned pro rata to those with a long POS. Shippers that 'help' the system (i.e. running imbalances in the other direction), are not affected. Offline settlement is based upon the difference between offline allocations and near-real-time allocations, determined for each day, and charged at the 'neutral gas price' for that day – determined as the volume-weighted TTF price on ICE-Endex for that day and the two previous days. For the Linepack Flexibility Service, to transfer net imbalance between days, shippers pay a fee of 0.4% x the 'neutral gas price'.

5.4 Storage Arrangements

Storage Access	Netherlands has several depleted gas fields (DGF) turned into storage as well as some salt cavern gas storage (SC). Access rights depend on the facility: • Grijpskerk, Norg & Alkmaar: Access restricted to Gasterra, which offers virtual storage instead of physical access to any individual facility. 'Standard bundled units' are sold via ICE-Endex, which also operates a secondary market for the virtual storage. • Bergermeer (DGF): full third-party access but unregulated tariffs. Some capacity grandfathered. Additional capacity, with TTF as delivery point, sold via ICE-Endex, which also operates a secondary market for this capacity. • Zuidwending (SC): controlled by Gasunie; capacity not required for system integrity is offered to the market. • Epe, Germany (SC): just east of the Dutch border, and connected to the Dutch transmission system only; controlled by three suppliers – Essent (RWE), Nuon (Vattenfall) and Eneco – with no third-party access. • Several other German salt caverns have entry capacity into the Dutch system. • LNG Terminal Gate: third-party access; operated by Gasunie.
Storage Rights	For physical facilities with full third-party access, storage rights are entry/exit rights, at the facility or TTF. For virtual storage, rights are entry/exit at the TTF.
Primary Sales – Storage Rights	Storage rights are purchased either directly from the storage operator or via ICE-Endex, depending on the facility.
Secondary Market	Via ICE-Endex, or bilateral if the storage operator consents.
Capacity Release	-

5.5 Trading Arrangements

5.5.1 Trading Reference Points

NAME	TYPE	DESCRIPTION
Title Transfer Facility	Virtual location	Virtual point which all gas is nominated to/from. GTS provides various hub services at TTF.
Den Helder (WTG & Nogat pipes) Eemshaven (NGT pipe)	Physical supply point	Offshore producers use the beach-head processing installation as a trading point, swapping volumes with other producers.

5.5.2 Balancing Market

Market Operator	ICE-Endex (within-day market)
Trading Mechanism	ICE-Endex operates a within-day market which GTS uses to buy or sell gas if within day balancing actions are required. Type of product bought/sold depends on GTS's need. Minimum requirements for offered products are in place, such as size (at least 150 MW), required response time (30, 90 or 150 minutes) and certainty of being able to supply or take physical gas. Bids/offers must be submitted 8 hours in advance, but prices can be changed until 4 hours in advance. The market transacts via a continuous automated auction.
Locational Basis	Trading takes place nominally at the TTF. However, entry/exit points of bids/offers must be specified, and in exceptional circumstances, location may be a decision factor.
Trading Interval	The trading interval is an hour. Two products are used for balancing – slow response with end-of-day delivery, and fast response with hour delivery.
Participation	Limited to physical participants capable of offering/taking gas with a suitable response time.
Measurement	The within-day market settles based upon transacted quantity.
Settlement and Credit Risk	The quantities actually transacted are driven by regular within-day orders, as well as balancing orders from GTS. Assignment of these costs is discussed under Balancing Payment earlier in this profile. Settlement is carried out by APX Clearing BV at present, but is due to move to ICE Clear Europe later in 2015. Billing period is weekly, but will likely move to business day once migrated to ICE Clear Europe. Participant creditworthiness is validated on order submission. Collateral requirements are determined to cover entire trading exposure (i.e. no unsecured credit).

5.5.3 Prompt/Short-Term Forward Market

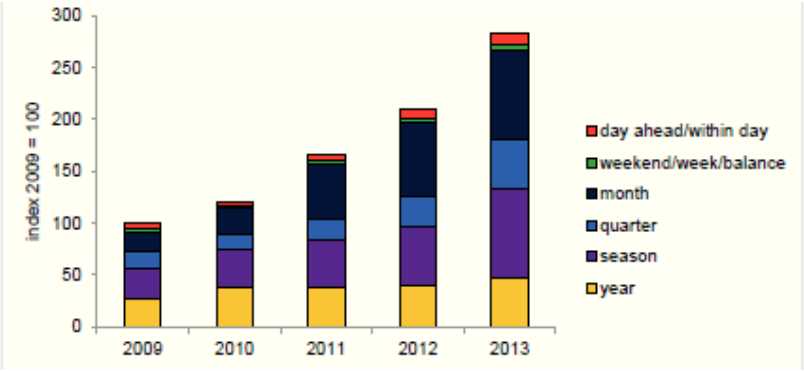
OTC Trading	Trading of prompt/short-term forward contracts represents around 6% of the overall OTC market, according to the 2014 Liquidity Report published by ACM[xc]. Overall, 86% of gas traded in the Netherlands in

	2013 was executed OTC, 7% bilateral, and 7% on exchanges.
Exchange Trading	Trading of prompt/short-term forward products occurs on both ICE-Endex and PEGAS. CME Europe also has daily Dutch gas products.
Trading Mechanism	The market transacts via a continuous automated auction.
Locational Basis	Trading is based around the TTF virtual hub.
Product Tenor	Both ICE-Endex and PEGAS list prompt products covering within-day, day-ahead, Saturday and Sunday (tradable separately or as a weekend block) and individual days (for bank holidays). ICE-Endex also lists working-days-next-week and balance-of-week products. CME Europe offers trading in a daily future, and strips of dailies. In Europe these are typically all referred to as 'spot' markets, even though only trading proximate to actual delivery is truly spot.
Participation	All TTF deliveries are deemed to be delivered. Therefore, in itself there is no need for physical capability. However, gas programs must be in balance for every hour of the day. This makes it impossible for non-physical players to go long or short. Trading in financially-settled products is open to all traders (satisfying the general participation requirements of the exchange).
Settlement and Credit Risk	'Spot' (prompt) trades on ICE-Endex are cleared using APX Clearing on a weekly basis. It is intended to move clearing of these products into ICE Clear Europe some time in 2015. Trading on PEGAS is cleared through European Commodity Clearing (ECC), a subsidiary of EEX. Trading on CME Europe is cleared through the CME Clearing House. All three clearing houses offer OTC clearing.
Delivery Method	The 'spot' (prompt) contracts of both ICE-Endex and PEGAS are physically delivered at the TTF hub. CME Europe offers both a physically delivered daily product, and a daily product financially-settled against the index published by ICIS Heren.
Delivery Integration	ICE-Endex, ECC and CME Clear Europe all carry out "single sided nominations without (the) requirement to counter nominate." i.e. they support *multilateral submission* of a balanced delivery file to GTS via the Edig@s system.

5.5.4 Forward Market

The regulator publishes annually liquidity reports, based on information from shippers/traders. The following section is based on the liquidity report 2014, published in October 2014. Most data provided refers to 2013.

OTC Trading	According to the ACM[xci], 86% of gas traded in the Netherlands in 2013 was executed OTC, 7% bilateral and 7% on exchanges. OTC brokers facilitate trade through both voice brokerage and broker trading platforms. The so called EFET master trading agreement is much used for physical gas trading, and ISDA for financial products. Standard block size is 30 MW.
Exchange Trading	Trading of cash/short-term forward products occurs on ICE-Endex, PEGAS and CME Europe. ICE-Endex is the most widely traded of

	these markets for TTF.
Trading Mechanism	The market transacts via a continuous automated auction.
Locational Basis	Dutch trading is based around the TTF virtual hub. Locational spreads are also available between TTF and neighbouring hubs, including NCG and Gaspool in Germany, PEG Nord in France (PEGAS only), and ZTP (Zeebrugge Trading Point) in Belgium, and NBP in Great Britain (ICE-Endex and CME Europe).
Product Tenor	ICE-Endex: lists futures contracts for dailies (up to 92 days), months (next 71), quarters (next 11), seasons (next 11), calendar years (next 5). PEGAS: lists futures contracts for: months (next 3), quarters (next 4), seasons (next 3), calendar years (next 3). CME Europe: lists a monthly physical contract spanning the balance of the current year and the next five calendar years, and a financially-settled contract spanning the balance of the current year and the next two calendar years.  ***Figure 17 – Distribution of Volumes per Product***[xcii]
Participation	Trading is open to all traders (satisfying the general participation requirements of the exchange). For physically delivered contracts, as the time of delivery approaches restrictions may be placed upon positions held by traders unable to make/take delivery.
Settlement and Credit Risk	Futures trades on ICE-Endex are cleared through ICE Clear Europe. Trading on PEGAS is cleared through European Commodity Clearing (ECC), a subsidiary of EEX. Trading on CME Europe is cleared through the CME Clearing House. All three clearing houses offer OTC clearing.
Delivery Method	The futures contracts of both ICE-Endex and PEGAS are physically delivered at the TTF hub. CME Europe offers both physically delivered futures products, and futures financially-settled against the index published by ICIS Heren.
Delivery Integration	ICE-Endex, ECC carry and CME Clear Europe all out "single sided nominations without (the) requirement to counter nominate." i.e. they support *multilateral submission* of a balanced delivery file to GTS, via the Edig@s system.

5.6 Market Information

Market Information	The major exchanges publish current and historical pricing, trade volume, open interest and other information. Basic end-of-day information, such as end-of-day settlement prices, must be made available to the public free of charge. Brokers also publish information about trade on their own platforms to their customers.
Publication Platform	Exchanges publish information through their own platforms and via third-party data resellers (e.g. Reuters). The European Network of Transmission System Operators for Gas (ENTSO-G) operates the ENTSO-G Transparency Platform, which publishes information on European gas capacity and flows, with a particular focus on cross-border points.
Third-Party Services	The London Energy Brokers Association (LEBA) operates a service for the collection, validation and distribution of price and volume indices, and forward price curves, based on 100% of members' daily market transactions. These indices are widely used in pricing shorter-term (up to a year out) contracts with retailers and transmission connected users. Major price reporting services – such as ICIS Heren, Argus and Platts – provide spot and forward gas prices and analysis covering major European hubs including TTF. The ICIS Heren European Spot Gas Market Report is used as a reference for CME Europe's financially-settled futures contract.

5.7 Retail Competition

Retail Contestability	The retail gas market has been fully contestable since July 2004. The retail market had a switiching rate of 12.3% in 2013.[xciii]
Retail Opening	The retail market opened in tranches: • 2000: The Gas Act opened the retail market to consumers using more than 10 million m^3/yr. • 2002: Market opened to consumers using between 1 million and 10 million m^3/yr. • July 2004: Market open to consumers below 1 million m^3/yr. However, comsumers belows 170,000 m^3/yr – later changed to connections below 40 m^3/hr – were designated as 'protected', meaning that only licensed suppliers are allowed to serve them.
Customer Switching	The regional grid operators (distribution networks) are responsible for the operation of the system for customer switching. They have delegated this responsibility to a joint company called EDSN, which operates a central connections register. The new supplier is the responsible party for issuing a switching message.

5.8 Regulatory Structure

5.8.1 Legal Framework

National Legislation	The Gas Act, which came into force in three stages in the 2000/2001 period, and which has been changed since then numerous times. (Currently, the government is working on modernisation and integration with the Electricity Act).
International Agreements	The EU has been a key driving force behind liberalisation of the gas market. Key instruments include: • Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas. • Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009, on conditions for access to the natural gas transmission networks. • Regultion on wholesale Energy Market Integrity and Transparency (REMIT), No 1227/201, of 25 October 2011, which addressed market manipulation and market monitoring. The EU is moving gradually towards a more integrated European gas market. Many pan-EU arrangements, however, leave room for member states to incorporate local variations (e.g. the Dutch cumulative hourly balancing system varies from the daily balancing requirements of the EU gas codes). The EU rulemaking process can be quite complicated, with elaborate 'comitology' processes involving the Agency for the Cooperation of European Regulators (ACER), and ENTSO-G. Financial/derivative markets in energy (including products resulting in physical delivery) are also subject to various EU regulations, including: • European Market Infrastructure Regulation (EMIR), No 648/2012, of 16 August 2012, requiring standardised OTC trades to be cleared, higher capital requirements for non-cleared trade, and requirement for establishment of trade repositories. • Market in Financial Instruments Directive (MiFID), 2004/39/EC, of 30 April 2004, which addresses harmonised financial market regulation, and various specific requirements. In 2017, MiFID II is supposed to take effect. The interaction between these various regulations has required increased cooperation between ACM and the Dutch financial authority, AFM.
Regulations	Based on the Gas Act, the Ministry of Economic Affairs is delegated power to establish general decrees and ministerial rulings. Some 20 decrees and rulings have been established. Decrees for energy subjects often require the ministry to inform Parliament (both chambers). Once informed, Parliament has four weeks to request a debate and make the decree subject to approval. If Parliament doesn't react, the decree automatically becomes valid once the four weeks are over. A decree is put in force via royal assent. A ministerial ruling is 'lighter' and can be arranged faster since it only requires the Minister's approval. In its turn, the Ministry can delegate power to the regulator, ACM. On several issues, ACM is assigned the

	task to advise the Ministry or to act on the Ministry's behalf. A form of regulation much used in the Netherlands is covenants – binding undertakings entered into by market parties and/or their representative organisations. These are frequently imposed subject to the implicit threat of stricter obligations being imposed through legislation. The weakness of covenants is the difficulty of enforcing them, especially if only representative organisations sign up.
Codes	Codes are established by the regulator (ACM), based on proposals for change issued by the joint grid operators, or NEDU in case of data handling. The most important codes are: • Transport Conditions National Grid: General rules, such as system entry/exit, capacity planning, services to be offered, gas nominations and scheduling, and balancing. • Tariff Code: Addresses how to calculate and when to charge tariffs for transport-related services. • Allocation Code: Code for shipper allocation and load profiling. • Connection Code: Requirements for transmission connected parties (~400 end users). Separate code for connections to distribution systems (~ 6.4 million connections). The market is also subject to 'network codes' at the EU-level, promulgated via ENTSO-G, which are then interpreted into codes (new, or changes to existing), and potentially other instruments, at the national level. The European Network Code on Capacity Allocation Mechanisms (NC CAM) is already active, the Congestion Management Procedures (CMP) are expected to be fully implemented by November 2015, and the Balancing Code (NC BAL) in late 2015 (though this may be deferred until late 2016).
Market Rules	Each exchange is responsible for development and maintenance of its own rule book, though these rules, and any changes to them, are subject to authorisation by the Ministry of Economic Affairs.

5.8.2 Licensing

Wholesale Market	For physical trading, no license is required. However, physical traders must appoint shippers, or become one themselves. Shippers do require a licence – obtained through the TSO registration process. Shippers who wish to serve connections in regional grids must prove they are capable of handling the more complicated messages required for allocating gas to regional grid connected parties. GTS is established as the national TSO by statute.
Retail Market	Supply of gas to 'protected' customers requires a retail license. ACM is responsible for the licencing process. Protected customers are parties with a connection equipped with a meter that can handle maximum 40 m^3/hr. An exception to this rule is business multi-site contracts. Supplying end users that waive their right to be protected under multi-site contracts can be done without a license.
Financial Market	Dutch-registered exchanges (i.e. ICE-Endex) must hold authorisation from the Ministry of Economic Affairs. Under the 'EU Passport' arrangements, exchanges properly accredited

	in other EU countries can offer services to participants in the Netherlands (e.g. PEGAS can allow trading from Dutch participants without having to obtain a Dutch exchange licence). Conversely, accredited participants from other EU jurisdictions can trade on ICE-Endex without ICE-Endex having to obtain local licensing. For financial trading, a financial market license is required. Under MiFID, a financial market license is only required if the services offered qualify as a 'financial service'. A clear definition is lacking, but to avoid doubt, suppliers and their advisors often stress that contracts are physical. Under the proposed MiFID II extensions, exemptions for physical trading will be limited to those using less than 5% of their working capital for energy trading. This would subject many currently exempt to financial market licensing requirements.

5.8.3 Behavioural/Market Conduct Regulation

Open Access	Third-party access to the transmission system has been on a non-discriminatory basis since gas liberalisation commenced. It was felt by some, though, that until April 2011 the rules in place for gas transport favoured GasTerra. Similarly, access to the distribution system is meant to be on a non-discriminatory basis. Government policy is for full ownership unbundling between distribution networks and retail. Eneco and Delta continue to own both, with this subject to current legal action. Besides the appointed regional grid operators, parties are not allowed to own and operate gas distribution networks, unless an exemption for holding a 'closed distribution system' is granted. A few dozen industrial estates, office estates, university complexes, and greenhouse development areas hold such exemption.
Rules Compliance	AFM oversees compliance with forward market rules. The Ministry of Economic Affairs, with responsibility delegated to ACM, overseas the cash market. ACM also regularly investigates the wholesale markets in general and price determination process specifically. The regulator can impose penalties which can mount up to 10% of turnover, or alternatively, take matters to court. Under REMIT, the Agency for the Cooperation of Energy Regulators (ACER) has overarching responsibility for the supervision of EU energy markets.

5.8.4 Economic Regulation

Transmission	The tariff of the TSO is regulated based on a 'reasonable return on economically effective investments'. The reserve price for each connection point is set by the regulator, and as such constitutes a regulated tariff. Additional revenues may be received from the auction premium (see Transportation Rights for a discussion of reserve price and auction premium). Every 3-5 years, the regulator starts a new regulation period. Such periods start with establishing a regulation methodology, followed by completion of the required details. This is frequently subject to litigation.

	Under the method decision for 2014-2016, any auction premiums accrue to a separate account. These revenues can be used by the TSO for investments to reduce congestion (with investment proposals by GTS approved by ACM), or to reduce future 'allowed revenues'.[xciv] The auctions are not meant to increase the TSO's profit. As tariffs are set in advance, actual revenues may be over or under allowed revenues. Any differences must be tracked in an overs/unders account, and will be corrected as an adjustment against future tariffs (the delta in year *t* being applied to year *t+2*). Variation in GTS's profit and loss is principally associated with its performance against regulator-defined norms. e.g. achieving a lower average weighted cost of capital than that assumed by ACM.
Distribution	The tariffs of the regional grid operators are regulated based on a 'reasonable return on economically effective investments'. In the case of the regional grid operators, this also includes some incentive-based regulation, in the form of 'comparative competition', which. This is intended to reward better performers at the expense of worse performers. The conditions imposed on 'closed distribution systems' resemble the regulation in place for appointed grid operators, including 'not more than reasonable' tariffs.
Retail	For 'protected' customers, the rates charged remain subject to 'reasonable cost' regulation by the ACM. Interference by the ACM is rare. In order to promote competition and improve transparency, it is mandatory to offer pricing against a standardised 'model contract'.

5.8.5 Other

Obligation to Serve	There is the equivalent of an obligation to serve for 'protected' customers. Suppliers (retailers) are not allowed to refuse customers but may request pre-payment. Delinquent customers may not be disconnected if temperature is below freezing, nor if a member of the connected household has a medical problem. If a supplier goes bankrupt, the TSO can supply up to two weeks gas in order to give the administrator time to sell the company or client base. If that fails, the clients will be allocated pro rata over the active suppliers. If a shipper fails, the impacted suppliers have to appoint an alternative shipper.

5.9 Market Evolution and Future Development

5.9.1 Market Evolution

Establishment - Wholesale	Commencing in 1996, marketers tried to sell gas, with first deliveries in 1998, being the year of commissioning of the Interconnector, being the pipeline between Belgium and the UK. After the Gas Act came into force in 2000, gradually, competition increased aiming at the large power plants and very large industrials

Establishment - Retail	[See earlier section on Retail Opening].
Evolutionary Path	Some of the key milestones on the project's evolutionary path are: • 1998: First market deliveries. • 2000: Gas Act; initial retail opening. • 2002: Further retail opening. • 2003: Establishment of Title Transfer Facility (TTF). • 2003: Gasunie required to provide access to storage. • 2004: Introduction of entry/exit system. • 2004: Establishment of TSO; intended to create some distance system operator and suppliers. • 2004: Full retail opening. • 2005: Full unbundling of roles. • 2005: GasTerra moves to pricing off TTF gas index (rather than gasoil). • 2011. Old hourly balancing regime (with significant penalties for imbalance outside the tolerances) replaced by market based cumulative hourly balancing regime.

5.9.2 Market Development

Areas of the current arrangements that are presently under debate or changing include:

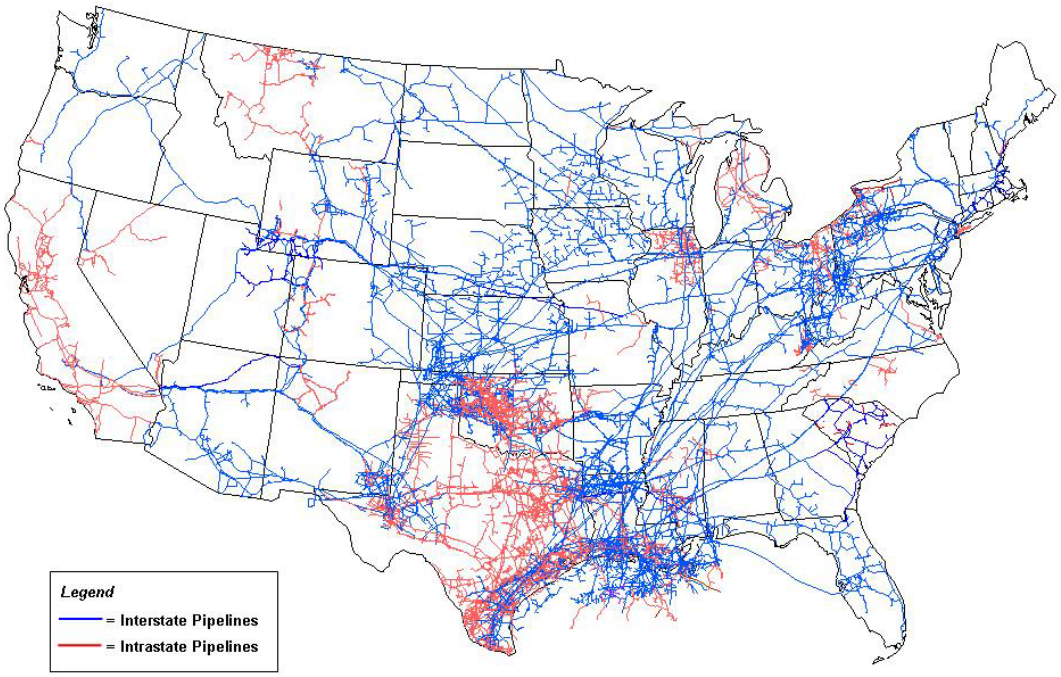
- *The method of allocation of costs for small consumer arrangements*: Exit capacity requirements for small consumers are profiled by the TSOs (based on forecast usage at -9 °C). These costs are charged to these consumers' suppliers. The supplier must also estimate regional grid losses when establishing a tariff around the end of January. Some would like this to move closer to the arrangements in electricity where the distribution operator incorporates losses in their tariff which they charge to suppliers.
- *Gas balancing period*: The EU CAM code stipulates that the gas balancing period should be daily, whereas the Netherlands operates on a cumulative hourly balancing regime, nominally for security of supply reasons. Some are concerned that hourly balancing is leading to near-term price volatility, which presents a risk for gas-fired generators in particular, and there is ongoing debate about whether this regime should change.
- *Risk of variance between tariff setting and open season process*: the TSO uses the 'open season' process for deciding if, when and where, additional capacity is required (the process is discussed earlier in this paper). However, the capacity costs associated with commitments from this process are not locked in, but are instead subject to revision when the final transportation tariff is set. This creates a risk to shippers from participating in the open season process.
- *Barriers to effective movement between H-gas and L-gas systems*: In the 2000's, quality of gas acted as barrier-to-entry. Newcomers depended on import, which is principally high-calorific value gas, whereas most users are connected to L-gas system (all the regional grids are L-gas). Shippers had to contract quality conversion capacity, which was cheap but frequently sold out. This created contractual congestion that hit only new entrants.

6 MARKET PROFILE – UNITED STATES

6.1 Context

6.1.1 Location and Physical Reach

The US is the world's largest consumer of natural gas, and since 2009, again became the world's largest producer.[xcv] The country is spanned by an extensive network of pipelines, as well as having extensive interconnection to Canada, and some interconnection to Mexico. Figure 18 shows the major inter-state and intra-state pipelines in the USA



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

Figure 18 – US Natural Gas Pipeline Network 2009[xcvi]

6.1.2 Key Statistics[xcvii]

Total Consumption (TJ)	26,791,224 MMcf or 28,410,930 TJ [2013]
Total Production (TJ)	25,706,937 MMcf Dry Production or 27,261,091 TJ [2013]
Peak Daily Consumption (TJ)	Highest was 127,000 MMcf or 134,678 TJ (which is twice the average daily amount), during the great polar vortex of 2013/14.
Total Length of Pipeline (km)	~ 488,000km (305,000 miles)
Import/Export (TJ)	Imports (2014): 2,695,394 MMcf = 2,964,933 TJ Exports (2014): 1,495,764 MMcf = 1,645,340 TJ
Storage Capacity (TJ)	Total Capacity (2013): 9,172,951 MMcf or 10,090,246 TJ

6.1.3 Key System Characteristics and Considerations

The U.S. natural gas pipeline network is the most extensive in the world, with the capability to transfer gas throughout the country. It comprises:

- More than 210 natural gas pipeline systems.
- 305,000 miles of interstate and intrastate transmission pipelines.
- More than 11,000 delivery points, 5,000 receipt points, and 1,400 interconnection points that provide for the transfer of natural gas throughout the United States.
- Over 24 major hubs or market centers.
- 400 underground natural gas storage facilities.
- 49 locations where natural gas can be imported/exported via pipelines.

The natural gas system has traditionally been based around a number of long-haul pipelines bringing gas from major production sources in the Gulf of Mexico, and to a lesser extent, Canada, to demand centres around the country, particularly in the Midwest and Northeast. Figure 19 shows principal flows of natural gas around the US in 2013.

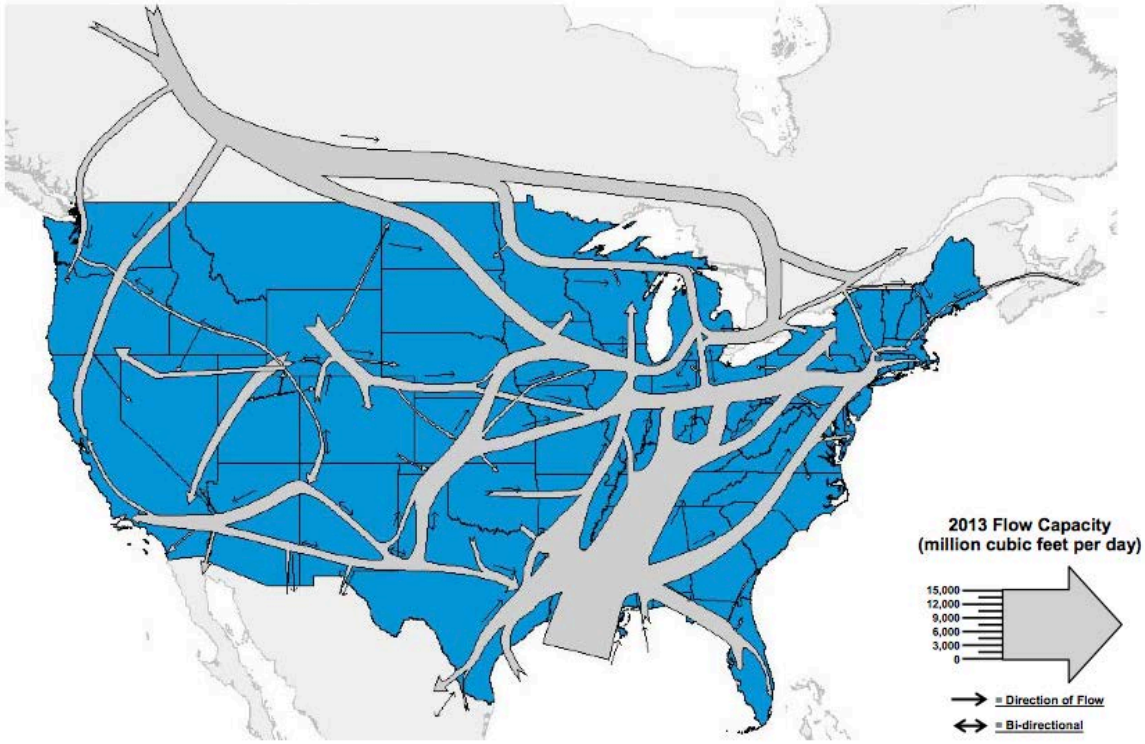


Figure 19 – Principal Interstate/International Natural Gas Flows (2013)[xcviii]

Recently the dynamics of natural gas flows have begun to change, with reduced production in the Gulf Of Mexico being (more than) replaced by the unlocking of substantial supplies of shale gas, from source such as the Marcellus Shale in Pennsylvania and Ohio. System dynamics are also being dramatically altered by a shift in consumption profile – facilitated in part by cheaper supply – in particular a dramatic increase in gas-fired power generation (discussed further later). This has, amongst other things, resulted in a change in principal flow direction on some major pipelines.

