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June 2013

Getting gas right

Australia's energy challenge

Tony Wood and Lucy Carter

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Grattan Institute Report No. 2013-6, June 2013

This report was written by Tony Wood, Grattan Institute Energy Program Director and Lucy Carter, Energy Fellow. Daniel Mullerworth and James Button provided extensive research assistance and made substantial contributions to the report.

We would like to thank the members of Grattan Institute's Energy Reference Group for their helpful comments, as well as numerous industry participants and officials for their input.

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This report may be cited as:
Wood, T. Carter, L., and Mullerworth, D., 2013, *Getting gas right: Australia's energy challenge*, Grattan Institute

ISBN: 978-1-925015-40-9

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Overview

Next year the first liquefied natural gas (LNG) carrier ships will dock off Gladstone in Queensland, ready to ship LNG to Asian and other markets. By 2017 east coast gas, added to growing Western Australian supplies, could create the world's biggest gas export industry, worth $53 billion a year. But this transformation is not good news for everyone.

Strong Asian demand and high prices are inducing Australian producers to export their gas. That means local consumers will have to pay higher prices. Within the next couple of years, gas prices for households on the east coast, particularly in Victoria, will rise by as much as $170 a year. Large industrial users of gas will come under pressure from equally significant price increases.

Gas presents other challenges, too. Infrastructure constraints plus commercial battles over prices mean there may be difficulties getting gas to where it is needed on the east coast, especially in New South Wales. And the long-anticipated 'dash for gas', in which it acts as a transition fuel while electricity generation shifts over time from coal to low-carbon technologies, is not happening in Australia. Falling demand, rising gas prices and a renewable energy target that largely supports new wind energy mean new gas-fired electricity generation is unlikely to be required for at least the next decade.

With more than $160 billion forecast to be invested in LNG production, the export industry is good for the economy. Governments should therefore resist self-interested calls from some industries to cap prices or reserve gas for the domestic market. Western Australia should go further, and end its policy of reserving gas for domestic use. Protectionism may provide some short-term price relief for targeted industries, but ultimately it leads to higher prices and damages the economy.

Yet government and industry both have vital roles in ensuring the market works efficiently. Governments must:

- Resolve the coal seam gas impasse in New South Wales.
- Create a more transparent gas market that includes new trading hubs, such as Wallumbilla in Queensland, and a gas price index that provides clear information to all players.
- Remove barriers to efficient supply by freeing up trading of pipeline capacity, and moving towards elimination of joint marketing arrangements as the market matures.

Industry, for its part, must ensure supply can flow. There is no shortage of gas, but infrastructure may be physically unable to meet growing demand in the short term. Gas producers must respond to the needs of their customers or political pressure will push governments to intervene.

With global gas resources likely to last at least 200 years, the International Energy Agency has described the next decade as the 'golden age of gas'. Australia is well placed to reap the commercial benefits, but has further to go to create an affordable, reliable and sustainable energy sector.

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1. What does the global gas revolution mean for Australia?

1.1 Gas markets are on the move

Around the world, gas markets are changing on an unprecedented scale. Demand is surging. Between 1990 and 2010 gas consumption increased by 63 per cent. By 2020 it is forecast to have nearly doubled since 1990.[1]

A number of developments are driving demand for gas:

- Worldwide demand for energy is growing due to rapid economic development in China, India, and the Middle East.[2]
- Global supplies are growing, and are more than enough to meet demand. Increased supply pushes down the price.
- Several countries have banned or restricted the use of nuclear power following the Japanese nuclear disaster in 2011.
- Concerns about climate change mean that companies and nations need to limit emissions of carbon dioxide. Gas power plants are usually cheaper than renewable power generators such as solar and wind. Gas produces fewer carbon emissions than coal and does not have the waste disposal problems of nuclear energy.

Australia has an unparalleled opportunity to exploit its vast gas reserves and access to major markets in Japan, Korea, China and India. By 2015, Australia is projected to be the world's second largest LNG exporter, after Qatar (see Box 1 for a description of LNG).[3] By 2017 it may be the largest.[4] But what is good news for exporters is not necessarily good for local consumers of gas.

1.2 Supply has rapidly emerged to meet the market

Current assessments of global gas resources exceed 200 years of supply at current levels of production.[5] The 'game-changer', as the United States Energy Information Administration (EIA) called it, has been the invention of affordable ways to extract shale gas. Shale gas is a standard form of gas but is extracted from a different type of rock under the earth's surface. Innovative drilling techniques have made it possible to extract this gas at affordable prices. There is also a lot of it.

Figure 1 shows how shale gas production - virtually non-existent a decade ago - is projected to dominate US gas production by 2040. This chart also reflects how new supply was developed to meet higher demand and higher prices. The techniques

[1] From 76 exajoules to 147 exajoules per year. IEA (2012)
[2] Ibid.
[3] BREE (2012c)
[4] Bethune (2013)
[5] IEA (2012)

developed in the US have the potential to be applied more widely. While producers face challenges to extract gas from new locations using these new techniques, supplies have the potential to last a long time.

Box 1: What is LNG? What is an LNG train?

