MARKET REFORM

Evolution of the Gas Supply Hub

October 2013

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

About Market Reform

Market Reform is an international consultancy specialising in energy, water and environmental markets. We advise a range of energy sector clients – including system and spot market operators; exchanges, clearing houses and registries; market participants; banks and investment funds; metering providers; network asset owners; governments and regulators; and information and other service providers – with our experience spanning over 14 countries across four continents.

The authors of this paper are Todd Bessemer (Melbourne/Philadelphia) and Francis X. Shields (Philadelphia).

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1 EXECUTIVE SUMMARY

A 'supply hub' for natural gas has been defined around Wallumbilla in Queensland. Trading of spot and short-term forward contracts, using this point as a reference, is expected to commence in early 2014. These are important steps in the development of a robust and liquid trading market – part of a continuing process of reform over the last 15 or so years – not the end of the journey. Using international experience in the evolution of energy markets as a reference, this paper discusses the key features of a successful trading market, how the market at Wallumbilla and in Eastern Australia more generally might be expected to develop, and steps that might be taken to help it along.

1.1 Gas Market Evolution

The last 15 years have seen substantial development of the natural gas markets in Eastern Australia – with the introduction of wholesale and retail competition in many regions, increasing interconnection, increased demand – particularly for power generation – and the opening up of new sources of supply – in particular through the development of substantial Coal Seam Gas (CSG) resources in Queensland. Nevertheless, the Eastern Australian gas market remains a work in progress.

The present 'gas boom' sets the stage for development of significantly more active gas trading in Eastern Australia, and in particular, for the advent of a liquid reference point – a 'hub' – for spot and forward trading, in the tradition of the great gas trading hubs of the world, such as the Henry Hub in the US and Zeebrugge in Belgium. To this end, a 'supply hub' has been defined around Wallumbilla in Queensland – a major convergence point of Cooper/Eromanga Basin supplies with gas from the Queensland CSG fields.

The aim of a hub is to serve as a locus for trading, ideally in the form of organised, transparent markets. It should be a point of substantial commercial activity, such as a major supply, demand or trans-shipment point. Features which tend to make for an effective hub include:

- A plurality of market participants present at, or shipping through, the location;
- Easy integration between the cash market and physical delivery;
- 'Hub services' which aid the commercial convenience of hub users. The Henry Hub, for example, provides facilities for gas balancing, compression, confirmation and renomination.
- Little or no commercially material internal transportation constraint. i.e. the hub can facilitate any likely combination of injections and withdrawals.

AEMO is presently in the process of developing a cash market based around the Wallumbilla hub, due to commence in early 2014. It is aimed that this will also serve to encourage forward trading and the development of a transparent forward market. However, while the Wallumbilla location ticks many of the required boxes, it also faces challenges. The range of hub services on offer will initially be quite limited. More importantly, the hub has material internal constraints, resulting in three effective trading points rather than one, with the potential for price divergence between them – a situation somewhat antithetical to the normal intent in creating a hub, to concentrate liquidity rather than fragment it (as an example, see the case of the Central European Gas Hub in Figure 1).

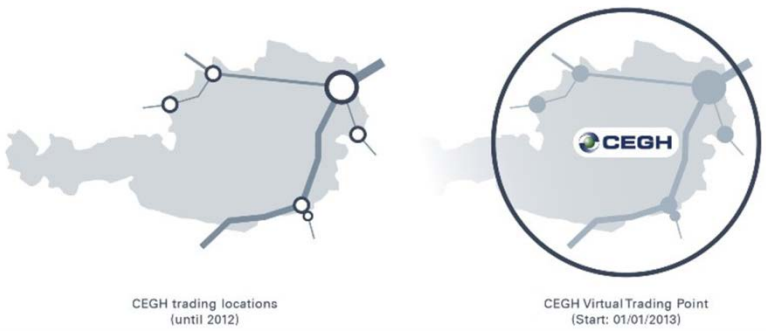


Figure 1 – Central European Gas Hub as a Single Virtual Trading Point[1]

[1] Source: Central European Gas Hub (www.cegh.at)

An effective forward price curve provides participants greater confidence to make medium-term investment decisions, and banks more confidence to lend. As such, the advent of liquid forward markets with transparent pricing is a key step in the evolution of any market.

1.2 Characteristics of an Effective Gas Market

Those effective competitive markets in natural gas that have emerged globally tend to exhibit five key characteristics:

Access to supply and transportation

Competition in natural gas – or any other commodity – cannot thrive if all the gas supply is locked up in long-term take-or-pay contracts, or only a select few can gain adequate access to transportation to bring their gas to market. Both problems exist to varying degrees in the Eastern Australian gas markets – in particular, some pipelines continue to offer 'negotiated' tariffs, allowing them to offer preferential pricing to some of their customers over others. By contrast, the elimination of such preference arrangements has been fundamental to gas market reforms in the US – where pipeline capacity must be sold either at regulated tariff rates, or via a transparent 'open season' auction process – and more recently Europe.

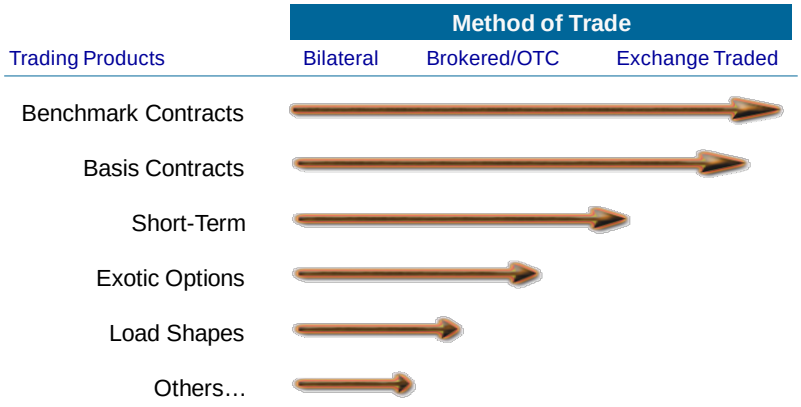
The corollary to this issue is ensuring the efficient transfer of unused pipeline capacity. This requires incentives to encourage capacity release (or discourage hoarding), and provision of an effective mechanism for potential buyers and sellers of unused capacity to find each other. AEMO is presently considering options for a centrally-facilitated market in gas transport capacity, though to reach its full potential such a mechanism may also require regulatory action to ensure its use.

Availability of hedging instruments

'Hedging' is intended to shield a party with physical exposures from the impact of potentially adverse market movements in the underlying commodity. It can be achieved physically – through storage, demand reduction, etc. – or financially – through the use of derivative instruments. As a market evolves it commonly develops standard items and terms of trade for these instruments, defined in the form of a slate of standardised 'products', whose characteristics are well understood, allowing trading in any instant to reduce to a matter of quality and price. This standardisation encourages transactional efficiency and the development of liquidity. Mature markets tend to offer products spanning a wide range of commodities, locations, tenors, and instrument types. Sophisticated trading houses will utilise a portfolio of these instruments to hedge a range of likely and contingent scenarios across the full range of their exposures.

Efficient, price-transparent trading markets

Commodities trading can take three general forms – bilateral, over-the-counter (OTC) or exchange-based – each with different characteristics. As a market matures, the products associated with it become more standardised and tend to migrate from less opaque bilateral trading, through OTC trading, to more efficient and transparent exchange-trading. Exchange trading, in turn, encourages greater price transparency and transactional efficiency, serving to further grow liquidity.



In a broad product suite, such as North American or European natural gas, there will typically be a range of products at different stages of evolutionary development. e.g. with benchmark contracts being actively exchange-traded, more exotic contracts traded OTC, and long-term customised deals remaining the province of bilateral trading. The general trend over time, however, is towards standardisation and exchange trading.

It follows logically, therefore, that the establishment of marketplaces for spot/cash and derivatives trading is key to the broader development of natural gas markets in Eastern Australia. From a global perspective, cash marketplaces in natural gas in Eastern Australia are relatively well developed, with AEMO already operating markets in Victoria and at the STTM demand hubs, and presently in the process of establishing a market based around the Wallumbilla hub. However, in any active market, the forward market is where, by far, the bulk of trading occurs. Despite active spot markets, forward gas markets in Australia remain relatively immature; forward pricing remains opaque, with no OTC price indices and the one attempt at an exchange-listed product failing to gain traction.

This does not necessarily mean that exchange trading of natural gas cannot succeed in Australia. However, development of successful energy derivatives requires significant understanding of, and focus on, the energy market. In the authors' opinion it is no coincidence that almost all of the major energy contracts traded globally emerged on exchanges where energy was a significant, if not dominant, focus. In lieu of the ASX significantly enhancing its energy efforts, or a suitable domestic competitor emerging, the Australian natural gas market may be better served by an international exchange with significant experience developing energy products, such as CME/NYMEX or Intercontinental Exchange.

Mechanisms for effective credit risk management

Efficient markets utilise robust credit risk management mechanisms to safeguard the financial integrity of the market, often bundled under the title of 'clearing'. The raison d'être of the clearing house is to provide a mechanism which all but eliminates counter-party credit risk, giving those trading in the market confidence that, no matter who it was executed against, their deal will perform. For this reason, clearing houses have come to dominate the settlement of the world's futures markets.

Clearing involves an integrated set of structures, policies and processes, the purpose of which is to safeguard the integrity of trading and reduce systemic risk in the market(s) being cleared. These include:

- Novation of all contracts to a central clearing house, which acts as central counter-party to all trade.
- Levying of collateral to cover potential exposures to a high degree of statistical confidence (e.g. 99% or 99.7%).
- Multilateral netting of positions across all trading counter-parties.
- Incremental settlement, or 'mark-to-market', of positions in each contract on a daily, or even intra-day, basis.
- An escalating guarantee structure – including guarantee funds, insurance, etc. – to cover events falling outside the collateralised range.

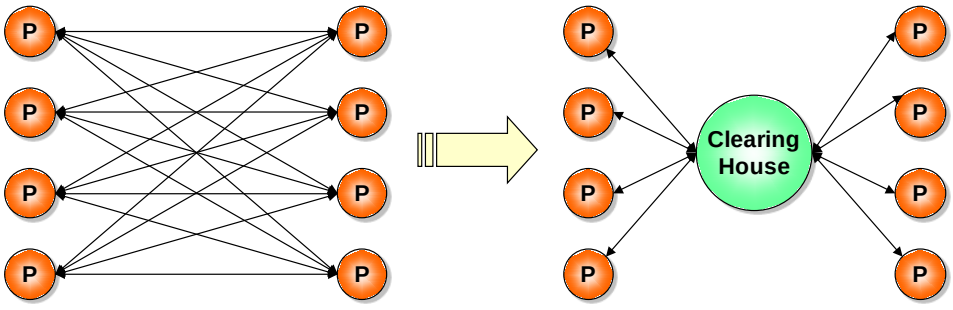


Figure 2 – Clearing House as Central Counter-Party

More recently there has been a significant trend towards the clearing of trades executed OTC, particularly where they can be mapped to a standardised template. This trend has been particularly prevalent in the global energy markets, driven initially by the 'flight to quality' that occurred following the collapse of many North American and European energy merchants in 2002-03. Post-GFC, a far broader application of clearing has been widely embraced by regulators and governments of the G20 and other nations. Notwithstanding the failure of an exchange-traded gas contract to gain traction (to-date), OTC Clearing would seem to present a substantial opportunity for the Australian energy markets, including those in natural gas.

Reliable 'delivery' mechanisms

In order to be useful for hedging purposes, forward trading must converge upon the underlying commodity. Financially-settled products ensure convergence to the underlying commodity by settling against a reliable 'physical' market index, either derived from participant price survey – such as those published by Platts – or preferably, determined through actual spot market trading.

'Physical' products ensure the same convergence through actual delivery of the underlying. This is typically achieved through either of:

- Bilateral Delivery Matching: Participants with net open positions are paired into bilateral delivery transactions. It is up to the paired participants to arrange the delivery themselves, including booking any necessary transportation.
- Multilateral Submission: The exchange (or clearing house) submits a balanced set (i.e. net long = net short) of open positions directly to the operator of the delivery location – be it a system operator, hub operator, pipeline, etc.. The exchange must have suitable arrangements in place with the delivery location operator to directly accept nominations, and to share other required information.