As these assets have come online, the demand for pipeline capacity has outstripped the capacity of existing pipelines, and outpaced the rate at which new capacity is being added, leading to serious constraints at times in regions such as New England, and parts of New York, with constraints also emerging in the Mid Atlantic region.

Historically US natural gas consumption exceeded production, with the difference made up by natural gas pipeline imports from Canada, as well as LNG imports. The US is net exporter to Mexico. Key import and export points are shown in Figure 20.

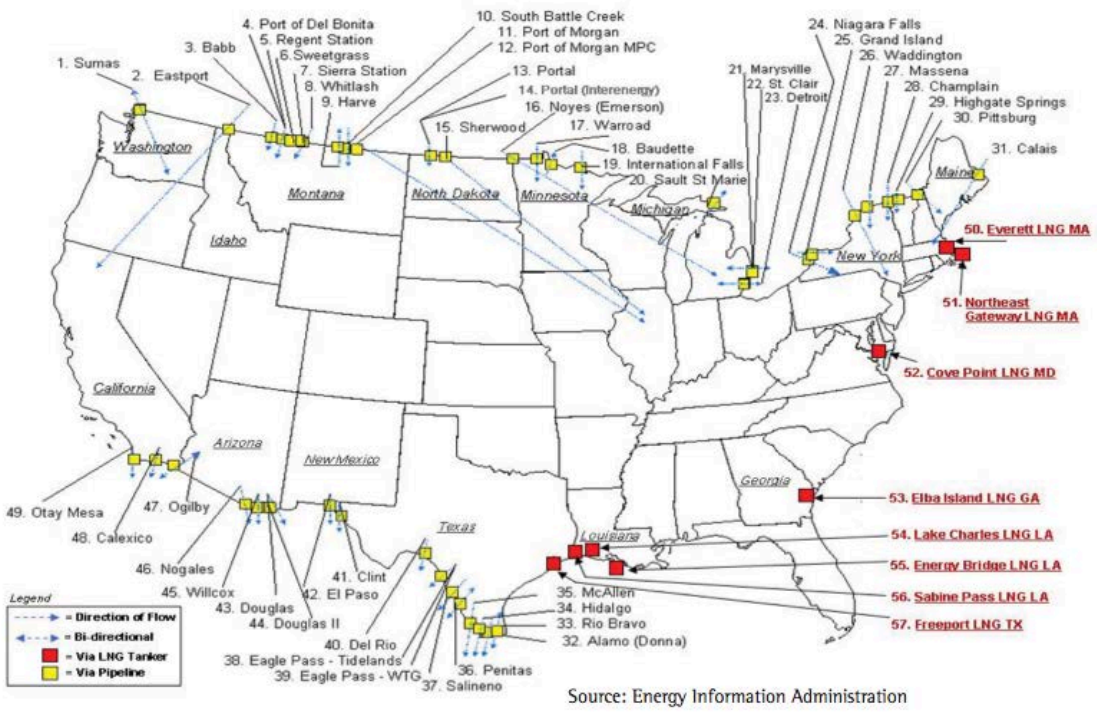


Figure 20 – Natural Gas Import/Export Points[xcix]

Since the recent growth in domestic shale gas supplies, imports have declined and the US is expected to soon become a net exporter of natural gas as shown in Figure 21.

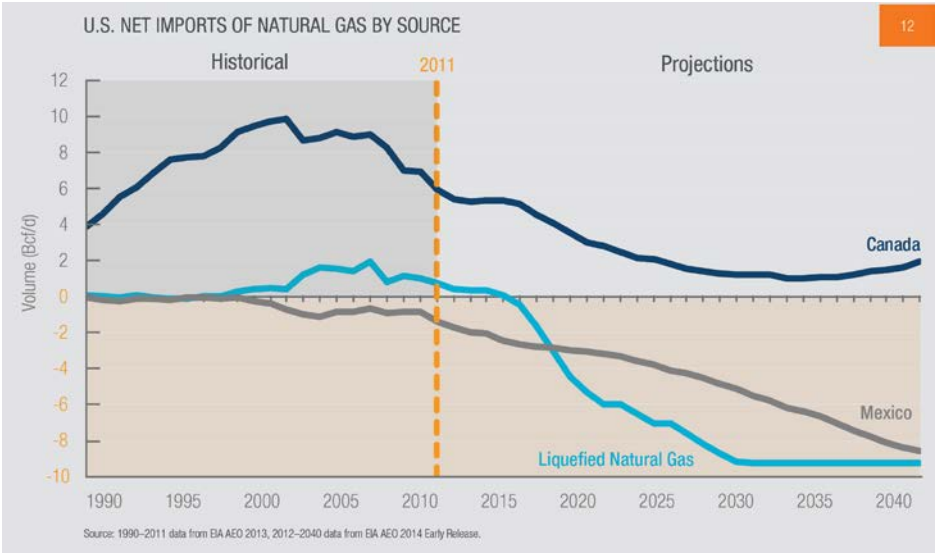


Figure 21 –Natural Gas Import/Export Balance[c]

Natural gas consumption in the US consists principally of residential use (heating, cooking and hot water), commercial, industrial (for both energy and feedstock) and power generation. Since 2007, electricity generation has become the largest gas customer class as shown below in Figure 22.[xcix]

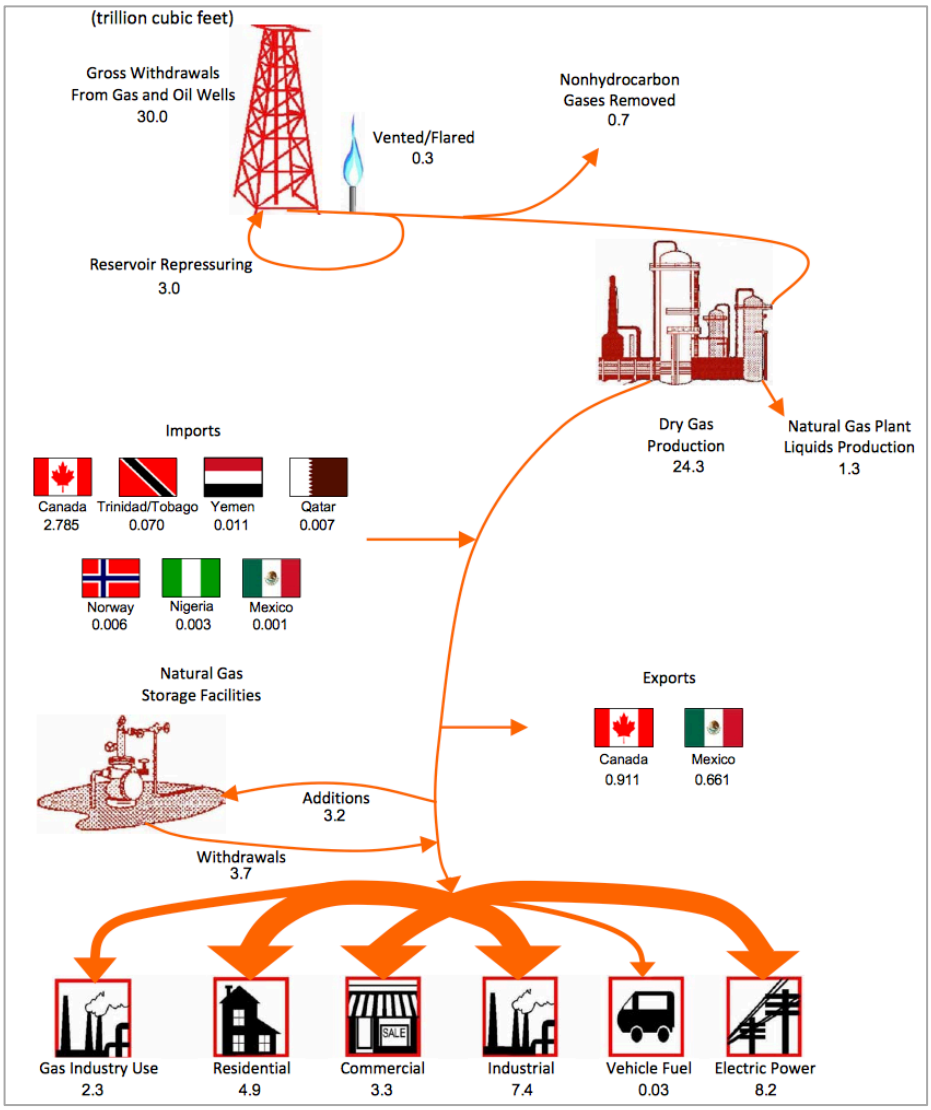


Figure 22 – US Natural Gas Supply and Disposition[civ]

Like virtually all natural gas systems worldwide, winter is the peak consumption period, driven historically by residential and commercial heating load. The summer his historically seen a lesser peak in usage for electricity generation, driven by electricity air conditioning demand.[34] The relative usage of gas by sector by season can be seen in Figure 23 below. However, this diagram, which dates to 2011, does not necessarily make clear the increasing usage of natural gas for power generation even in winter – due in no small part to the availability of cheap natural gas supply. An increasing number of gas-fired generators, in the North-East and Mid-Atlantic in particular, are being designed and run as baseload generation.

[34] Every organized electricity market in the US is a summer peaking system, even in cooler parts of the country such as New England.

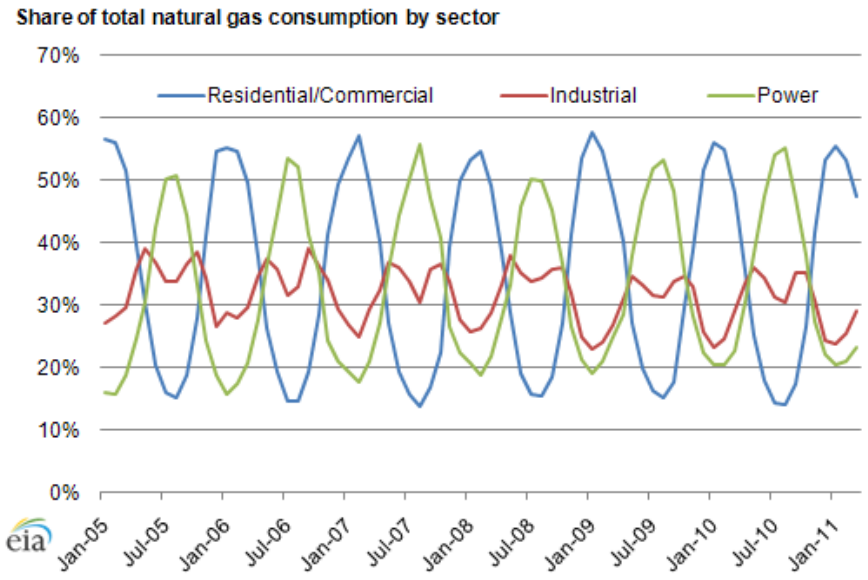
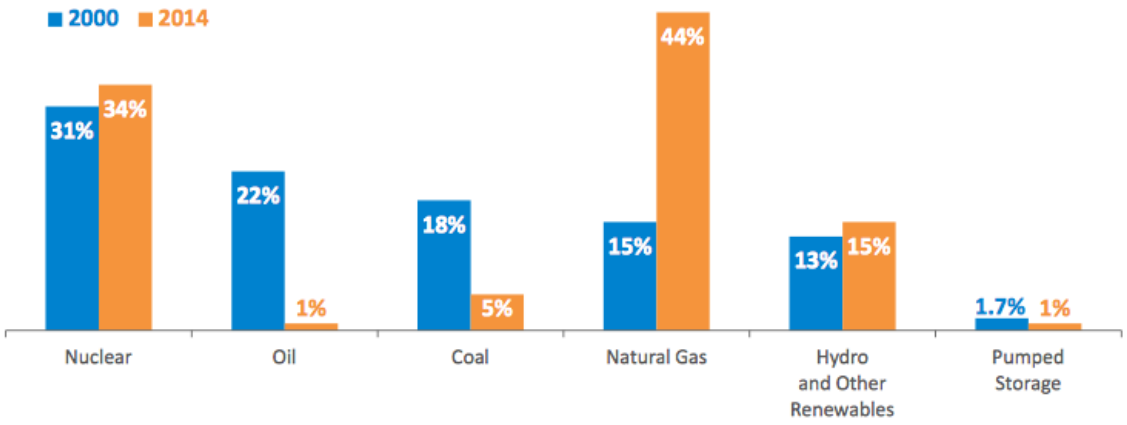


Figure 23 - Natural Gas Consumption by Sector[ci]

As well as power generation becoming the largest source of natural gas demand, gas-fired plant is becoming an increasingly large portion of the generation mix. In New England it has transitioned from fourth to first in its share of the fuel mix over the last 14 years, as seen in Figure 24. Similar trends are emerging elsewhere, with PJM, the largest electricity market in the US (by consumption) recently announcing that: "Next May [2015], for the first time ever, we will see natural gas surpass coal in our fuel mix."[cii]

Figure 24 – ISO New England Electric Energy Production by Fuel Type (2000 vs. 2014)[ciii]



The US has a substantial number of storage facilities nationwide – shown in Figure 25 and Table 12 below – principally in the form of depleted fields, salt caverns and aquifers.

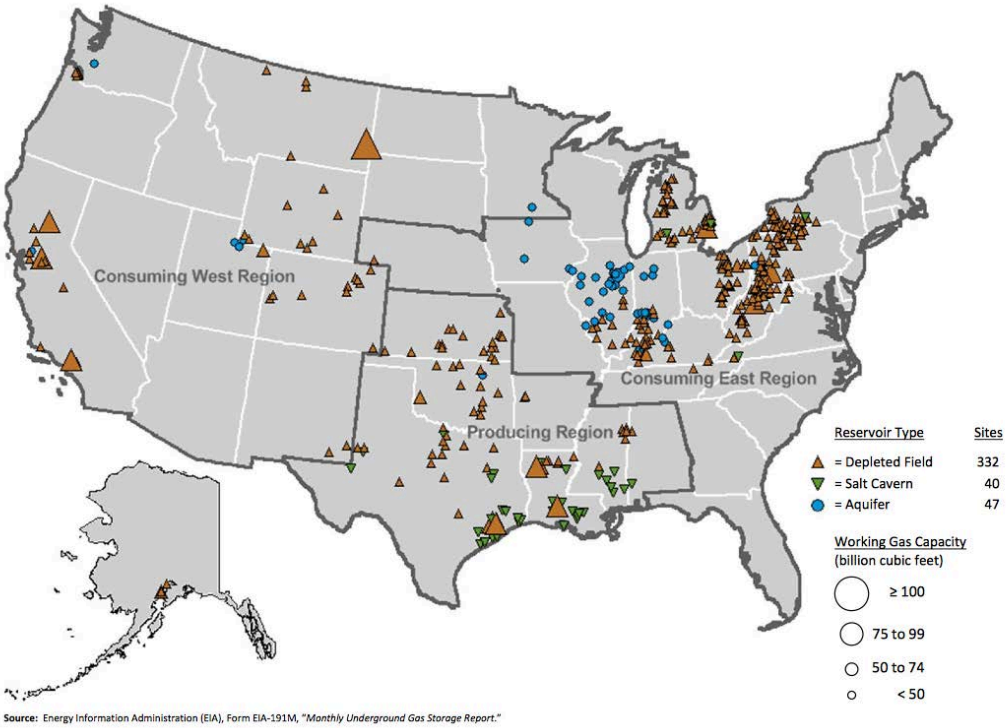


Figure 25 – Location and Type of US Gas Storage Facilities [civ]

Table 12 – Underground Natural Gas Storage Capacity 2013 (million cubic feet) [cv]

20-03-2015

	Salt Caverns			Aquifers			Depleted Fields			Total		
State	Number of Existing Fields	Working Gas Capacity	Total Capacity	Number of Existing Fields	Working Gas Capacity	Total Capacity	Number of Existing Fields	Working Gas Capacity	Total Capacity	Number of Existing Fields	Working Gas Capacity	Total Capacity
Alabama	1	16,150	21,900	0	0	0	1	11,200	13,500	2	27,350	35,400
Alaska	0	0	0	0	0	0	5	67,915	83,592	5	67,915	83,592
Arkansas	0	0	0	0	0	0	2	12,178	21,853	2	12,178	21,853
California	0	0	0	1	10,000	12,000	13	364,296	587,711	14	374,296	599,711
Colorado	0	0	0	0	0	0	10	60,582	122,086	10	60,582	122,086
Illinois	0	0	0	19	291,544	974,362	9	11,768	25,920	28	303,312	1,000,281
Indiana	0	0	0	12	19,215	80,746	10	13,809	30,003	22	33,024	110,749
Iowa	0	0	0	4	90,313	288,210	0	0	0	4	90,313	288,210
Kansas	0	0	0	0	0	0	18	122,970	283,974	18	122,970	283,974
Kentucky	0	0	0	3	6,629	9,567	20	100,971	212,156	23	107,600	221,723
Louisiana	11	154,333	213,039	0	0	0	8	292,380	520,900	19	446,713	733,939
Maryland	0	0	0	0	0	0	1	18,300	64,000	1	18,300	64,000
Michigan	2	2,159	3,834	0	0	0	43	672,808	1,075,590	45	674,967	1,079,424
Minnesota	0	0	0	1	2,000	7,000	0	0	0	1	2,000	7,000
Mississippi	6	109,495	153,733	0	0	0	6	71,159	149,789	12	180,654	303,522
Missouri	0	0	0	1	6,000	13,845	0	0	0	1	6,000	13,845
Montana	0	0	0	0	0	0	5	197,501	376,301	5	197,501	376,301
Nebraska	0	0	0	0	0	0	1	14,819	34,850	1	14,819	34,850
New Mexico	0	0	0	0	0	0	2	59,738	89,100	2	59,738	89,100
New York	1	1,450	2,340	0	0	0	25	128,101	243,439	26	129,551	245,779
Ohio	0	0	0	0	0	0	24	230,828	577,944	24	230,828	577,944
Oklahoma	0	0	0	1	31	170	12	181,025	370,365	13	181,055	370,535
Oregon	0	0	0	0	0	0	7	15,935	29,565	7	15,935	29,565
Pennsylvania	0	0	0	1	938	0	50	432,276	774,309	51	433,214	774,309
Tennessee	0	0	0	0	0	0	1	0	0	1	0	NA
Texas	18	168,143	253,220	0	0	0	19	373,018	588,852	37	541,161	842,072
Utah	0	0	0	2	948	4,265	1	53,950	120,200	3	54,898	124,465
Virginia	1	4,000	6,200	0	0	0	1	1,400	3,300	2	5,400	9,500
Washington	0	0	0	1	24,600	46,900	0	0	0	1	24,600	46,900
West Virginia	0	0	0	0	0	0	30	258,056	524,337	30	258,056	524,337
Wyoming	0	0	0	1	836	6,705	8	72,869	151,280	9	73,705	157,985
Total	**40**	**455,729**	**654,266**	**47**	**453,054**	**1,443,769**	**332**	**3,839,852**	**7,074,916**	**419**	**4,748,636**	**9,172,951**

[NA] Not available.

Notes: Existing fields include both active and inactive fields. Geographic coverage is the Lower 48 States and the District of Columbia. Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration (EIA), Form EIA-191, *"Monthly Underground Gas Storage Report."*

The market trades around a number of hub and 'citygate' points. The most actively traded of these is the Henry Hub in Louisiana, a major point of supply and gas trans-shipment, with most other

locations trading as a basis differential to this location. Futures based around Henry Hub are the most actively traded natural gas products in the world.

6.2 Industry Structure

Since the 1980's the structure of the natural gas industry in the USA has undergone a dramatic change. Originally exploration and production companies explored and drilled for natural gas and sold their product at the well head to large transportation pipelines who transported and sold gas to distribution utilities who then sold the gas to end customers. The prices for producers and inter-state transporters were federally regulated, and state utility commission regulated intra-state pipelines and distribution utilities.

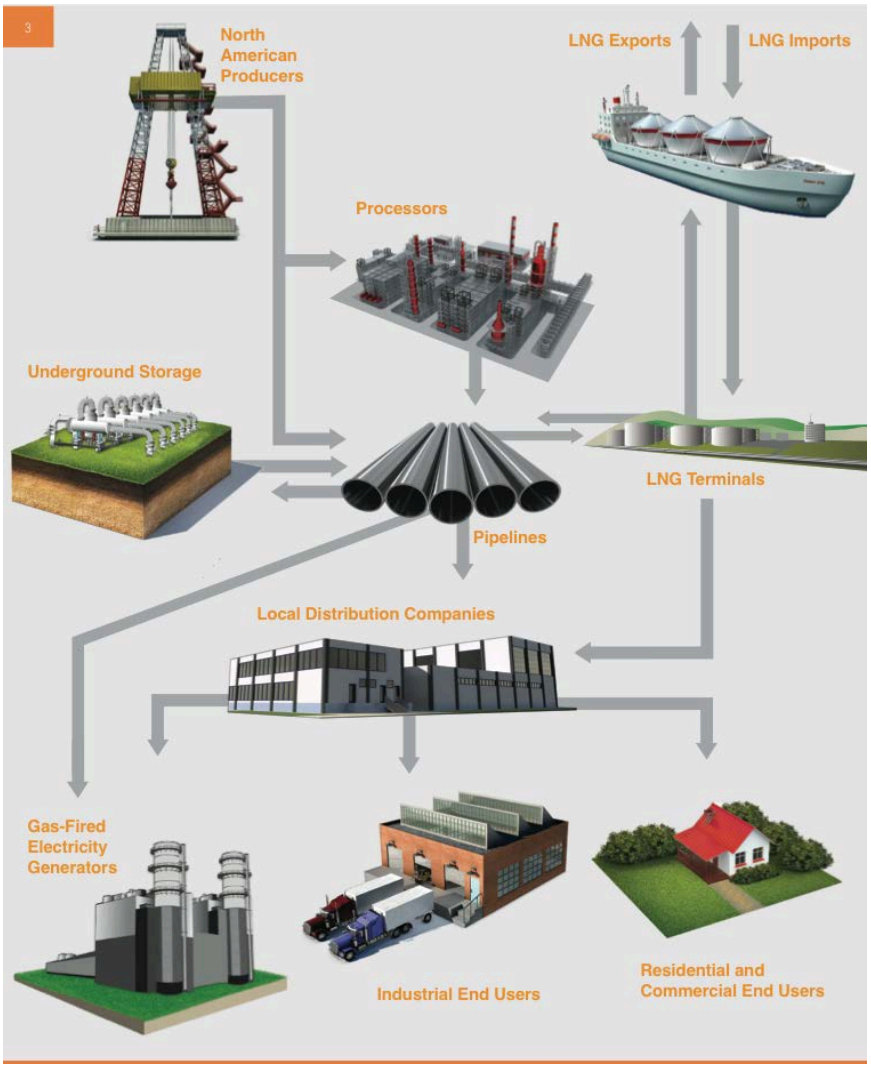


Figure 26 – Natural Gas Industry Structure and Physical Flows[cvi]

Today the structure is more open to competition:[cvii]

- Wellhead prices are not regulated but dependent on supply and demand forces.
- Inter-state pipelines no longer take ownership of natural gas, but rather offer transportation only, and are subject to federal regulation.
- Licenced local distribution companies (LDCs) distribute gas to low pressure customers, and often also function as the seller of the gas, although retail competition in some states allows for alternate sellers.

- 'Marketers' serve as middlemen to facilitate the sale or purchase of natural gas, and contract for transportation and storage. Marketers may own the gas being bought and sold, or simply act as facilitators.
- Large users can purchase natural gas directly from producers, from LDCs (if distribution connected), or from marketers.

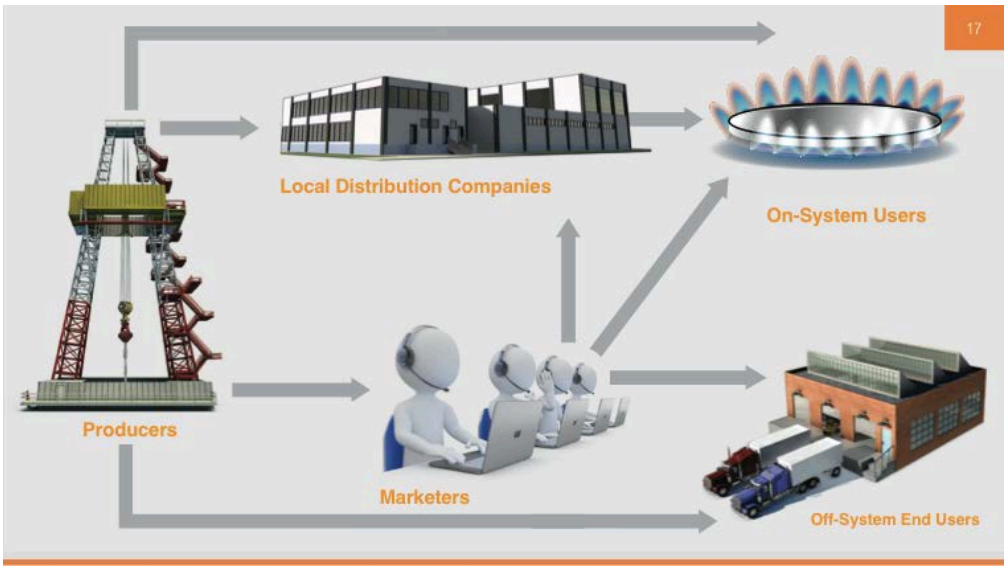


Figure 27 – Commercial and Financial Arrangements[cviii]

6.2.1 Key Roles

Key roles in the US gas market are:

- producer
- pipeline company – pipeline owner and transmission system operator
- storage provider
- shipper
- marketer – essentially a shipper and trader of gas, and in some cases a direct retailer to larger gas customers
- transmission connected users
- local distribution company (LDC) – combined distribution company and retailer
- supplier – retailer; exists as a stand-alone entity only in jurisdictions with competitive retail markets

FERC orders, which govern all interstate pipelines, require the separation of marketing/supply functions from pipeline operations. There is typically no requirement for distribution to be separate from supplier functions, even in those regions where retail competition exists.

6.2.2 Infrastructure Providers

Pipeline/Transmission System Operator(s)	The US has more than 210 natural gas pipeline systems[cix], with the 30 largest interstate pipelines representing 72% of all interstate transport capacity and 81% of gas transported (in 2007)[cx]. In the US there is typically a 1:1 relationship between a pipeline company and the operation of that pipeline. i.e. each pipeline operates its own system.