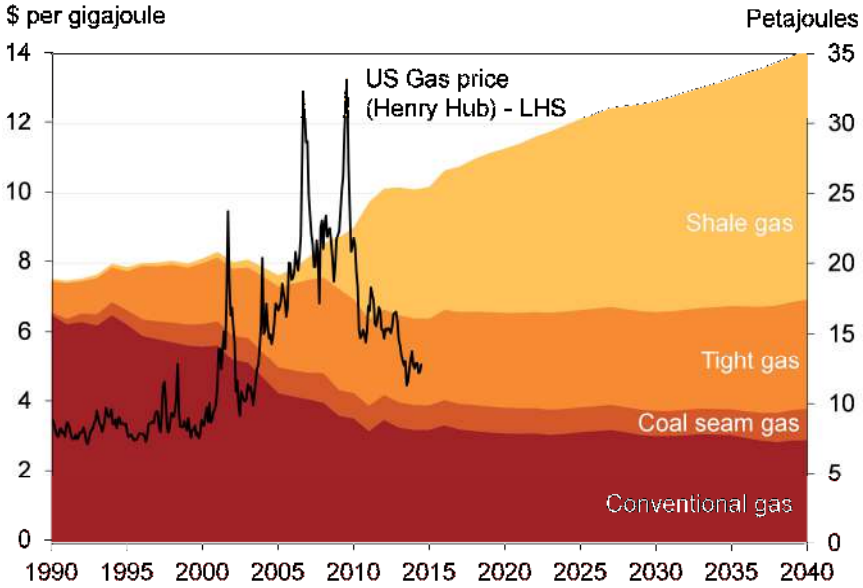
In domestic markets, gas is typically transported through pipelines. But when gas needs to be transported overseas it may not be technically viable or economically attractive to build a pipeline. In this case, gas must be transported by ship.

Liquefied natural gas or LNG is produced because it is more efficient to transport than natural gas. The LNG is created by passing gas through a system called an LNG train, which cools and compresses the gas, then loads it onto a ship for transport.

When LNG arrives at its destination, it is regasified – turned back into gas - and then delivered to end users through domestic pipelines. Converting gas to LNG, transporting it and regasifying it on arrival is expensive. To liquefy and ship it from Australia to Asia may cost $5 to $6 a gigajoule, more than the cost of gas in many Australian markets today.

Coal seam gas and shale gas are often grouped under the heading 'unconventional gas' as described in Box 2.

Figure 1: US natural gas prices and production, 1990 to 2040



Source: EIA (2012); EIA (2013b); EIA (2013a)

As shown in Table 1, Australia's 'proven and probable' reserves of coal seam gas and conventional gas are around 140,000 petajoules, enough to meet more than 70 years of gas demand at current rates of production. [6] The potential in-ground resource of coal seam and shale gas could be four times as large as known reserves.[7] A recent report for the Australian Council of Learned Academies describes the shale potential in Australia,

[6] EnergyQuest (2012) cited in AER (2012)
[7] BREE (2012c)

whilst also indicating that it may not be as readily realised as it has been in the USA.[8]

Table 1: Australia's 'proven and probable' gas reserves and production, 2012

Market	Type	Reserves (petajoules)	Production (petajoules)
Western Australia	Conventional	89,900	1,193
Northern Territory	Conventional	1,300	33
East Coast	Conventional	7,100	453
East Coast	Coal seam gas	41,700	247
Total		**140,000**	**1,924**

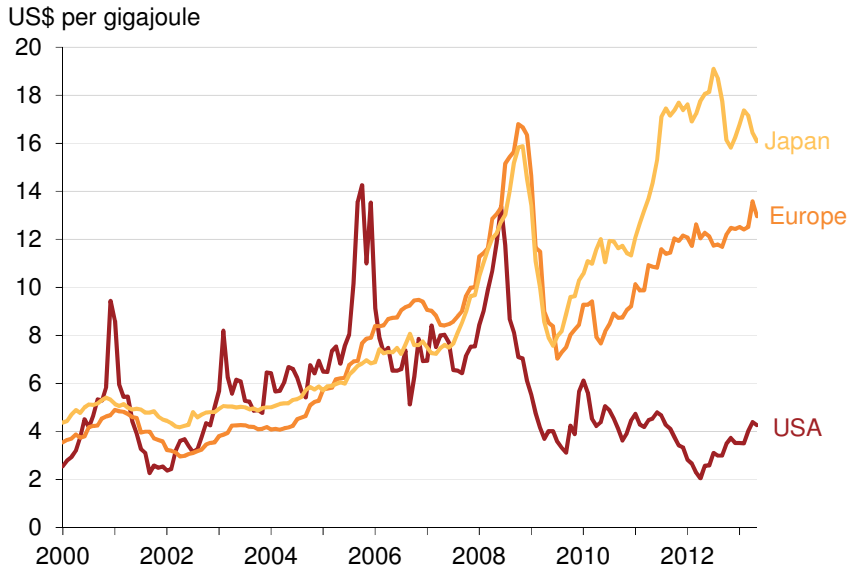
Notes: Totals may not add due to rounding.
Production includes both domestic sales and exports.
Source: EnergyQuest (2012), as cited in AER (2012)

1.3 Rising demand expands the Australian industry

High gas prices in Asia, as shown in Figure 2, have supported enormous investment in infrastructure in Australia, despite its high construction costs relative to other countries.