In comparison to bilateral matching, multilateral submission avoids the imposed constraint of having to resolve delivery with potentially a number of paired counter-parties, and allows trading significantly closer to the time of actual physical delivery.

1.3 Development of the Gas Supply Hub

Experience globally indicates that development of the natural gas market – or in fact any networked market – will settle-down into one of two end-states:

- A 'Closed Shop': characterised by supply locked up by a few large players, unequal access to transportation, opaque pricing and little opportunity for entry – but commercial certainty for those who already have a foothold.
- An Open Market: characterised by ready access to supply, open access to transportation, price transparency and easy access to market through efficient trading mechanisms such as exchanges – though with competition resulting in less commercial certainty.

The possibility of some sort of hybrid solution, while alluring to some, is a 'red herring' – with various attempts invariably taking on the worst characteristics of both models.

Taking the premise that the desired objective is an 'open market', how might the gas market at the Wallumbilla hub, and more broadly in Eastern Australia, develop over time? What actions are required to promote or accelerate this process?

Various market development initiatives are already underway, including the establishment of cash market trading at Wallumbilla, to commence in Q1 2014, and implementation of a basic 'bulletin board' for secondary trading of transmission capacity. This simply represents a start. A logical evolutionary path, broken down into stages, would be as follows:

- *Stage 1*: Implement more robust arrangements for secondary trading of transportation capacity; encourage OTC broker participation in gas trading.
- *Stage 2*: Enhance the Wallumbilla hub to become a single virtual trading location; enhance and extend hub services.

- *Stage 3*: Mandate open and equal access to transportation; require sale and re-sale through a transparent mechanism.
- *Stage 4*: Define standardised forward trading products; implement exchange trading, and clearing of OTC and exchange-traded products.
- *Stage 5*: Expand the product slate to additional delivery locations, either as basis differential or outrights.
- *Stage 6*: Extend clearing to allow settlement netting, and risk/collateral offsets between all AEMO-operated gas markets, and potentially electricity markets.

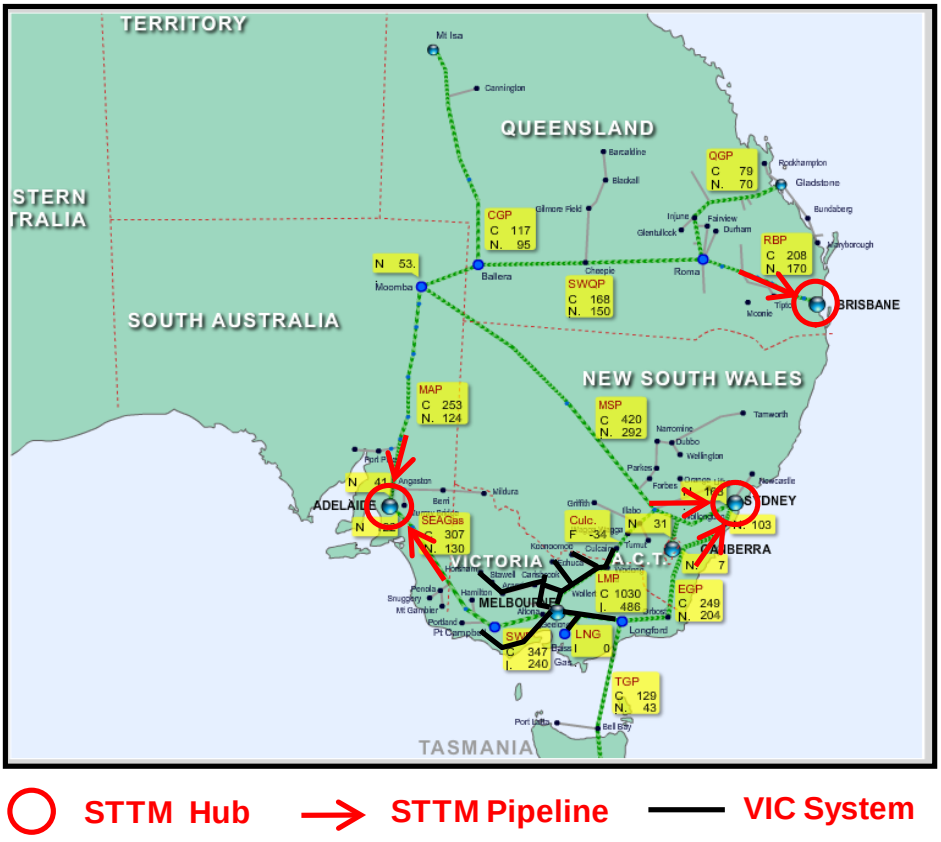
2 WHAT IS 'MARKET EVOLUTION' AND WHY IS IT IMPORTANT?

2.1 Historical Evolution of the Natural Gas Market in Eastern Australia

The natural gas market in Eastern Australia developed as a series of independent, geographically separate markets – with the major systems being a meshed transmission network in Victoria, long-haul pipelines from the Cooper Basin to major demand points in Sydney and Adelaide (with spurs to some lesser demand points), and separately, pipelines from the Cooper/Eromanga Basins into Brisbane and Gladstone. Supply to end users was the province of regional distribution/retail monopolies, which in some cases were the same organisations as the pipeline/transmission owners.

The last 15 years have seen substantial development of these markets. The transportation systems have become increasingly interconnected – from Moomba to Ballera within the Cooper/Eromanga Basins, and from Victoria to South Australia, New South Wales (at two points) and Tasmania – though do not (yet) operate in an integrated fashion. Retail competition has been introduced in most states, and wholesale spot/cash markets established, initially in Victoria (1999), and more recently, via the Short-Term Trading Market (STTM), around demand hubs at Sydney (2010), Adelaide (2010) and Brisbane (2011).

Figure 3 – Eastern Australia Gas System[2]



The same period has seen substantial increases in demand for natural gas, particularly for power generation, and a number of new sources of supply; initially 'conventional' gas from sources such as the Otway Basin, and more recently, 'unconventional' coal-seam gas (CSG). The substantial reserves of CSG in QLD and NSW (the latter presently constrained by political factors) raise the prospect of a

[2] Source: Larry Ruff, *Network Transportation Markets Lectures for Energy Supply & Value Chains*, University of Melbourne, 2013. Underlying map from AEMO National Gas Market Bulletin Board (NGMBB).

'gas boom', including an active export trade, with substantial LNG terminals already being developed at Gladstone.[3]

Nevertheless, the Eastern Australian gas market remains a work in progress.

2.2 The Advent of the Wallumbilla Gas Supply Hub

This 'gas boom' sets the stage for development of significantly more active gas trading in Eastern Australia, and in particular, for the advent of a liquid reference point – a 'hub' – for spot and forward trading, in the tradition of the great gas trading hubs of the world, such as the Henry Hub in the US and Zeebrugge in Belgium.

The aim of a hub is to serve as a locus for trading, ideally in the form of organised, transparent markets. As such, the hub should be a point of substantial commercial activity, such as a major supply, demand or trans-shipment point. The Henry Hub (depicted schematically in Figure 4 below), for example, is a convergence point of a number of major pipelines, in addition to the injection point for a major gas processing facility.

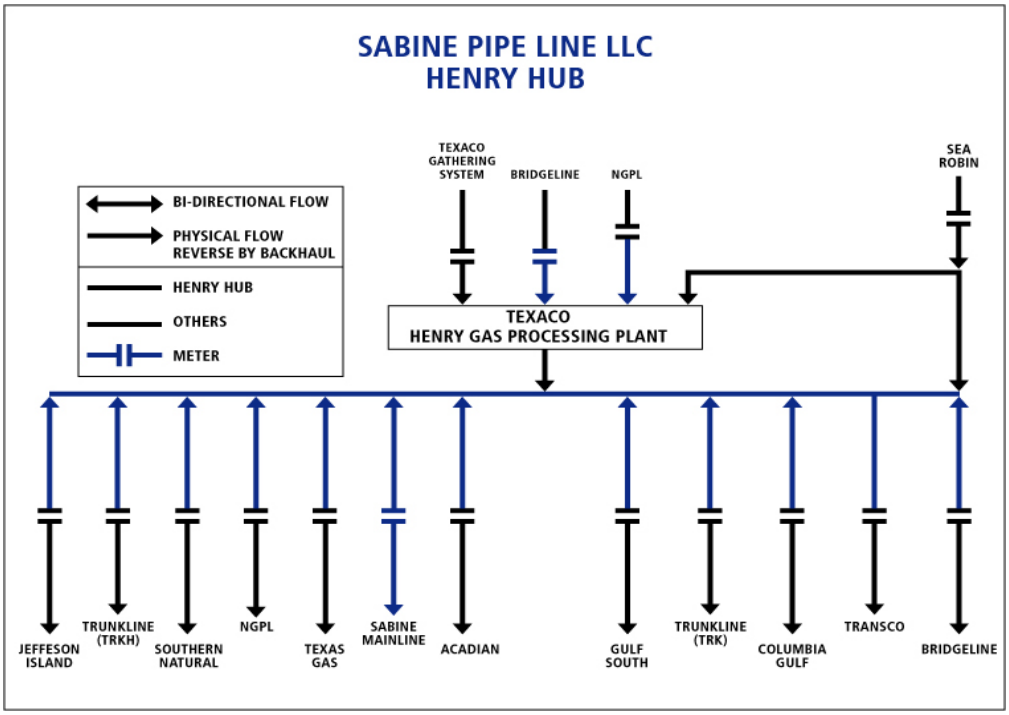


***Figure 4 – Henry Hub Schematic*[4]**

A hub can be a single point, aggregate location or virtual point. Features which tend to make for an effective hub include:

- A plurality of market participants present at, or shipping through, the location;
- Easy integration between the cash market and physical delivery;
- 'Hub services' which aid the commercial convenience of hub users. The Henry Hub, for example, provides facilities for gas balancing, compression, confirmation and renomination.
- Little or no commercially material internal transportation/capacity constraint. i.e. the hub can facilitate any likely combination of injections and withdrawals.

[3] This paper does not discuss the broader opportunities and challenges presented by this 'gas boom'. This has already been well addressed in other papers, including: Wood, T., Carter, L., and Mullerworth, D., 2013, *Getting gas right: Australia's energy challenge*, Grattan Institute.

[4] Source: Chevron Texaco

While a number of 'demand hubs' have been defined in the Eastern Australian gas market – based on the single pricing zone of the Victorian gas market (a virtual point), and the three major 'city-gate' trading points in the STTM, there has not yet been a successful 'supply hub'. An early attempt at creating such a hub was the VicHub, centred around Longford in Victoria. However, while this location is well connected – to the Victorian, Sydney and Tasmanian markets – it is dominated by a single large producer, making it an ineffective locus for trading.

Recently, a 'supply hub' has been defined around Wallumbilla in Queensland. This is a major convergence point of Cooper/Eromanga Basin gas with gas from the Queensland CSG fields, which then feeds off to Brisbane and Gladstone. This location is utilised by a range of shippers, with gas from a number of different fields. AEMO is presently in the process of developing a facility for the trading of cash market products based around the Wallumbilla hub, due to commence in early 2014. It is aimed that this will also serve to encourage forward trading and the development of a transparent forward market.