Pipeline Owner(s)

Major US pipelines and their owners are shown in the table below:

Table 13 - Major US Pipelines

Pipeline	Owner	Length (Miles)
Northern Natural Pipeline	Berkshire Hathaway Energy	15,874
Tennessee Gas Pipeline Company	Kinder Morgan	13,900
El Paso Natural Gas/Mojave Pipeline	Kinder Morgan	10,700
Transcontinental Pipeline	Williams Companies	10,450
Columbia Gas Transmission Corporation	NiSource	10,365
ANR Pipeline Company — formerly Michigan Wisconsin	TransCanada Corp	9,388
Natural Gas Pipeline Company of America (NGPL)	Myria Holdings (80%) Kinder Morgan (20%)	9,200
Texas Eastern Transmission Pipeline	Spectra Energy Corp	8,987
Southern Natural Gas Company	Kinder Morgan	7,600
Gulf South Pipeline — formerly, United Gas Pipeline Company	Boardwalk Pipeline Partners	7,400
Texas Gas Transmission, LLC	Boardwalk Pipeline Partners	6,060
Panhandle Eastern Pipe Line Company, LP	Energy Transfer Partners	6,000
Southern Star Central Gas Pipeline, Inc	Morgan Stanley Infrastructure Partners	6,000
Florida Gas Transmission Company	Energy Transfer Partners (50%) Kinder Morgan (50%)	5,400
Tallgrass Interstate Gas Transmission	Tallgrass Energy Partners	4,645
Northwest Pipeline Corporation	Williams Companies	3,900
Williston Basin Interstate Pipeline	MDU Resources Group	3,800
Columbia Gulf Transmission Company	NiSource	3,400
Trunkline Pipeline	Energy Transfer Partners	3,000
Transwestern Pipeline Company, LLC	Energy Transfer Partners	2,560
Questar Pipeline Company	Questar Corporation	2,500
Kern River Pipeline	Berkshire Hathaway Energy	1,679

	Rockies Express Pipeline	Tallgrass Energy Partners, Phillips 66, Sempra Energy	1,679
	East Tennessee Pipeline	Spectra Energy Corp	1,515
	Northern Border Pipeline Company	TransCanada Pipelines and ONEOK Partners (50%)	1,407
	Gas Transmission Northwest Corporation — formerly Pacific Gas Transmission	TransCanada Corp (75%) TC Pipelines (25%)	1,353
	Algonquin Gas Transmission	Spectra Energy Corp	1,100
	Alliance Pipeline	Enbridge (50%) Veresen Inc. (50%)	1,097
	Maritimes and Northeast Pipeline	Spectra Energy Partners 77.53% + others	810
	Ruby Pipeline	Kinder Morgan (50%), Global Infrastructure Partners (50%)	680
	Viking Gas Transmission Company	ONEOK Partners	671
	Southern Trails Pipeline	Questar	488
	Trailblazer Pipeline Company	Tallgrass Energy Partners	436
	Midwestern Gas Transmission Company	ONEOK Partners	366
	Portland Natural Gas Transmission System	TransCanada Pipelines (62%), Gaz Metro (38%)	295
Spot Market/Balancing Operator(s)	There is no organised exchange for spot trading/balancing. Spot trading in the US is conducted bilaterally between parties, or facilitated through brokers (or via bulletin boards).		
Prompt/Short-Term Forward Market Operator(s)	The New York Mercantile Exchange (NYMEX) – now part of the CME Group, the Intercontinental Exchange (ICE) and the Natural Gas Exchange (NGX) all offer trading in prompt US natural gas.		
Forward/Futures Market Operator(s)	NYMEX, ICE and NGX operate futures markets, and offer OTC clearing, for natural gas.		

6.2.3 Regulators

Energy Regulator – National	FERC is the national energy regulator for the US. Its functions with respect to natural gas include: • Oversight of physical markets in natural gas • Approval of LNG terminals • Authorisation of 'Presidential Permits' for natural gas pipeline border crossings. • Approval of pipeline access regimes • Economic regulation of pipeline revenues FERC is responsible for making both company-specific and industry-wide decisions. Company-specific decisions include applications for rate changes, changes in terms or conditions for transportation

	contracts and complaints.[cxi] Industry-wide decisions include orders (e.g. FERC Order 636) governing matters such as open access, functional separation, etc.
Energy Regulator – Regional	The natural gas industry within each state is typically regulated by that state's Public Utilities Commission, or similar body. Typical responsibilities include the regulation of: • distribution networks, including reliability, non-discriminatory access, authorised investment, and allowed revenues • gas safety • sale of natural gas, which in the majority of states involves revenue regulation, but may also include stipulation of the rules for retail competition • onshore gathering systems from production fields
Financial Market Regulator	The Commodity Futures Trading Commission (CFTC) regulates the financial markets in energy, including natural gas.
Competition Regulation	General prohibitions against anti-competitive conduct – including the various 'anti-trust' laws in the US – are enforced by the Federal Trade Commission (FTC) the US Department of Justic (DoJ), and in some cases, various state bodies. In addition, FERC has its own Office of Enforcement with responsibility for identifying and taking action against fraud and anti-competitive practices in electricity and gas sectors.
Other	A number of federal agencies are involved in various aspects of the natural gas markets.[cxii] • Environmental Protection Agency (EPA): has primary responsibility for enforcing many of the environmental statutes and regulations of the US. • Bureau of Land Management (BLM): manages federal onshore gas operations. • Bureau of Safety and Environmental Enforcement (BSEE): has environmental and safety oversight of offshore resources. • Bureau of Ocean Energy Management (BOEM): manages the exploration and development of offshore oil and gas leases. • Pipeline and Hazardous Materials Safety Administration (PHMSA): regulates transportation of hazardous materials, including oil and gas.

6.3 Transmission Arrangements

Each major pipeline in the US has its own transportation tariff. While these tariffs contain similar elements – due to the need to comply with the same regulatory requirements – ultimately each has its own transportation arrangements with which shippers must comply.

The discussion below contains a general discussion of transportation arrangements in the US, where those arrangements are fairly common amongst all US pipelines, followed by a discussion of specific arrangements for a selection of economically significant pipelines:

- Columbia Gas Transmission: a significant, meshed pipeline network, costing of 12,000 miles of miles of pipe, principally serving the US Mid-Atlantic.
- El Paso Natural Gas (EPNG): a major system of gas pipelines bringing gas principally from Texas to California.
- Natural Gas Pipeline Company of America (NGPL): the largest transporter of gas into the Chicago market.
- Transcontinental Pipeline (Transco): a major transporter of gas from the Gulf Coast to major East Coast demand centres, terminating in the New York City area.

These pipelines have been chosen because they have somewhat different characteristics, and serve different areas.

6.3.1 Transportation Rights – US General

US General	
Form of Transportation Rights	Shippers must hold transportation rights to ship on the system. These contracts specify, amongst other things: • the maximum daily quantity (MDQ) of gas that can be shipped; • points of injection and withdrawal; • any allowed variation from a constant (1/24) hourly flow rate; • reliability of service; • charges.
Type	The specific types of transportation rights offered will tend to vary for each pipeline, though as a minimum they will include: • *Firm transportation*: (see glossary for definition for *firm capacity*) • *Interruptible transportation*: transportation subject to interruption at source or sink, based on scheduling priority. [See pipeline-specific discussions]
Locational Nature	[Differs by pipeline]
Tenor and Duration	Rights are typically sold in multiples of a year, but in the secondary market can be re-sold for periods as short as a day. In open season processes, the pipeline may require extensive commitment periods. Many set a minimum of around 15 years, with maximums often in the range of 25-30 years.
Primary Sales – Existing Capacity	Most long-term capacity is sold via an ‘open season’ process. Additional capacity may also be made available on a periodic basis, e.g. seasonally, or daily if ‘operationally available’ (i.e. not scheduled). FERC requires each pipeline to maintain a ‘bulletin board’, on which all ‘unsubscribed’ and ‘operationally available’ capacity must be posted.

US General	
	Where an existing pipeline has been fully subscribed such that no firm capacity is available, the only ways to obtain firm capacity (without expansion) is if an existing shipper relinquishes their capacity at the end of their contract term, or through capacity release. Capacity for each transportation service must be offered at a 'recourse rate', a regulated rate set by FERC as part of the pipeline's tariff. The pipeline and its customer may alternately utilise a 'negotiated rate' by mutual agreement. In order to ensure transparency (and that there is no preference behaviour), pipelines are required to list all negotiated contracts in their tariffs.[35] All sales of existing capacity must be reported by the pipeline on its bulletin board, including the purchaser, duration, receipt and delivery points, contract quantity, and rate charged.[36] Due to the long length of certain contracts, of 20 years or more, there is potential for grandfathering of rights to occur if changes are made during the life time of that contract.
Secondary Market	FERC requires each pipeline to facilitate secondary trading of capacity via its bulletin board. The holder of primary capacity can release segments (by location or time) rather than their full holdings, provided such segmentation is operationally feasible on the pipeline's system. The pipeline must also report details of secondary trades of released capacity on its bulletin board – the same details as for sales by the pipeline, as well as the identity of the releasing party.
Capacity Release	There is no formal 'use it or lose it' requirement or other provision to force capacity re-sale. Individual tariffs may include provisions to discourage hoarding. For example, in response to concerns raised by Texas Gas regarding hoarding, FERC has recently approved a change in its tariff "to limit a shipper's mainline primary receipt point capacity to 100 percent of the shipper's firm contract demand." [37] [cxiii] There is little substantive history of capacity 'hoarding' in the US, though any suspected abuses or market manipulation can be addressed through FERC (which has a history of aggressively enforcing its rules regarding anti-competitive behaviour), or general competition regulation. Capacity releases of one year duration or greater may not be sold at a price greater than the published maximum price in the pipeline tariff.

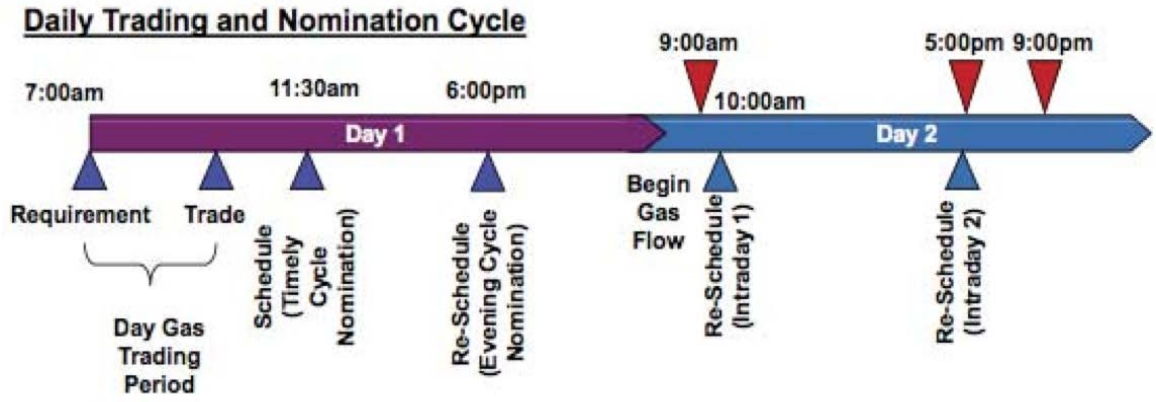
[35] Elements of tariffs may be updated periodically through the submission of new 'tariff records' to FERC. All negotiated rate tariffs must be submitted to FERC, and openly published, in this way.

[36] The relevant (abridged) sections of the FERC regulation state:
§ 284.13 Reporting requirements for interstate pipelines. An interstate pipeline that provides transportation service under subparts B or G of this part must comply with the following reporting requirements … (b) *Reports on firm and interruptible services.* An interstate pipeline must post the following information on its Internet web site… and must maintain access to that information for a period not less than 90 days from the date of posting. (1) For pipeline firm service and for release transactions under § 284.8, the pipeline must post … (i) The full legal name of the shipper… (iii) The rate charged under each contract… (v) The duration of the contract; (vi) The receipt and delivery points and zones or segments covered by the contract… (vii) The contract quantity or the volumetric quantity under a volumetric release …

[37] In this particular situation, a number of existing shippers had acquired primary receipt point capacity (effectively entry capacity) in excess of the transportation capacity they held through the system (their "contract demand"), thus limiting the ability of new shippers to gain access, even though transportation through the main systems was available.

US General	
	This was historically the case for short-term (less than one year) capacity releases also, but this changed with FERC Order 712, to allow short-term capacity to be sold at prices in excess of the tariff maximum, provided it is 'put to bid'.
Capacity Expansion Process	New capacity is generally funded by the sale of transportation rights. Because of recent gas deliverability constraints in New England, a proposal has been put forward by the New England Governors to underwrite the construction of additional pipeline capacity into the region[cxiv] – to increase reliability, particularly for gas-fired generation – and to uplift this cost onto the retail bill for all electricity ratepayers. This would represent a new regulatory paradigm – one that many are concerned may have a dulling effect on regular pipeline investment processes.
Primary Sales – Capacity Expansion	Before a US gas pipeline company can build a new, or expand an existing, pipeline, it must (under FERC regulations) conduct an 'open season' in which it: • Advertises for bids to buy specified amounts of the various long-term point-to-point maximum daily quantities the project will provide, at either 'recourse'/regulated prices or lower negotiated prices. • Solicits offers to release or 'turn back' outstanding point-to-point maximum daily quantities that could reduce the need for or size of the capacity expansion. • Evaluates competing bids (when they cannot all be accepted) in terms of the net present value (NPV) of net pipeline company revenue implied by the bid prices, in effect conducting a form of capacity-constrained auction. • Resolves ties (which are common, because there may be several/many bids at the regulated maximum price) by prorating, queuing, a lottery, etc. Offers from multiple affiliates of the same firm are prorated when capacity is oversubscribed and are treated as one bid per affiliated group. The value of the portfolio is maximised even if this excludes the highest individual NPV offers.[cxv] This may be a two-stage process, where the pipeline originally asks for non-binding indications, followed by a second round where they require binding commitments. Typical information required as part of an open season bid include: • Requested MDQ • Minimum acceptable MDQ • Contract term (the pipeline will typically specify a minimum) • Receipt (injection) and delivery (withdrawal) points • Bid price for capacity: $/Quantity/Month

6.3.2 Nominations, Scheduling and Balancing – US General



Cycle	Cycle Description
T	Timely Nominations sent by 11:30 AM and to the Pipeline by 11:45 AM to be effective at 9 AM next gas day
E	Evening Nominations sent by 6 PM and to the Pipeline by 6:15 PM to be effective 9 AM the next day. This is the cycle used for reporting on today's flow before the I2 cycle data is available.
I1	Intraday 1 nominations sent by 10 AM and to the Pipeline by 10:15 AM to be effective at 5PM the same day
I2	Intraday 2 nominations sent by 5 PM and to the Pipeline by 5:15 PM to be effective at 9 PM the same day. This is the cycle used for most Pipe2Pipe reporting purposes.

Figure 28 – Standard[38] Pipeline Nomination Schedule (Source: FERC)[cxvi]

US General	
Nominations	Shippers nominate flows from a source to sink, within the limits of the capacity rights they hold (whatever form those rights take. e.g. contract path, zonal entry/exit, etc.). The pipeline operator schedules the system based on submitted nominations and the physical constraints of the system. If not all nominations can be scheduled, curtailments are made on the basis of interruptible tranches, and after that, established priority for firm transportation – normally pro-rata based on capacity held. Confirmation messages are issued to all schedule flows, and curtailments to all those not scheduled.
Scheduling Period	The standard scheduling period for natural gas in the US is the gas day, which runs from 9:00am – 9:00am Central Time. The regular nominations deadline is presently 11:30am on the day prior to the gas day, but FERC, in its recent Order 809[cxvii] of 16 April 2015, has mandated this shift to 1:00pm.
Changes to Nominations	Nominations may be updated at various points both prior to the gas day ('re-nominations') and during the gas day ('intra-day nominations'). These can be used to request increases or decreases in total flow, and changes to receipt and delivery points of scheduled gas. The standard schedule for re-nominations and intra-day nominations is shown in Figure 28, with one re-nomination window (at 6:00pm prior to the gas day) and two intra-day nomination windows (at 10:00am and 5:00pm on the gas day). Order 809 introduces an extra intra-day window, with submission times moving to 10:00am, 2:30pm and 7:00pm. Pipelines may set additional time windows, and these may

[38] As defined by the North American Energy Standards Board (NAESB) WGQ Standard 1.3.2

US General	
	vary depending on the form of transportation service (e.g. 'no notice' service doesn't require any before-the-fact nomination). Flows in excess of capacity held as designated (after the fact) as overrun nominations, and generally subject to overrun penalty.
Multiple Pipelines	Flows are nominated separately onto each pipeline. There is generally no coordination amongst non-affiliated pipelines – it being the responsibility of the customer to ensure that flows scheduled to exit one pipeline and enter another match. Some affiliated pipelines may simplify this process for their customers. Additionally, some pipelines offer 'park-and-loan' services to allow participants to nominally leave gas with the pipeline, or borrow gas from it (e.g. to ensure their flows into a connecting pipeline match withdrawal on that system). Additionally, some major trans-shipment points, such as Henry Hub, offer services to facilitate the notional transfer of gas between pipelines.[39]
Balancing	Under most forms of transportation service, shipper injections (minus retainage, principally for compressor fuel) and withdrawals must be balanced.
Balancing Period	[Differs by pipeline, but usually either daily or monthly]
Balancing Gas	Balancing gas is firstly sourced from linepack, storage, and fuel retainage owned by the pipeline. If required, the pipeline can also enter the market to buy/sell gas to maintain the system in physical balance.
Participant Balancing	Shippers are required to maintain their injections and withdrawals within balance over a defined balancing period. However, FERC requires that TSOs must: • Allow imbalances to be netted across contracts and traded among shippers. • Facilitate imbalance trading by providing timely information on who has imbalances. • Provide fee-based imbalance management services, and let others compete to do so. • Demonstrate that imbalances are a real operational problem on its system, and only recover actual costs of resolving. TSOs (and others, e.g., hub operators) provide various services for shippers to manage imbalances: • Park and Loan (P&L) service is the most common. Shippers pay a fee to 'park' gas in or borrow gas from linepack on a short-term basis (e.g., overnight). • Some hubs provide operational balancing services to allow participants to maintain balance in their transit from one pipeline to another. • Others include automatic nomination adjustment, deferred delivery, and storage in transit. All pipelines are required to provide 'electronic bulletin boards' to

[39] The transfer is notional as the hub nets across the various transfers it arranges, to arrive at a single set of net physical transfers.

US General	
	facilitate imbalance netting/trading by participants. Pipelines also maintain operational balancing agreements (OBAs) between each other so that any net imbalance at an interconnect is cashed-out or carried forward at the end of a balancing period, with the costs allocated amongst shippers based on their individual net imbalances for the balancing period.
Quantity Measurement	[Metering/allocation are often pipeline-specific]
Recompense for Participant Imbalances	[The method of shippers paying or otherwise compensating the pipeline operator for imbalances is generally pipeline specific]
Balancing Payment	[The methodology for determining balancing payments, in the case of 'cashout' for imbalances, is ultimately pipeline specific – though in general imbalances are priced based on an externally-derived index, and often multiplied by a penalty factor determined by a tolerance band]

6.3.3 Transportation Rights – Columbia Gas Transmission

Columbia Gas Transmission	

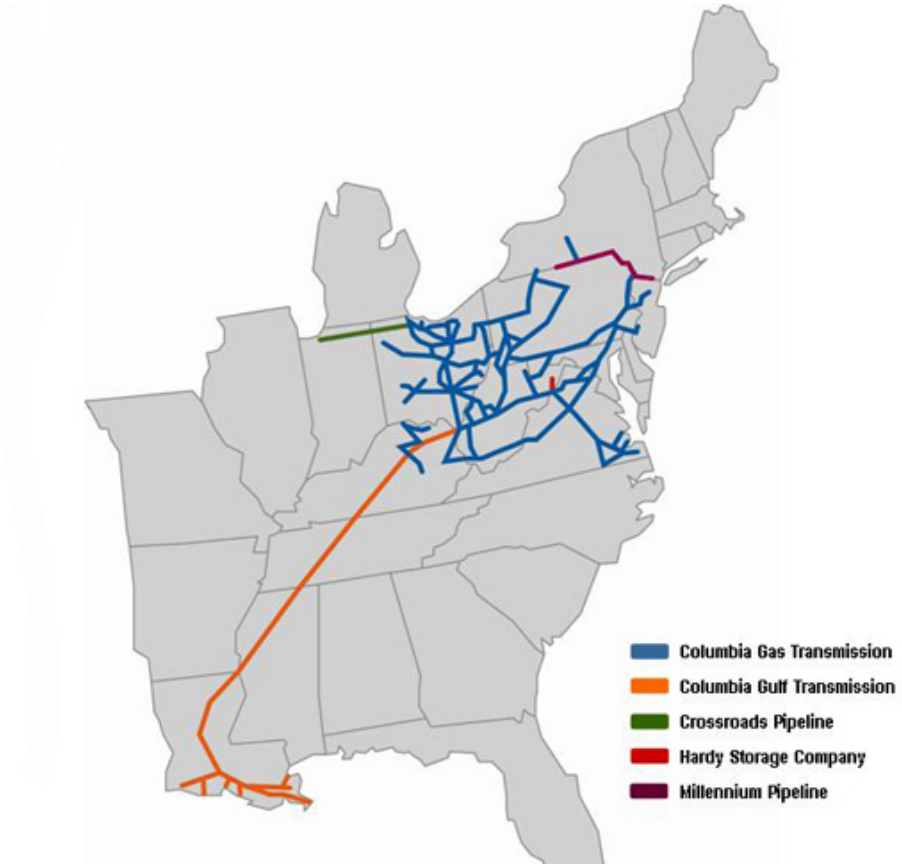


Figure 29 Columbia Gas Transmission System (and Affiliates)

Form of Transportation Rights	[See US – General]
Type	The principal forms of transportation right offered by Columbia are: • *Firm transportation*: (see glossary for definition for *firm capacity*)

Columbia Gas Transmission	
	• *No-notice firm transporation*: similar to firm transportation, except holder is not required to maintain a daily balance between scheduled and delivered natural gas (i.e. they can use more gas than scheduled, with the pipeline covering the balance from its flexible stores).[40] • *Summer hourly no-notice transportation*: an un-nominated no-notice firm service, with variable hourly flow rates up to 1/16 of daily demand, available only in summer. • *Interruptible transportation*: (see glossary for definition for *interruptible capacity*). • *General transportation*: a form of grandfathered firm service for those who had precedent agreements prior to May 18, 1992, and transporting less than 10,000 dekatherm(Dth)/day. Allows, amongst other things, overruns on capacity provided it is to meet demand in the shipper's 'historic service area', and no-notice service. • *Off-peak firm transportation*: transportation that is subject to interruption during the period November 1 to March 31, for a maximum period of 30 or 60 days, and is firm at other times. • *Third-party storage transportation*: firm transport to/from third-party storage facilities
Locational Nature	The Columbia natural gas pipeline is a complex, reticulated pipeline system which effectively operates as a single virtual zone, with entry/exit rights. e.g. Firm shippers in northern Ohio can source their gas supply in West Virginia and Pennsylvania even if there is no direct path from the producing area to the market area. The system also utilises postage stamp rates. i.e. shippers pay the same rate for transportation regardless of how far the gas is moved. This reflects the meshed nature of the system, with multiple entry and exit points, and where there is little correlation between cost and distance.
Tenor and Duration	[See US – General] In open season processes, the pipeline may require extensive commitment periods. For example, the Columbia Gas Leach Xpress open season reserved the right to rejects bids that provided a contract term of less than 15 years.
Primary Sales – Existing Capacity	[See US – General]
Secondary Market	[See US – General]
Capacity Release	[See US – General]
Capacity Expansion Process	[See US – General]
Primary Sales – Capacity Expansion	[See US – General]

[40] This service is especially helpful to LDCs that must serve their load without knowing their exact load level each day. No-notice service is generally priced at a premium to firm transportation service.

6.3.4 Nominations, Scheduling and Balancing – Columbia Gas Transmission

Columbia Gas Transmission	
Nominations	[See US – General]
Scheduling Period	[See US – General]
Changes to Nominations	[See US – General]
Multiple Pipelines	[See US – General]
Balancing	
Balancing Period	Cumulative daily, with monthly 'settlement' of net imbalances. Additionally, quantities for shipper 'storage in transit' accounts must 'cross zero' twice per month.
Balancing Gas	[See US – General] Columbia offers transportation between designated receipt and delivery points (which may be aggregate points). Columbia manages flows on its network to effect deliveries (without any requirement for designation of a 'contract path'), and takes operational action to resolve any deliverability constraints. In particular, there are operational constraints associated with customers (consumers and storage) purchasing lower-cost Marcellus shale gas in Pennsylvania and West Virginia, at the Appalachian Pool and physical points, and then withdrawing it in Northern Ohio. Columbia is unable to physically deliver all of the purchased gas. [cxviii] To resolve this issue, Columbia makes operational purchases of gas in Northern Ohio, delivered by other pipelines that serve the region (such as ANR and Panhandle Eastern), and operational sales at the Appalachian pool. The cost of these actions is recovered from shippers withdrawing in Northern Ohio via an Operational Transaction Rate Adjustment (OTRA).
Participant Balancing	[See US – General]
Quantity Measurement	Where there is a difference between scheduled and actual (measured) flows at a receipt (injection) or delivery (withdrawal) point this must be allocated. This can take place according to the default order specified in the tariff, or a Pre-Determined Allocation Method (PDA). The default order in the tariff specifies: • For a delivery point, the 'last gas through the meter' is allocated to those holding firm storage, pro-rated based on storage capacity held, and thereafter against their other transportation contracts in the specified priority order, pro-rata based upon scheduled quantities.[41] • For a receipt point, differences shall be allocated pro rate amongst shippers based on scheduled quantities. If a PDA is used, this is provided by the ('interconnecting operators' responsible for operating the connection point to the Columbia system). For multi-tiered allocations:

[41] This is a somewhat simplified discussion of the actual rules. For further information consult the pipeline's FERC Tariff.

Columbia Gas Transmission	
	• Interconnecting operators at receipt locations shall provide a PDA to allocate to upstream title holders. • Upstream title holders may provide a PDA to allocate to the parties taking possession of their gas at a receipt location. • Shippers may provide a PDA to allocate their flows at either receipt or delivery locations. The party responsible for custody transfer (i.e. performing the measurement function) at the location determines the allocation and provides it to the pipeline. Types of allocation methods include, but are not limited to: Ranked, Pro Rata, Percentage, Swing, and Operator Provided Value. If parties cannot agree upon an allocation methodology, 'pro rata based upon confirmed nominations' is used as the default method.[cxix]
Recompense for Participant Imbalances	Imbalances over the month are recompensed through physical replacement ('payback').
Balancing Payment	A penalty of $0.25 per Dth is imposed on the portion of cumulative imbalances over a month exceeding 10% of cumulative deliveries for that month. This is not a 'cashout' purchase of imbalances, but a penalty in addition to the requirement to replace (or remove) the gas. Additionally, the cost of the OTRA is recovered from shippers in Northern Ohio based on their individual imbalances.