On the east coast, $50 billion has been committed to developing LNG export facilities based on coal seam gas in Queensland. In Western Australia, over $116 billion is being spent on projects under construction to expand the LNG export industry. Figure 3 shows forecast demand for east coast gas over the next two decades.

Figure 2: Global gas prices for key regions



Source: World Bank (2013)

This investment of over $160 billion will pay for the 13 new LNG trains currently under construction on Australia's east and west coasts. A further 19 trains are in the planning stage for possible development. The LNG industry is set to become a driving force for jobs and growth in the economy over the next decade and beyond.

[8] Australian Council of Learned Academies (2013)

Box 2: What is 'unconventional' gas?

Imagine trying to get all of the air out of a hollow chocolate Easter egg. Now, imagine trying to get the air out of a chocolate Aero bar, where it is trapped in small bubbles between the chocolate. The analogy illustrates the differences between extracting gas from conventional and from unconventional gas reservoirs.

'Conventional' gas is extracted from a large underground chamber - like an Easter egg. The gas filters upwards through layers of porous sandstone deep in the earth's crust until it is trapped under a dense layer of 'impermeable' rock. To extract the gas, a hole is drilled to the highest point in the reservoir and gas, which is lighter than air, flows to the surface.

Unconventional gas, like the air in an Aero bar, is not found in a continuous underground chamber. To encourage gas to flow from an unconventional well, producers sometimes inject fluid into the gas reservoir to fracture the rock and encourage gas flow. This technique is called hydraulic fracturing or 'fracking'. Its critics say that fracturing the rock may allow gas or chemicals to enter ground water supplies.

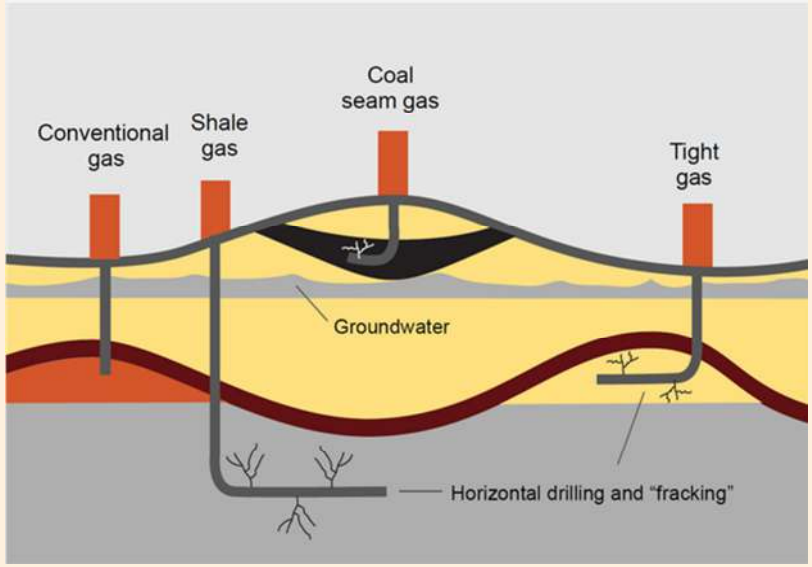
Unconventional gas supplies fall into several categories.

Coal seam gas (CSG) is extracted from coal deposits. The gas is released by extracting water from around the coal deposit. Removing the water reduces pressure and releases the gas.

Shale gas and tight gas are extracted from layers of rock with low permeability (small gas bubbles), which prevents gas collecting in a reservoir. Shale gas is found in sedimentary rocks such as sandstone. Tight gas is found in denser types of rock.

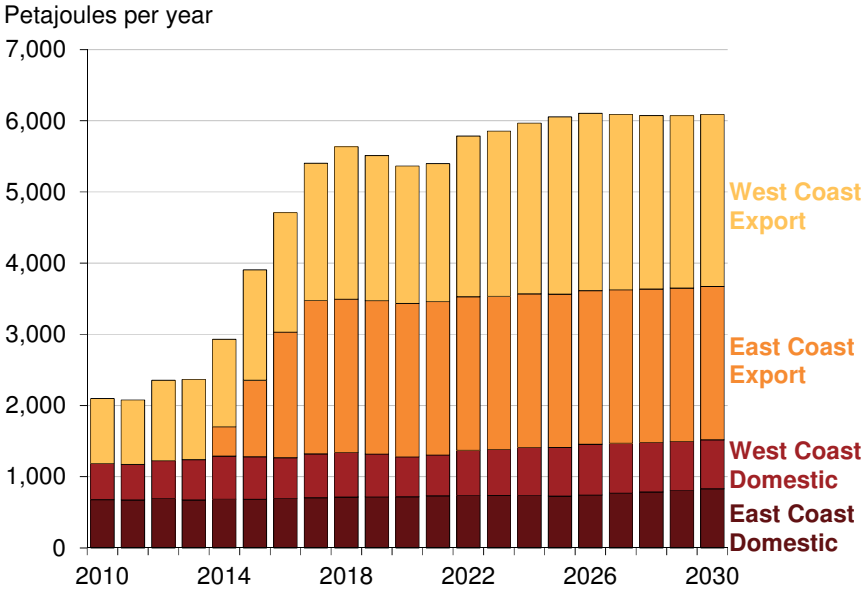
Australia is a world leader in coal seam gas technology and production but development of shale and tight gas resources remain in their infancy.