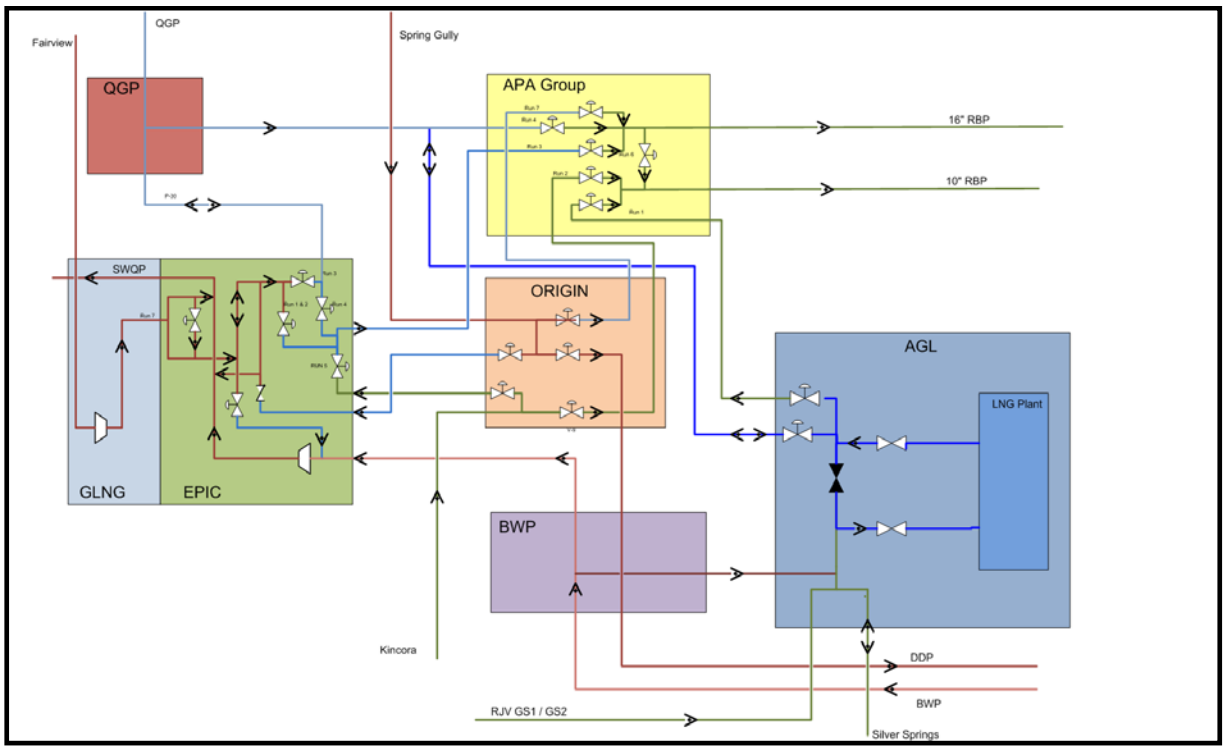


Figure 5 – Wallumbilla Hub Schematic[5]

However, while the Wallumbilla location ticks many of the required boxes, it also faces challenges. The range of hub services on offer will initially be quite limited. More importantly, the hub has material internal constraints, resulting in three effective trading points rather than one, with the potential for price divergence between them – a situation somewhat antithetical to the normal intent in creating a hub, to concentrate liquidity rather than fragment it. This fragmentation may also create 'basis risk'[6], participant perceptions of which will be a key driver of how hub liquidity develops.

2.3 Liquidity and the Role it Serves

Liquidity is the ability to conveniently enter or liquidate a position in a defined product. As such, it is a proxy for transactional efficiency. Illiquid markets expose participants to the risk that adverse price movements will occur before they can execute their trades ('liquidity risk'). Highly liquid markets

[5] Source: AEMO.
[6] 'Basis risk' arises when the product being traded is not a perfect hedge for the underlying commodity. i.e. movements in the price of one are not perfectly correlated with the other.

make it easier to 'get a fill', and narrow the 'bid-ask spread'[7], aiding the price discovery process and creating greater price certainty. Furthermore, the ability to transact efficiently encourages others into the market, serving to further improve liquidity, in a virtuous circle. In other words, liquidity begets liquidity.

Liquidity is often characterised in terms of 'trade velocity' – the ratio between trading volume in a product, and the underlying physical volume. Figure 6 below provides an illustration of the dramatic growth in liquidity of natural gas trading in the US since the advent of the first natural gas futures in 1990.

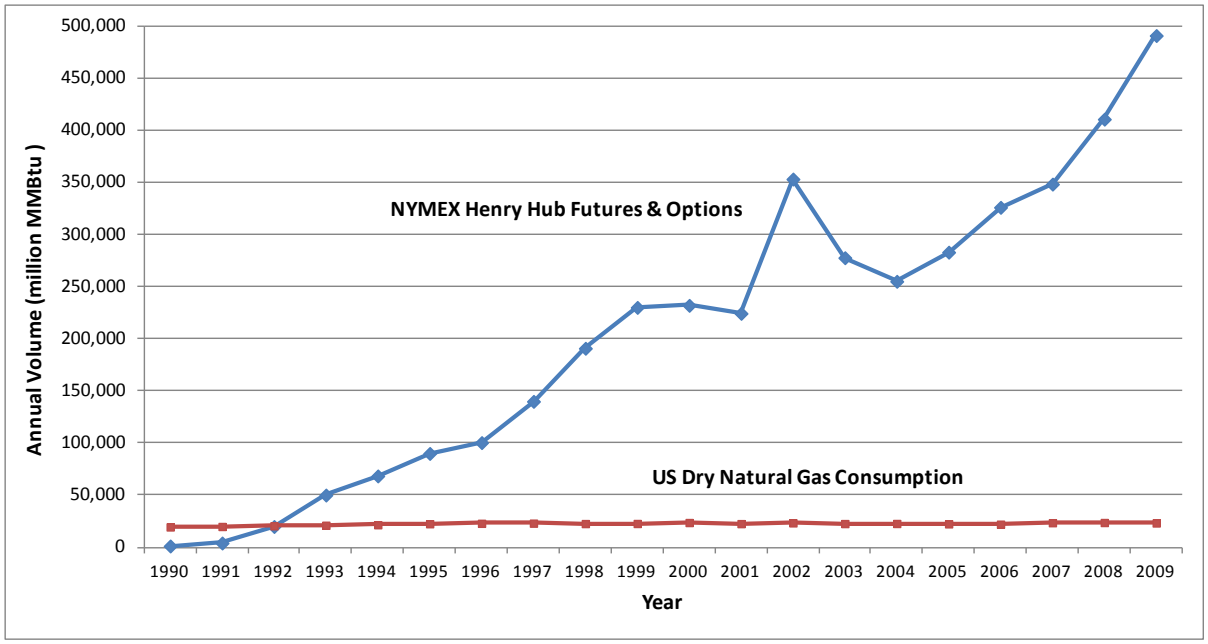


Figure 6 – Natural Gas Benchmark Futures Volume vs. Physical Consumption[8]

This diagram, which considers only NYMEX's benchmark Henry Hub futures (NG) and options (ON) contracts, shows trade multiples of over 20 times the entire US natural gas consumption by 2009 – elegant proof of the liquidity which can accrete around a well-defined hub. By 2011, NYMEX's top four natural gas contracts, all based around Henry Hub, represented a trade multiple of over 55 times underlying physical.[9]

The development of an effective benchmark contract has helped to spur the development of dozens of additional natural gas contracts, most of which trade as a basis differential to the benchmark (e.g. Henry Hub to Chicago City-Gate), driving liquidity and transparency to points well beyond the benchmark location.

2.4 The Importance of Forward Price Discovery

The advent of liquid forward markets with transparent pricing is a key factor in the development of a reliable forward price curve – an important indicator of the evolving maturity of a market.

Greater transparency of forward price enhances participants' ability to manage price risk. It also directly influences capital expenditure, capital raising and funding. An effective forward price curve

[7] The 'bid-ask spread' is the difference between the highest price a buyer is willing to pay and the lowest price a buyer is willing to accept. The narrower, the more price certainty, and greater the likelihood of a quick 'fill'.
[8] Data sources: NYMEX Annual Reports, Futures Industry, CME 2009-12 Monthly Volume Report, EAI World Dry Natural Gas Consumption (www.eai.gov).
[9] Henry Hub Natural Gas Futures, European-Style Options, Natural Gas Swap Futures and Penultimate Swap Futures collectively totalled over 1,451,621 million MMBtu (Source: *FIA Annual Volume Survey 2012*, Futures Industry, March 2013), versus underlying physical consumption of 26,063 million MMBtu (Source: *Dry Natural Gas Consumption 2012*, EAI).

provides participants greater confidence to make medium-term investment decisions, and banks more confidence to lend. The most effective mechanism for achieving transparent forward pricing is through the development of efficient secondary markets.

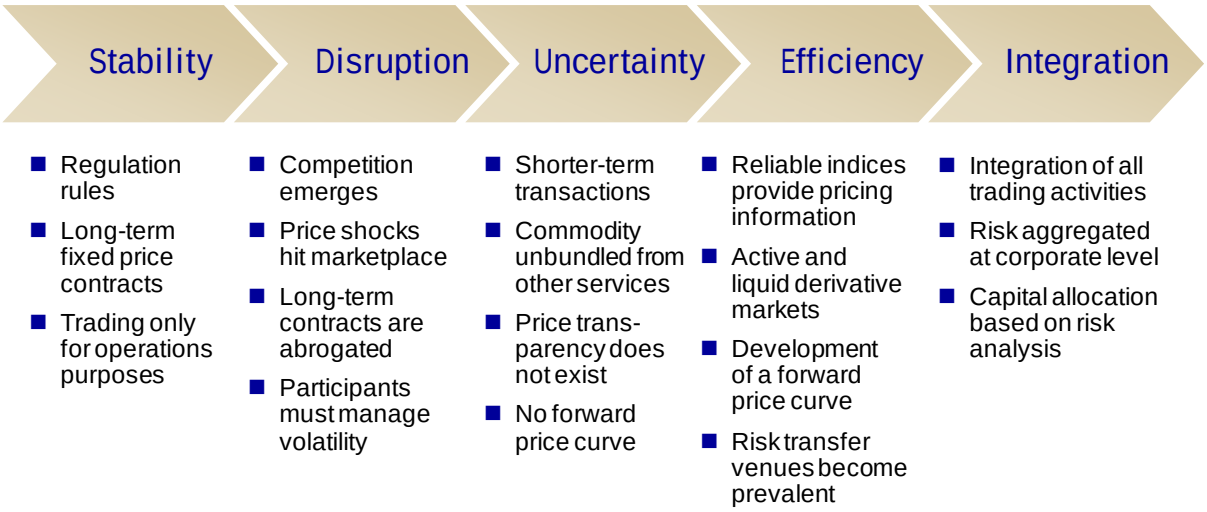
2.5 Development Path for Commodity Markets

As natural gas (and other network commodity) markets around the world have developed and become more competitive, they have tended to follow a fairly common evolutionary path:

Long-term take-or-pay supply contracts	➔	Mix of longer and shorter-term instruments
Vertical integration	➔	Unbundling of transportation from shipping/trading activities
Unequal/preferential access to transportation	➔	Open and equal access to transportation
Little to no competition	➔	Wholesale (and often retail) competition
No venues for price discovery	➔	Trading through exchanges and other open venues

The Eastern Australian gas market is only part way into this process.

Figure 7 – Market Evolution Schematic[10]



This evolution may occur organically, as it did with the first securities markets – with a bunch of like-minded merchants deciding to get together and trade in a coffee house, or around an old oak tree. However, progress can be hampered by individual interests in the short-term taking precedence over mutual benefit in the longer-term. In markets that utilise monopoly network infrastructure, it has often taken a regulatory and/or legislative push in the right direction. In the US, for example, FERC Order 636 is considered instrumental in driving that country's wholesale gas market reforms. However, even in these circumstances the role of policy makers should be limited to ensuring that the key elements required to ensure openness and competition are in place, then getting out of the way and letting the market run.

[10] Source: Market Reform.

3 KEY CHARACTERISTICS OF AN EFFECTIVE MARKET

So what are the key elements required to ensure an effective natural gas market?

- Access to supply and transportation
- Availability of hedging instruments
- Efficient, price-transparent trading markets
- Mechanisms for effective credit risk management
- Reliable 'delivery' mechanisms

These are discussed individually below, in the context of natural gas.

3.1 Access to Supply and Transportation

An essential pre-requisite to development of effective competition in natural gas – or any other commodity – is fair competition in the physical market. This is predicated upon fair access to supply, and equal and open access to transportation. Ultimately, it is impossible for new player to gain market entry, or an existing player to thrive, if all the gas is locked up in long-term take-or-pay contracts; at least some shorter-term supply availability is required. Similarly, it is no good obtaining the keenest gas commodity pricing if you cannot bring your gas to market.