6.3.5 Transportation Rights – El Paso

El Paso

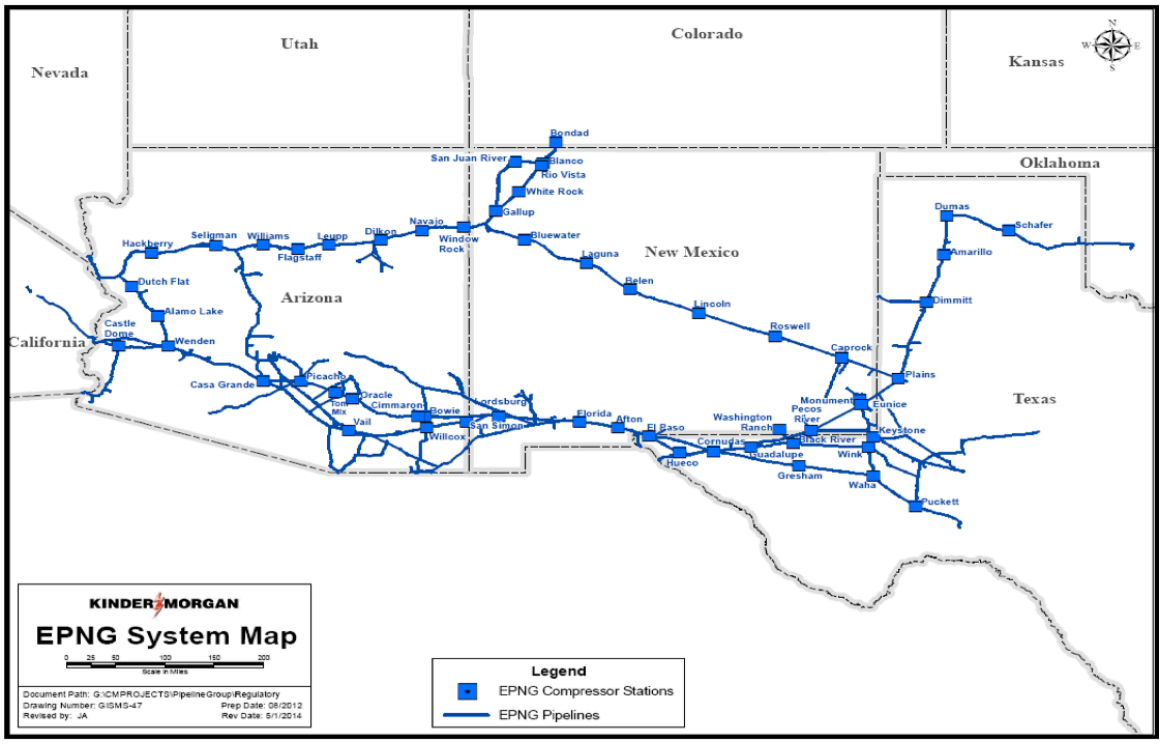


Figure 30 – El Paso Natural Gas System

Form of Transportation Rights	[See US – General]
Type	The principal forms of transportation service offered by El Paso are: • *Firm transportation (FT-1)*: (see glossary for definition of *firm capacity*). • *Firm transportation (FT-2)*: grandfathered firm service allowing greater hourly flexibility without penalty. Limited to East-of-California customers electing such service as of 1 September 2003, and consuming less than 10,000 Dth/day. • *Hourly firm transportation (FT-H)*: daily firm transportation service based on deliveries with varying hourly entitlements (only at 'premium service delivery points'). ⇒ 3-Hour Enhanced Peaking (FTH-3) ⇒ 12-Hour Peaking (FTH-12) ⇒ 16-Hour Peaking (FTH-16) ⇒ 8-Hour Peaking (FTH-8) • *Small shipper firm hourly transportation-virtual area (FTH-V)*: Daily firm transportation based on three hour enhanced peaking, available only to small shippers (<10,000 Dth/day

El Paso	
	taking delivery in the Permian virtual area. • *No-notice firm transporation – daily (NNTD)*: similar to firm transportation, except shipper may flow more gas than they were scheduled for.[42] • *No-notice firm transporation – hourly (NNTH)*: similar to NNTD, except with uneven hourly delivery rates, for 3-hour enhanced peaking, 12-hour peaking and 16-hour peaking. • *Interruptible transportation (IT-1)*: (see glossary for definition for *interruptible capacity*). • *Interruptible hourly swing (IHSW)*: service provided to accommodate hourly flow variations above hourly entitlements.
Locational Nature	Transmission service is sold on the basis of specified receipt point(s), delivery point(s) and flow path. "To the extent operationally feasible, a Shipper may make use of its firm Primary Capacity by segmenting that capacity into separate parts for its own use or for the purpose of releasing that capacity to the secondary market."[cxx] In other words, a shipper may break its capacity path into constituent parts, to use for transport between alternate points, or for resale. For the purposes of charging for transportation service, the system is broken into a number of zones: Production Area, Texas, New Mexico, Arizona, Nevada, California and Lateral Facilities (Wilcox).
Tenor and Duration	[See US – General] Firm transportation can be bought on an annual basis, or for the winter (Nov-Mar) or summer (Apr-Oct) periods.
Primary Sales – Existing Capacity	[See US – General] Some transportation service may allow for grandfathered terms, carried over from earlier forms of service. Additionally, upon expiration of a transportation services agreement (TSA) of 12 months or longer at the maximum tariff, or a TSA that was in effect on 26 March 2000, the shipper shall be offered a 'right of first refusal' to purchase for a new term, at prevailing maximum rates.
Secondary Market	[See US – General]
Capacity Release	[See US – General]
Capacity Expansion Process	[See US – General]
Primary Sales – Capacity Expansion	[See US – General]

[42] i.e. flows in excess of the shipper's nominated and scheduled quantity are deemed to be quantities flowed under 'no-notice service'. On El Paso, no-notice quantities cannot exceed +/- 10% of MDQ at each delivery point – though these totals can be aggregated as long as it does not "effectuate transport across persistent system constraints". Any amounts in excess will be treated as imbalances.

6.3.6 Nominations, Scheduling and Balancing – El Paso

El Paso	
Nominations	[See US – General]
Scheduling Period	[See US – General]
Changes to Nominations	[See US – General] In addition to the NAESB standard nomination cycles, El Paso also offers two additional nomination cycles: • Late Day Nomination Cycle Cycle 5: 11:00 p.m. for receipt of nominations; 12:00 a.m. for transporter to provide scheduled quantities to affected shippers and point operators. Scheduled quantities to be effective from 1:00 a.m. on gas day. • Final Nomination Cycle 6: 7:30 a.m. for receipt of nominations; 8:30 a.m. for transporter to provide scheduled quantities to affected shippers and point operators. The purpose of this cycle is to reflect quantities that have already flowed for the gas day.
Multiple Pipelines	[See US – General]
Balancing	
Balancing Period	Cumulative daily, with monthly 'settlement' of net imbalances.
Balancing Gas	[See US – General]
Participant Balancing	[See US – General]
Quantity Measurement	Quantities deviating from schedules are allocated according to either a pre-determined allocation method (PDA) or operational balancing agreement (OBA). PDA allocations are performed by the delivery point or receipt point operator, and may be based on:[cxxi] • Pro rata allocation, based on scheduled flows at the receipt or delivery point. • Swing allocations, whereby deviations are allocated to a designated 'swing contract'. OBA allocations occur as designated in the OBA with the connected facility – typically another pipeline.
Recompense for Participant Imbalances	Shippers can purchase 'firm daily balancing service', in a quantity no greater than 10% of their firm transportation. This defines a 'maximum inventory amount'. A shipper's daily imbalances accrue to its inventory account, with overrun penalties resulting if the balance of this account exceeds their maximum inventory amount. Imbalances may be netted: • across a shipper's transportation agreements • against other shippers' imbalances, based on imbalance trading • across points, provided it does not "effectuate transport across persistent system constraints" The imbalance account is brought back into balance through physical 'payback', during the month or within five business days of the monthly invoice date. If a final end-of-month imbalance is not eliminated within 30 days it may be cashed out by the pipeline. Additionally, a shipper may elect to

El Paso	
	cashout its imbalance at any time.
Balancing Payment	Cashout of unresolved monthly balances is based on the Cash-Out Index Price (COIP) multiplied by a penalty factor based on imbalance tolerance level. If imbalance <= 2% of scheduled quantity COIP = Average (COIP imbalance month, COIP cashout month) Otherwise COIP = Max(COIP imbalance month, COIP cashout month) for underage, or Min(COIP imbalance month, COIP cashout month) for overage If shipper sources from only one supply basin: Monthly COIP = monthly basin price = average of daily mid-point prices for that basin (e.g. Permian, San Juan, SoCal) Otherwise Monthly COIP = weighted average of all monthly basin prices Daily prices are sourced from ICE Day Ahead Index and Natural Gas Intelligence Daily Gas Price Index (Cash Market Prices).

Table 14 – Imbalance Penalty Factors (El Paso)

Imbalance	**Overage (shipper paid)**	**Underage (shipper pays)**
0 – 2 %	100%	100%
2 - 5%	100%	100%
5 – 10%	90%	110%
10 - 15%	80%	120%
15 - 20%	70%	130%
> 20%	60%	140%

6.3.7 Transportation Rights – Natural Gas Pipeline Company (NGPL)

NGPL

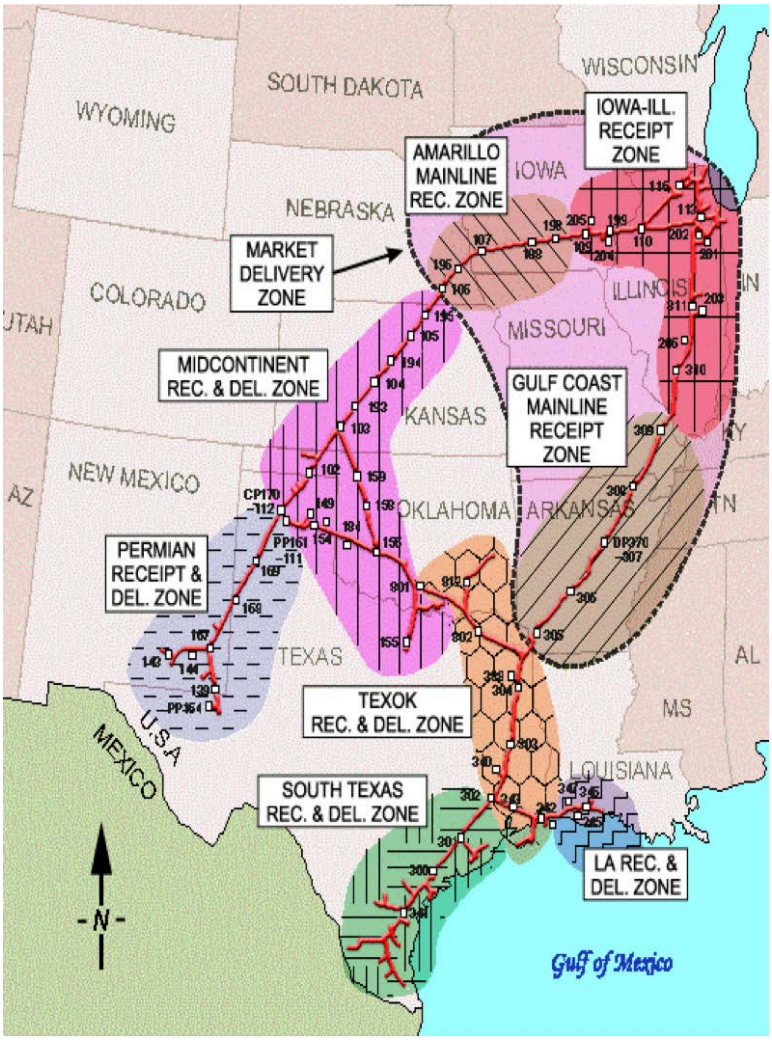


Figure 31 – NGPL Pipeline System

Form of Transportation Rights	[See US – General]
Type	The principal forms of transportation service offered by NGPL are:[cxxii] • *Firm transportation (FTS)*: (see glossary for definition for *firm capacity*) • *Flexible firm transportation (FFTS)*: a variant on FTS, where NGPL and the shipper agree the minimum and maximum number of days over a period for which NGPL shall obligated to provide service. • *Interruptible transportation (ITS)*: (see glossary for definition for *interruptible capacity*). A no-notice balancing (NB) service option is available with FTS and FFTS when combined with Nominated Firm Storage (NSS).
Locational Nature	Firm transportation service is sold between designated primary receipt points and delivery points. More than one primary receipt and/or delivery point can be selected, provided the sum of their maximum

NGPL	
	daily quantities (MDQs) equals the aggregate MDQ. A shipper's path is defined by these receipt and delivery points. Interruptible service includes all available points on NGPL's system. A shipper may segment its capacity path into constituent parts, to use for transport between alternate points, or for resale. Additionally, system-wide (SW) service option is available for shippers with firm service. This entitles the shipper to nominate any receipt or delivery point(s) on NGPL's system, on a secondary point basis. NGPL transportation rates are calculated from receipt to delivery zone. The zones are: Iowa-Illinois; Amarillo; Gulf Coast Mainline; Midcontinent; Texok; Louisiana; South Texas; Permian; and Market.
Tenor and Duration	[See US – General] Due to the nature of FFTS – drawing down on a specified number of days over a time period – it cannot logically be broken down into individual days and sold. FTS, by contrast, could be broken into individual days resold through the secondary market. The maximum duration for agreement is typically 25 years. For example, the NGPL Chicago market expansion requested a contract term of at least 10 years and no more than 25 years.[cxxiii]
Primary Sales – Existing Capacity	[See US – General]
Secondary Market	[See US – General]
Capacity Release	[See US – General]
Capacity Expansion Process	[See US – General]
Primary Sales – Capacity Expansion	[See US – General]

6.3.8 Nominations, Scheduling and Balancing – NGPL

NGPL	
Nominations	[See US – General]
Scheduling Period	[See US – General]
Changes to Nominations	[See US – General] A Shipper electing the Late Notice (LN) service option shall (for a fee) have the right to submit late nominations and intra-day nominations.
Multiple Pipelines	[See US – General]
Balancing	
Balancing Period	Cumulative daily, with monthly 'settlement' of net imbalances.
Balancing Gas	[See US – General]
Participant Balancing	[See US – General]
Quantity Measurement	Allocations for a receipt point are provided by those controlling the gas injected into NGPL's system, and for a delivery point by the entity control the facility immediately downstream. This occurs in accordance

NGPL	
	with a pre-determined allocation method (PDA), with valid methods including: ranked, pro rata, percentages, swing, operator-provided value and matching of supply sources with specified customers.[cxxiv] Combinations are also possible, and different methods may be utilised for overages and underages. No PDA is required if an Operational Balancing Agreement (e.g. with another pipeline) is utilised at the point. If there is no effective PDA or OBA, allocation is pro rata based upon scheduled quantities. Physical delivery points associated with an LDC may be aggregated into a logical 'central delivery point', for the purposes of allocation.
Recompense for Participant Imbalances	A shipper's daily imbalances are accrued across the month. These are netted: • across the shipper's different transportation agreements • against other shippers' imbalances, based on imbalance trading • across points, where material constraints do not exist between them …to to give the shipper's total monthly imbalance. Any net imbalance remaining 10 days after the end of the month is cashed out. In addition, daily imbalances incur a 'balancing service charge' each day, with a tolerance band applicable if the shipper holds 'interruptible balancing service' (IBS).
Balancing Payment	The cashout price for residual imbalances is determined by the Average Monthly Index Price (AMIP) multipled by a penalty factor for escalating imbalance levels (see Table 15). AMIP is calculated by taking the arithmetic average of Weekly Index Prices (WIP) for: • Louisiana, Gulf Coast, Onshore, Spot Delivered to Pipeline • Texas, Gulf Coast, Onshore, Spot Delivered to Pipeline. • Midcontinent, Spot Delivered to Pipeline. … reported in Gas Price Report issued by Natural Gas Week.

Table 15 – Imbalance Penalty Factors (NGPL)

Imbalance	Overage (shipper paid)	Underage (shipper pays)
0 – 5 %	100%	100%
5 – 10%	90%	110%
10 - 15%	80%	120%
15 - 20%	70%	130%
> 20%	60%	140%

During non critical times, daily imbalances are subject to a balancing service charge – effectively a variation penalty – ranging from $0.10-$0.50/Dth, with a tolerance band from 0-5% variance for IBS holders. In conditions of operational flow orders, this range adjusts to between Max($1.00/Dth, 0.5 x AMIP) and Max($8.00/Dth, 4 x AMIP) with a tolerance band of 0-3% for IBS holders.

6.3.9 Transportation Rights – Transco

Transco

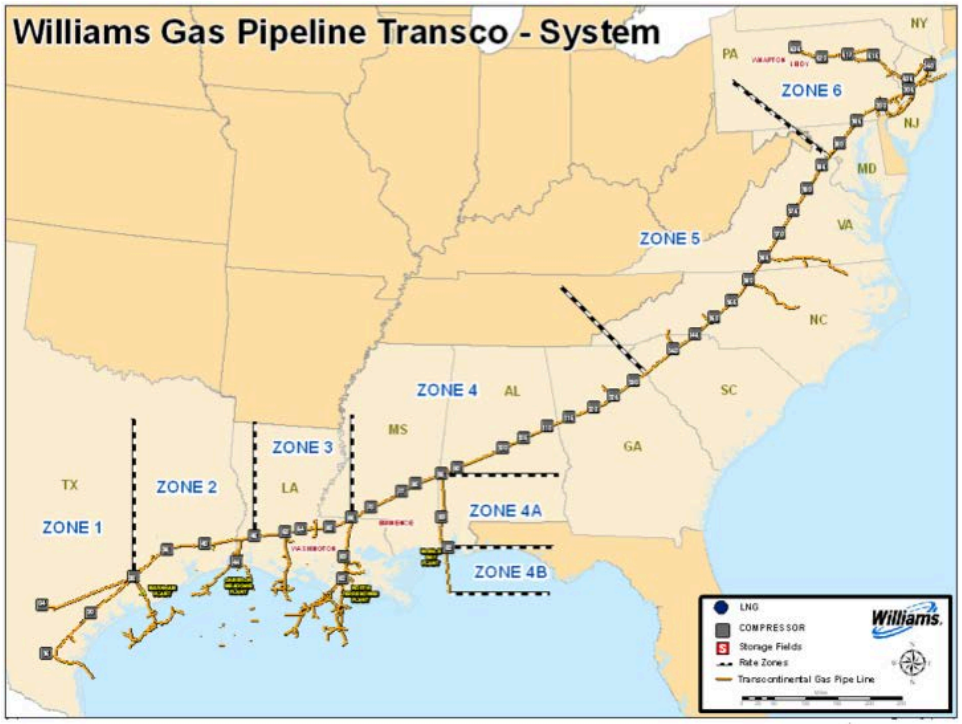


Figure 32 – Transco Pipeline System[cxxv]

Form of Transportation Rights	[See US – General]
Type	The principal forms of transportation service offered by Transco are: • *Firm transportation (FT)*: (see glossary for definition for firm capacity). • *Firm transportation notice (FTN)*: firm service classed as 'notice' service, and subject to scheduling penalties if quantities flowed are not within a band ±10% of scheduled quantities. • *Firm delivery lateral service (FDLS)*: for firm transportation on a delivery lateral. • *Interruptible transportation (IT)*: (see glossary for definition for *interruptible capacity*). • *Interruptible delivery lateral service (IDLS)*: for interruptible transportation on a delivery lateral.
Locational Nature	All firm transportation service is purchased from a receipt point to a delivery point, either on the Transco 'main-line', or separately, on a 'delivery lateral'. This implies a 'primary path'. Shippers may also nominate flows between 'non-traditional' receipt and delivery points along their primary path.[43] The Transco system is divided into multiple zones. Shippers can access any receipt and delivery points outside their primary path but within their zone, on a secondary basis.

[43] Scheduling from/to these locations, while not 'secondary', may be subordinate to firm services primary to these points.

Transco	
	Transco also offers a 'pooling service', which allows shippers to pool gas from multiple physical and/or virtual receipt points to a single point and then disaggregate gas from a single pooling point to multiple physical and/or virtual delivery points. There are 10 such pooling points in the Transco system (e.g. Station 210, in Northern New Jersey). Interruptible transportation is also provided on a point-to-point basis, from any available point(s) of receipt to any available point(s) of delivery. Each of the Transco system's eight zones (Z1, Z2, Z3, Z4, Z4A, Z4B, Z5, Z6) is also a separate rate zone for charging purposes.
Tenor and Duration	[See US – General]
Primary Sales – Existing Capacity	[See US – General]
Secondary Market	[See US – General]
Capacity Release	[See US – General]
Capacity Expansion Process	[See US – General]
Primary Sales – Capacity Expansion	[See US – General]

6.3.10 Nominations, Scheduling and Balancing – Transco

Transco	
Nominations	[See US – General] For FTN service, any scheduled flows greater than 110% or less than 90% of scheduled quantities (regardless of whether in balance) are deemed to have bought and nominated interruptible transportation for the excess.
Scheduling Period	[See US – General]
Changes to Nominations	[See US – General]
Multiple Pipelines	[See US – General]
Balancing	
Balancing Period	Cumulative daily, with monthly 'settlement' of net imbalances.
Balancing Gas	[See US – General]
Participant Balancing	[See US – General]
Quantity Measurement	Allocations for a receipt or delivery point are made in accordance with a pre-determined allocation method (PDA) for that point. For 'swing service delivery points', the PDA must designate the transportation contracts that will 'take the swing'. For other points, the PDA may use one of four methods: • Numeric rank • Operator provided value, with residual by numeric rank

Transco	
	• Operator provided value, with residual pro rata • Percentage assignment to each transaction Allocation of receipts and deliveries at points of interconnection with other facilities (pipelines and production) is according to the 'operational balancing agreement' (OBA) with the other facility. If there is no effective PDA or OBA for the point, allocation is pro rata based upon scheduled quantities. Additionally, special arrangements exist for the New York area, where: "The quantity of gas delivered to The Brooklyn Union Gas Company, Consolidated Edison Company of New York, Inc. and Long Island Lighting Company (New York Companies) through [Transco's] meters at the points of delivery into the New York facilities, defined as the mains and appurtenant facilities referred to in the New York Facilities agreement dated as of December 31, 1959, shall be determined, for any period, by allocating to each [shipper] the total quantity of gas delivered by [Transco]. The method for allocating such total quantity shall be mutually agreed to by the New York Companies and furnished to [Transco].
Recompense for Participant Imbalances	A shipper's daily imbalances, positive and negative, are accrued across the month. These are netted: • across the shipper's different transportation agreements • against other shippers' imbalances, based on imbalance trading • across all points within a zone • across zones, when the zones are in the same Operational Impact Area.[44] Imbalances netted across zones are 'traded' from one zone to the other, by the same shipper or between shippers, with a 'trading fee' payable (as the 'trading' represents de facto transportation). …to to give the shipper's total monthly imbalance. Any net imbalance remaining 17 days after the end of the month (known as the 'trading period') is cashed out.
Balancing Payment	The cashout price for residual imbalances is determined by zone, with the Reference Spot Price (RSP) for that zone multipled by a penalty factor for escalating imbalance levels (see Table 16). RSP for a zone is determined from the weekly reference spot prices for that zone for the balancing month, plus the first week of the following month. These are sourced from: • Zone 1 - Natural Gas Week Transco Station 30 Price • Zone 2 - Natural Gas Week Gulf Coast Regional Average Price • Zone 3 - Natural Gas Week Transco Sta. 65 Price • Zone 4, 4A and 4B - Natural Gas Week Transco Zone 4 Price • Zone 5 - Natural Gas Week Columbia Appalachia Pooled Price • Zone 6 - Natural Gas Week Dominion North Point Price, or in the event that price is not published for a given week, Natural Gas Week Dominion South Point Price.

[44] There are two Operational Impact Areas: Upstream of Station 90 (in Alabama), and Station 90 and Downstream.

Transco	

	If Net Imbalance ≤ 2.5%, then
	RSP = Average(weekly reference spot prices)
	Else
	RSP = Max(weekly reference spot prices) for underage, and Min(weekly reference spot prices) for overage

Table 16 – Imbalance Penalty Factors (Transco)

Imbalance	Overage (shipper paid)	Underage (shipper pays)
0 – 2.5%	100%	100%
2.5 – 5 %	100%	100%
5 – 10%	80%	120%
10 - 15%	70%	130%
15 - 20%	60%	140%
> 20%	50%	150%

Cashout for OBAs may be subject to alternate arrangements, as defined in each OBA.

6.4 Storage Arrangements

There are nearly 400 active underground storage facilities in the lower 48 states, operated by approximately 120 entities (or 80 parent entities).

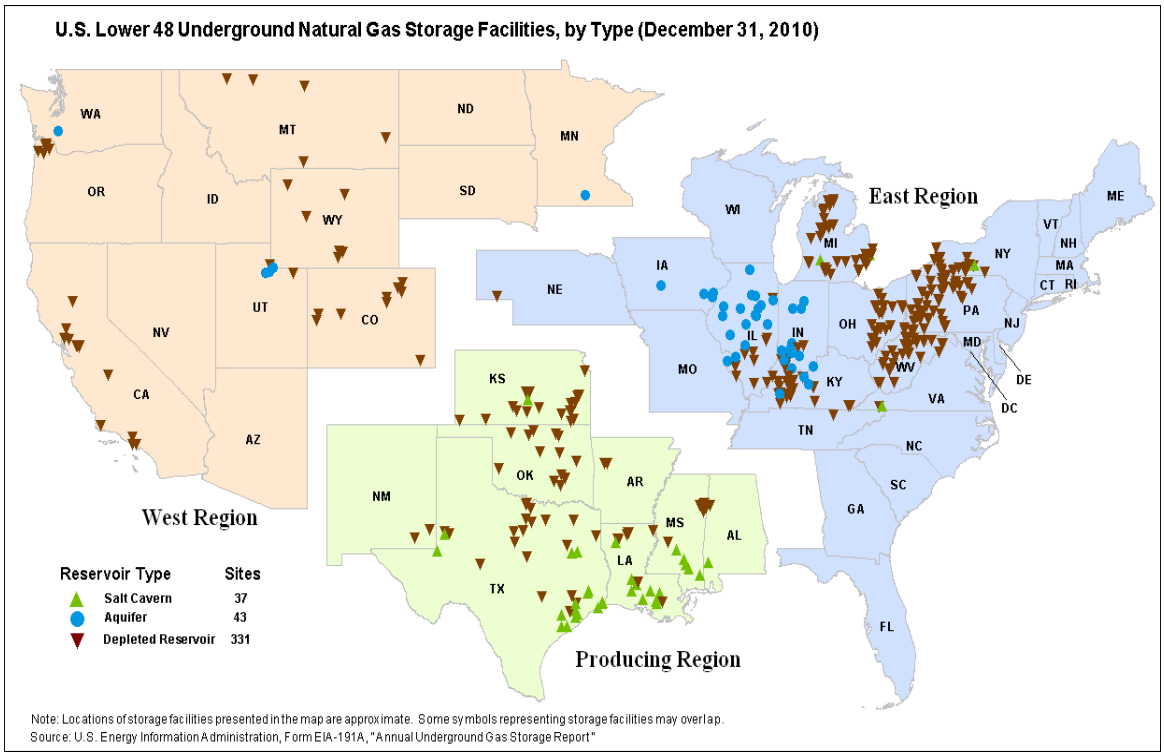


Figure 33 – US Natural Gas Storage Facilities

Storage Access	The principal owners/operators of underground storage facilities are:[cxxvi] • Inter-state pipeline companies, • Intra-state pipeline companies, • Local distribution companies (LDCs), and • Independent storage service providers. If a storage facility serves interstate commerce, it is subject to the jurisdiction of FERC; otherwise, it is state-regulated. FERC requires third-party access to storage facilities. Pipeline companies may withhold some of their storage capacity to support their operational management of the system. The bulk of the working capacity[45] of the storage facility, however, is made available on a third-party basis. LDCs tend to retain the bulk of their storage to meet their obligations to serve their customers, though in recent years some have also made portions of their storage capacity available. These arrangements are subject to approval by the LDCs' respective state regulators.[cxxvii]
Storage Rights	While every storage facility subject to FERC jurisdiction publishes an individual tariff, there is some commonality in the types of storage services offered. Most storage facilities offer both: • *Firm storage*: a firm right to store a defined quantity of gas • *Interruptible storage*: injections or withdrawals may be interrupted, based upon other storage users' priority. Shipper may also be required to withdraw some of its gas in storage. There are also commonly-found variations on these services: • *Seasonality*: Storage may be made available on a seasonal basis – both peak season and off-peak – or all year around. • *Specified vs. General*: Storage may be for a specified facility (e.g. the shipper may desire particular characteristics, such as deliverability rate), or for unspecified storage within the system, or a subset of it (e.g. a zone). • *Bundled*: May be bundled with transportation service to/from the storage facility. Many storage agreements require some form of adherence to injection and withdrawal patterns in order to maximise peak-season deliverability (e.g. to inject certain percentages in storage by given dates, and to withdraw certain amounts by the end of the heating season). Additionally, some pipelines offer flexibility services implying some use of storage – be it underground storage, LNG, or just taking advantage of their operational flexibility through linepack. These include: • Park & Loan: service to hold shipper's gas on the transportation system and return it an agreed time, or loan gas to the shipper and receive it back at an agreed time. • Storage in Transit: service to place net positive daily imbalances

[45] A portion of any storage facility – which differs based on the type of facility – is utilised for storage of 'base' or 'cushion' gas. This gas is required to maintain system pressure and deliverability rates, and is not part of the working storage of the system (though in off-peak season, some facilities can 'loan out' a portion of their cushion gas.

	into storage, or take them out of storage, as appropriate.
Primary Sales – Storage Rights	Storage rights that relate to storage facilities connected to interstate pipelines are subject to the same provisions as interstate pipelines in terms of access and rights, and are purchased much the same way. Storage may be priced at cost-based rates – published in a tariff – or market-based rates – determined through open season. Typically: • Firm storage rights for new capacity are purchased through open seasons. • Any unsubscribed or short-term firm capacity, as well as interruptible capacity, must be made available at regulated rates published in an approved tariff. A typical tariff structure might include the following elements: • capacity charges for firm contract rights to physical storage capacity. • injection charges for the injection of gas into storage. • withdrawal charges for the removal of gas from storage • daily storage charges for gas stored. If transportation is bundled, there may also be demand and throughput charges for transportation to/from the storage (or this may be purchased separately by the shipper).
Secondary Market	Trading of storage rights uses the same 'bulletin board' mechanism utilised for secondary trading of transportation capacity rights. Rights may be: • offered to other shippers via an open season process (in a number of cases it is mandatory to make capacity available via competitive bidding). • offered for sale at a designated price. • sold via pre-arranged trades, with trade details submitted to the transporter. Rights can be time-segmented and sold for only a specified period, or sold permanently. Capacity releases made under state-approved retail programs are generally exempt from capacity release bidding requirements. With substantial amounts of gas storage capacity locked up, the efficient function of the secondary market is essential to new entrants being able to gain access to storage.
Capacity Release	There is no substantial history of capacity 'hoarding' in the US, and as such, no formal 'use it or lose it' requirement or other provision to force capacity re-sale. Any suspected abuses or market manipulation can be addressed through FERC, or general competition regulation.