Conventional and unconventional gas wells both produce the same product – methane or 'natural gas'.



Source: Grattan analysis

Figure 3: Forecast gas demand for eastern and Western Australia, 2010 to 2030



Source: AEMO (2012a); ACIL Tasman (2011); Government of Western Australia (2012a)

The domestic gas industry will also gain from production economies of scale, which bring down the cost of extracting unconventional gas such as coal seam or shale gas. Australian markets are also unlikely to suffer the fate of US markets, where gas users faced several years of shortages and high prices before producers made breakthroughs in developing unconventional gas. In Australia, export opportunities are driving these breakthroughs.

Yet this good news for the Australian economy also carries a price.

1.4 The price of going global

Until now, Australia's east coast gas market and the global gas market have been physically disconnected. As such, there has been no way for gas sellers to move gas from lower-priced domestic markets to higher-priced international markets. This has allowed different gas prices to develop in each market. From next year, LNG exports will commence from the east coast and the two markets will be connected for the first time. That will bring their prices together, and lift prices at home. Sellers, attracted by higher prices, will move supply from the cheaper to the more expensive market until prices converge.

At present, Japanese buyers are prepared to pay about $15 a gigajoule. While Australian gas prices are forecast to rise, it is highly unlikely that domestic gas prices will rise to the same level as the prices seen in Japan. The gas price in importing countries includes the cost for converting gas to LNG, transporting it by ship and converting back to gas on arrival. The process is expensive – in the range of $5 to $6 a gigajoule to send gas from Australia to Japan. This cost differential provides an advantage for businesses buying gas in a country with gas reserves relative to competitors in countries that have to import their gas.

This 'export parity' price is therefore setting the benchmark for new gas contract negotiations in Australia. Because east coast gas prices have not been exposed to international markets, domestic wholesale contract prices have been both stable and low by international standards - about $3 to $4 a gigajoule.[9] Underlying low costs of production plus the need to compete with

[9] AER (2012)

coal and oil for electricity and industry have also kept prices low. But when exports start, prices are likely to rise. At the same time, the production cost of new gas sources is also expected to rise.

In Western Australia, which already exports LNG in large volumes, prices are around $5.40 a gigajoule.

Over the next several years, wholesale domestic gas price increases of more than 80 per cent nationally can be expected. Table 2 shows 'base case' gas price forecasts from a number of analysts of Australia's east and west coast markets.

Table 2: Analysts' gas price forecasts for the east and west coasts of Australia (real $ a gigajoule, $2012-13)

Source	Forecast year	Eastern Market		Western Market	
		2020	2030	2020	2030
ACIL Tasman	2010	6.6	7.9	8.0	8.4
ACIL Tasman	2011	7.9	10.6	-	-
ACIL Tasman	2012	8.6	11.7	13.4	11.8
AEMO/IES	2011	7.0	8.3	-	-
Australian Treasury (ROAM)	2011	-	10.1	-	10.1
Australian Treasury (SKM-MMA)	2011	6.2	9.3	6.2	9.3
Average		**7.3**	**9.6**	**9.2**	**9.9**

Notes: Where necessary, data adjusted using CPI to Dec 2012
Sources: AER (2012); BREE (2012c); BREE (2012b); ACIL Tasman (2012); AEMO (2011); ROAM Consulting (2011); SKM MMA (2011)

We have used the average of the above forecasts to estimate the impact of such price rises. While this table shows price increases that may be expected by 2020, the transition to higher prices may not be gradual. It is possible that prices will rise sharply over the next few years as exports commence on the east coast and are expanded on the west, then increase only moderately before 2020.

The expected price increases will follow major increases in electricity prices over the last several years. They will be felt most acutely by residential customers and some parts of the manufacturing industry.

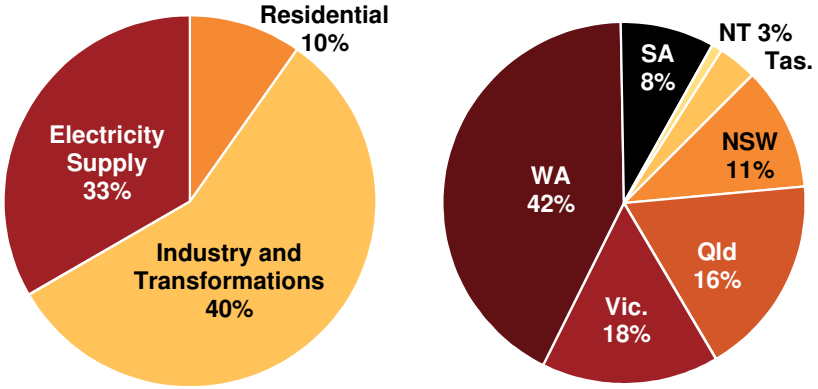
1.4.1 Gas use in Australia

Gas is a major source of energy in Australia. Gas provided 20 per cent of all final energy consumption in the Australian economy in 2010-11, with the balance coming from oil (52 per cent), electricity (21 per cent), coal (4 per cent) and renewable energy (4 per cent).[10]

A third of the gas used in the domestic economy is used for supplying electricity, as shown in Figure 4. Another sixth is used in other energy transformations, where gas is used to refine other fuels, such as coal or petroleum. This is one of the reasons why the significant role of gas in the Australian economy is not always obvious – for every gigajoule consumed directly by an end-user, an equivalent amount of gas has been used to help produce some other type of energy.