Both problems exist to varying degrees in the Eastern Australian gas markets – in particular, some pipelines continue to utilise 'negotiated' tariffs, allowing them to offer preferential pricing to some of their customers over others. By contrast, in the US and more recently in Europe, the elimination of such preference arrangements has been fundamental to gas (and electricity) market reforms. In a process starting with Order 436 in 1985 and concluding with Order 636 in 1992, FERC required all pipelines to provide access on a non-discriminatory basis, and subsequently imposed unbundling, rate structure and other associated obligations to give this effect. Almost all pipeline capacity in the US must now be sold either at regulated and published tariff rates, or via a transparent 'open season' auction process providing equal access to all-comers.[11]

The corollary to this issue is ensuring the efficient transfer of unused pipeline capacity. This requires incentives to encourage capacity release (or discourage hoarding), and provision of an effective mechanism for potential buyers and sellers of unused capacity to find each other. In the US, many of the original gas market 'bulletin boards', typically operated by pipelines, were implemented for this purpose (another outcome of Order 636). AEMO is presently considering options for a centrally-facilitated market in gas transport capacity. However, any such mechanism may require regulatory action to reach its full potential – to allow holders of annual firm capacity to break their contracts into shorter-period blocks, which can be individually traded. To this end, in May 2013, the Standing Council on Energy and Resources (SCER) issued a consultation "on current pipeline capacity trading activity and practices and whether any improvements could be made to facilitate increased trade in unused capacity."[12]

3.2 Availability of Hedging Instruments

'Hedging' is any activity intended to shield a party with physical exposures from the impact of potentially adverse market movements in the underlying commodity. Hedging can be achieved physically – through storage, demand reduction, diversity of physical portfolio, etc. – or financially – through the use of derivative instruments. The availability of such instruments is an important indicator of market maturity.

3.2.1 Standardisation and 'Products'

In theory, a trader can transact anything they can put a definition to, and memorialise in an agreement. It is far more commercially convenient, however, to develop standard items and terms of trade.

[11] The one notable exception is that, for substantial new build of pipeline capacity, a pipeline may make negotiated sales of a percentage of capacity to 'anchor tenants'.
[12] See: http://www.scer.gov.au/files/2013/05/SCER-Bulletin-5-May-2013.pdf

Organised markets tend to define a slate of standardised 'products', whose characteristics are well understood, allowing trading in any instant to reduce to a matter of quality and price. This standardisation encourages transactional efficiency and the development of liquidity.

	Definition	Examples
Commodity	"An article of trade or commerce; any unprocessed or partially processed good" In the context of markets, generally represents a broad class of good.	Natural gas, NGLs Electricity, coal, uranium, ethanol Crude oil, refined products, freight Emissions permits, RECs
Product	A tradeable unit of a commodity, with defined specific characteristics in terms of location, grade, etc.	Henry Hub Natural Gas Monthly Futures UK NBP Natural Gas Futures
Contract	A specific instance of a product, for a given time period.	Henry Hub Natural Gas July 2013 UK NBP Natural Gas Jan 2014

Table 1 below provides an example product specification for NYMEX Henry Hub Gas Futures.

Table 1 – Example Product Specification: NYMEX Henry Hub Futures[13]

Commodity	Natural Gas
Delivery location/reference point	Henry Hub, Louisiana
Grade and quality requirements	Natural gas meeting the specifications set forth in the FERC-approved tariff of Sabine Pipe Line Company.
Tenor/delivery period	One calendar month
Size/delivery rate	10,000 MMBtu
Settlement method	Physical delivery

A product's specification forms its 'basis'. Any difference between this definition and the underlying spot exposure – be it based on location, grade, etc. – results in an imperfect hedge, and constitutes 'basis risk'. In recent years a number of markets with strong benchmarks have evolved additional products, known as 'basis hedges', to allow participants to hedge these differentials. e.g. NYMEX trades products based around the price differential between Henry Hub and Chicago City-Gate, Houston Ship Channel, Permian Basin, Transco Zone 6, and dozens of other locations.

Table 2 – Example Product Specification: NYMEX Transco Zone 6 Basis Futures[13]

Commodity	Natural Gas
Delivery location/reference point	Basis differential between Transco Zone 6 and Henry Hub
Grade and quality requirements	Natural gas meeting the specifications set forth for Transco Zone 6 and Henry Hub respectively.
Tenor/delivery period	One calendar month

[13] Data source: CME Group.

Size/delivery rate	2,500 MMBtu
Settlement method	Cash settled. Final settlement price = Platts IFERC Transco Zone 6 index minus final-day settlement price for NYMEX Henry Hub futures.

3.2.2 Portfolio Trading

As a market evolves it will tend to offer products spanning an increasing range of:

- Commodities: allowing participants not just to hedge outright positions in a commodity, but the differential between them (e.g. spark spreads between natural gas and electricity).
- Locations: both as outright contracts, and as basis differentials from a benchmark location.
- Tenors: ranging from the long-term down to daily instruments allowing fine-tuning of short-term exposure.
- Instrument Types: including physically-delivered and cash-settled futures, options, strips, spreads, etc.

Sophisticated trading houses will utilise a portfolio of these instruments to hedge a range of likely and contingent scenarios across the full range of their exposures, as well as making assessments regarding how much of their exposure to leave unhedged.

3.3 Efficient, Price-Transparent Trading Markets

Commodities trading can take three general forms – bilateral, over-the-counter (OTC) or exchange-based – each with different characteristics.

Table 3 – Trade Execution Methods[14]

Bilateral	Over-The-Counter (OTC)	Exchange-Based
Contracts are negotiated directly between the two contract counter-parties	Contracts are negotiated via a broker, who helps the two parties find each other and reach agreed terms	Deals are made through a multilateral exchange, which provides a managed marketplace
▪ Contracts are often highly customised, and of longer duration	▪ Contract parameters can vary significantly, though customisation often allowed.	▪ Contracts are highly standardised
▪ Longer duration	▪ Various durations available, down to short-term forwards	▪ Various durations available, down to short-term forwards
▪ Trading counter-parties are known to each other	▪ Trading usually anonymous (amongst selected counter-parties) until execution.	▪ Trading is anonymous
▪ Pricing is opaque	▪ Pricing is opaque	▪ Pricing is transparent
▪ Execution is lengthy and expensive	▪ Execution time and cost can vary significantly	▪ Execution is quick and cheap
▪ No formal safeguards	▪ Few formal safeguards	▪ Processes exist to safeguard market integrity

[14] Source: Market Reform

As a market matures, the products associated with it become more standardised and tend to migrate towards more efficient trading venues. As such, the development of active exchange-traded markets is a key indicator of market maturity. Exchange trading, in turn, encourages greater price transparency and transactional efficiency, serving to further grow liquidity.

In a broad product suite, such as North American or European natural gas, there will typically be a range of products at different stages of evolutionary development. e.g. with benchmark contracts being actively exchange-traded, more exotic contracts traded OTC, and long-term customised deals remaining the province of bilateral trading. The general trend over time, however, is towards standardisation and exchange trading.

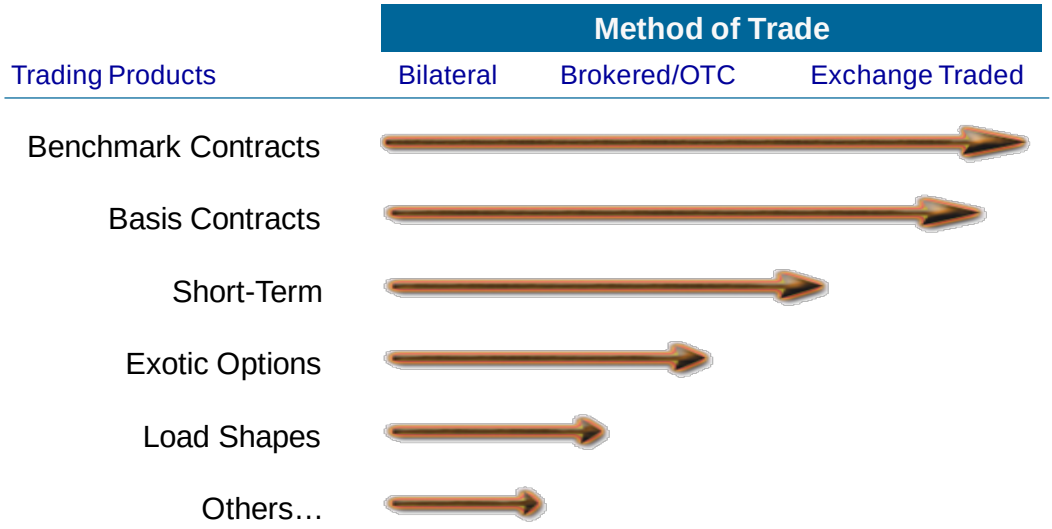


Figure 8 - Evolution of Trading Method[15]

It follows logically that the establishment of marketplaces for spot/cash and derivatives trading is key to the broader development of natural gas markets in Eastern Australia.

3.3.1 Spot/Cash Marketplaces

AEMO already operates auction-based spot markets in Victoria and at the STTM demand hubs of Sydney, Adelaide and Brisbane. It is presently in the process of establishing a continuous-trading 'cash' market[16] for products based around the Wallumbilla hub. From a global perspective, cash marketplaces in natural gas in Eastern Australia are relatively well developed. However, while reliable spot marketplaces represent a necessary condition for the development of an efficient market, in isolation they are not sufficient.

3.3.2 Forward/Derivative Marketplaces

In any active market, the forward market is where by far the bulk of trading occurs, sometimes in the form of forward 'physical' contracts, but increasingly, as the market matures, in the form of 'derivatives' – be they exchange-traded 'futures', OTC-executed 'swaps', etc.[17]

Despite active spot market development, forward gas markets in Australia remain relatively immature. The majority of trading occurs bilaterally, in long-term contracts between principals. OTC trading is becoming more active, particularly as further supplies are developed in Queensland, and

[15] Source: Modified from original in: Bessemer, T.W. & Shields, F.X., *Through the Furnace – The Transformation of Energy Trading*, Futures Industry, September/October 2002.
[16] A 'cash' market consists of the spot market, plus short-term forward instruments which settle in cash (e.g. day-ahead contracts), rather than trading on margin. This typically applies to situations where the product would be delivered by the time forward margin could be assessed and levied.
[17] See the Glossary at the end of this paper for a definition of key terms.

some standardised documentation has been developed under the auspices of the Australian Financial Markets Association (AFMA). Forward pricing, however, remains opaque, with no OTC price indices, and the one attempt at an exchange-listed product – the ASX's Victorian gas futures – failing to gain traction.

The failure of the ASX's first attempt does not necessarily mean that exchange trading of natural gas cannot succeed in Australia. The success of an exchange-traded derivative involves a number of factors (many of which are discussed in this paper), including having enough buyers and sellers, sufficient market maturity, and a well-designed product that meets the market's commercial needs.

The last of these requires significant understanding of, and focus on, the energy market. In the authors' opinion it is no coincidence that almost all of the major energy contracts traded globally emerged on exchanges where energy was a significant, if not dominant, focus (see Table 4).