6.5 Trading Arrangements

6.5.1 Trading Reference Points

The benchmark for North American natural gas is the Henry Hub, located in southern Louisiana. The Henry Hub is interconnected with 13 different intra-state and inter-state pipelines. Because of its

central location and its high degree of interconnectedness, the Henry Hub is used as the delivery point for the New York Mercantile Exchange's (NYMEX) natural gas futures contract. While Henry Hub has served as the pricing reference point for virtually the entire North American natural gas market, other locations have also become important market trading points, such as Alberta, Canada, Chicago Citygate, and Dawn, Ontario, with some of these locations having an even larger number of spot market transactions than Henry Hub. Figure 34 below shows the top trading locations.

Figure 34 – Top 25 North American Gas Trading Locations

NAME	TYPE	DESCRIPTION[cxxviii cxxix cxxx]
Alberta AECO	Physical supply hub	Located adjacent to supply and storage in the Western Canada sedimentary basin.
Chicago Citygate	Physical demand hub	Deliveries into the Nicor Gas, Peoples Gas Light & Coke, North Shore Gas, and NIPSCO systems in the Chicago demand area.
Columbia Gulf Mainline	Physical supply hub	Located at Perryville, LA. Receipts into the Mainline portion of the Columbia Gas Transmission system between Rayne in Acadia Parish, LA and the Mississippi/Tennessee border.
Columbia Gas, Appalachian	Virtual supply zone	Deliveries into the ten aggregation areas listed in the Aggregation Service rate schedule of Columbia Gas Transmission, covering parts of WV, PA, OH & NY. Proxy for Marcellus/Utica shale gas into the Columbia system
Dawn Hub	Physical storage and trans-shipment point	Gas traded at Union Gas' Dawn Hub in Dawn Township, Ontario.
Dominion South Point	Virtual supply zone	All transactions within Dominion's South Pool, covering parts of PA, OH, MD, WV, VA. Proxy for Marcellus/Utica shale gas into the Dominion system.
El Paso Permian	Virtual supply zone	Deliveries into El Paso Natural Gas in the Permian virtual area, which includes the Waha, Keystone, and Plains pools.

NAME	TYPE	DESCRIPTION[cxxviii cxxix cxxx]
El Paso San Juan	Physical (aggregate) supply hub	Deliveries into El Paso Natural Gas receipt points in the San Juan Basin, including supply from the Blanco and Rio Vista processing plants in New Mexico.
Emerson Viking	Physical trans-shipment point	Transactions from TransCanada Pipeline into both Viking Gas Transmission and Great Lakes Gas Transmission at Emerson, MN. Prices are listed in $US/MMbtu.
Henry Hub	Physical supply hub, storage and trans-shipment point	Flows in/out of Henry Hub in Erath, LA. 11 interconnected inter-state and intra-state pipelines, plus salt cavern storage at Jefferson Island.
Katy	Physical storage and trans-shipment point	Includes transactions into both the Enstor Katy Storage Hub (Enstor Pool) and the DCP Midstream Katy Hub. 11 interconnected pipelines.
Kern River Opal	Virtual demand zone	Contains deliveries of gas within Kern River's Fuel Zone #11 (Las Vegas Area) and Fuel Zone #12 (California).
MichCon Citygate	Physical demand hub	Deliveries into the Michigan Consolidated LDC system, serving the Detroit area.
NGPL Mid Continent	Virtual supply and demand zone	Transactions in NGPL's Mid-Continent receipt and delivery zone, in TX, OK, KS.
NGPL Texok Zone	Virtual supply and demand zone	Transactions in NGPL's Texok receipt and delivery zone in Texas and Oklahoma.
Panhandle T_Okla	Virtual supply zone	Includes deliveries into Panhandle anywhere within its Field Zone, which incorporates the Kansas, Oklahoma, and Texas portions of PEPL that are upstream of its Haven, KS Compressor Station.
PG&E Citygate	Physical demand hub	Deliveries to customers behind PG&E's local distribution system in Northern California.
PG&E Malin	Physical demand hub	Comprised of deliveries from TransCanada's GTN Pipeline and El Paso/Kinder Morgan's Ruby Pipeline into PG&E's Redwood Path at Malin, Oregon.
SoCal Gas	Virtual supply and interconnection zone	Connections into Pacific Gas & Electric's Line 300 ('Baja Path'): El Paso Pipeline and Transwestern Pipeline at Topock, AZ; Kern River Pipeline at Daggett, CA; gas delivered along Kern River's High Desert Lateral; and Questar's Southern Trails Pipeline at Essex, CA.
SoCal Gas Citygate	Physical demand hub	Deliveries to customers behind Southern California Gas' local distribution system in Southern California. Includes storage.
Transco Z3	Virtual supply zone	Transactions between Transco Station 45 in Beauregard Parish, LA and Station 65 in St. Helena Parish, LA. Also includes the Central Louisiana Gathering System that intersects at Station 50, and the Southeast Louisiana Gathering System that flows directly into Station 65.[cxxxi]

NAME	TYPE	DESCRIPTION[cxxviii cxxix cxxx]
Transco Z4	Virtual supply and demand zone	Zone 4 begins just upstream of Station 65 at the Louisiana/Mississippi border, and ends at the Georgia/South Carolina Border, taking in supply laterals, storage (Eminence) and load (Atlanta).
Transco Z6 NY	Virtual demand zone	Serves major demand centres of New York and Northern New Jersey.
Texas Eastern M3	Virtual demand zone	Transactions within TETCO's 'Market Zone 3' representing demand around Philadelephia, New York City and New Jersey.
Waha	Physical supply and trans-shipment point	Transactions at the Waha Hub in the northern area of Pecos County, TX.

6.5.2 Balancing Market

There are no formal balancing markets for gas in the US.

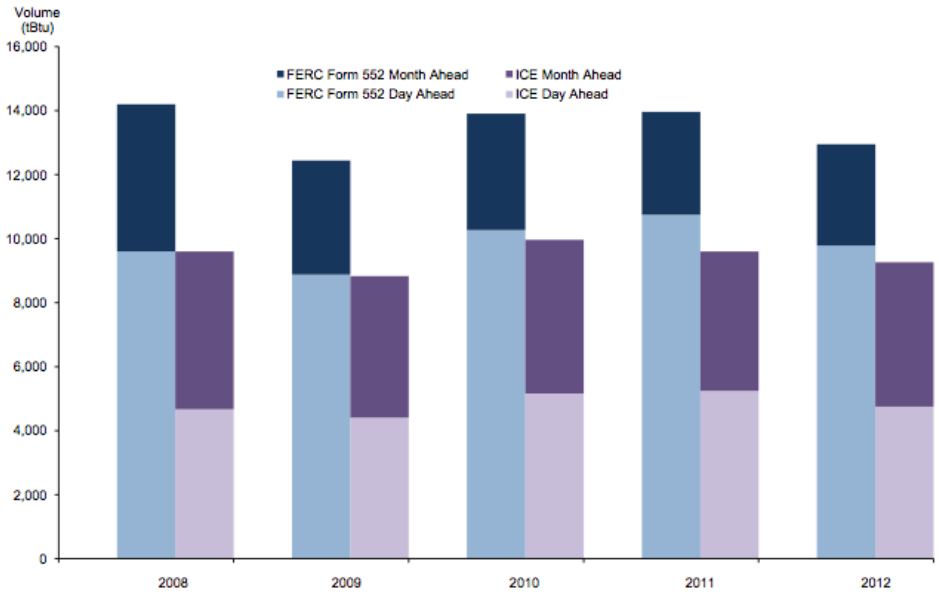
6.5.3 Prompt/Short-Term Forward Market

OTC Trading	The cash market for natural gas in the US typically operates in the period from next gas day to balance-of-month. OTC markets in gas are actively traded. In the previous decade ICE was historically a major venue for trade that was nominally OTC[46]. Because of the regulatory pressure to clear standardised trades, ICE has now converted many of its gas products to be futures. A large number of OTC brokers are active in the US natural gas market, such as ICAP, GFI, Amerex, Spectron and Tullet Prebon. Figure 35 gives some indication of the volume of day-ahead OTC transactions reported to FERC.
Exchange Trading	NYMEX, ICE and NGX all list prompt/short-term forward products for US gas. Figure 35 gives some indication of the volume of day-ahead transactions on ICE.
Trading Mechanism	All trading of prompt products on NYMEX, ICE and NGX occurs via a screen-based continuous auction.
Locational Basis	The benchmark location for natural gas trading in the US is the Henry Hub. NYMEX, ICE and NGX[cxxxii] all list a range of other locations – around 50 in all – for prompt (or 'swing') trading. These are typically traded as outright locations.
Product Tenor	The short-term US natural gas products traded on NYMEX and ICE are predominantly daily contracts – generally referred to as 'swing' contracts – or strips of dailies. There are also a small number of weekly options. On NYMEX, dailies tend to trade out for the current month and the next month. On ICE tend to trade out further, ranging from 65 to 365 days. Short-term (daily) options tend to be listed out for current and next four days, and weekly options for the next four weeks.

[46] Principally because trades, even though conducted on an exchange mechanism, resulted in bilateral deals settled directly between principals.

Participation	As these markets are operated by registered futures markets, participation requirements are the same as for futures trading, discussed under Forward Market, below.
Settlement and Credit Risk	The market is settled, and credit risk is managed, according to the same risk management disciplines as discussed in Forward Market below. Additionally, for product traded out only one or two days into the future, consideration must be given to settlement risk as regular margining discipline cannot be applied (the energy is consumed by the time regular margining could collect collateral and variation margin). All clearing for NYMEX is done through the CME Clearing House. Clearing of all financially-settled trade on ICE is done via ICE Clear Europe. Clearing of all trade on NGX, and all physically-delivered trade on ICE is done via NGX.
Delivery Method	All cash/prompt contracts on NYMEX are cash settled. The products listed through ICE's futures and options platform are all cash-settled, though it lists a range of prompt physical products on its OTC platform. NGX indicates its products as capable of being either physically delivered or cash-settled.
Delivery Integration	NGX utilises 'multilateral submission', for those points which allow it, to submit nominations on its users behalf. These nominations can be one-sided provided the overall set is in balance.

Figure 35 – Volume of FERC Reported Fixed Price Natural Gas Transactions 2008-1012



Source: FERC Form 552 submissions as of May 15, 2013; ICE
Note: All contracts are fixed-price contracts. ICE fixed-price month-ahead volumes are reported as delivery per day and are multiplied by 30 to reflect total monthly volume. FERC fixed-price month-ahead volumes are reported as monthly volume. One tBtu equals 1 million mmBtu.

6.5.4 Forward Market

OTC Trading	The cash market for natural gas in the US typically operates in the period from next gas day to balance-of-month.

	OTC markets in gas are actively traded. In the previous decade ICE was historically a major venue for trade that was nominally OTC. Because of the regulatory pressure to clear standardised trades, ICE has now converted many of its products to be futures. A large number of OTC brokers are active in the US natural gas market, such as ICAP, GFI, Amerex and Tullet Prebon. Figure 35 gives some indication of the volume of forward OTC transactions reported to FERC.
Exchange Trading	Natural gas futures trading takes place on both NYMEX and ICE. NGX offers physical products which trade on the ICE platform. Daily volume on NYMEX Henry Hub gas futures (NG) averaged over 342,500 contracts in 2014. Figure 36 and Figure 37 give an indication of the volume of natural gas trading on NYMEX, and each exchange's relative market share.

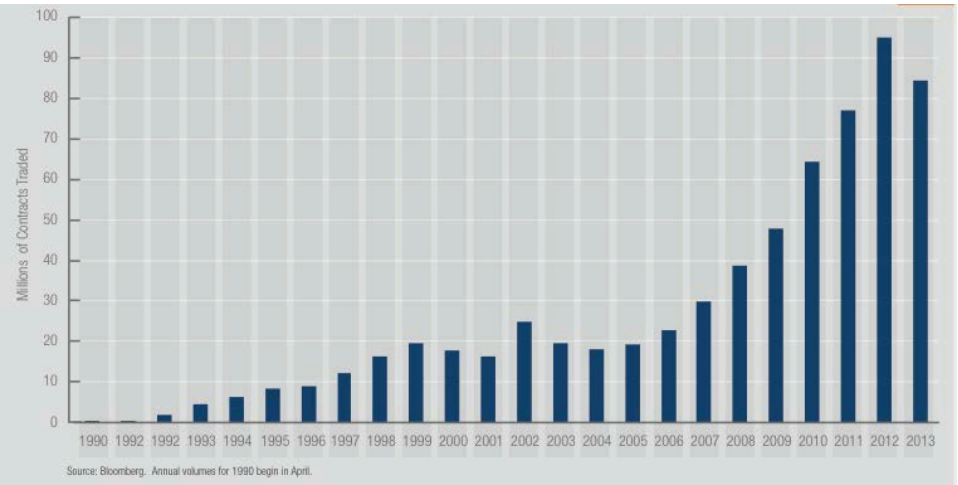


Figure 36 – NYMEX Annual Natural Gas Volume (1990-2013)[cxxxiii]

Trading Mechanism	All trading of regular products on all three exchanges is conducted electronically. Trades executed off-exchange may also be submitted for clearing. Additionally, a small amount of open outcry trading continues to take place at NYMEX, for options only (open outcry trading of futures has now ceased).
Locational Basis	The benchmark location for natural gas trading in the US is the Henry Hub. Additionally, NYMEX, ICE and NGX all list a range of other locations – around 50 in all – with the top 25 locations shown in Figure 34. On NYMEX and ICE these locations are offered for trading as both 'outright' products, and at a basis differential to Henry Hub. NGX products are listed as outrights. Additionally, ICE also offers an index market based on the change in the Weekly Gas Storage Inventory Number published by the EAI.

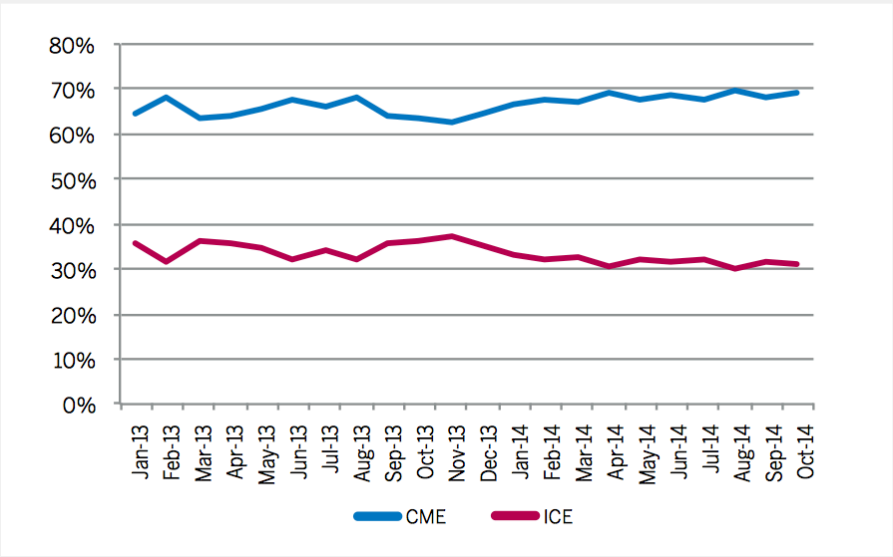


Figure 37 – Henry Hub Futures Market Share [cxxxiv]

Product Tenor	Natural gas futures traded on both NYMEX and ICE are predominantly monthly contracts. There are also a small number of 1, 2, 3, 4, 5, 6 and 12 month calendar spread options. How far out contracts are listed tends to differ: • The most liquid contracts, based around the Henry Hub, are listed out all months for the current year and next 12 years, on both exchanges. • Less liquid outrights and basis swaps tend to be listed out for periods ranging from 36 to 120 months, with 60-72 months being fairly common. • Calendar spread options (which are listed only for Henry Hub) tend to be listed out for the next 12 expiries (meaning 12 years for the annual option), except for the monnthly, which is listed out for 24 expiries.
Participation	CME/NYMEX and ICE distribute their trading screens worldwide. Organisations must be registered to participate, but need not be a 'member' or 'seat holder' of the exchange. Participants also require a relationship with a clearing member of the clearing house, to act as clearing intermediary. Trading organisations may be those seeking to hedge a physical exposure, or those with no direct interest in receipt or delivery of physical product. Individual traders are generally required to hold an appropriate trading licence. Only those with the ability to make or take delivery are permitted to carry a net open position in a physically-delivered contract through to delivery – all others exit their positions prior.
Settlement and Credit Risk	Settlement and credit risk management is performed by accredited clearing houses: • NYMEX: uses CME Clearing House • ICE: uses ICE Clear Europe for financially-settled products, and NGX for physically delivered products

	• NGX: uses NGX clearing These clearing houses use robust settlement and credit risk management disciplines including: [cxxxv] • daily mark-to-market (variation margining), a form of incremental settlement based on daily price moves. • assessment of collateral requirements based on portfolio risk. • leving of delivery margin for net positions to be delivered. • other levels of credit intermediation and protection in the event of extraordinary events.
Delivery Method	The only physically delivered US natural gas product on NYMEX is the Henry Hub futures contract (and its associated option). All other NYMEX contracts are cash-settled, either as outrights against a defined external index, or as a basis differential against Henry Hub. The products listed through ICE's futures and options platform are all cash-settled, either as outrights our basis futures. The natural gas products listed on ICE's platform as 'OTC', however, are all classified as physically delivered, and cleared by NGX. Not surprisingly, these mirror the contracts listed by NGX on its own platform, which have the option of being physically delivered, or cash-settled as outrights.
Delivery Integration	For net non-zero positions on NYMEX at the completion of trading (i.e. when he contract 'comes off the boards'): • Participants first have an opportunity to reduce their positions through lodging an EFP (Exchange of Futures for Physical) transaction. • Remaining net long and short positions at this point will be matched for delivery using 'bilateral matching' (see glossary). • Participants will be expected to nominate these flows for delivery at the contract's nominated delivery location (Henry Hub in this instance). NYMEX holds 'delivery margin' against satisfactory delivery performance. • Alternately, the matched parties can agree an Alternate Delivery Protocol (ADP), and lodge notice with NYMEX. In this instance all delivery performance is a bilateral matter between the parties, and delivery margin is returned. NGX utilises 'multilateral submission' (see glossary), for those points which allow it, to submit nominations on its users behalf. These nominations can be one-sided provided the overall set is in balance. In the event of a delivery failure, NGX also has arrangements in place to secure replacement gas.

6.6 Market Information

Market Information	The Energy Policy Act of 2005 (EPAct 2005), authorises FERC to "facilitate price transparency in markets for the sale or transportation of physical natural gas in interstate commerce." The EPAct 2005 allowed FERC to issue rules to "provide for the dissemination, on a timely basis, of information about the availability and prices of natural gas sold at wholesale and in interstate commerce to the Commission, State commissions, buyers and sellers of wholesale natural gas, and the public." Subsequently FERC issued Order 704-A, which establishes

	requirements to report information to price-index publishers, as well as certain annual information to FERC. Prior to this, reporting to price-index publishers was not consistent across industry segments. Integrated-upstream and integrated-downstream companies, along with traders or wholesale marketers, reported the majority of eligible volume to the price-index publishers, whereas industrial or commercial consumers and chemical consumers reported less than 10 percent of their eligible volume. Additionally, the major exchanges publish current and historical pricing, trade volume, open interest and other information. Basic end-of-day information, such as end-of-day settlement prices, must be made available to the public free of charge. Brokers also publish information about trade on their own platforms to their customers.
Publication Platform	Exchanges publish information through their own platforms and via third-party data resellers (e.g. Reuters). Major OTC brokers also distribute information via their own platforms – though only to their own customers. Additionally, each pipeline is required to have an electronic bulletin board (EBB) where key information on system state, available capacity, operational flow constraints and other essential system operations matters can accessed by shippers and others.
Third-Party Services	There are a number of third-party price reporting services active in the US market, including: • Platts Gas Daily • Natural Gas Intelligence • Argus Natural Gas Americas • Canadian Gas Price Reporter • Energy Intelligence, Natural Gas Week • Bentek Energy These organisations provide services ranging from transaction price surveys and publication of various indices (e.g. daily, weekly and monthly) for key hubs, to provision of detailed analytics. These are used to inform participants individual trading and operational decisions, as well as used more generally across the industry, e.g. to set imbalance cashout prics. Figure 38 provides an overview of the coverage guide for Platts North American price assessment service. Also providing information and data analytics services, usually with data from the public markets, are the major information services such as Reuters and Bloomberg.

Platts M2MS-Gas (North America) Coverage Guide

Platts M2MS-Gas provides independent assessments of North America monthly forward gas prices at 79 hubs. Daily 10-year and monthly 20-year curves are derived using a combination of IntercontinentalExchange (ICE) activity and settlement data, broker quotes, and sophisticated quantitative techniques. Monthly price granularity and an open and validated methodology bring greater transparency to forward natural gas markets.

Key Features of M2MS-Gas

- Published daily, 120-month (10-year) forward curves provide market-based forward prices with monthly granularity
- Published monthly, 240-month (20-year) forward curves combine current 120-month daily forward assessments with 20-year annual price projections incorporating market fundamentals
- Published daily, 10-year monthly historical volatilities for all locations are based on daily price changes over the last 22 business days
- Published monthly, 20-year monthly historical volatilities for all locations are based on monthly price changes over the last 12 months

Platts, the Exclusive Publisher of ICE-driven Forward Curves, Offers Curves for 79 Natural Gas Locations in Five Regional Packages

Northeast Region	Gulf Coast Region		Mid-Continent Region	Upper Midwest Region	Rockies & West Region
Algonquin City Gate	Agua Dulce Hub	Tenn 100 Leg	ANR OK	ANR ML 7	Cheyenne
Columbia Gas Appalachia	ANR LA	Tenn 500 Leg	Centerpoint East	Chicago City Gate	CIG Rocky Mountains
Dominion South Point	Columbia Gulf LA	Tenn 800 Leg	Centerpoint West	Cons Energy City Gate	El Paso Permian
Dracut MA	Columbia Gulf Mainline	Tenn Zone 0	NGPL Midcon	Dawn Ontario	El Paso San Juan
Iroquois Receipts	Florida City Gate	Texas Eastern M-1	Northern TX-OK-KS	Emerson	Empress
Iroquois Zone 2	Florida Gas Zone 1	Texas Gas Zone SL	Oneok OK	Mich Con City Gate	Kern River Dlvd
Lebanon Hub Ohio	Florida Gas Zone 2	Texas Gas Zone 1	Panhandle TX-OK	Northern Demarc	Kern River Opal
Leidy	Florida Gas Zone 3	Transco Zone 1	Southern Star TX-OK-KS	Northern Ventura	NW Can Border Sumas
Niagara	Henry Hub	Transco Zone 2			NW WY Pool Rockies
Tenn Zone 6 Delivered	Houston Ship Channel	Transco Zone 3			PG&E City Gate
Transco Zone 5 Delivered	Katy	Transco Zone 4			PG&E Malin
Transco Zone 6 non-NY	Lone Star	Trunkline E LA			PG&E South
Transco Zone 6 NY	NGPL LA	TX Eastern E LA			So Cal Gas
TX Eastern M-3	NGPL S TX	TX Eastern East TX			Socal Ehrenberg
	NGPL TX-OK	TX Eastern S TX			TC Alberta AECO-C
	Southern Natural LA	TX Eastern West LA			Transwestern Permian
					Waha

M2MS-Gas National Package Locations	
Algonquin City Gate	NW Can Border Sumas
Chicago City Gate	NW WY Pool Rockies
Columbia Gas Appalachia	Panhandle TX-OK
Columbia Gulf Mainline	PG&E City Gate
Dawn Ontario	PG&E Malin
Dominion South Point	So Cal Gas
El Paso Permian	TC Alberta AECO-C
El Paso San Juan	Tenn 500 Leg
Florida Gas Zone 3	Transco Zone 3
Henry Hub	Transco Zone 4
Houston Ship Channel	Transco Zone 6 NY
Mich Con City Gate	TX Eastern M-3
NGPL TX-OK	Waha
Northern Demarc	Southern Natural LA
Northern Ventura	

Optional M2MS-Gas National Package includes a cross-section of 29 North America trading hubs.

ADDING NEW LOCATIONS SOON!
For details, stop by the Platts exhibit or contact support@platts.com.

Customers Who Subscribe to Both Platts M2MS-Power and Platts M2MS-Gas also Receive

- Historical correlations for all power locations versus selected natural gas locations
- Heat rates for all power locations versus selected natural gas locations
- Spark spreads for all power locations versus selected natural gas locations at varying plant heat rates

Figure 38 – Platt's Natural Gas Coverage Guide

6.7 Retail Competition

Retail Contestability

While deregulation of inter-state pipelines did provide an opportunity for some larger customers to bypass their LDC and become wholesale customers, the retail market is subject to state jurisdiction, with the result that the status of retail contestability varies widely.