[10] BREE (2012a)

Figure 4: Share of gas consumption by use and state in 2010-11



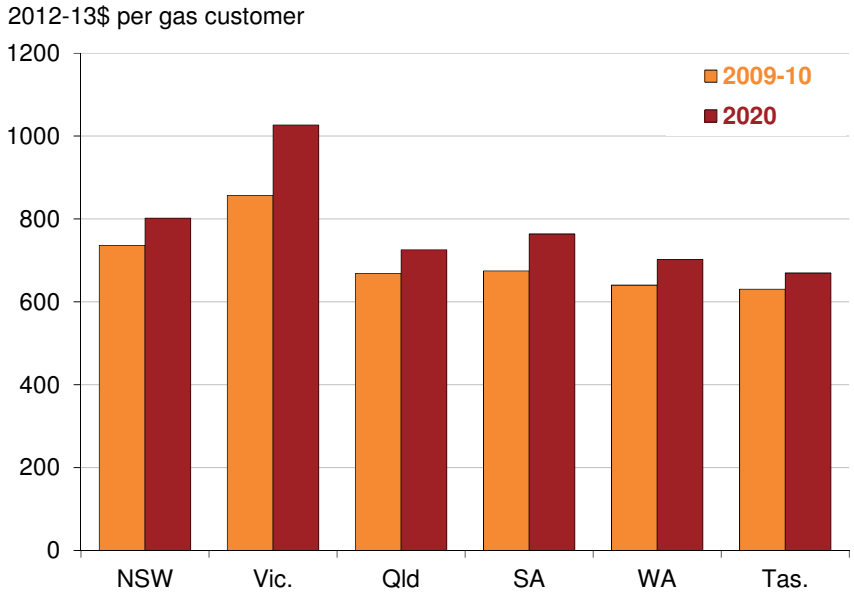
Source: BREE (2012a)

1.5.1 Household gas use

Households use around 150 petajoules of gas a year, or 10 per cent of Australia's gas consumption. Victorians use more than 100 petajoules – two thirds of the national household total.[11] Across the country, people are worried about the rising cost of household energy bills after rapid increases in electricity and gas prices in recent years. Victorians are particularly exposed to the impact of rising gas prices.

Figure 5 shows how household gas expenditure varies among Australian states. Victoria's extensive pipeline network makes gas available to most metropolitan households. Its relatively cold winters also increase household demand for gas for heating.

Figure 5: Average household gas bills by state, $2012-13

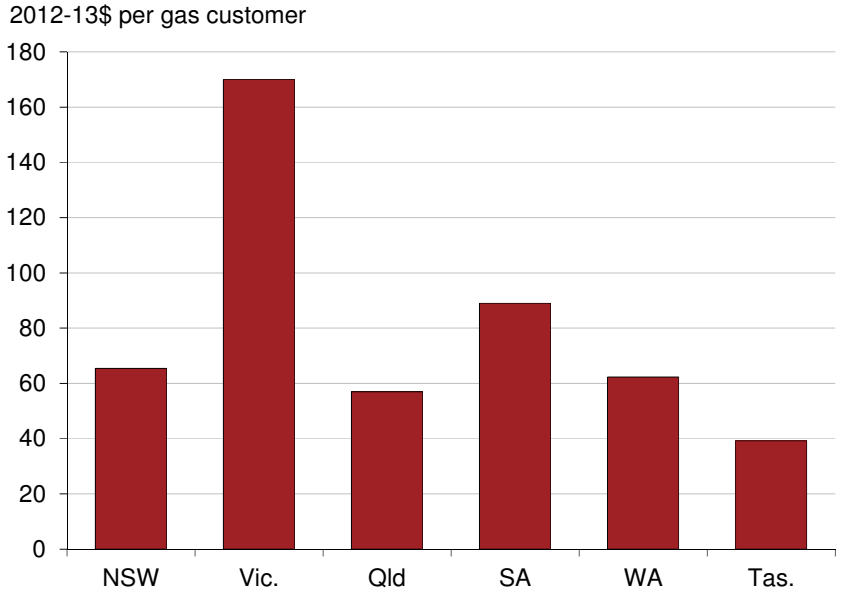


Notes: Assumes volumes remain at 2009-10 levels in 2020. New South Wales values include data for the Australian Capital Territory.
Sources: ABS (2011b); ABS (2011a); ACIL Tasman (2010); AER (2012); BREE (2012a)

Across Australia, households are likely to pay an extra $544 million a year in retail gas bills in the next few years. In Victoria, the cost increases will be most acute. Our analysis, illustrated in Figure 6, suggests that higher wholesale costs will put around $170 extra onto the annual gas bill of the average Victorian gas customer.

[11] Ibid.