Table 4 – 2012 Global Top 20 Energy Futures and Options Contracts[18]

Rank	Contract	Contract Size	Jan-Dec 2011	Jan-Dec 2012	% Change
1	Brent Crude Futures, ICE Futures Europe	1,000 barrels	132,045,563	147,385,858	11.6%
2	Light, Sweet Crude Oil Futures, Nymex	1,000 barrels	175,036,216	140,531,588	-19.7%
3	Henry Hub Natural Gas Futures, Nymex	10,000 MMBTU	76,864,334	94,799,542	23.3%
4	Gasoil Futures, ICE Futures Europe	100 tonnes	65,774,151	63,503,591	-3.5%
5	Crude Oil Futures, MCX	100 barrels	54,753,722	57,790,229	5.5%
6	NY Harbor RBOB Gasoline Futures, Nymex	42,000 gal	31,129,256	36,603,841	17.6%
7	No. 2 Heating Oil Futures, Nymex	42,000 gal	31,838,626	36,087,707	13.3%
8	WTI Crude Futures, ICE Futures Europe	1,000 barrels	51,097,818	33,142,089	-35.1%
9	Light Sweet Crude Oil Options, Nymex	1,000 barrels	36,716,805	32,525,624	-11.4%
10	Natural Gas Futures, MCX	1,250 MMBTU	9,882,133	27,886,670	182.2%
11	Natural Gas European-Style Options, Nymex	10,000 MMBTU	23,773,183	24,260,726	2.1%
12	U.S. Oil Fund ETF Options *	N/A	28,881,647	21,348,808	-26.1%
13	Henry Hub Natural Gas Swap Futures, Nymex	2,500 MMBTU	20,825,660	18,156,113	-12.8%
14	Brent Oil Futures, Micex-RTS	10 barrels	18,707,384	11,952,101	-36.1%
15	Brent Crude Oil Options, ICE Futures Europe	1,000 barrels	2,191,733	8,908,862	306.5%
16	Natural Gas Penultimate Swap Futures, Nymex	2,500 MMBTU	7,384,147	7,945,695	7.6%
17	EUA Futures, ICE Futures Europe	1,000 EUAs	5,444,050	6,465,262	18.8%
18	UK Nat. Gas (Monthly) Fut., ICE Futures Europe	1,000 therms/day	2,788,240	3,114,820	11.7%
19	UK Nat. Gas (Seasons) Fut., ICE Futures Europe	1,000 therms/day	2,604,150	3,096,300	18.9%
20	Crude Oil 1 Month Cal. Spread Options, Nymex	1,000 barrels	2,886,427	2,873,842	-0.4%

In lieu of the ASX significantly enhancing its energy efforts, or a suitable domestic competitor emerging[19], the Australian natural gas market may be better served by an international exchange with significant energy experience, such as NYMEX (owned by CME Group) or Intercontinental Exchange (ICE) – assuming that regulatory hurdles are not prohibitive[20].

Alternatively, operation of a gas derivatives exchange is a function that could be taken on by AEMO. There are a number of examples globally of gas (and electricity) spot and futures markets being operated by the same entity. e.g. Powernext in France operates both a spot and futures market in gas. Similarly, ICE, which already operated futures markets, recently acquired the gas spot market operations of APX. This is not to suggest such a move would be simple; it would require obtaining an Australian Market Licence, establishing market rules and market infrastructure (though a continuous trading system will already be in operation for trading at the Wallumbilla hub), and putting in place appropriate clearing arrangements. It is also likely to attract the competitive ire of the ASX.

[18] Source: *FIA Annual Volume Survey*, Futures Industry, March 2013.

[19] The Financial and Energy Exchange (FEX) has expressed its intent to operate energy derivatives markets, and was recently granted an Australian Market Licence. However, it has not yet commenced trading, nor announced its planned product slate and whether this will include any natural gas products.

[20] Both CME and ICE are already 'overseas financial markets licensed to operate in Australia'. See ASIC website (www.asic.gov.au).

3.4 Mechanisms for Effective Credit Risk Management

A lucrative deal on paper is worthless if you are unable to collect upon it because of counter-party default. Poor credit risk management can also pose a risk to the integrity of the market as a whole, through the possibility of cascading default, as seen through several examples in recent years.

> *A number of firms experienced serious power trading losses and defaulted contracts, which led to more losses and defaulted contracts in a complicated daisy chain. "The cascading effect sucked other people into that vortex—a very expensive vortex"*[21]

Efficient markets utilise robust credit risk management mechanisms to safeguard the financial integrity of the market, often bundled under the title of 'clearing'.

Clearing – a little disambiguation

The term "clearing" has more than one meaning in a network market context:

1. "Clearing", as the process for matching bids and offers in a multi-lateral auction (usually subject to supply/demand, network, and other constraints).
2. "Clearing", as the actual clearance of cash transfers, as part of the settlement process.
3. "Clearing", as the sum set of functions performed by a Clearing House, including credit risk management, settlement and banking (clearance of funds).

The third definition is the common financial usage of the term, and that used in this paper.

The raison d'être of the clearing house is to provide a mechanism which all but eliminates counter-party credit risk, giving those trading in the market confidence that, no matter who their deal was executed against, it will perform. For this reason, clearing houses have come to dominate the settlement of the world's futures markets.

More recently there has been a significant trend towards the clearing of trades executed OTC, particularly where they can be mapped to a standardised template. This trend has been particularly prevalent in the global energy markets, driven initially by the 'flight to quality' that occurred following the collapse of many North American and European energy merchants in 2002-03, and has continued to gain pace since.

As well as reducing the counter-party credit risk of individual participants, clearing houses also reduce the risk of cascading default, and other systemic risks to the market-at-large. It is for this reason that clearing has been so warmly and widely embraced by regulators and governments post-GFC.

3.4.1 How Does Clearing Work?

Clearing involves an integrated set of structures, policies and processes, the purpose of which is to safeguard the integrity of trading and reduce systemic risk in the market(s) being cleared. These typically include the novation of all contracts to a central clearing house, levying of collateral to secure positions, and daily mark-to-market.

3.4.1.1 Central Counter-Party Novation

A Clearing House acts as the central counter-party to all trading in the markets it clears. i.e. it is the buyer to all sellers, and seller to all buyers. A participant is no longer exposed to the failure of any of its original counter-parties to perform, only to the clearing house itself, which has robust processes to ensure performance.

[21] *Comments on 1998 Midwest Electricity Credit Crisis*, Derivatives Strategy, August 1998, Vol. 3, No. 8.

> "A CCP (Central Counter-Party) has the potential to reduce significantly risks to market participants by imposing more robust risk controls on all participants and, in many cases, by achieving multilateral netting of trades. It also tends to enhance the liquidity of the markets that it serves, not only because it tends to reduce risks to participants but also, in many cases, because it facilitates anonymous trading. However, a CCP also concentrates risks and responsibility for risk management in the CCP. Consequently the effectiveness of a CCP's risk controls and the adequacy of its financial resources are critical aspects of the infrastructure of the markets it serves."[22]

In other words, clearing houses can reduce systemic risk, and improve market stability and liquidity, but they also concentrate risk, so must be managed carefully.

> "*The wise man saith, 'Put all your eggs in the one basket and -- watch that basket!'*"
> *Pudd'n'head Wilson*, Mark Twain

3.4.1.2 Credit Intermediaries

Most clearing houses also utilise financial intermediaries known as Clearing Members (CMs). These are typically large money-market banks, though well-capitalised trading companies, who meet the more stringent financial requirements, may also function as their own CM. It is the CM who is responsible to the clearing house for financial performance of all positions, with the participant responsible in turn to their CM. This structure provides an intermediate layer of credit protection between the participant and the clearing house, as well as serving to diversify risk.

3.4.1.3 Full Collateralisation

Clearing houses operate on the principle of 'full collateralisation', requiring that collateral be posted to cover the potential exposure posed by a participant's position[23], to a high degree of statistical confidence – usually 99% or 99.7% worst-case move over a one-day period for liquid markets, and a longer period for less liquid markets.

Collateral (also known as 'initial margin') requirements are typically reassessed every trading day, and may be adjusted due to changes in the participant's position and/or underlying product volatility. Failure to post collateral on-time results in a 'margin call' which, if not satisfied, results in seizure of collateral and liquidation of open positions. Collateral is posted in liquid, redeemable instruments: cash; treasury bills/bonds, and letters-of-credit (LCs)/bank guarantees. Unsecured credit is not accepted from any entity, regardless of credit standing or rating.

[22] Committee on Payment and Settlement Systems, *Recommendations for Central Counterparties*, Bank for International Settlements, November 2004.
[23] A participant's 'position' in a given contract is the accumulated sum of its trades in that contract, over the present and all past trading days. i.e. current position = yesterday's position + sum of today's trade.

3.4.1.4 Multilateral Netting and Portfolio Margining

One of the attractive features of novation to a central counterparty is that it facilitates multilateral netting amongst participants, reducing credit exposures (and hence collateral requirements) and net cashflows.

Take the example in Figure 9 (below), with P7 executing three trades – 150 short, 15 short and 120 long – with three separate parties on the other side of those trades. If the trades are uncleared, P7 holds credit risk separately against P1, P6 and P2 respectively – and they in turn hold risk against P7. If the trades are novated, P7 holds a net position of 45 short against the clearing house.

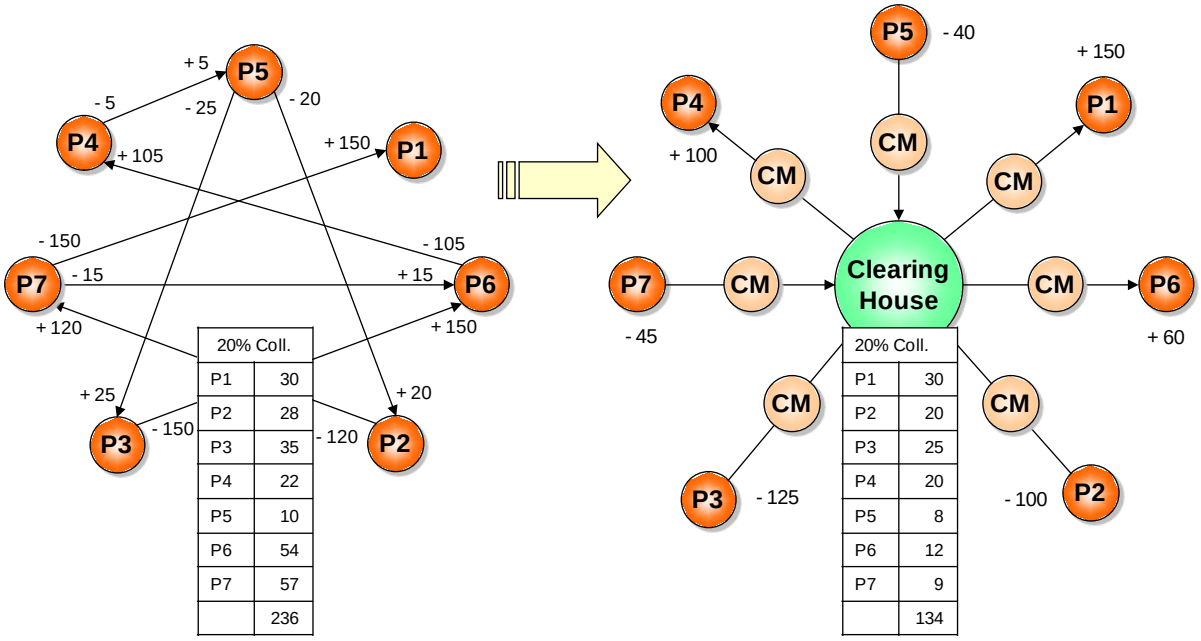


Figure 9 – Multilateral Netting[24]

Collateral requirements are assessed based on the participant's net position. Taking the example above, if we assume that the collateral required to secure a position is 20% of the contract's face value, total margin for P7 required by the clearing house is 9 units. By contrast, if P7's bilateral counterparties require it to post collateral at the same ratio[25], this would be assessed on the absolute value of each separate position (as each can move up or down in any given day), requiring a total of 57 units of collateral to be posted. Similarly, P7, as a prudent participant, should make provision on its own balance sheet for its exposures against each counter-party. This exposure is dramatically reduced if the counter-party is the clearing house.

As can be seen, novation and multilateral netting result in significant collateral efficiencies. Further efficiencies can be gained by assessing exposures, and associated collateral requirements, on a portfolio basis ('portfolio margining'), allowing margin offsets between contracts with correlated risk profiles. These can take the form of intra-commodity credits between products (e.g. long gas, short electricity), and intra-commodity credits between periods (e.g. short July, long August).

3.4.1.5 Mark-to-Market

Clearing also uses a process of incremental settlement, known as 'variation margining' or 'mark-to-market'. A participant's net position in each contract is 'marked-to-market' on a daily – or in some cases, intra-day – basis. The same process is used for final settlement of cash-settled products, but

[24] Source: Todd Bessemer, *Financial Markets in Energy Lectures for Energy Supply & Value Chains*, University of Melbourne, 2013.

[25] Such matters are usually determined by the master agreements between the parties, and may be influenced by factors such as credit rating, etc.

with the 'final settlement price' based on an external index. Failure to pay on-time results in a 'margin call'.