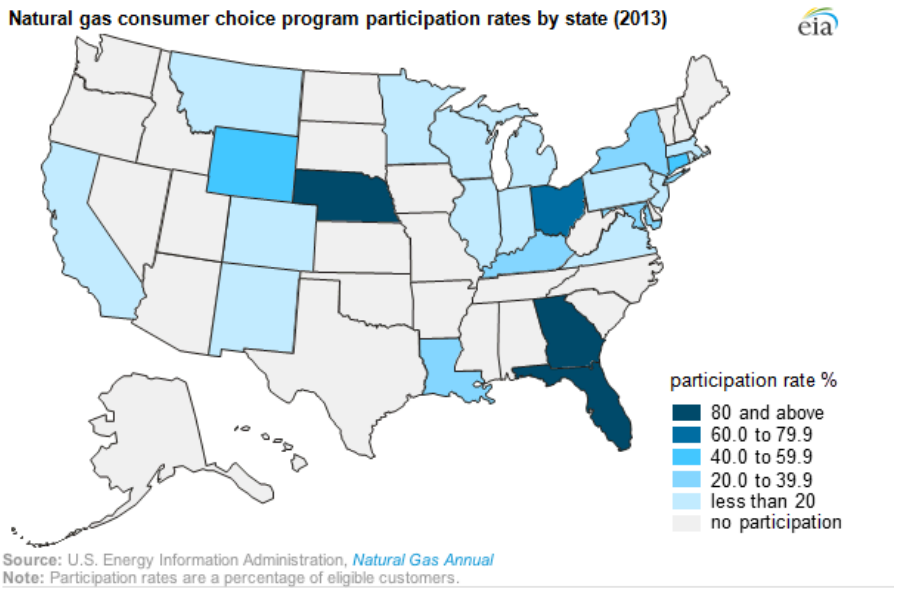


Figure 39 – Natural Gas Retail Choice Participation (2013)[cxxxvi]

	Figure 39 shows the level of participation in state retail choice programmes throughout the US. Note that, while correlated, this does not indicate the percentage of the state's demand trchnically open to competition[cxxxvii], but how many have actually availed themselves of their competive choice. Although nearly 34 million of the approximately 62 million residential gas customers in the US have access to choice programmes, only about 11 per cent in total are participating in such programmes.
Retail Opening	Some states have opened their retail market to competition only for industrial and commercial premises. However, where the intent is to open the market fully, it is more common in the US for all segments to open to competition at once, sometimes by region, rather than in demand tranches as seen in many other parts of the world.
Customer Switching	While rules vary by state, it is most common for the incumbent LDC to manage the switching process, and maintain the customer registry.

6.8 Regulatory Structure

6.8.1 Legal Framework

National Legislation

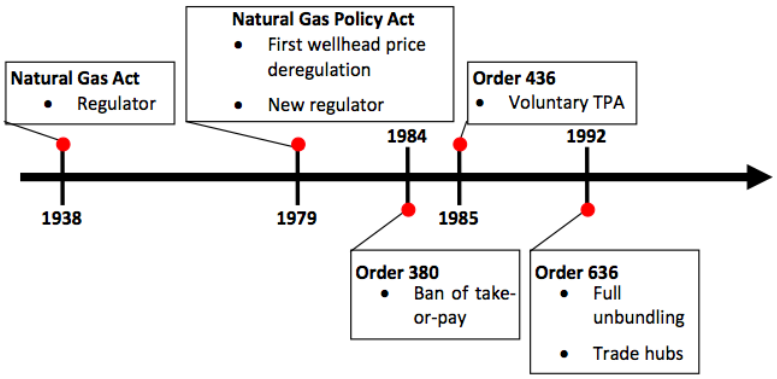


Figure 40 – Evolution of Gas Trading Laws[cxxxviii]

A number of laws govern the structure and regulation of the natural gas industry in the US:

- Natural Gas Act of 1938
- Natural Gas Policy Act of 1978
- Outer Continental Shelf Lands Act
- Natural Gas Wellhead Decontrol Act of 1989
- Energy Policy Act of 1992

The natural gas industry is also subject to various environmental and safety laws, not discussed herein.[cxxxix]

Organised financial markets in energy are subject to various statutes, including the:

- Commodity Exchange Act 1936
- Commodity Futures Modernisaton Act 2000
- Wall Street Reform and Consumer Protection Act (Dodd-Frank) Act 2010

International Agreements and Arrangements	Any natural gas facilities crossing a US border point, for purposed of import or export, require a Presidential Permit for a Border Crossing Energy Facility. For natural gas pipeline border crossings, this permitting authority is delegated to FERC.[cxl] While the US negotiated a treaty with Canada related to a Northern Natural Gas Pipeline, this related to the transport of gas from Alaska to the lower 48 states, and is not relevant to this profile.
Regulations	FERC issues regulations in the form of Orders and Policy Statements. Some of the key regulatory instruments driving the form of the US gas market are:[cxli] • Order 436 (Open Access Pipeline Transportation): initiated the restructuring of interstate pipelines from merchant sellers and transporters of gas into transportation only businesses. • Order 636 (the Restructuring Rule—Mandatory Unbundling): required interstate pipelines to separate their sales and transportation services and to provide equal, open-access transportation regardless of from whom the gas is purchased. • Order 637 (Pipeline Transportation Regulations): amended regulations governing the provision of unbundled pipeline transportation service. • Order Nos. 2004 and 497 (Pipeline/Affiliates Standards of Conduct): adopted 'standards of conduct' to regulate natural gas pipelines' interactions with their marketing affiliates. • PL04-3 (Policy Statement on Gas Quality and Interchangeability): established five principles to regulate gas quality and interchangeability issues. • Order 678 (Market-Based Storage): liberalized FERC's market-power analysis to permit consideration of close substitutes to gas storage in defining the relevant product market. Governing the safety standards, procedures, and actual development and expansion of any pipeline system is the job of the US Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA).
Codes	The codes governing how inter-state transportation and other system services are provided are encapsulated within each pipeline's FERC-approved tariff. For intra-state transportation and LDCs, analogous documents are defined on a state-by-state basis.
Market Rules	To the extent that pipelines operate/facilitate any quasi-market functions – such as open season bidding, and secondary trading of capacity – the operation of these is governed by the pipeline's approved tariff. Exchange-based trading on NYMEX, ICE and NGX is governed by the rule-books for those exchanges, which are written by the exchanges themselves, and authorised by the CFTC.

6.8.2 Licensing

Wholesale Market	FERC grants certificates for the construction and operation of new inter-state pipelines and storage facilities, coordinating with other government agencies with responsibility for safety and environmental matters, such as PHMSA and the EPA. Additionally, for storage FERC may grant

	market-based rates or require cost-based rates. No explicit licencing of shippers is required. Shippers apply for service, and if they meet requirements, service is granted.

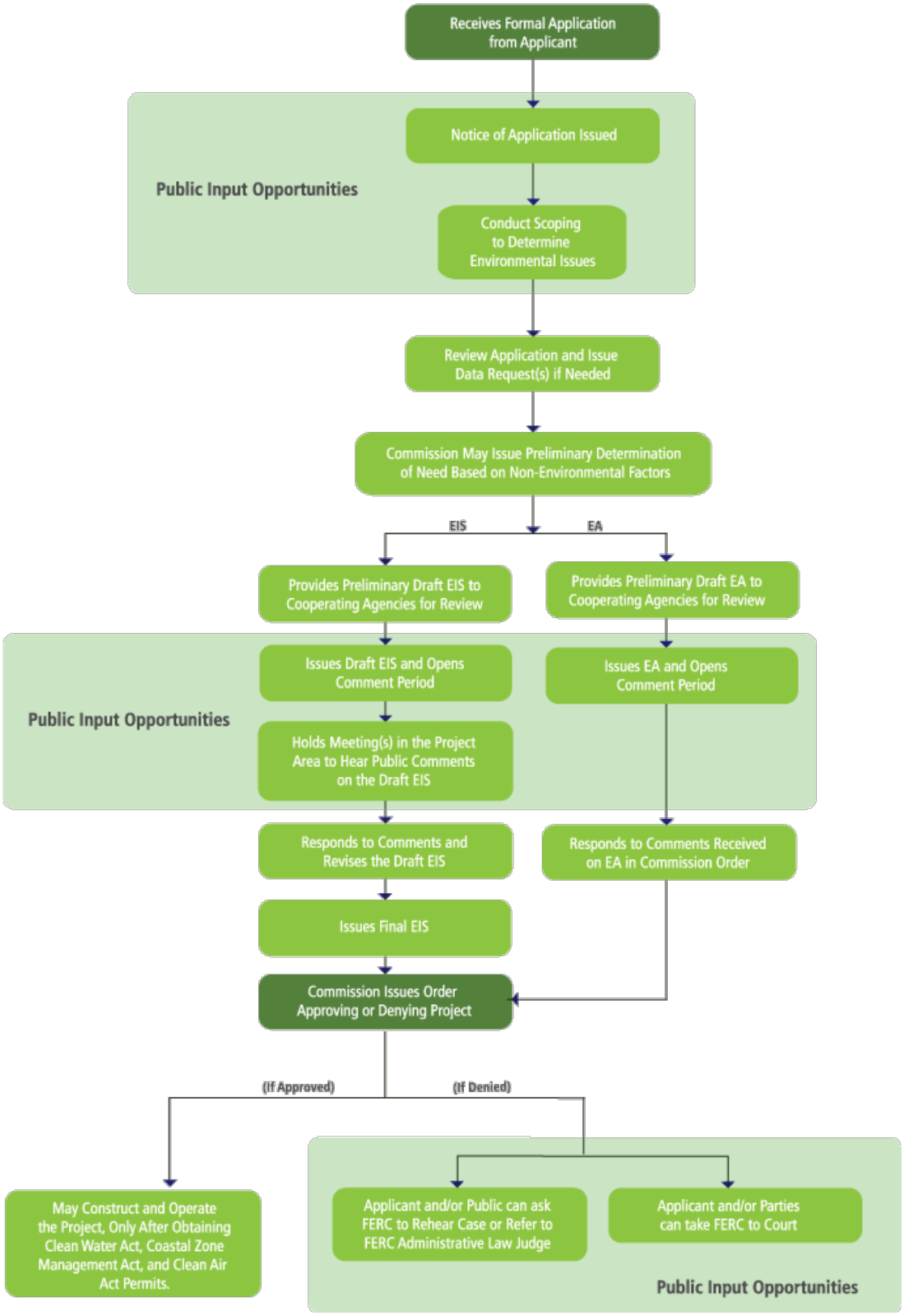


Figure 41 – FERC Process for Natural Gas Pipeline Certification[cxlii]

Retail Market	While requirements vary from state to state, typically an LDC will be licenced at the state level – though most LDCs existed prior to such regimes being implemented, and as such, are grandfathered in. Additionally, in those state with retail competition, competitive suppliers must also be licenced by the state public utilities commission or equivalent. An example licence application package for Pennsylvania can be found at (http://www.puc.state.pa.us/general/onlineforms/pdf/NGS_License_App_Package.pdf).
Financial Market	Typically for financial energy markets in the US, the following types of entity must be registered: • A derivatives exchange, such as those operated by NYMEX and ICE must be registered by the CFTC as a Designated Contract Market (DCM)[cxliii], or in the case of NGX, which is a foreign entity, as a Foreign Board of Trade[cxliv]. • The clearing house associated with the exchange must be registered by the CFTC as a Derivatives Clearing Organisation (DCO)[cxlv], regardless of whether the exchange is a foreign entity (though the CFTC may accept the DCO's oversight by another competent regulator) • OTC brokers must be registered as a Swaps Dealer. • Major traders in the OTC markets (i.e. passing a defined trading threshold, and generally trading not just for basic physical hedging requirements) must be registered as a Major Swap Participant.

6.8.3 Behavioural/Market Conduct Regulation

Open Access	FERC is responsible for monitoring inter-state pipeline and storage operator compliance with provisions related to open access. It may enforce this through its own administrative law proceedings (including the levying of penalties), or through the courts.
Rules Compliance	FERC is responsible for monitoring and enforcing compliance with the terms of a transporter's tariff. Compliance with the rules of an exchange is firstly enforced by the exchange's compliance department (which may be internal, or outsourced to an external body such as the National Futures Association). Matters may be escalated to, or independently taken up by, the CFTC depending on severity. In the US the exchange is typically entitled to levy penalties, and the CFTC may levy further (or alternate) penalties, without requiring court action – though in the most serious cases the CFTC may choose to bring court action, in order to make criminal as well as civil penalties available).

6.8.4 Economic Regulation

Wholesale	Pipeline revenues are regulated at the wholesale level by FERC, though if demand exceeds supply FERC may allow competitive bidding for the service in question. Similarly, storage facilities may have their revenue regulated on a cost-of-service basis, or may be granted the ability to charge market-based rates. The 'recourse rates' for a pipeline's various services are set as part of that pipeline's tariff, filed with and approved by FERC. There is no fixed

	duration or 'reset period' for pipeline tariffs. Instead they remain current until revised – normally through lodgement by the pipeline of revised 'tariff records'[47], though FERC may also examine the tariff if a complaint is made, or (rarely) on its own initiative. How FERC addresses such submissions often depends on whether any comments are received, and the nature of any objection. There is no explicit remedy for over/under recovery of revenues (versus the revenue projections on which the tariff was based). The implicit remedy is that the pipeline may file revised tariff records with FERC, or conversely, customers may complain to FERC and seek tariff revision if they believe circumstances have changed sufficiently that they should be charged less.
Retail	Revenue regulation at the retail level will depend on the state of contestability. If customer choice is available, typically the network component of an LDC's revenue is revenue regulated (by its PUC), in order to ensure fair and non-discriminatory access, but the retail component is free to float. If there is no retail competition for all or a segment of customers, the retail rate for those customers is typically revenue regulated on a cost-of-service basis. In some markets with competition, the PUC will still revenue regulated a 'default' service or 'price to beat' to be offered by the incumbent LDC, though such actions have over time been shown to often have a dulling effect on competition if insufficient 'headroom' is provided.

6.8.5 Other – Retail Market

Obligation to Serve	As with other retail market matters, this is determined on a state-by-state basis. While each LDC retains the right to disconnect service for non-payment, those rights are subject to limitations in most jurisdictions. For example, it is not permissible to involuntarily disconnect a customer during the principal heating season. In some jurisdictions the LDC is regarded as a retailer of last resort, able to step in if the competitive supplier fails. In fact, some jurisdictions even required the competitive supplier to pay the LDC a 'standby charge' to compensate for this.

6.9 Market Evolution and Future Development

6.9.1 Market Evolution

Establishment - Wholesale	Competition was first introduced at the wholesale level in 1985, and developed to a state of relative maturity by 1992.
Establishment - Retail	Large retail customer began being able to bypass their retailer and access the wholesale market from the time unbundling became effective with FERC Order 636, in 1992. The first residential customer choice programs for natural gas began being implemented in 1996. The initial uptake, however, was relatively slow.
Evolutionary Path	Some of the key milestones in the evolution of the market include: • 1954: Imposition of wellhead price controls

[47] These represent individual pages or sections of the overall tariff document – which it must be remembered, in the US also encompasses all the pipeline's rules, etc.

	• 1970s: Regulatory model leads to shortages and curtailments. • 1978: Natural Gas Policy Act reforms well-head price controls, leading to large production increases • 1980s. Market prices declined and production for older lower priced supply sources dropped. • 1985: Open Access Rules FERC Order 436 is released, encouraging pipelines to give equally favourable terms to existing customers and direct purchasers. Beginning of industry restructuring to current system. • 1989: Natural Gas Wellhead Decontrol Act deregulates the price of natural gas sales at the well head. Pipelines contracted for large amount of long-term gas using high incentive prices provided by the NGPA • 1992: FERC Order 636 orders interstate natural gas pipelines to 'unbundle,' or offer separately, their gas sales, transportation and storage services. The goal of this order is to ensure that all natural gas suppliers compete for gas purchasers on equal footing. [cxlvi] • 1996: First residential natural gas customer choice programs were implemented.

6.9.2 Market Development

Areas of the current arrangements that are presently topics of concern or under debate include:

- *Misalignment of Gas and Electricity Days*: The operating days for the natural gas and electric industries are not aligned in some parts of the country, posing particular problems for gas-fired generators. For example, gas-fired generators within PJM must submit their gas nominations before the results of the PJM day-ahead market are known, exposing them to significant coordination risk.

As gas generators become an increasingly prevalent part of the fuel mix – as with New England, and New York Zones J&K (Manhattan and Long Island) – this can pose risks for the electricity market as a whole. ISO New England and New York ISO resolved this problem by bringing forward the gate closure and schedule publication times for their day-ahead markets, with other ISOs presently considering similar measures.

- *Future of the Henry Hub Benchmark*: The continued growth of gas supply in the Appalachian region from the Marcellus shale has led to significant changes in pipeline flows – including causing flows on some pipeline segments to reverse their historical direction – and increased gas deliverability constraints. Pricing in the central and north-eastern portions of the Marcellus region can, at times of constraint, cause Appalachian spot prices to be more volatile, and separately significantly from prices outside the constrained region. While there are basis hedging products, to hedge the price differential between the Henry Hub and various Appalachian prices, these are significantly less liquid and shorter-dated than products based on the Henry Hub. As an increasing proportion of gas comes out of the Appalachian region, some wonder whether the critical mass for trading will eventually shift.
- *Incentives for Construction of Sufficient Pipeline Capacity*: The historic model of funding pipeline expansion through long-term (15-25 year) sales of pipeline capacity evolved from an industry model where the principal customers for this gas were LDCs with captive, price-regulated retail demand. With long-term guaranteed revenues, LDCs were well able to enter into long-term transportation agreements. This model is starting to come under pressure with the changing nature of both gas consumption and system dynamics.

Electricity generation is now the largest consumer of gas in the US, with investment in new gas-fired plant typically driven on a 7-year cycle – two years to construct, with many project developers looking to make an exit five years from when the plant enters service. As a result, many are unwilling to commit to the cost of funding long-term firm capacity additions, and instead elect to purchase interruptible capacity. Without such new capacity, the incidence of gas system constraint is becoming higher. This dynamic is already being seen in New England, where sufficient new capacity is not getting built, despite what would appear to be a clear need for it.[48]

Additionally, the dynamics of gas system operation are changing, with increasing gas consumption for generation leading to more volatile offtake profiles, and the changing nature of system flows likely to lead to more meshing of the network. For those pipelines selling capacity as a point-to-point contract path, the model is likely to start to break down, requiring an alternate model for sale of capacity (e.g. entry/exit rights), or for otherwise allowing pipeline revenue recovery. These dynamics are also likely to make it increasingly difficult to operate each pipeline in isolation.

Taken together, these factors are leading to an increasing examination of the US gas regulatory model, and whether an alternative approach is required.

[48] In response, the New England Governors have proposed an alternate funding model – see discussion earlier in this document.

7 HUB PROFILE – ZEEBRUGGE

7.1 Context

7.1.1 Location and Physical Reach

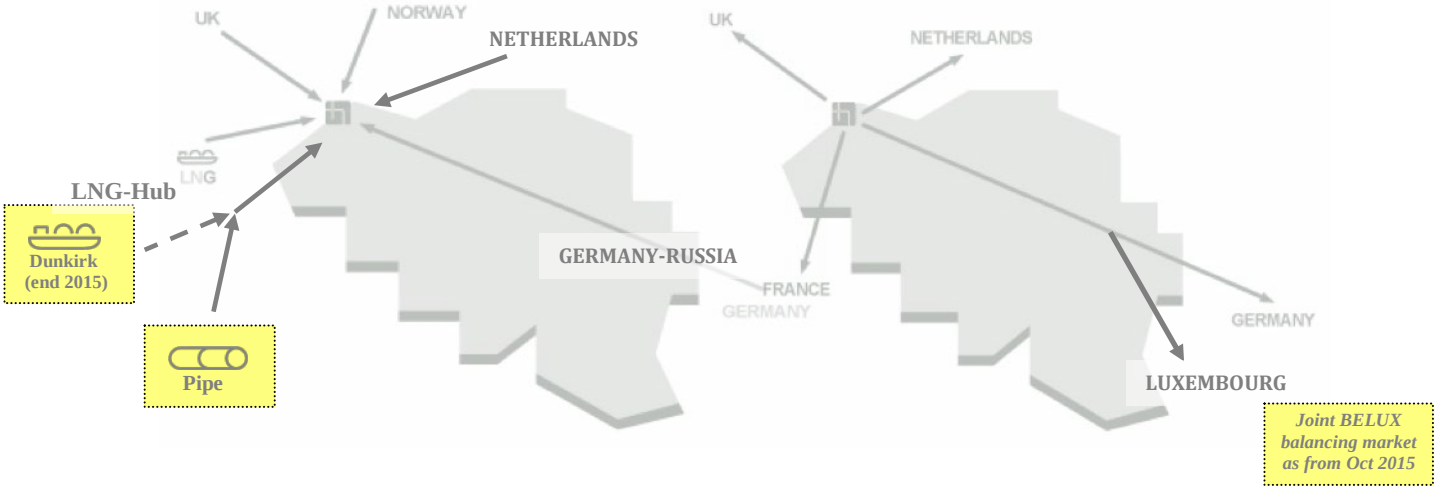


Figure 42 – Main Connections at Zeebrugge Gas Hub: Upstream (left) and Downstream (right) [49]

The Zeebrugge hub consists of a number of physical facilities:

- Bi-Directional Fluxys Grid Connection: Any gas brought into the Zeebrugge Hub can be shipped through the Belgian gas grid, operated by Fluxys, for delivery into Belgian market or onward, and similarly any gas brought into the Fluxys system can be traded for delivery to any point connected to Zeebrugge.
- Interconnector Zeebrugge Terminal (IZT): Bi-directional interconnector from Great Britain (Bacton). This is a key import route and the only export route from Great Britain to the Continental European markets.
- Zeepipe Terminal (ZPT): uni-directional pipe bringing Norwegian North Sea natural gas (Troll and Sleipner offshore gas fields).
- Zeebrugge LNG Terminal.
- At the end of 2015 a new connection with France will be operational, linking the LNG terminals of Zeebrugge and Dunkirk.

The principal trading locations are:

- Zeebrugge Beach (ZEE): physical trading facility, with ~ 50 active participants
- Zeebrugge Trading Point (ZTP): a notional balancing point (also serving as a proxy for the Belgian market), with ~40 active participants

7.1.2 Key Statistics

Trading volumes for 2014 amount were:[cxlvii]

- Zeebrugge Beach: 747 TWh (2.7 million TJ)
- Zeebrugge Trading Point: 95 TWh (342,000 TJ)

[49] Huberator website http://www.huberator.com; G&T Management Int'l

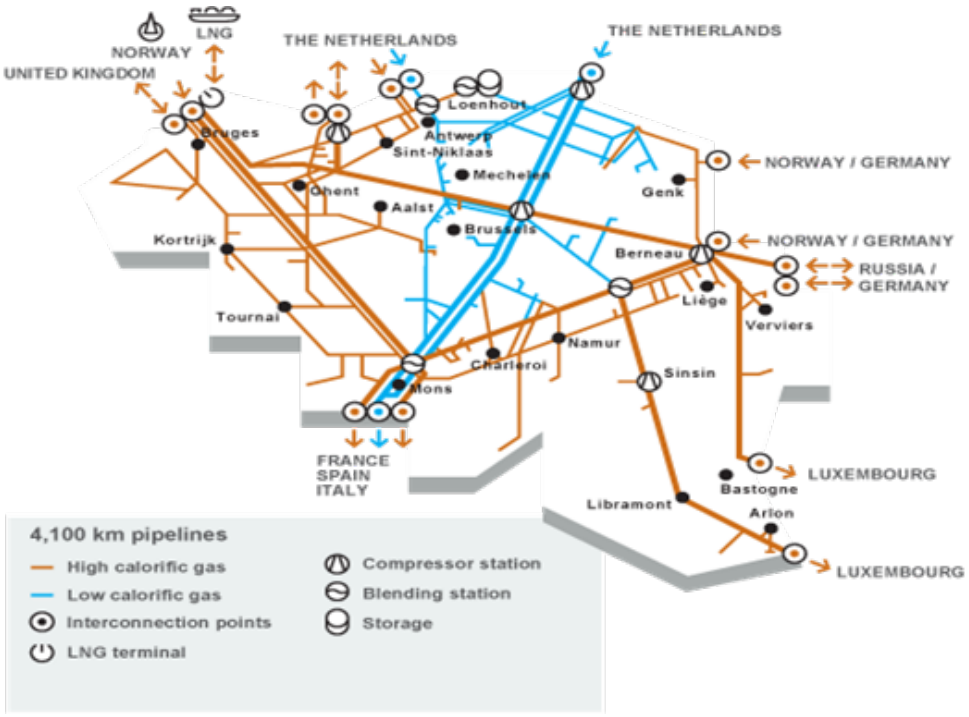


Figure 43 – Fluxys Transmission System

7.2 Industry Structure

7.2.1 Key Roles

The key roles in trading at Zeebrugge are:

- shipper
- hub operator
- transmission system operator
- connecting pipeline owners
- storage providers
- LNG terminals
- non-physical traders

7.2.2 Infrastructure Providers

Hub Operator	The operator of both the Zeebrugge Beach and Zeebrugge Trading Point is Huberator, a 90% owned subsidiary of Fluxys
Connecting Pipelines/TSOs	The Zeebrugge hub is directly connectred to the Belgian gas transmission system, operated by Fluxys. The other connecting pipelines are: • Bacton-Zeebrugge interconnector: to/from Great Britain. • Zeepipe: from Norway (part of the Gassco system)
Spot Market/Balancing Operator(s)	ICE-Endex (within-day market)
Prompt/Short-Term Forward Market Operator(s)	PEGAS and ICE-Endex

Forward/Futures Market Operator(s)	PEGAS and ICE-Endex

7.2.3 Regulators

Energy Regulator – National	The Commission de Régulation de l'Electricité et du Gaz' (CREG) regulates the Belgian gas market at large, and trading at the ZTP, but not presently at Zeebrugge Beach.
Energy Regulator – Regional	ACM cooperates with the EU regulator ACER. The EU's Regulation on Energy Market Integrity and Transparency (REMIT) requires reporting of all transactions to ACER, via the national regulators, to ensure cooperation in preventing market manipulation
Financial Market Regulator	ICE-Endex is a regulated market in the Netherlands, supervised by the AFM, and Powernext (which operates PEGAS), a regulated market in France, supervised by the AMF. Under EU financial regulatory arrangements, these entities are not required to be separately regulated in Belgium.

7.3 Hub Arrangements

7.3.1 Hub Characteristics

Hub Type	ZEE is a physical trans-shipment point ZTP is a virtual trading location
Hub Services	The Huberator offers standard hub services such as title tracking, nominations, matching and confirmations. Through its parent, Fluxys, shippers can also access: • transportation through the Belgian grid • storage • balancing services (automatic backup gas/offtakes) • LNG storage and regasification

7.3.2 Hub Transportation Rights

Form of Hub Rights	The hub services offered at Zeebrugge Beach are governed by a Hub Services Agreement (HSA) that all users must enter into with Huberator. This is sufficient for trading solely within the hub. Those transporting gas into or out of the hub must enter into a Standard Transmission Agreement (STA) with Fluxys, and/or transportation arrangements with connecting pipelines. Entering into the STA also provides access to the ZTP location and services.

7.3.3 Nominations, Scheduling and Balancing – Zeebrugge Beach

Nominations	Nominations are made to the Huberator for flows through Zeebrugge Beach.
Scheduling Period	Nominations are made for a gas day: 06:00 to 06:00, by 14:00 the day before.

Changes to Nominations	Renominations and intra-day nominations may be made at any time, with effect at 'hour +2' (two hours end of the current hour).[cxlviii] For purely title transfers, related to notional trading, changes are accepted up to 30 minutes before the hour.
Balancing	All the nominations are matched and no imbalance is allowed.
Balancing Period	Hourly
Balancing Gas	Huberator maintains access to flexibility supplies (via linepack or storage) from Fluxys to support its "automatic backup" activies.
Participant Balancing	The Huberator provides "automatic backup" services to inject, and "automatic offtake" services to withdraw gas to ensure balance is maintained, for up to 5 hours in the event of a curtailment into or out of the ZEE hub. Beyond this time, if a shipper's deliveries into the hub remain curtailed, the hub operator will in turn curtail the onward deliveries of all those the shipper is delivering the gas to, in order to maintain balance – and similarly if offtakes remain curtailed, it will curtail the shipper's deliveries into the hub (if feasible).
Quantity Measurement	"Effective hourly deliveries" are determined by the hub operator.
Recompense for Participant Imbalances	Imbalances are cash-settled through payment of an Automatic Backup and Offtake Charge. This is calculated for each hour in which an imbalance occurred, and billed monthly.
Balancing Payment	The Automatic Backup and Offtake Charge equals:[cxlix] Automatic Backup Commodity Charge - Automatic Offtake Commodity Charge + Automatic Backup and Offtake Service Charge Automatic Backup Commodity Charge = Imbalance quantity x weighted average paid for backup gas for the day (<= 135% of daily gas price published day-ahead) Automatic Offtake Commodity Charge = Imbalance quantity x weighted average paid for backup gas for the day (<= 135% of daily gas price published day-ahead) Service Charge = is the maximum of a fixed charge and variable charge (per MWh) per event.