Figure 6: Potential annual increase in household gas cost, 2009-10 to 2020, $2012-13

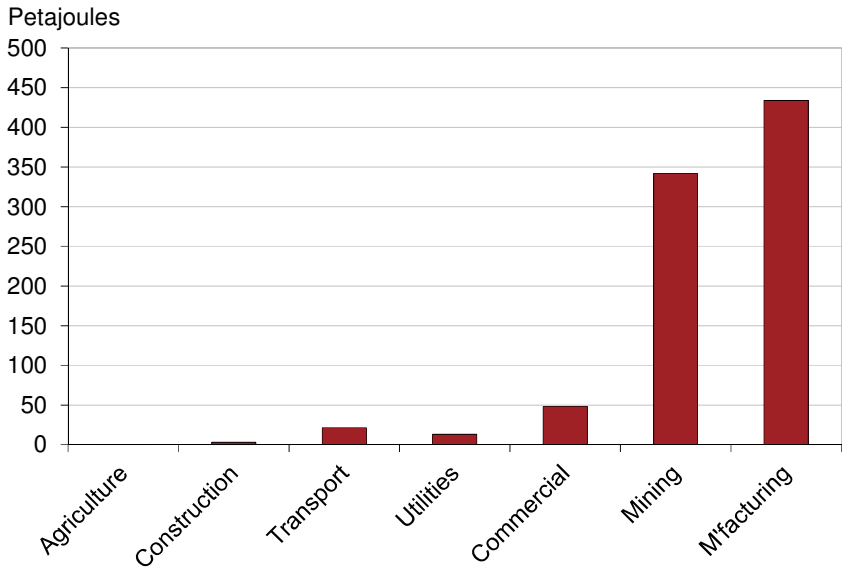


Note: Assumes volumes remain at 2009-10 levels in 2020.
Sources: ABS (2011b); ABS (2011a); ACIL Tasman (2010); AER (2012); BREE (2012a)

1.4.2 Industrial gas use

In 2010-11, a little over 1500 petajoules of gas were used in the Australian economy. [12] Removing the gas used by households and for electricity supply, around 860 petajoules were used for industry or in industrial energy transformations; 57 per cent of all gas used in Australia. Assuming no change in levels of gas use, our analysis suggests that rising gas prices could cost industrial users up to $3.2 billion a year. It is likely that industrial users would take steps to reduce their gas use in response to higher prices, so the actual impact to industry could be substantially lower.

Figure 7: Annual energy use by industry sector: all consumption, less residential use and electricity supply, 2010-11



Source: BREE (2012a)

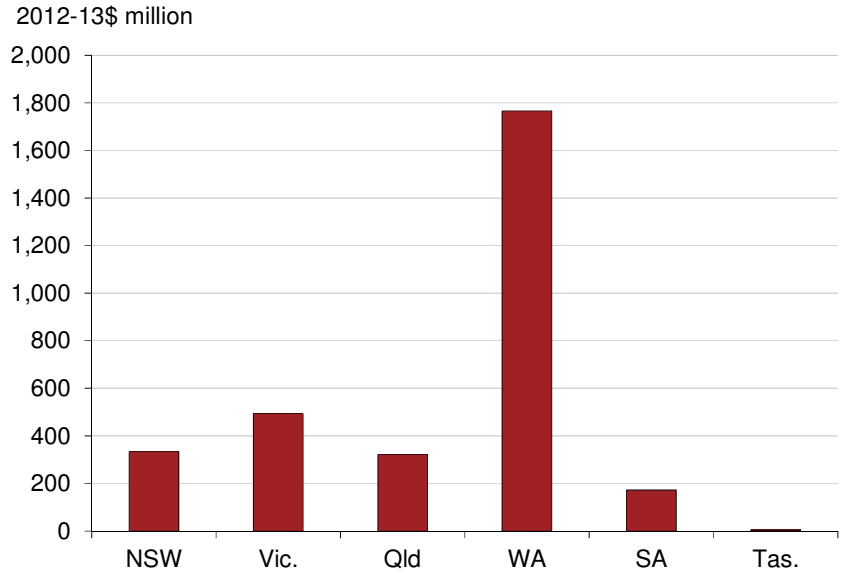
As Figure 7 shows, this cost will not be distributed evenly across the economy. A large portion of gas consumed in Australia is used by a relatively small number of gas-intensive industries,

[12] BREE (2012a) Table F

mostly in manufacturing. In several industries – including fertiliser, petrochemical, aluminium, cement and brick manufacturing – gas is a material cost.

Similarly, the cost will not be distributed evenly by state. As shown in Figure 8, over half of the total cost increases to industrial users, a total of almost $1.8 billion, could be borne in Western Australia.

Figure 8: Potential effect of higher wholesale prices on industry by state, all consumption, excluding electricity supply and households, $2012-13



Note: Assumes volumes remain at 2010-11 levels in 2020.
Source: ACIL Tasman (2010); AER (2012); BREE (2012a)

Groups representing affected companies maintain that higher gas prices pose a major threat to Australian manufacturing, already under pressure from high labour costs and a high exchange rate.[13]