This process is an important adjunct to the collateral process, serving to keep the participant's potential exposure, and thus collateral requirement, down. It also lessens the size of any exposure that falls outside the probability range used for collateralisation.

3.4.1.6 Guarantee Structures

Collateral protects the clearing house against credit events to a given statistical confidence. There is always a residual risk, however, of a default event exceeding this range, and hence, posted collateral. Clearing houses typically have an extensive trade guarantee structure to protect the integrity of the clearing house in such an event. This can include a range of financial resources, including:

- A guarantee/default fund contributed to by all clearing members.
- Default insurance, generally callable after the guarantee fund is exhausted.
- Use of some or all of the clearing house profits.
- Utilisation of a defined quantum of clearing house capital.
- Socialisation of any residual amount to all clearing members.

A typical series of escalating guarantees is illustrated in Figure 10 below.

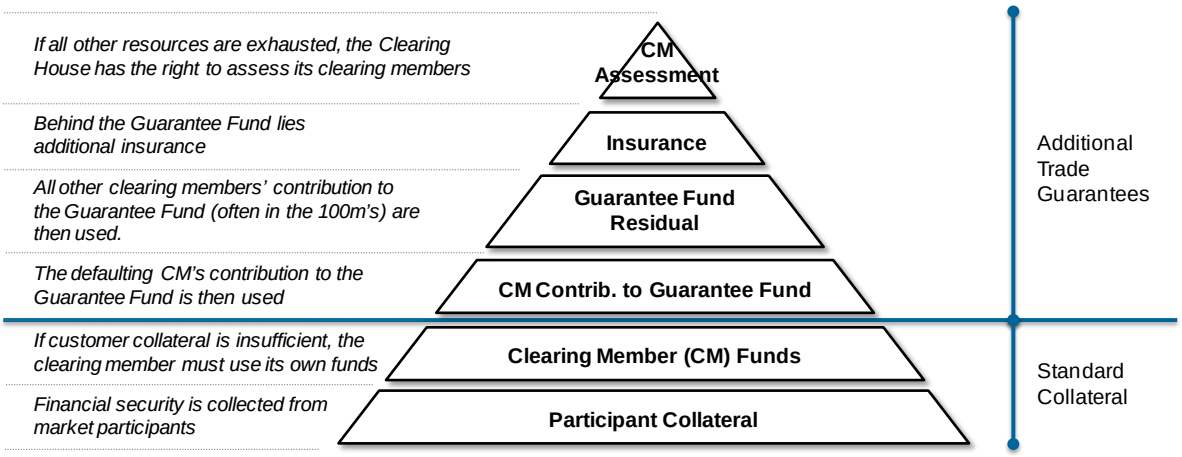


Figure 10 – Example Clearing Guarantee Structure[26]

3.4.2 OTC Clearing

'OTC Clearing' refers to the clearing of financial contracts executed off-exchange, most commonly over-the-counter, but also potentially directly between counter-parties. From a risk management perspective, futures and cleared OTC products are functionally identical. To be capable of being cleared, OTC contracts must generally be capable of being mapped to a standardised product definition (see Section 3.2.1). The principal historical difference has been lighter regulatory treatment.

In the aftermath of the GFC, OTC Clearing has come to broader public attention, with the Pittsburgh G20 summit in 2009 agreeing that central counter-parties should be used for the clearing of all standardised OTC derivatives by the end of 2012. Australia's Council of Financial Regulators, while not mandating any particular solution, encouraged each of the various markets its members regulate to adopt an appropriate clearing solution.[27]

OTC Clearing has a far more extensive history in the global energy markets, with Nord Pool offering the service as far back as 1997. NYMEX and ICE – the latter originally in concert with LCH-Clearnet

[26] Source: Market Reform
[27] *OTC Derivatives Market Reform Considerations*, Council of Financial Regulators, March 2012.

– commenced development of similar services in 2000/01, with a significant surge in uptake in the North American and European markets from 2002/03, driven by the 'flight to quality' that occurred following the collapse of Enron, Dynegy, TXU Europe and a number of other energy merchants. By allowing smaller and less-creditworthy parties to remain in (or enter) the market, overall liquidity was stimulated – a trend that continued over subsequent years (see Figure 11)[28].

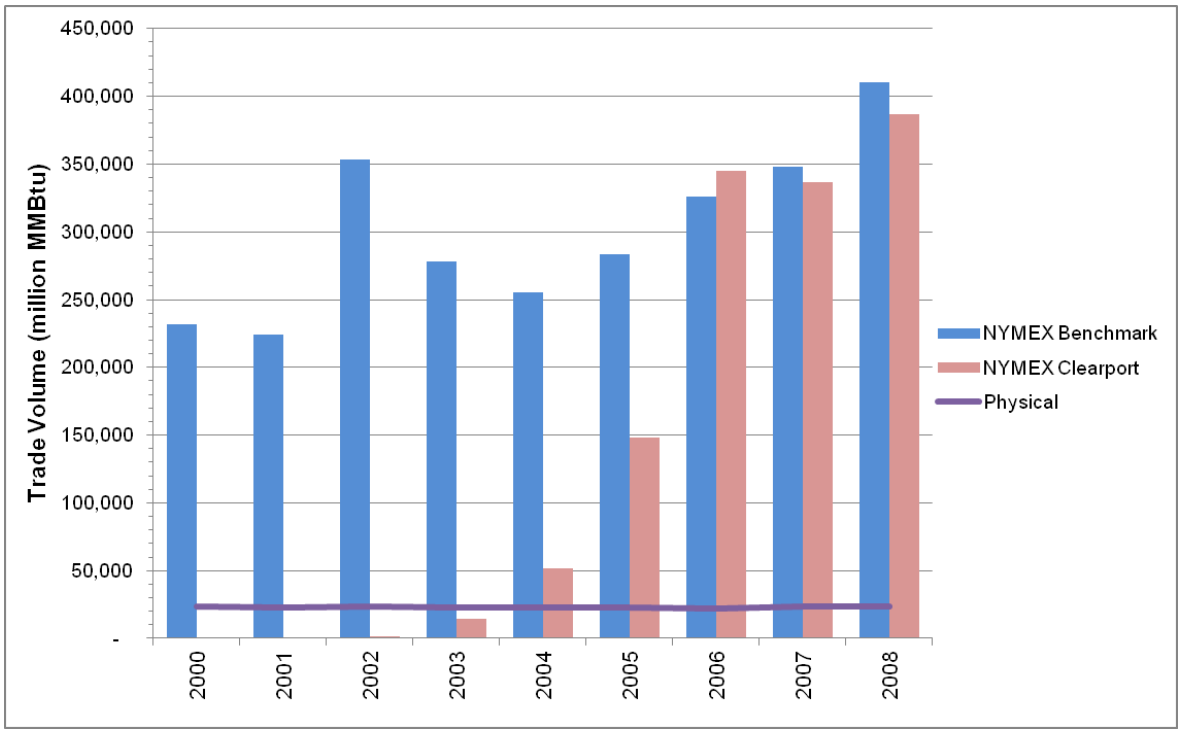


Figure 11 – Growth of Natural Gas OTC Clearing at NYMEX[29]

With recent regulatory changes in the US and Europe, the lighter regulatory burden for OTC markets has diminished, or some would argue has even reversed. This is demonstrated by the recent shift by ICE to convert all of its OTC energy products to futures.[30] Even though these deals may be executed OTC, upon submission to ICE they will immediately become futures contracts. This is also the case with trades submitted to NYMEX.

Looking back over the last decade or so, OTC Clearing has been an extraordinarily successful advent for the OTC energy markets of both North America and Europe – as well as their key clearing houses. It has also served to increase the liquidity of associated futures markets. Given its success in most other advanced economies, this begs the question: why has uptake of OTC Clearing in the Australian energy markets lagged?

[28] This figure shows statistics through 2008, the last year for which energy-only statistics can be reliably obtained. While volumes cleared through the Clearport platform have continued to increase dramatically, CME Group (which acquired NYMEX in 2008) now lists a wide variety of other contracts on this platform (metals, agricultural, financial, etc.), and does not explicitly split out energy volumes in its Clearport annual reporting.

[29] NYMEX volumes derived based on contract volume by average contract size:

- Contract volumes 2007-2008 from Futures Industry Association, Annual Volume Surveys (http://www.futuresindustry.org/volume-statistics.asp). Contract volumes 2000-2006 from NYMEX Annual Reports.
- Contract size equals 10,000 MMBtu for benchmark contracts. For Clearport contracts, weighted average contract size was determined based on CME/NYMEX 2009-12 Year-to-Date Volume Report.

Physical volumes: *World Dry Natural Gas Consumption*, US Energy Information Administration (EIA).

[30] *ICE shifts OTC energy swaps to futures*, Financial Times, 31 July 2012, and *Energy traders look to futures markets for regulatory certainty*, Financial Times, 16 September 2013.

3.4.3 The Present Limits of Clearing … and Beyond

Originally the preserve of a small number of benchmark futures contracts, the range of instruments being cleared has grown steadily over the last decade, as common OTC trades have acquired standardised definitions, and electronic listing has allowed dramatically wider market access. Nevertheless, the reach of clearing is inherently limited by the ability to apply its underlying disciplines.

The mark-to-market process relies upon the ability to determine a settlement price every trading day. However, 'longer-dated' contracts (i.e. further from the date of nominal delivery) tend to have significantly less liquidity, making this process more complicated and less reliable. This poses limits on how far into the future contracts can be reasonably listed. At NYMEX, for example, most natural gas basis contracts are listed up to 72 months out, whereas the highly-liquid Henry Hub Futures benchmark is listed for the current year plus the next 12 years.[31]

Similarly, the initial margining process relies upon the ability to assess volatility for a given contract, as well as determine risk correlations between contracts. This requires an ability to make 'apples against apples' comparisons – thus, a standardised definition. As a result, more exotic instruments, as well as deals with unique characteristics, have typically not been capable of being cleared.

However, demand drives innovation. Recent years have seen the classic clearing approach extended to incorporate specialised risk models, which allow a wider array of trading activity to be cleared.

For example, Nodal Exchange operates forward markets based around hundreds, and potentially thousands, of individual locations/nodes in each of the electricity systems it covers[32], all cleared by LCH-Clearnet. While trading at each individual node may be thinly liquid, and thus difficult to clear in isolation, the clearing model recognises that there is a relationship between these nodes, and as such, they form a single portfolio of inter-related trades. As a result, rather than use standard risk models – which tend to look at products in isolation, and then a limited set of the correlations between them – these markets are margined using a specialised methodology based on the value-at-risk of the entire portfolio.

Similarly, various models have been devised for the application of clearing house disciplines to natural gas and electricity cash markets[33] – clearing a 'settlement risk', rather than the more traditional 'replacement risk' associated with forward trading. For example:

- The Natural Gas Exchange (NGX) provides clearing for spot (and forward) trading on its own markets in Canadian and US natural gas, as well as US physical gas contracts traded on ICE.
- All trading on EpexSpot –which operates day-ahead and intra-day (but not real-time/spot) markets for Germany, France, Austria and Switzerland – is cleared through European Commodity Clearing (ECC).
- Significant investigations have also been made into clearing of the ISO-operated cash markets (including real-time markets) in the US, by NYMEX[34] and others.

3.4.4 Alternatives for Clearing Natural Gas in Australia

Depending on how the market evolves, there are a number of options for the clearing of exchange-based and OTC natural gas trading in Australia.

- The dominant derivatives clearing house in Australia is ASX Clear (Futures) – a subsidiary of the ASX. However, the vast majority of the clearing house's activity is outside the energy markets, and the gas futures product it nominally clears is essentially untraded.
- LCH.Clearnet has recently been granted a Clearing & Settlement Facility (CSF) licence for the clearing of trading on, and OTC deals submitted through, FEX. LCH currently clears

[31] Source: www.cmegroup.com (as of September 2013).
[32] The markets covered are essentially the nodal-priced US markets: PJM, New York ISO, ISO New England, Midwest ISO, California ISO and ERCOT.
[33] See, for example: Bessemer, T.W. & Shields, F.X., *Spot Market Clearing – Solving the Electricity Credit Malaise*, Public Utilities Fortnightly, May 2005.
[34] The authors of this paper led one such project for NYMEX, in 2003.