7.4 Trading Arrangements

7.4.1 Balancing Market

Market Operator	The TSO (=Fluxys) is formally the operator of the balancing market for the low-calorific value (L-Gas) and high-calorific value (H-Gas) grids in Belgium. It has appointed ICE-Endex to operate this market.
Trading Mechanism	ICE-Endex operates a within-day market which is used by the market parties to trade and balance themselves, and by Fluxys to balance the Belgian to buy or sell gas if within day balancing actions are required. The market transacts via a continuous automated auction on the ICE trading system WebICE.

Locational Basis	The balancing market offers separate products at the ZTP notional point for the L-Gas and H-Gas systems. Additionally, the TSO may enter into locationally-specific trades should operational requirements dictate.
Trading Interval	The trading interval is an hour.
Participation	All shippers allowed to nominate on Zeebrugge can participate, provided they sign the membership agreement of ICE-Endex and adhere to the market rules of the exchange and the clearing house.
Measurement	Quantities are measured and/or allocated by Fluxys.
Settlement and Credit Risk	Settlement is carried out by APX Clearing BV at present, but is due to move to ICE Clear Europe later in 2015. Billing period is weekly, but will likely move to business day once migrated to ICE Clear Europe. Participant creditworthiness is validated on order submission. Collateral requirements are determined to cover entire trading exposure (i.e. no unsecured credit).

7.4.2 Prompt/Short-Term Forward Market

OTC Trading	OTC brokers facilitate trade through both voice brokerage and broker trading platforms.
Exchange Trading	PEGAS and ICE-Endex offer ‘spot’ (in actuality day-ahead) trading at Zeebrugge.
Trading Mechanism	The market transacts via a continuous automated auction.
Locational Basis	Both ICE-Endex and PEGAS trade products for the L-Gas and H-Gas systems at the ZTP virtual hub. PEGAS also lists a product at the ZEE physical hub.
Product Tenor	Both ICE-Endex and PEGAS list prompt products covering within-day, day-ahead, Saturday and Sunday (tradable separately or as a weekend block) and individual days (for bank holidays). ICE-Endex also lists working-days-next-week and balance-of-week products. In Europe these are typically all referred to as ‘spot’ markets, even though only trading proximate to actual delivery is truly spot.
Participation	Only shippers able to nominate at the ZTP, or ZEE as applicable, are able to participate, provided they sign the membership agreement of the exchange and adhere to the rules of its and the clearing house.
Settlement and Credit Risk	Settlement on ‘spot’ (prompt) trading at ICE-Endex is carried out by APX Clearing BV at present, but is due to move to ICE Clear Europe later in 2015. Trading on PEGAS is cleared through European Commodity Clearing (ECC), a subsidiary of EEX.
Delivery Method	All contracts, at present, are physically delivered.
Delivery Integration	Both exchanges utilises multilateral submission of a balanced delivery file of one-sided nominations.

7.4.3 Forward Market

OTC Trading	OTC brokers facilitate trade through both voice brokerage and broker trading platforms.
Exchange Trading	Both PEGAS and ICE-Endex offer futures trading.
Trading Mechanism	The market transacts via a continuous automated auction.
Locational Basis	Both ICE-Endex and PEGAS trade products at the ZTP virtual hub. PEGAS also lists a product at the ZEE physical hub.
Product Tenor	ICE-Endex: lists futures contracts for dailies (up to 92 days), months (up to 26), quarters (next 2), seasons (next 2), calendar years (next 1). PEGAS: lists ZTP futures only for the next month PEGAS: lists ZEE futures contracts for: months (next 3), quarters (next 3), seasons (next 3), calendar years (next 1).
Participation	All participants on the exchange are eligible to trade, though only shippers able to nominate at ZTP, or ZEE as applicable, can hold positions through to delivery.[50]
Settlement and Credit Risk	Futures trades on ICE-Endex are cleared through ICE Clear Europe. Trading on PEGAS is cleared through European Commodity Clearing (ECC), a subsidiary of EEX.
Delivery Method	All contracts, at present, are physically delivered.
Delivery Integration	Both exchanges utilises multilateral submission of a balanced delivery file of one-sided nominations.

[50] These restrictions are often enforced through position limits and 'proof of ability to make/take delivery' requirements approaching the time the product ceases trading prior to delivery.

8 HUB PROFILE – CENTRAL EUROPEAN GAS HUB

8.1 Context

8.1.1 Location and Physical Reach

The Central European Gas Hub (CEGH) is a virtual gas trading location representing the Eastern portion of the Austrian gas market. It serves as an important gas trading point in Central Europe, and price reference for gas flows on to other parts of Europe, such as Slovenia, Italy, Germany, and Hungary.

Over 60% of gas inflows come from Russia, just under 20% from Norway, and the remainder from elsewhere[cl], with about 80 per cent of all physical gas imports were re-exported, primarily to Italy.[cli] Reinforcing CEGH's position as a major transit location is the substantial levels of seasonal gas storage in Austria, corresponding to around 84% of total internal gas consumption.[clii]

The CEGH Virtual Trading Point is a single point encompassing 20 previous title transfer points at various locations in Austria (13 in Baumgarten)

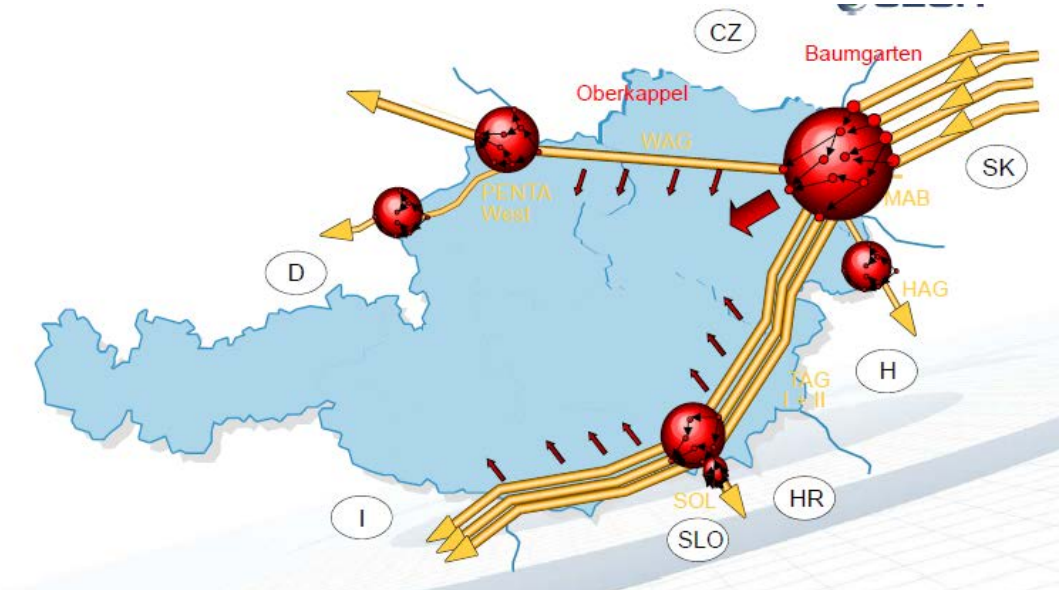


Figure 44 – Former Title Transfer Points Encompassed by CEGH Virtual Trading Point[cliii]

8.1.2 Key Statistics

Total trading volume at CEGH in 2014 was 440 TWh (1.58 million TJ).[cliv]

8.2 Industry Structure

8.2.1 Key Roles

The key roles involved in trading at CEGH are:

- Transmission System Operators (TSO).
- Interconnecting pipelines: connecting to other jurisdictions.
- Hub Operator: also known as the Virtual Trading Point Operator (VTP-O).
- Market Area Manager (MAM): manages collective arrangements for balancing and data provision (e.g. to support settlement) across TSOs.

- Distribution Area Manager (DAM): aggregator of demand requirements for the various distribution system operators.
- Balance Groups (BG)/Balance Group Representatives (BGR): a convoluted construct for what are essentially shippers.
- Balancing Group Coordinator (BGC): appointed by the Balance Groups, and responsible for ex post balancing settlement.
- Distribution System Operator (DSO): also serve as gas retailers.
- Storage System Operator (SSO).
- Producers
- Non-physical traders.

Figure 45 – Eastern Austria Market Area Model[clv]

8.2.2 Infrastructure Providers

Hub Operator	Central European Gas Hub (CEGH) is the Hub Operator – referred to as the Virtual Trading Point Operator.
Connecting Pipelines/TSOs	There are two transmission system operators in the Eastern market area: Gas Connect Austria (GCA) and Trans-Austrian Gas Pipeline (TAG). The principal interconnecting pipelines are: • SOL: South- East Gas Pipeline • HAG: Hungarian-Austrian Gas Pipeline • KIP: Kittsee-Petržalka-Gas Pipeline • WAG: West-Austrian Gas Pipeline • PW: Penta-West Pipeline • MAB: March-Baumgarten Gas Pipeline

Market Area Manager	Gas Connect Austria serves as the Market Area Manager for the region covered by CEGH.
Balancing Group Coordinator	Austrian Gas Clearing and Settlement (AGCS)
Spot Market/Balancing Operator(s)	Purchasing of balancing gas takes place through the within-day market of the CEGH Gas Exchange, operated by Wiener Börse and cleared by European Commodity Clearing (ECC).
Prompt/Short-Term Forward Market Operator(s)	CEGH Gas Exchange Spot Market, operated by Wiener Börse and cleared by ECC.
Forward/Futures Market Operator(s)	CEGH Gas Exchange Futures Market, operated by Wiener Börse and cleared by ECC. CEGH OTC Market.

8.2.3 Regulators

Energy Regulator – National	The principal national regulatory agency is Energie-Control Austria (E-Control).
Energy Regulator – Regional	E-Control cooperates with the EU regulator ACER. The EU's Regulation on Energy Market Integrity and Transparency (REMIT) requires reporting of all transactions to ACER.
Financial Market Regulator	The Austrian Financial Markets Authority (FMA) is the principal financial market regulator. The Austrian National Bank (OeNB) supervises prudential regulation and responsible for the regulation of payment systems.

8.3 Hub Arrangements

8.3.1 Hub Characteristics

Hub Type	*Virtual trading point*
Hub Services	The hub operator offers: • nominations, matching and confirmations • title tracking and transfer • direct nomination of net delivery positions (from the clearing house) to the MAM • allocations based on confirmed nominations

8.3.2 Hub Transportation Rights

Form of Hub Transportation Rights	The CEGH operates as an entry/exit rights system, where capacity is booked at designated entry and exit points, without reference to any transportation path. Contracts can be annual, monthly and daily. Both firm and interruptible capacity are traded. Where technically feasible, reverse flow (backhaul) transportation services are also offered.
Sale of Hub Rights	Capacity sales occur through the pan-European PRISMA platform. CEGH follows the auction calendar recommendations by the CAM network code (CAM NC):

	• Yearly capacity auctioned annually • Quarterly capacity auctioned annually • Monthly capacity auctioned monthly • Daily capacity auctioned daily • Within-day capacity auctioned hourly Unsold capacity from auctions is available for purchase through bulletin board screens In accordance with the CAM network code (CAM NC), an ascending clock algorithm[51] applies to yearly, quarterly and monthly capacity auctions and a uniform price algorithm[52] applies to day-ahead and within-day auctions.
Secondary Market	System users can resell or sublet their rights holdings to other registered users, either entirely or partially, without the agreement of the TSO. They can trade their capacity rights on the secondary market through a common online platform or through an energy exchange. Gas Connect Austria's capacity booking is available at the Capacity Bulletin Board (to support trading of cross-border natural gas transportation capacity) and Online Capacity Booking (to manage MAB transportation services).
Capacity Release	Austria has implemented the SoC, FDA UIOLI, and LT UIOLI mechanisms, and has chosen not to implement the OBB mechanism.[clvi] [See German or Dutch market profiles for definitions of these terms]

8.3.3 Nominations, Scheduling and Balancing

Nominations	Nominations are made to CEGH. Based on this, the relevant TSO(s) determines the relevant injections and withdrawals, and issues confirmations.
Scheduling Period	Nominations are made for a gas day: 06:00 to 06:00, by 14:00 the day before.
Changes to Nominations	Renominations and within-day nominations may be made at any time until 3:00 on the gas day D, with a lead time of 135 minutes.
Balancing	Balancing occurs at the aggregate level of market area. Balancing occurs in two timeframes: • Ex ante, based on nominated quantities, and conducted by the Market Area Manager. • Ex post, based on actual quantities, with balancing gas 'called off' by the DAM and settled by the Balancing Group Coordinator (BGC). Ex post balancing is principally relevant to domestic consumption

[51] In the various bidding rounds, price increases in order to determine the clearing price. In each round bidders submit quantity bids for the required amount of capacity at the specified price. If the demand for capacity exceeds supply, price is increased – initially by large and finally by small price steps – until capacity requests equals supply. The last price serves as clearing price at which capacity is allocated to bidders.

[52] In a single bidding round bidders can submit a list of bids for their company with up to ten combinations of price and capacity.

	(typically distribution connected), as nominations for trans-shipment are matched by the MAM (with allocations based on these), and any imbalances addressed ex ante.
Balancing Period	The balancing period is a gas day. Imbalances are initially assessed before the day. Thereafter the balancing positions are assessed on an hourly basis, though it is permissible for participants to be out of balance from hour to hour. [clvii] A final balancing assessment is made after the fact, on both an hourly and daily imbalance basis.
Balancing Gas	Ex ante balancing gas is procured by the MAM through the CEGH Gas Exchange within-day gas market operated by Wiener Börse. Ex post balancing gas is 'called off' by the DAM, utilising the CEGH Gas Exchange within-day gas market, and otherwise its own merit order list. The latter is also utilised for any balancing gas required at specific points on the system, rather than the VTP.
Participant Balancing	Balancing Group (shipper) nominations must consist of balanced injections and withdrawals.
Quantity Measurement	Ex ante balancing is based on nominations. For ex post balancing, the BGC determines energy allocations and after-the-fact imbalance quantities, based upon inputs received from TSOs and others.
Recompense for Participant Imbalances	If a participant imbalance prior to the day exceeds the de minimis level, of 24 MWh, the participant will be notified and provided an opportunity to remedy it within the hour through nomination of additional quantities. If not rectified, the MAM will purchase gas through the CEGH Gas Exchange Intra-Day Market and charge the shipper. While ex ante hourly imbalances are permissable during the day, the are subjected to a 'balancing incentive markup', to encourage ongoing maintenance of balance. Any residual imbalances at the conclusion of the gas day are cashed out by the BGC.
Balancing Payment	Payment for ex ante balancing is based on the market price of any gas procured on the within-day market to correct the imbalance. The 'balancing incentive markup' for ex ante hourly imbalances is set administratively as a fixed €/MWh, approved by the regulator. Ex post hourly balancing prices are determined based on the volume-weighted average price of the quantities procured in each hour by the DAM, from the gas exchange where possible, and otherwise from a merit order list maintained by the DAM. These are subject to a penalty factor of +20% for positive imbalances (gas bought) and -10% for negative imbalances (gas sold). For ex post daily balancing, net positive daily imbalances pay the highest price paid on the day in question, and net negative daily imbalances receive the lowest price.

8.4 Trading Arrangements

8.4.1 Balancing Market

Market Operator	Balancing utilises the within-day market operated by CEGH Gas Exchange, as a service of Wiener Börse.
Trading Mechanism	The within-day market transacts via a continuous auction for 45 minutes each hour, followed by a 15 minute call auction phase.
Locational Basis	CEGH Virtual Trading Point
Trading Interval	Hourly and Rest-of-Day, both with a lead time of three hours.
Participation	As all trades result in delivery, only BGRs are authorised to trade. They must also sign the membership agreement of the exchange.
Measurement	Quantities for the within-day market are 'as traded'
Settlement and Credit Risk	*Settlement and clearing is carried out by European Commodity Clearing (ECC), a division of EEX. Bills are presented, and funds transferred, each working day.* *The settlement of ex post balancing is carried out by AGCS, on a monthly basis.*

8.4.2 Cash/Prompt/Short-Term Forward Market

OTC Trading	The CEGH OTC Market provides a platform for OTC gas trading (essentially non-cleared bilateral trading). OTC brokers also facilitate trade through both voice brokerage and their own trading platforms.
Exchange Trading	The CEGH Gas Exchange of Wiener Börse offers trading of within-day and day-ahead products.
Trading Mechanism	The within-day market transacts via a continuous auction for 45 minutes each hour, followed by a 15 minute call auction phase. The day-ahead market transacts via a continuous auction.
Locational Basis	CEGH Virtual Trading Point
Product Tenor	Cash market product tenors are[clviii]: • Next Hour: single-hour with a lead-time of three hours • Rest of Day (ROD): remainder of day to 6:00, with a lead time of 3 hours. • Day-Ahead: for the following day, plus Saturday, Sunday and Weekend contracts.
Participation	All players must sign the membership agreement of the exchange. All those wishing to have the capability of making or taking physical delivery must also be registered as a BGR. Purely financial traders, with no capability to make or take delivery, cannot hold a position through to physical delivery.
Settlement and Credit Risk	*Settlement and clearing is carried out by European Commodity Clearing (ECC), a division of EEX. Bills are presented, and funds transferred, each working day.*
Delivery Method	All contracts held to expiry are physically delivered.

Delivery Integration	The delivery process uses multilateral submission. ECC nominated a balanced set of single-sided nominations to CEGH.

8.4.3 Forward Market

OTC Trading	The CEGH OTC Market provides a platform for OTC gas trading (essentially non-cleared bilateral trading). OTC brokers also facilitate trade through both voice brokerage and their own trading platforms.
Exchange Trading	Both CEGH Gas Exchange of Wiener Börse and CME Europe offer trading of futures products.
Trading Mechanism	Both futures markets transacts via a continuous auction.
Locational Basis	CEGH Virtual Trading Point
Product Tenor	CEGH Gas Exchange lists futures products of the following tenor: • Monthly: next 3 months • Quarterly: next 4 quarters • Season: next 3 seasons • Yearly: next 2 years CME Europe lists a monthly future, for the remainder of the current year and the next two years.
Participation	All players must sign the membership agreement of the exchange. For the CEGH Gas Exchange product, all those wishing to have the capability of making or taking physical delivery must also be registered as a BGR. Purely financial traders, with no capability to make or take delivery, cannot hold a position through to physical delivery.
Settlement and Credit Risk	*Settlement and clearing for CEGH Gas Exchange is carried out by European Commodity Clearing (ECC), a division of EEX.* *Trading on CME Europe is cleared through the CME Clearing House.*
Delivery Method	All contracts on CEGH Gas Exchange which are held to expiry are physically delivered. CME Europe contracts are settled against Austrian VTP price assessments published by ICIS Heren.
Delivery Integration	The delivery process uses multilateral submission. ECC nominated a balanced set of single-sided nominations to CEGH.

APPENDIX A – GLOSSARY OF TERMS

TERM	CONTEXT	DEFINITION
Allocation	Settlement	Process of assigning injection or withdrawal quantities, per *trading interval*, for a *transmission connection point*. Often this involves deriving quantities for multiple *participants* based on a single measurement.
Allocation Agent	Roles	Entity responsible for carrying out the *allocation* process for a given location.
Anchor Tenant	Transportation Rights	Transmission customer who enters into a long-term purchase of *capacity rights*, to support the construction or augmentation of a pipeline.
(Physical) Balancing	Balancing	Process of continually ensuring that supply = demand + the change in *linepack*, without violating system pressure constraints.
Backhaul	Transportation Rights	Transportation counter to the principal direction of flow.
Balancing Market	Trading	Market for procuring gas for *balancing*.
Balancing Mechanism	Balancing	Set of processes for keeping the gas *transmission system* in physical balance and determining the provision of balancing gas.
Balancing Operator	Roles	Operator of the *balancing mechanism* (which may or may not be market-based). Often the *transmission system operator*.
Balancing Period	Balancing	Period over which *participant imbalances* are determined.
Balancing Point	Balancing	Single point or grouping of *transmission connection points* used for the purpose of determining *participant imbalances*.
Bare Transfer	Transportation Rights	Secondary sale of *capacity rights* where the *transmission system operator* is informed of the transfer, but all operational arrangements (e.g. *nominations*) and financial arrangements (e.g. settlement) remain the responsibility of the primary holder.
Base Gas	Storage	See *Cushion Gas*
Basis Swap	Trading	*Swap* in which the reference price is based upon the differential between two separate indices (frequently representing separate locations).

TERM	CONTEXT	DEFINITION
Bilateral Matching	Delivery	Delivery mechanism where the *market operator* matches net long and short positions to determine bilateral delivery obligations, with matched *participants* then responsible for making *nominations* directly to the operator of the delivery point (often the *transmission system operator*).
C&I	Retail Market	Commercial and industrial retail customers.
Calorific Value	Gas System	Amount of chemical potential energy contained in a given volume of gas.
Capacity Hoarding	Transportation Rights	Act of withholding previously purchased but unused *capacity rights* from the *secondary market*, in order to deny their utilisation by other *participants*.
Capacity Release	Transportation Rights	Collective term for a range of mechanisms for allowing, encouraging or forcing release of unused *firm capacity* to other *participants* who may find economic use for it.
Capacity Right	Transportation Rights	A commercial right to transport a quantity of gas between a designated *source* and *sink*.
Cash Market	Trading	Any market settling in cash rather than requiring margining of forward positions. Includes the *balancing market* and the *prompt market*.
Cashout	Balancing	Process of resolving *participant imbalances* within a *balancing period* by a cash payment according to a pre-agreed formula or market price.
Cash-Settled Delivery	Delivery	Process of closing out open *forward market* positions through settlement at the contract's underlying reference price.
Citygate	Trading	See *Demand Hub*
Clearing House	Roles	Organisation responsible for carrying out the processes of settlement, credit risk management and banking in an organised futures market, and potentially other markets. This function often requires licensing from the financial market regulator.
Congestion (Contractual)	Transportation Rights	State in which further transportation through a pipeline cannot be scheduled, regardless of physical capability, because all contractual capacity is reserved.
Congestion (Physical)	Gas System	Physical state in which a pipeline segment becomes physically constrained preventing any increase in the flows of gas.

TERM	CONTEXT	DEFINITION
Contestible Customer	Retail Market	Retail customer allowed to choose its gas retailer.
Continuous Trading	Trading	Process of order matching in which bids and offers are matched continuously as they arrive.
Contract Carriage	Transportation Rights	Model of assigning *transmission capacity*, where capacity is divided into *capacity rights*, which are sold to *market participants*, who may ship gas up to that limit.
Contractual Transfer	Transportation Rights	Secondary sale of *capacity rights* where the *transmission system operator* coordinates both operational arrangements (e.g. nominations) and financial arrangements (e.g. settlement) with the secondary holder, removing the primary holder of all obligations for the period of the transaction.
Controllable Withdrawal	Gas System	*Withdrawal* taken by loads capable of responding to *scheduling instruction*.
Curtailment	Scheduling	Interruption of gas supply to a *delivery point*.
Cushion Gas	Storage	Gas maintained as permanent inventory in a *storage facility* in order to maintain pressure and deliverability rates.
Delivery Point	Gas System	Point of withdrawal of gas from the *transmission system*.
Demand Hub	Trading	*Hub* representing a major demand location. Also known as a 'citygate'.
Distribution Company	Roles	Organisation responsible for operation of the low pressure pipeline system responsible for the distribution of gas to the end consumer.
Firm Capacity	Transportation Rights	Form of *capacity right* guaranteeing the right to transport gas from designated *source* to *sink*, subject to *curtailment* only in emergency circumstances, and for the preservation of system security.
Firming	Hub Services	Service to physically correct for *participant imbalances* within a *hub* through the provision of additional gas in stores held by the *hub operator*.
Forward Haul	Transportation Rights	Transportation in the principal direction of flow. i.e. of *firm capacity*.
Forward Market	Trading	Market for trading of a product, or derivatives of a product, in advance of the time of scheduled physical delivery.
Futures Market	Trading	Specialised form of *forward market*, with standardised *products*, and subject to formal, regulated, trading and clearing disciplines.

TERM	CONTEXT	DEFINITION
Gas Day	Scheduling	See Scheduling Period
Gas Quality Specifications	Gas System	Specifications detailing the quality requirements for gas injected into the gas *transmission system*.
GFG	Gas System	Gas-fired generation
Hub	Trading	Designated locus for market trading activity, often associated with the convergence of multiple *transmission systems*, and various *hub services* to aid trading activity. Can be a *physical hub* or *virtual hub*.
Hub Operator	Trading	Entity responsible for operating a trading hub, and provision of *hub services*. Often operate under agreement with a *market operator* and *transmission system operators* at the hub.
Hub Services	Hub Services	Services provided at a hub to facilitate commercial transactions. May include *scheduling*, *balancing*, managing inter-pipeline transfers, validation of title transfer, *park & loan*, and storage.
(Participant) Imbalance	Balancing	Difference between *participant injections* into and *withdrawals* from a *balancing point*.
Injection	Gas System	Physical insertion of gas into the *transmission system*.
Injection Point	Gas System	Point of injection of gas into the *transmission system*. This can include *producers*, import terminals, *storage facilities*, and interconnecting systems, and can represent a single or aggregate location.
Interruptible Capacity	Transportation Rights	Form of *capacity right* which can be curtailed at *source* or *sink* based upon pre-defined scheduling priority, for economic and other non-emergency reasons.
Intra-Day Nominations	Scheduling	Changes to nominated flows submitted after the *scheduling period* has commenced.
Intra-Hub Transfer	Hub Services	Movement of gas from one interconnected *transmission system* to another, within a *hub*.
ISDA	Trading	International Swaps and Derivatives Association – association for traders in the OTC derivatives markets. Best known for promulgation of standardised master agreements for gas and electricity *OTC trading*.
Linepack	Gas System	Gas stored in the *transmission system*.
LNG	Gas System	Liquefied natural gas

TERM	CONTEXT	DEFINITION
Market Carriage	Transportation Rights	Model of assigning *transmission capacity*, where all capacity is assigned to the *transmission system operator*, who uses market bids and offers to optimise flows on the transmission system.
Market Operator	Trading	Entity responsible for operation of a given market (be it *balancing market*, *prompt market*, *forward market*, etc.)
MDQ	Transportation Rights	The maximum daily quantity a *participant* can withdraw at a given *transmission connection point*, as defined in its *capacity rights*.
MHQ	Transportation Rights	The maximum hourly quantity a *participant* can withdraw at a given *transmission connection point*, as defined in its *capacity rights*.
Multilateral Submission	Delivery	Delivery mechanism where the market operator provides a multilateral matched set of positions for delivery directly to the *system operator*.
NBP (Great Britain)	Trading	National Balancing Point – the principal (virtual) location for gas trading in Great Britain
Nomination	Scheduling	Request to schedule a quantity of gas to flow from *source* to *sink* on a *transmission system*.
Non-Firm Capacity	Transportation Rights	See *interruptible capacity*.
Open Access	Transportation Rights	General term for the process of ensuring that all *participants* are able to enjoy equal and unbiased access to *capacity rights*.
Open Season	Transportation Rights	Process for expansion of capacity and allocation of *capacity rights* – generally of medium to longer-term – in which pipeline operators gather expressions of interest through an open and transparent process, and if sufficient interest is shown, obtain binding commitments. In some cases this may occur through an auction process.
Operational Transfer	Transportation Rights	Secondary sale of *capacity rights* where the *transmission system operator* coordinates operational arrangements (e.g. nominations) with the secondary holder, but financial arrangements (e.g. settlement) remain the responsibility of the primary holder.
OTC	Trading	Over-the-counter. A form of trade execution where trading is facilitated by a third-party broker.
Park & Loan	Hub Services	*Hub service* which allows a *participant* to manage its gas position by leaving excess gas at the hub in the possession of the *TSO* (‘park’) or borrowing gas from the *TSO* (‘loan’).