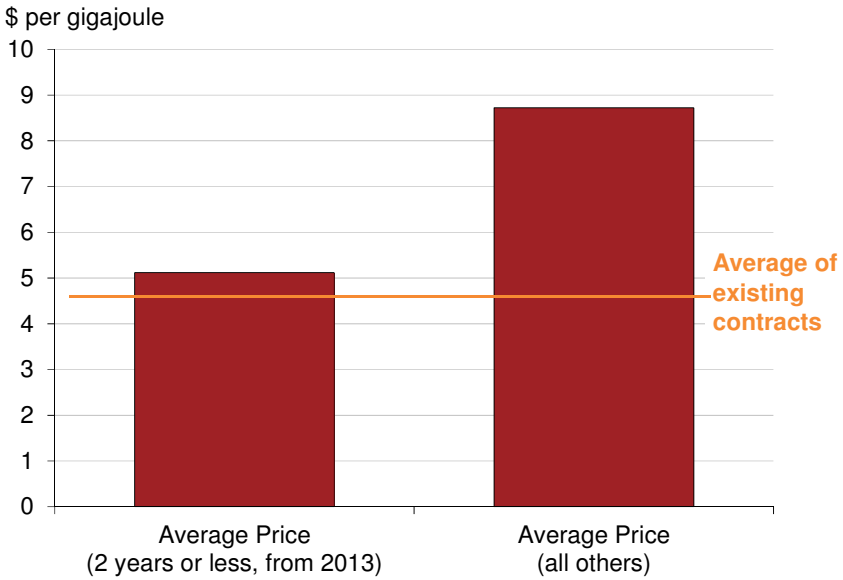
The Australian Industry Group, an industry association, recently surveyed gas users in New South Wales, Victoria, Queensland and South Australia on their experiences of obtaining gas contracts in the current market. Of 62 respondents to the survey, the average price for existing gas contracts was around $4.80 a gigajoule.

Of the 29 respondents who were seeking to renew or add to existing gas contracts, all of those who were offered contracts received offers at prices above the current average, as shown in Figure 9. Of particular note, customers who wanted longer contracts (more than two years) or contracts commencing after 2013 were quoted an average price of $8.70 a gigajoule - much higher than the average price of $5.10 a gigajoule for short term contracts (less than two years) from 2013.

To some extent, the higher price for gas contracts beyond 2015 reflects the broader state of the gas market. Facing high levels of uncertainty about future prices, suppliers may be reluctant to sign long term contracts. If buyers want to lock in their gas costs, they will have to pay high prices. However, this does not make matters easier for buyers, who may be forced to accept higher gas prices, less certainty around their future fuel costs, or both.

[13] AIG (2013b)

Figure 9: Gas prices offered for new contracts, 2013



Source: AIG (2013a)

Higher gas prices will have a negative impact on some industrial users. The fact that significant price increases simply reveal the working of efficient markets will not make the pain any easier.

There is evidence to suggest that companies are already passing costs on to customers. Brickworks, a clay and concrete products manufacturer that operates nationally, maintains that the effect of higher gas prices on brick prices has raised the cost of a new house in Perth by $1352.[14]

In some cases, companies with options to source cheap gas in other locations may move operations outside Australia. Incitec Pivot notes in its 2012 annual report that "comparing potential projects in Australia and the United States a significant difference lies in the price of our major raw material, gas."[15]

The government should resist pressure from particular user groups urging it to intervene in the market. Australia has far more to gain than to lose from the global gas revolution. Nevertheless, both government and industry should take measures to ensure the market works effectively. Chapter 2 sets out in detail what these measures are.

1.5 The medium-term price outlook is uncertain

Gas prices in the USA have started to rise modestly after an extended period of low prices (see Box 3). Prices at the Henry Hub, the price point for gas futures contracts traded on the New York Mercantile Exchange, have recently risen from record lows of $2 a gigajoule to $4, and there are forecasts that they could rise to $6 by 2020.[16] If the US Government were to lift restrictions on gas exports to countries without free trade agreements with the USA, as recent decisions suggest that it might, the current domestic price of $4 would translate into prices of $10 to $11 in

[14] Roberts (2013)
[15] Incitec Pivot (2012)
[16] PIRA (2013)

Box 3: Cheap gas in the USA

Figure 2 shows how gas prices in Japan, Europe and the USA have diverged in recent years. So, why have US gas prices been so low compared with prices in other parts of the world?

The first explanation is that many US shale gas wells also produce liquid hydrocarbons, or 'liquids', which are found in some natural gas wells and extracted when the gas is processed.[17] The liquids can substantially improve the economics of a gas well, so producers are willing to sell the gas at low prices. Many US shale gas fields have high liquids content, whereas coal seam gas fields have almost none.[18]

Further, US gas markets have developed differently to Australian markets. Unconventional gas supplies in the US were developed mainly for the domestic gas market, which used over 25,000 petajoules of gas in 2012.[19] Barriers to gas exports have helped to keep supplies high and prices low. It has also been argued that US gas prices have been driven to unsustainably low levels as the result of a supply glut.[20]

These forces have combined to create a market where "gas is so cheap that it's no longer profitable to drill".[21] Further, the US Government has begun to lift export barriers.[22] It seems inevitable that US gas prices must rise in future to more sustainable levels.

[17] EIA (2013a)
[18] John Williams Scientific Services (2012)
[19] EIA (2012)
[20] Dicolo (2013)
[21] Philips (2012)
[22] Spectator (2013)

Japan, well below recent contracted prices of more than $15 a gigajoule.

The impact of US exports would be downward pressure on Asian prices, and therefore prices in Australia. This would also tend to be the case if Japan restarts a significant number of its nuclear power stations or if other countries in the region, such as China, were to develop a local shale gas industry. There is also potential for shale gas development in Australia, [23] although, again, the economics are speculative. The recent decision of KOGAS, a Korean gas firm, to withdraw from negotiations with Chevron to buy gas from the Gorgon project in Western Australia indicates that the company believes lower-priced supplies of gas may soon become available.[24]

The outlook for international gas prices is highly uncertain. Even so, depending on contractual arrangements, this should not adversely impact the long-term contracts underpinning committed LNG infrastructure in Queensland. However, there is much less certainty for proposed LNG projects on both sides of the Australian continent where contracts for the sale of LNG have yet to be negotiated, and for domestic gas prices in the medium-term, that is, beyond the next three to five years.