Nodal Exchange, and has previously cleared the energy products of ICE (prior to ICE establishing ICE Clear Europe), and a number of European electricity markets.

- The Australian Market Licences granted to both CME (which includes NYMEX) and ICE Futures Europe, provide for trading on those facilities to be cleared by their associated clearing houses, domiciled in the US and Europe respectively.
- Other clearing houses with substantial experience clearing energy markets could choose, or be encouraged, to offer clearing services. The principal candidates would NGX, ECC and Nasdaq OMX Clearing[35] (which clears Nord Pool futures and the N2EX market in Great Britain).

AEMO could also decide to establish a clearing house, building upon its gas and electricity cash market franchise, and potentially providing the ability for margin offsets between the cash and derivatives markets. However, the credit risk management practices of most gas and electricity cash markets – with long settlement timeframes and insufficiently secured credit – are rudimentary when compared to those of a fully-fledged clearing house. While AEMO is not unique amongst its global peers in this regard, it would need to significantly enhance its settlement and credit capabilities to take on a more expansive clearing role and gain a Clearing & Settlement Facility (CSF) licence.

3.5 Reliable 'Delivery' Mechanisms

In order to be useful for hedging purposes, forward trading must converge upon the underlying commodity – without this convergence, it is little more than betting.

3.5.1 Financially-Settled Products

Financially-settled products ensure convergence to the underlying commodity by settling against a reliable 'physical' market index. This is generally either:

- a derived index, usually based on participant price survey, such as those published by Platts (see discussion below), or preferably;
- an index set through actual spot market trading, such as the Victorian and STTM gas spot markets facilitated by AEMO.

Derived price indices and their limitations

As OTC markets become more actively traded it is common for price indices to develop, as a proxy for the forward price transparency provided by exchange trading. These indices are typically produced from participant price surveys, facilitated by either a third-party price-reporting service – such as Platts or Argus, which compile indices for a wide range of US natural gas receipt and delivery locations – or an industry association – such as AFMA, which publishes indices for Australian electricity.

However, while these indices bring some transparency, and are better than nothing, they are a poor second choice to exchange-derived prices. OTC indices are typically available only to subscribers, rather than being openly published.[36] Of greater concern is the potential for manipulation of indices, given they are derived from self-reported data. For example, subsequent to the collapse of a number of energy merchants in the US, investigations conducted by the Commodity Futures Trading Commission (CFTC) uncovered significant "reporting (of) false natural gas trading information." This resulted in a total of $272 million in fines being levied against 12 separate organisations between 2003 and 2005.[37]

[35] However, as a major trading and clearing technology supplier to the ASX, it is unlikely Nasdaq OMX would want to enter into competition with them.
[36] From the data providers' commercial point-of-view this is fair enough – they take time and money to compile, and those performing this function should be compensated – but it does not aid broader transparency.
[37] For further information, see: *Factbox: CFTC's biggest fines for trading infractions*, Reuters, 26 January 2011.

3.5.2 Physically-Delivered Products

'Physical' products ensure the same convergence through actual delivery of the underlying. This process of delivery is typically achieved through either Bilateral Delivery Matching or Multilateral Submission.

3.5.2.1 Bilateral Delivery Matching

At the conclusion of trading, participants with net open positions are paired into bilateral delivery transactions.[38] The objective of this matching process is to minimise the number or discrete deliveries that must be made, though for the sake of simplicity and reproducibility, it is often achieved through a simple heuristic, rather than a formal optimisation. It is up to the paired participants to arrange the delivery themselves, including booking any necessary transportation to/from the delivery point.

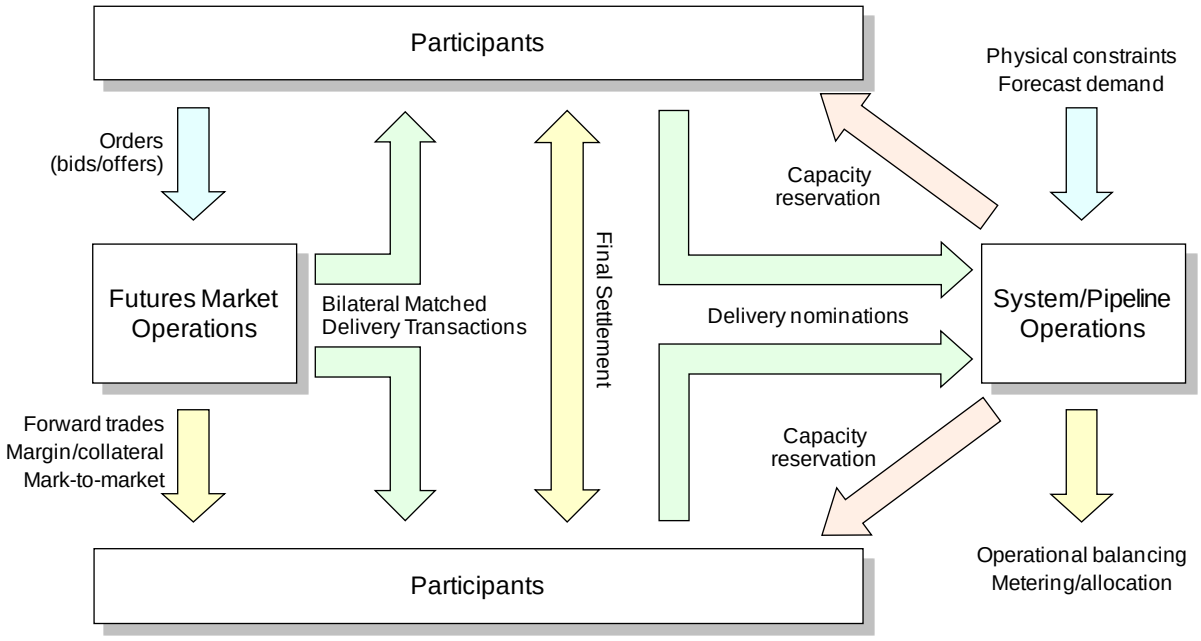


Figure 12 – Bilateral Delivery Matching

To allow time for this process[39], contracts often cease trading some days in advance of delivery. NYMEX is a classic example of a marketplace following this process for its physically delivered contracts, such as Henry Hub futures, which come 'off the boards' three trading days prior to commencement of the delivery period.

3.5.2.2 Multilateral Submission

Rather than pairing positions for delivery, the exchange (or clearing house) submits its set of open positions directly to the operator of the delivery location – be it a system operator, hub operator, pipeline, etc.. Although positions are not paired, the set is still balanced in aggregate – i.e. the sum of short (selling/injecting) positions equals the sum of long (buying/withdrawing) positions. In order for multilateral submission to work, the exchange must have suitable arrangements in place with the delivery location operator to accept nominations directly from the exchange, and to share other required information (e.g. which organisations are authorised to make or take delivery).

[38] For markets in which non-physical players are able to participate, the exchange or clearing house will, as the time of delivery approaches, typically verify that all participants with open positions have the capability to make and/or take physical delivery

[39] The end-to-end physical delivery process typically involves a number of other processes not discussed here, such as Exchange of Futures for Physical (EFP), Alternate Delivery Procedures (ADP), etc..

Under this delivery approach, futures market positions will become spot market positions as the time of delivery approaches. The participant can then trade in the cash market to fine-tune its position (or exit it, if it wishes). At the closure of the spot market trading timeframe, the residual positions for each participant – which represents its nominal schedule – are then submitted as a balanced set to the delivery location operator (see Figure 13).

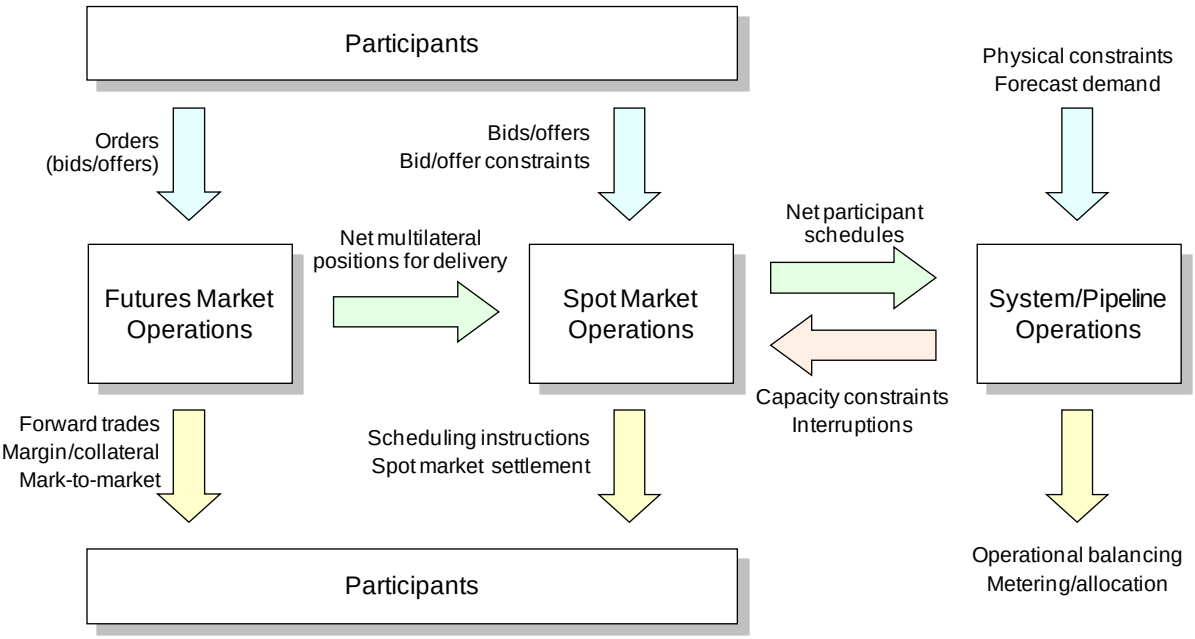


Figure 13 – Multilateral Submission

The gas market operated by Powernext in France is an example of this approach, with open futures positions at contract expiry submitted to the spot market (also operated by Powernext) and becoming nominal spot market flows. These flows are adjusted by further trading in the spot market to result in a final delivery schedule submitted to GRT, the gas system operator.

In comparison to bilateral matching, multilateral submission avoids the imposed constraint of having to resolve delivery with potentially a number of paired counter-parties. It also allows trading significantly closer to the time of actual physical delivery (in the case of Powernext, trading can occur right into the delivery day), thus offering a more complete hedge.

4 DEVELOPMENT OF THE GAS SUPPLY HUB

4.1 Possible End-States

Experience globally indicates that development of the natural gas market – or in fact any networked market – will settle-down into one of two end-states:

4.1.1 Closed Shop

The 'closed shop' is characterised by:

- Access to transportation through individually negotiated agreements with pipelines. There is no open or equal access to transportation, and little transparency regarding pricing and terms.
- Supply exhibits oligopoly features, with the bulk of supply locked up in long-term (usually take-or-pay) supply agreements negotiated bilaterally with a small number of suppliers.
- Forward pricing is opaque, with no reliable forward price curve. Little trading liquidity.
- Long-term agreements provide commercial certainty for investment (for those who already have a foothold in the market), though lack of liquidity and forward price transparency can depress banks' willingness to lend.
- Little opportunity for new entry or competition.

While this scenario runs counter to the general trend in Australia, US/Canada and much of Europe, towards market competition in natural gas, it describes the state of the industry in many parts of the world[40].

4.1.2 Open Market

The 'open market' is characterised by:

- Equal and open access to transportation, with prices set through regulation, or transparently through a competitive process.
- Ready access to supply, with a range of buyers and sellers.
- Transparent spot markets, tightly integrated with the underlying delivery mechanism(s), providing an effective price reference for forward trading.
- Forward trading principally through efficient, price-transparent exchanges, accompanied by robust central counter-party clearing. OTC trading utilised for non-standardised instruments, and large 'block trades', with the latter also subject to clearing.
- Strong trading liquidity, with a robust forward price curve.
- Greater commercial risk to participants through competition, though the presence of a robust forward price curve allows the debt markets to better assess price risk.
- Strong infrastructural support for wholesale and retail competition.