TERM	CONTEXT	DEFINITION
Participant	Roles	Entity trading and transporting gas in the gas market.
Payback	Balancing	Process of resolving *participant imbalances* within a *balancing period* by the physical replacement of gas provided by the *TSO* for balancing purposes.
Periodic Auction	Trading	Process of order matching in which bids and offers are matched via an auction process conducted periodically at fixed intervals.
Physical Delivery	Trading Arrangements	Process of closing out open *forward market* positions by delivery of the underlying *product*. Typically achieved through *bilateral matching* or *mulilateral submission*.
Physical Hub	Trading	*Hub* based around an actual physical location often a point of convergence on the *transmission system*. Examples include Henry Hub, Zeebrugge and Wallumbilla.
Pipeline	Gas System	The physical components involved in the high pressure conveyance of gas, including pipe segments, compressors and other assets.
Pipeline Operator	Roles	See *Transmission System Operator*
Pipeline Owner	Roles	Owner of a given set of pipeline assets on the gas *transmission system*.
Point-to-Point	Transportation Rights	A form of *capacity right* based on the right to inject gas at a designated *injection point*, and withdraw gas at designated *withdrawal point*.
Producer	Roles	Organisation responsible for the upstream drilling, extracting and processing of natural gas.
Product	Trading	A tradeable, and fungible, unit of a commodity, with defined location, *tenor*, grade/quality, trading size, and potentially other characteristics. Delivery may be through physical flows, or cash settlement against an underlying index.
Prompt Market	Trading	*Forward market* trading close to the time of delivery – and thus settling in cash rather than margining of open forward positions – but not associated with actual physical delivery. e.g. day-ahead markets (‘swing swaps’).
Renominations	Scheduling	Revision of a *nomination* prior to the gas day / scheduling period commencing

TERM	CONTEXT	DEFINITION
Retailer	Roles	Organisation responsible for selling gas to end consumers, including domestic, commercial and industrial customers. Usually a buyer of gas in the wholesale market.
Scheduling	Scheduling	Process for determining the amount, location and timing of gas to be injected and withdrawn from the *transmission system* for a given *scheduling period*. Based upon received *nominations*, and any additional flows or *curtailments* required to maintain system security.
Scheduling Instruction	Scheduling	Instruction to a *participant* to flow or curtail a quantity of gas, based upon the *schedule*.
Scheduling Period	Scheduling	Period over which the *schedule* of gas flows is determined. In many cases a calendar day.
Secondary Market	Trading	Market for resale of already contracted gas, or *capacity rights*, to a third-party.
Shipper	Roles	Organisation financially and operationally responsible for organising the transport of a quantity of gas from a designated *injection point* to *withdrawal point*. A type of *participant*.
Short-Term Forward Market	Trading	See *Prompt Market*
Sink	Gas System	See *Withdrawal Point*
Source	Gas System	See *Injection Point*
Spot Market	Trading	A market where products are traded for immediate delivery. In the gas context, this is typically the *Balancing Market.*
Storage Capacity	Storage	The total amount of gas that can be stored in a storage facility.
Storage Facility	Gas System	Facility capable of storing a quantity of gas (other than in the *transmission system* itself), and re-injecting it into the *transmission system*.
Supply Hub	Trading	*Hub* representing a major location for supply entering the system, or trans-shipment point.
Swap	Trading	Forward instrument which, at maturity, is cash-settled at the differential between the agreed strike price and a defined reference price.
Tenor (Product)	Trading	The nominal delivery period for a *product* traded in the *forward market*.
Trading Interval	Trading	Smallest period of time for which market trading is conducted, and transmission service settled.

TERM	CONTEXT	DEFINITION
Transmission Capacity	Gas System	Amount of gas which can be physically moved through a pipeline/network segment in a given time period.
Transmission Connected User	Roles	Gas consumer (usually a large industrial) directly connected to the *transmission system*.
Transmission Connection Point	Gas System	Point where supply, demand or another network connect to the *transmission system*.
Transmission System	Gas System	Integrated transmission network consisting of one or more *pipelines*.
Transmission System Operator (TSO)	Roles	Organisation responsible for operational management of the *transmission system*.
Transportation Right	Transportation Rights	See *Capacity Right*
TTF (Netherlands)	Trading	Title Transfer Facility – the principal (virtual) location for gas trading in the Netherlands.
Uncontrollable Withdrawal	Gas System	*Withdrawal* taken by loads which cannot be guaranteed to respond to *scheduling instruction*.
Use-It-or-Lose-It (UIOLI)	Transportation Rights	A provision included in some *capacity rights* arrangements, whereby unutilised *firm capacity* can be made available for the use of other *participants*. Used, amongst other things, to discourage *capacity hoarding*.
Virtual Hub	Trading	*Hub* based around an aggregate or synthetic location, rather than a designated physical point. Treated as a single location for economic purposes. Examples include the National Balancing Point (NBP) in GB, and the Title Transfer Facility (TTF) in NL.
Withdrawal	Gas System	Physical extraction of gas from the *transmission system*.
Withdrawal Point	Gas System	Point at which gas is withdrawn form the *transmission system*. Can be a single physical location, or aggregate location (e.g. *zone*).
Working Capacity	Storage	The portion of a *storage facility*'s capacity that is available for commercial purposes, or to support operational management. Equals total *storage capacity* minus *cushion gas*.
Zone	Gas System	Aggregate location representing a contiguous set of entry and/or exit points from the *transmission system*.
Zonal Entry/Exit Right	Transportation Rights	A form of *capacity right* based on the right for entry and/or exit into/from a *zone*.

APPENDIX B – REFERENCES

[i] Source: AEMO, *National Gas Forecasting Report, 2014*. Note: These figures exclude LNG consumption in Queensland for 2014, which is estimated at 13.3 PJ.
[ii] Source: AER, *State of the Energy Market 2014*, p112.
[iii] Data taken from the International Gas Union, *Wholesale Gas Survey 2014*. http://www.igu.org/sites/default/files/node-document-field_file/IGU_GasPriceReport%20_2014_reduced.pdf
[iv] World Bank Commodity Markets, Annual Historical Data http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:21574907~menuPK:7859231~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html
[v] Source: http://www.eon.com/en/business-areas/gas-storage-and-transport/transport-systems/pipeline-constructions.html
[vi] Pritzsche, Kai and Pooschke, Sebastian, *Germany - Oil & Gas Regulation 2015*, International Comparative Legal Studies, http://www.iclg.co.uk/practice-areas/oil-and-gas-regulation/oil-and-gas-regulation-2015/germany
[vii] Ibid.
[viii] Source: DECC, *Physical gas flows across Europe and diversity of gas supply in 2012*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/295223/Physical_gas_flows.pdf
[ix] Source: Bundesnetzagentur (BNetzA), http://www.bundesnetzagentur.de/cln_1432/SharedDocs/Pressemitteilungen/DE/2014/141202_Monitoringbericht2014.html?nn=265778
[x] http://www.gibgas.de/Fakten/Mobilit%C3%A4t/H%20und%20L-Gas
[xi] German Wikipedia (http://de.wikipedia.org/wiki/Erdgas)
[xii] http://www.icis.com/resources/news/2009/03/30/9310666/german-l-gas-1-zone-to-start-1-april-bringing-total-down-to-three/
[xiii] IEA Market Review Germany http://www.iea.org/publications/freepublications/publication/germanyoss.pdf
[xiv] Pritzsche and Pooschke, op. cit.
[xv] International Energy Agency, *Energy Policies of IEA Countries – Germany*, 2013 Review. https://www.iea.org/publications/freepublications/publication/Germany2013_free.pdf
[xvi] Pritzsche and Pooschke, op. cit.
[xvii] Energy Charter Secretariat, The Role of Underground Gas Storage for Security of Supply and Gas Markets, Occasional Paper, 2010 http://www.encharter.org/fileadmin/user_upload/Publications/Gas_Storage_ENG.pdf
[xviii] See Energy Charter Secretariat, *The Role of Underground Storage for Security of Supply and Gas Markets*, September 2010 (http://www.encharter.org/fileadmin/user_upload/Publications/Gas_Storage_ENG.pdf), p185.
[xix] Source: FNBGas. http://www.fnb-gas.de/en/transmission-systems/market-areas/market-areas.html
[xx] Open Grid Europe, et.al., *Primary Capacity Platform Concept 6.0*, 15 November 2012. https://www.open-grid-europe.com/cps/rde/xbcr/open-grid-europe-internet/Primary_Capacity_Platform_Concept_6.0.pdf
[xxi] ENTSOG, *Network Code on Capacity Allocation Mechanisms*, 2012, available http://www.entsog.eu/public/uploads/files/publications/CAM%20Network%20Code/2012/120917%20CAP0291-12%20CAM%20Network%20Code%20for%20resubmission%20-%20FINAL.pdf
[xxii] http://www.icis.com/resources/news/2013/10/28/9719587/european-natural-gas-tsos-disunited-over-eu-wide-congestion-management-rules/
[xxiii] ACER, *Implementation Monitoring Report on Congestion Management Procedures in 2014*, available http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20CMP%20Implementation%20Monitoring%20Report%202014.pdf
[xxiv] ACER, *Guidance to ENTSOG on the development of amendment proposals to the Network Code on Capacity Allocation Mechanisms on the matter of incremental and new capacity*. http://www.acer.europa.eu/Gas/Framework%20guidelines_and_network%20codes/Documents/ACER%20Guidance%20on%20NC%20CAM%20Amendments%20(final).pdf.
[xxv] ACER, op. cit.
[xxvi] https://www.ontras.com/cms/kapazitaetsvermarktung/nominierung/?L=2
[xxvii] NetConnect Germany, *NCG information event for balancing group managers*, 28 January 2015. https://www.net-connect-germany.de/Portals/2/NCG%20information%20event%20for%20BGM%2028.01.2015.pdf
[xxviii] A full discussion is contained in: NCG and Gaspool, *Target Model for a Standardized German Balancing Gas Market*, 12 October 2012. https://www.net-connect-germany.de/Portals/2/Taregt%20Model.pdf

[xxix] NetConnect Germany, *Information on price calculation (November 2014)*. https://www.net-connect-germany.de/Portals/2/Information%20on%20price%20calculation.pdf
[xxx] NetConnect Germany, *NCG information event for balancing group managers*, 28 January 2015.
[xxxi] Source: PEGAS. http://www.pegas-trading.com/pegas/products
[xxxii] ACER/CEER, *Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2013*., October 2014, p69.
http://www.europarl.europa.eu/meetdocs/2014_2019/documents/itre/dv/acer_market_monitoring_report_2014_/acer_market_monitoring_report_2014_en.pdf
[xxxiii] Council of European Energy Regulators, *Benchmarking Report on Meter data Management (Ref: C12-RMF-46-05*, 7 November 2012.
http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Customers/Tab3/C12-RMF-46-05_BR_MDM_07Nov2012.pdf
[xxxiv] ACER/CEER, op cit., p89.
[xxxv] ACER/CEER, op cit., pp203-205.
[xxxvi] For a detailed discussion of this subject, see: Carlos Lapuerta, Boaz Moselle, *Network Industries, Third Party Access and Competition Law in the European Union*, 19 Nw. J. Int'l L. & Bus. 454 (1998-1999).
[xxxvii] Deutsche Bank Research, *Liberalisation of the German gas industry – under pressure to increase competition*, 8 October 2003.
[xxxviii] Ofgem, *Updated consultation on National Transmission System (NTS) flexibility capacity*. 16 December 2010
[xxxix] Langefeld Pipeline completion. accessed at 24 March 2015, from http://www.statoil.com/en/About/History/Pages/Statoil40Years.aspx
[xl] NationalGrid, *Gas Ten Year Statement 2013*. November 2013.
[xli] IUK Interconnector operational from, accessed on 24 March 2015, from http://www.interconnector.com/about-us/how-we-got-here/construction-project/
[xlii] BBL interconnector operational from, accessed on 24 March 2015, from http://www.bblcompany.com/about-bbl
[xliii] Moffat to ROI interconnector operational from. Accessed on 24 March 2015, from http://www.bordgais.ie/corporate/index.jsp?p=353&n=363
[xliv] LNG Import countries, accessed on 24 March 2015, from https://www.gov.uk/government/statistics/gas-section-4-energy-trends
[xlv] Storage sites. Accessed on 24 March 2015, from http://www2.nationalgrid.com/UK/Our-company/Gas/Gas-Storage/
[xlvi] NationalGrid, *Gas Ten Year Statement 2013*. November 2013.
[xlvii] Source: National Grid. http://www2.nationalgrid.com/UK/Our-company/Gas/Gas-Storage/
[xlviii] DUKES (Digest of UK Energy Statistics). https://www.gov.uk/government/statistics/gas-section-4-energy-trends
[xlix] NationalGrid, *Gas Ten Year Statement 2014*. November 2014.
[l] Source: Gas Infrastructure Europe (http://www.gie.eu/index.php/maps-data/gse-storage-map) and press releases.
[li] Based on the mid-point of the calorific value range of 37.5 – 43.0 MJ/m^3 published by National Grid. http://www2.nationalgrid.com/UK/Industry-information/Gas-transmission-operational-data/calorific-value-description/
[lii] All figures are for 2013. See DUKES, op. cit.
[liii] Department of Energy & Climate Change, *Digest of United Kingdom Energy Statistics*. 31 July 2014.
[liv] Department of Energy & Climate Change, *Digest of United Kingdom Energy Statistics*. 31 July 2014.
[lv] *Quarterly EU Gas Report*, accessed 26 March 2015, from http://ec.europa.eu/energy/sites/ener/files/documents/201410_q3-4_quaterly_report_gas_market.pdf
[lvi] *Distribution system UK*. Accessed at 26 March 2015, from http://www2.nationalgrid.com/UK/Our-company/Gas/Gas-Distribution-Network/
[lvii] National Grid, *Entry Capacity Transfer and Trade Methodology Statement*, 20 August 2014.
[lviii] National Grid, *Entry Capacity Release Methodology Statement*, 27 February 2015.
[lix] Ofgem letter on CMP implementation, 12 March 2013. https://www.ofgem.gov.uk/ofgem-publications/59242/ofgem-cmp-implementation-open-letter.pdf
[lx] ACM, Ofgem & CReg, *Vision Paper LT UIOLI*, 8 April 2015
[lxi] National Grid, *Exit Capacity Substitution and Revision Methodology Statement v4.0*, 27 February 2015.
[lxii] National Grid, *Exit Capacity Release Methodology Statement*, 27 February 2015.
http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=39961

[lxiii] For latest Ofgem decision, see http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=39957
[lxiv] For the change to 5.00 AM, see https://www.ofgem.gov.uk/ofgem-publications/86874/unc0461d.pdf
[lxv] This and other details are described in *Project Nexus Workgroup: Gas Nominations & Allocations*, 9 September 2014. See project website: http://www.gasgovernance.co.uk/nexus/090914
[lxvi] European gas hubs. Accessed at March 15 2015, from http://ec.europa.eu/energy/observatory/gas/doc/20130611_q1_quarterly_report_on_european_gas_markets.pdf
[lxvii] This amount is the so called "Default System Marginal Price", expressed in pence/kWh. It is computed following a methodology that can be retrieved in Joint Office of Gas Transporters, 2012b, 1.1.2.h.
[lxviii] Gas storage ICE-Endex "Rough", Accessed at 27 March 2015, from http://www.iceendex.com/trading-clearing/storage-markets/rough-gas-storage/
[lxix] From APX-ENDEX Annual Report 2011, then the operator of OCM (transferred to ICE-Endex in 2013)
[lxx] See various sources: ICE-Endex (https://www.theice.com/products/43396041/UK-OCM-Gas-Spot, https://www.iceendex.com/wp-content/uploads/APX_Gas_UK_Market_Guide_v3_1.pdf)
[lxxi] CME Clearing Europe, *Clearing Procedures*, 16 January 2015. http://www.cmegroup.com/europe/clearing-europe/clearing/files/natural-gas-delivery-procedures.pdf
[lxxii] Ofgem, Liquidity in the GB wholesale energy markets. Discussion paper. Accessed at 27 March 2015, from https://www.ofgem.gov.uk/ofgem-publications/40515/liquidity-gb-wholesale-energy-markets.pdf
[lxxiii] ACER/CEER, *Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2013*.
http://www.europarl.europa.eu/meetdocs/2014_2019/documents/itre/dv/acer_market_monitoring_report_2014_/acer_market_monitoring_report_2014_en.pdf
[lxxiv] Gas Act 1986 (c44) in full: http://www.legislation.gov.uk/ukpga/1986/44/contents
[lxxv] See for an overview: Patrick Heather, *The Evolution and Functioning of the Traded Gas Market in Britain*, Oxford Institute for Energy Studies, 2010.
[lxxvi] Gas act 1995 (c45) in full: http://www.legislation.gov.uk/ukpga/1995/45/contents
[lxxvii] EU legislation. Accessed at 27 March 2015. From http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1427468214381&uri=URISERV:en0017
[lxxviii] Ofgem. The regulating authority. Accessed at 26 March 2015, from https://www.ofgem.gov.uk/about-us/who-we-are
[lxxix] ICE-Endex. *Regulatory information on the OCM gas market UK*. Accessed at 27 March 2015, from https://www.theice.com/endex/regulation
[lxxx] FCA, *Regulating the commodity markets: a guide to the role of the FCA*, February 2014.
https://www.fca.org.uk/static/documents/guide-to-commodity-markets-regulation.pdf
[lxxxi] Ofgem, *Network price controls*. Accessed at March 26 2015, from https://www.ofgem.gov.uk/gas/distribution-networks/charging-arrangements, https://www.ofgem.gov.uk/gas/distribution-networks/network-price-controls
[lxxxii] ACER/CEER, *Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2013, p205*, October 2014.
[lxxxiii] Centrica 1997Annual Report. https://www.centrica.com/files/reports/1997_annual_report.pdf
[lxxxiv] Centrica 1998 Annual Report. https://www.centrica.com/files/reports/1998_annual_report.pdf
[lxxxv] IPE Natural Gas Futures Contract Specification. http://www.levow.com/wp-content/uploads/SG/-%20Commodities/ICE%20IPE%20natural%20gas%20futures%20contract%20specification.pdf
[lxxxvi] Source: Gas Infrastructure Europe (http://www.gie.eu/index.php/maps-data/gse-storage-map) and press releases.
[lxxxvii] EU Energy Country Report – The Netherlands 2014, p226.
http://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_netherlands.pdf
[lxxxviii] Correspondence between ACM and Bert den Ouden, 4 May 2015.
[lxxxix] ACM, Ofgem & CReg, Vision Paper LT UIOLI, 8 April 2015
[xc] Autoriteit Consument & Markt (ACM), 2014 Liquidity Report, 29 October 2014.
[xci] ACM, op. cit.
[xcii] ACM, op. cit.
[xciii] *EU Energy Country Report – the Netherlands 2014*, p229
[xciv] Correspondence between ACM and Bert den Ouden, 4 May 2015.
[xcv] Source: EAI, http://www.eia.gov/todayinenergy/detail.cfm?id=5370
[xcvi] Energy Information Administration (EIA), Office of Oil and Gas, Gas Transport Information System, http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/ngpipelines_map.html
[xcvii] Source: EAI, *Natural Gas Annual 2013*, http://www.eia.gov/dnav/ng/ng_sum_lsum_dcu_nus_a.htm
[xcviii] EAI, Office of Oil, Gas and Coal Supply Statistics, http://www.eia.gov/naturalgas/annual/pdf/nga13.pdf

[xcix] http://www.ferc.gov/market-oversight/guide/energy-primer.pdf
[c] American Petroleum Institiute (API), *Understanding Natural Gas Markets*, 2014. http://www.api.org/oil-and-natural-gas-overview/exploration-and-production/natural-gas/~/media/Files/Oil-and-Natural-Gas/Natural-Gas-primer/Understanding-Natural-Gas-Markets-Primer-Low.pdf
[ci] EAI, *Natural gas consumption has two peaks each year*, 1 July 2001. http://www.eia.gov/todayinenergy/detail.cfm?id=2050
[cii] PJM Press Release, October 22, 2014.
[ciii] Source: ISO New England
[civ] EAI, *Natural Gas Annual 2013*. http://www.eia.gov/naturalgas/annual/pdf/nga13.pdf
[cv] EAI, *Natural Gas Annual 2013*, op.cit.
[cvi] API, *Understanding Natural Gas Markets*, op.cit.
[cvii] NaturalGas.org. http://naturalgas.org/business/industry/
[cviii] API, *Understanding Natural Gas Markets*, op.cit.
[cix] Source: EAI. http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/index.html
[cx] Source: EAI. http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/interstate.html
[cxi] NaturalGas.org. http://naturalgas.org/regulation/market/
[cxii] http://us.practicallaw.com/9-525-1545?source=relatedcontent
[cxiii] FERC Docket No. RP14-1083-000. http://www.ferc.gov/CalendarFiles/20140731115032-RP14-1083-000.pdf.
[cxiv] New England States Committee on Electricity, *Update on the New England Governors' Proposal to Invest in Strategic Infrastructure and Address Price Disparities*, Presentation to US Department of Energy Electricity Advisory Committee, 25 September 2014. http://energy.gov/sites/prod/files/2014/10/f18/08d-BDAntonio.pdf
[cxv] L.E. Ruff, *The 'US Model' Gas Market: Implementing Open Access*, April 2014
[cxvi] FERC, *Energy Primer*, July 2012. http://www.ferc.gov/market-oversight/guide/energy-primer.pdf
[cxvii] FERC, *Docket No. RM14-2-000, Order 809, Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities.* https://www.ferc.gov/whats-new/comm-meet/2015/041615/M-1.pdf
[cxviii] *The Foster Report No. 3025*, 14 November 2014. http://www.ceadvisors.com/publications/FosterReport/Foster%20Report%20No%203025,%20Issued%20on%20November%2014.pdf
[cxix] *FERC Gas Tariff Fourth Revised Volume No.1 of Columbia Gas Transmission LLC.* http://www.hostedtariffs.com/tco/pdf/tariff.pdf
[cxx] *FERC Gas Tariff Third Revised Volume No. 1A of El Paso Natural Gas Company LLC*, p187.
[cxxi] *FERC Gas Tariff Third Revised Volume No. 1A of El Paso Natural Gas Company LLC*, pp247-253.
[cxxii] Source: NGPL website, accessed April 2015. http://pipeline.kindermorgan.com/StaticContentManager.aspx?control=ngpl
[cxxiii] http://www.kindermorgan.com/content/docs/Chicago_Open_Season_Notice.pdf
[cxxiv] *FERC Gas Tariff Eighth Volume No. 1 of Natural Gas Pipeline Company of America.*
[cxxv] *FERC Gas Tariff Fifth Volume No. 1 of Transcontinental Gas Pipeline Company LLC.* http://www.1line.williams.com/Transco/files/Tariff/TranscoTariff.pdf
[cxxvi] http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/storagebasics/storagebasics.html
[cxxvii] http://www.naruc.org/International/Documents/7%20-%20Natural%20Gas%20Storage%20-%20Darren.pdf
[cxxviii] http://www.eia.gov/pub/oil_gas/natural_gas/feature_articles/2009/ngmarketcenter/ngmarketcenter.pdf
[cxxix] http://www.naturalgasintel.com/data/data_products/daily?region_id=south-louisiana&location_id=SLAHH
[cxxx] http://www.argusmedia.com/~/media/Files/PDFs/Nat-Gas-LNG/NGA-Hubs.pdf?la=en
[cxxxi] Source NGI Data.
[cxxxii] http://www.cmegroup.com/trading/products/#pageNumber=1&sortField=name&sortAsc=true&page=1&subGroup=16&exch=NYMEX&subCat=20; https://www.theice.com/products/Futures-Options/Energy/Natural-Gas; http://www.ngx.com/?page_id=9
[cxxxiii] API, *Understanding Natural Gas Markets*, op.cit.
[cxxxiv] Source: NYMEX, ICE. http://www.cmegroup.com/trading/energy/files/PM801-natural-gas-snapshot.pdf
[cxxxv] For a more comprehensive discussion of clearing house disciplines, see: Market Reform, *Evolution of the Gas Supply Hub*, October 2013. http://www.marketreform.com/wp-content/uploads/2014/06/Evolution-of-the-Gas-Supply-Hub.pdf
[cxxxvi] EIA, *Today in Energy*, December 3, 2014. http://www.eia.gov/todayinenergy/detail.cfm?id=19031
[cxxxvii] Information on which parts of the market are open to competition can be found at: http://competitiveenergy.org/consumer-tools/state-by-state-links/
[cxxxviii] http://www.iea.org/publications/freepublications/publication/chinagasreport_final_web.pdf
[cxxxix] If further information on this topic is desired, see: http://www.ingaa.org/cms/143.aspx

[cxl] Congressional Research Service, *Presidential Permits for Border Crossing Energy Facilities*, 29 October 2013.
[cxli] http://www.ingaa.org/Topics/Pipelines101/143/1341.aspx
[cxlii] http://www.ferc.gov/help/processes/flow/gas-2.asp
[cxliii] http://www.cftc.gov/IndustryOversight/TradingOrganizations/DCMs/index.htm
[cxliv] http://sirt.cftc.gov/sirt/sirt.aspx?Topic=ForeignBoardsofTrade
[cxlv] http://www.cftc.gov/IndustryOversight/ClearingOrganizations/index.htm
[cxlvi] http://www.liheapch.acf.hhs.gov/dereg/gasoview.htm
[cxlvii] Source: Huberator Web Site; http://www.huberator.com/en/Traded%20Volumes
[cxlviii] Huberator, *Operating Procedures Under the Hub Services Agreement Terms and Conditions*, HSA Version 2012. http://www.huberator.com/en/information/~/media/E11D613366B1413A90D05A998B1D1956.ashx
[cxlix] Fluxys, Access Code for Transmission, Attachment C5, Hub Services – Operating Procedures. http://www.fluxys.com/belgium/fr-BE/Services/Transmission/MarketConsultations/~/media/Files/Services/Transmission/ConsultationPlatform/Consultation17/Fluxys_ACT_AttachmentC5_HubOperatingProcedures_consultation.ashx
[cl] ACER/CEER, *Annual Report on the Results of Monitoring of the Internal Electricity and Natural Gas Markets in 2013*, October 2014.
[cli] Schoenherr, Bernd Rajal and Schoenherr, Christian Schmelz, *Austria - Oil & Gas Regulation 2015, in International Comparative Legal Studies*. http://www.iclg.co.uk/practice-areas/oil-and-gas-regulation/oil-and-gas-regulation-2015/austria
[clii] E-Control website. http://www.e-control.at/en/market_players/natural-gas/natural-gas-market/storage
[cliii] *CEGH Presentation at 9th CEGH Feedback Workshop*, 3 December 2014 Vienna. http://www.cegh.at/sites/default/files/2014_12_03_9th_cegh_feedback_workshop.pdf
[cliv] CEGH, *Central European Gas Hub – First-class gas trading in the heart of Europe*. http://www.cegh.at/sites/default/files/cegh_image2015_web_neu.pdf
[clv] AGGM website. http://www.aggm.at/en/legal-framework/market-model
[clvi] ACER, *Implementation Monitoring Report on Congestion Management Procedures in 2014*. http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20CMP%20Implementation%20Monitoring%20Report%202014.pdf
[clvii] E-Control, *Annual Report 2012*.
[clviii] See http://www.cegh.at/product-specification-2