4.1.3 The Third Option, that Isn't

The move to an effectively functioning wholesale market is often difficult, both because of the new disciplines it forces, and resistance from those with a vested interest in the status quo. On the other hand, maintaining a closed shop is viewed as a retrograde step, and generally even more unattractive. The possibility of some sort of hybrid solution can seem alluring. Except it doesn't work.

Multiple attempts have been made to concoct 'best of both worlds' solutions, driven by a myriad of motives, often politically inspired (e.g. the desire to preserve a 'national champion'). The result has invariably been an artificial melange that takes on the worst characteristics of both models – creating neither efficiency nor certainty – and ends up being unworkable.

The deregulation of the US natural gas sector provides a seminal example. Many large customers, who were captive to their local distribution company (LDC), were effectively cross-subsidising other customers. Following the introduction of initial competitive reforms (e.g. FERC Order 436), there was

[40] Or more specifically, places where an outright supply monopoly doesn't exist.

a rapid move by large users to bypass the LDC (e.g. purchasing from the emerging gas 'marketers'). This caused the status quo to unravel, resulting in dramatic changes to industry structure, and further regulatory reforms.[41]

Another classic example is the deregulation of the German electricity market. In response to the requirements of the (First) European Electricity Directive (96/92/EC), the German government passed a law that declared the market to be fully open to competition at both the wholesale and retail levels. However, no market infrastructure was established, no structural separation was required, and third-party access to the regional transmission networks was to be via negotiation. The result was preference behaviour from the incumbents, high network charges for the transactions of most interest to new entrants[42], and consequently, significant barriers-to-entry – leading the President of the Bundeskartellamt (German cartel authority) to remark in August 2002 that "fees for network use…currently constitute the main obstacle to effective competition in the electricity markets."[43] By 2004, negotiated third-party access was gone[44]. Subsequently, liquidity grew quickly, for trades executed both OTC and on the European Energy Exchange (EEX).

Ultimately, while various alternative outcomes to the 'closed shop' and the 'open market' have been propounded over the years, they have proven illusory; a mid-point on the journey, rather than the destination.

4.2 An Evolutionary Path to Market Development

Taking the premise that the desired objective is an open and competitive market, how might the gas market at the Wallumbilla hub, and more broadly in Eastern Australia, develop over time? What actions are required to promote or accelerate this process?

Various market development initiatives are already in place, or in the process of being implemented, specifically:

- The configuration of the supply hub at Wallumbilla has been defined, though as discussed in Section 2.2 of this paper, incorporates material internal constraints, and will initially have a limited range of hub services.
- AEMO is implementing a basic 'bulletin board'-style[45] facility for transmission capacity, to facilitate buyers and sellers finding each other for the purposes of secondary trading.
- Standard terms and conditions for shipper-to-shipper capacity trading are being defined by participants under the auspices of AEMO.
- Market arrangements and market infrastructure – including systems for trade execution and settlement – are in the process of being implemented, with cash market trading scheduled to commence in Q1 2014.

This simply represents a start. A logical evolutionary path, broken down into stages, might be as follows:

4.2.1 Stage 1 – Quick Wins

Initiatives that could aid market-development in the near term, and do not require significant implementation effort, include:

[41] For a more comprehensive discussion of this topic, see: Francis X. Shields, *Gas Pricing & Futures, Trends & Applications*, paper delivered to PCGA InfoTech Conference, May 1994.
[42] 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).
[43] *Germany - Regulatory Reform in Electricity, Gas, and Pharmacies*, OECD, 2004, p56.
[44] Driven in no small part by the Second European Electricity Directive (2003/54/EC).
[45] The original bulletin boards for US natural gas – established pre-world-wide-web – were simple free-format, text-only mechanisms, templated on the bulletin board systems operated by early online providers, themselves a computerised imitation of the original cork-and-pin bulletin boards. While the name has been retained, bulletin boards in the natural gas industry nowadays are often significantly more sophisticated, with advanced transactional and information presentation capabilities. Two such examples are the National Gas Market Bulletin Board operated by AEMO, and Gas Bulletin Board operated by the WA IMO.

1. Implement more robust arrangements for secondary trading of transportation capacity. Such arrangements should include acknowledgement or registration of the transfer by the pipeline operator, avoiding the need to maintain lengthy title chains. To this end, it is understood that AEMO is working with APA towards introduction of an 'operational transfer' process by the end of 2013, with AEMO to settle this trading[46].
2. An important adjunct to the first initiative is the ability to break capacity into smaller time-blocks – allowing a party to sell the capacity they hold in specific periods when they might not require it, and retain it in other periods[47]. While such an initiative could be voluntarily permitted by the pipeline operator, it has historically been resisted in other jurisdictions, and may require regulatory or legislative action.
3. Actively encourage the participation of OTC brokers in trading around the Wallumbilla hub, providing training and other educational support. This is particularly important in the early days of the market, with the vast majority of forward energy trading in Australia – by some estimates over 90% – presently conducted bilaterally or OTC.

4.2.2 Stage 2 – Hub Enhancement (Near-Term to Medium-Term)

Stage 2 initiatives focus on enhancement of the hub and the services provided at it. This can be achieved without substantial natural evolution of the market – which is a function of market maturity – but may involve appreciable implementation effort.

4. Augment facilities at the Wallumbilla hub to turn it into a single virtual trading location (rather than the present three), capable of facilitating all commercially likely transactions.[48] While the impacted pipeline operators may act on their own initiative, or as a result of the 2015 review of the gas supply hub, more rapid progress may be made if SCER acts to provide the owners of these facilities with assurances regarding their ability to recover their hub augmentation costs.
5. Provide additional hub services, to enhance commercial convenience and stimulate market liquidity at the hub. Based upon the outcome of Initiative 4, additional services which could be offered include storage, gas balancing, and nomination. The provision of these services could provide commercial opportunities for pipeline operators and other players.

4.2.3 Stage 3 – Open Access (Medium-Term)

Stage 3 initiatives focus on ensuring the efficient allocation of transportation capacity, to those who value it most highly, and discouraging strategic withholding (or hoarding). This is likely to require regulatory and/or legislative action, which would dictate the timing of implementation.

6. Mandate the sale of transportation capacity through open-access, price-transparent processes, such as capacity auctions (i.e. 'open-season'), and/or published tariffs. Capacity auctions could be conducted by pipelines themselves, or facilitated by AEMO.
7. Require the re-sale of capacity through the same transparent mechanism(s).[49]

4.2.4 Stage 4 – Exchange-Trading and Clearing (Medium-Term)

Action on the initiatives of Stage 4 can commence in the near-term, but some degree of evolution in trading maturity will likely be required to improve uptake, and justify implementation expenditures.

8. Define a standardised trading product based around the Wallumbilla Hub. The definition process should actively engage industry, in order to maximise the chances of product uptake.

[46] For prudential reasons AEMO, should only settle the current month in delivery plus the next/prompt month. Accepting trades any further out (be they for gas, or transportation capacity) is analogous to settling a forward product, and could provoke concerns from financial regulators.
[47] A logical consequence of such a change is that transportation capacity would have a time-differentiated, market-determined value, aligned with periods of greatest demand, rather than a uniform annual price.
[48] This does not mean that the hub can support every set of transactions that might possibly be devised, but those sets of flows most likely (to a high degree of statistical confidence) based on historically observed and projected pipeline flow patterns.
[49] Note that Initiative 1 provides for such a facility to be made available. This initiative would mandate its use.

Such a process could be run by any (or every) exchange interested in listing a product, though given initial trading is likely to be predominantly OTC, there may be a good case for AEMO to take a key role in facilitating the product definition.

9. Implement OTC Clearing of natural gas contracts. This will require a clearing house interested in carrying out the clearing. In addition, until exchange-trading liquidity builds, it will require the cooperation of market participants and OTC brokers in the process to set daily settlement prices for mark-to-market.
10. Implement exchange-trading of natural gas contracts. This will require a futures exchange interested in providing this service. As trade execution tends to follow a natural OTC-to-exchange evolution, the success of exchange-trading is likely to be predicated on how well the OTC markets have taken up the trading of standardised products.

4.2.5 Stage 5 – Expand the Product Slate (Medium-Term to Longer-Term)

Once liquidity is established in one or two core 'benchmark' products, the range of standardised products available for exchange-trading and clearing can be extended.

11. Define a range of contracts, based on different delivery locations, that can trade as a 'basis differential' to the underlying benchmark. This will require a suitable reference price for final settlement to exist at the basis location.
12. Define additional 'outright' contracts, as sought by the market, taking care not to split the liquidity of the core benchmark(s).

4.2.6 Stage 6 – Cross-Market Clearing (Medium-Term to Longer-Term)

As gas trading becomes more mature, participants are likely to seek greater collateral efficiencies between markets.

13. Allow settlement netting, and prudential risk (and hence collateral) offsets between all AEMO-operated gas markets.
14. Extend settlement netting and prudential risk offsets to all AEMO-operated markets, gas and electricity.
15. Extend the disciplines of clearing to the gas and electricity spot markets, and provide integrated clearing across spot and forward markets.

Appendix A – Glossary of Terms

Term	Definition
AEMO	Australian Energy Market Operator – operator, amongst other things, of the: • Victorian gas system. • Victorian gas spot market ('Declared Wholesale Gas Market'). • STTM spot markets at demand hubs located at Sydney, Adelaide and Brisbane. • (from Q1 2014) Gas spot and short-term forward markets at the Wallumbilla hub. • Retail gas markets in VIC, NSW, SA and QLD. • National gas market bulletin board. • National Electricity Market (NEM)
AFMA	Australian Financial Markets Association – an industry association of those involved in the Australian financial markets.
APX	Operator of electricity spot markets in the Netherlands, Belgium and Great Britain. Until recent sale of its interest to ICE, it also operated gas spot and forward markets, and electricity forward markets. Originally commenced business as the Amsterdam Power Exchange.
ASIC	Australian Securities and Investments Commission – principal regulator of Australia's financial markets.
ASX	Operator of the Australian Stock Exchange, as well as Australia's dominant derivatives market, and the clearing facilities associated with these markets.
Cash Market	Market in which traded products are promptly settled. Often treated as analogous to the Spot Market, though in the settlement timeframe of many energy markets can also include very-short-term forward instruments (e.g. day-ahead).
CFTC	Commodity Futures Trading Commission; regulator of commodity-based derivatives markets in the US.
Derivative	An instrument which derives its value from the performance of an underlying commodity.
EIA	US Energy Information Administration
FERC	Federal Energy Regulation Commission; regulator of the energy industry in the US.
Forward	Instrument representing an obligation to exchange an underlying product at a future date, according to pre-agreed terms.
Futures	Forward contract traded on a registered futures exchange – and hence subject to the trading and clearing disciplines of the exchange.
ICE	Intercontinental Exchange – a major operator of global derivatives markets, with origins in energy but since expanded to a range of other commodities.

Term	Definition
IMO	Independent Market Operator – operator of the Western Australian electricity market and gas bulletin board
NYMEX	New York Mercantile Exchange (now part of CME Group) – the world's largest physical commodities exchange.
Option	Derivative providing the holder the right, but not the obligation, to buy ('call') or sell ('put') the underlying commodity.
Outright	Forward contract in which, at maturity, the seller must deliver the underlying product to the buyer in the agreed quantity, with the buyer making payment at the agreed price. Also known as a 'physical' contract.
SCER	Standing Council on Energy and Resources – council of Australian federal, state and territory energy and resources ministers. Exists under the auspices of the Council of Australian Governments (COAG).
Spark Spread	Spread involving the purchase of a gas contract and the sale of an electricity contract, or vice versa.
Spot Market	Market in which products are traded for immediate delivery.
STTM	Short-Term Trading Market for natural gas. Encompasses the demand hubs of Sydney, Adelaide and Brisbane.
Spread	Transaction consisting of the simultaneous purchase and sale of two separate contracts. While executed as one transaction, it results in two separate underlying contracts, or 'legs'.
Swap	Forward contract in which, at maturity, the seller and the buyer exchange cash payments, based upon the difference between the agreed contract price and a pre-defined index price. Also known as a 'two-way contract for differences'.