[23] Australian Council of Learned Academies (2013)
[24] Klinger (2013)

2. How should government and industry respond?

2.1 Governments should not revert to protectionism

The prospect of rising gas prices has prompted some manufacturers to urge Australian governments to impose price controls on gas, to restrict LNG exports, or to force LNG producers in eastern Australia to commit a portion of their gas to domestic users, as already happens in Western Australia.

Imposing a requirement that producers must reserve a fixed volume or proportion of gas for domestic manufacturing consumers is a form of industry protection. The economic benefit of the gas resources is shifted from producers to particular industry consumers. This redistribution "would be achieved at a net cost to the Australian community", according to the Bureau of Resources and Energy Economics.[25] More bluntly, economics professor Stephen King has described such a reservation scheme as "blatant, inefficient and inequitable".[26]

Chapter 4 contains a more comprehensive assessment of reservation policies as applied in Western Australia.

Recent public commentary has asserted that Australian governments have failed to extract the best value from the resources boom.[27] Yet it is important to separate the question of whether taxes on gas producers should rise - a valid question for government - from whether any kind of tax on producers should be used to subsidise domestic manufacturing.

Three specific reasons why trade protections are not warranted for the Australian gas industry are outlined below.

There is no market failure

Many arguments for domestic gas reservation or quotas assume that markets have 'failed' in some way and that governments should therefore intervene.

While some industry claims about the economic effects of higher gas prices appear to be exaggerated (see Box 4), the emerging gas market and expected rising prices will prove challenging for some gas users. High demand for gas has shifted the balance of market power towards the gas producers and away from the wholesalers and large industrial gas users who buy gas from them. If buyers are unwilling to pay higher prices to sign long-term contracts, they may have to sign shorter contracts and accept the risk that prices will move in coming years.

Yet, these conditions reflect the dynamics of the underlying market; not a market failure. Our analysis found limited evidence that gas will not be available to users who are willing to accept higher prices and be flexible with contract terms. In the absence of a genuine market failure, it is in the interests of the Australian economy to allow gas to flow to the users that value it most highly.

[25] BREE (2012c)
[26] King (2013)
[27] eg Warwick McKibbin in Kehoe (2013)

Box 4: 'Multipliers' and dodgy economics

Higher gas prices will disadvantage a small number of Australian industries that use large amounts of gas as a production input or fuel source. High prices could lead some manufacturing facilities to close, causing some job losses. However, some in the manufacturing sector have greatly exaggerated the size and impact of these losses.

Dow Chemical is a large industrial gas user. In an opinion piece for *The Australian* newspaper, Dow's CEO called for policy intervention in the gas market to ensure natural gas prices that are "affordable and stable". He wrote:

> *"Transformed through the manufacturing process, natural gas actually creates eight times more value for the economy than when it is burned or exported."*[28]

The "eight times" multiple ascribed to the manufacturing sector is called a 'multiplier'. Multipliers are calculated by assuming that all industries in the economy are related to all other industries. It is assumed that an increase in production in one sector will have calculable 'flow on' effects to other sectors.

Unfortunately, the argument is deeply flawed.

This type of analysis makes the extreme assumption that no worker would find another job if a manufacturing facility closed. It also assumes that production inputs would not be put to other uses, which is clearly not the case – gas is clearly in demand from other sections of the economy and this is why prices are increasing. Further, multipliers assume that policy makers have no ability to influence employment and economic activity through fiscal and monetary policy settings.

None of these assumed conditions would hold, except under extreme conditions that are not relevant to the current Australian context.

Multipliers also suffer from 'double counting' as each industry implicitly takes credit for growth in other sectors of the economy. As Richard Denniss of The Australia Institute noted:

> *"…if there were 10 million people in the Australian workforce and each industry sought to estimate their direct and indirect contribution to employment then collectively their claims would add up to 18.7 million workers."*[29]

The Australian Bureau of Statistics stopped publishing data on economic multipliers in 2001-02 because:

> *"There was considerable debate ... as to their suitability for the purposes to which they were most commonly applied, that is, … to support bids for industry assistance of various forms."*[30]

[28] Liveris (2013)
[29] Denniss (2012)
[30] ABS (2010)

Potential effects on LNG investment

Large investments in LNG have been committed on the basis of existing government policies. Any changes to these policies should be considered in light of the potential impact they may have on Australia's attractiveness as an investment destination. Changes applied retrospectively to committed LNG projects would damage Australia's chances of securing future investment.

Western Australia gas reservation quotas were negotiated before LNG proponents committed to investments. Proponents who have argued for an east coast gas reservation frequently fail to acknowledge that policy implemented at this late stage of project development could significantly damage investors' confidence in the stability of Australian regulatory arrangements, and could deter investment.[31] A reservation policy applying only to future projects would be less damaging, but would be unlikely to relieve pressure on markets during the crucial transition period.

Protectionism will not work

Reflecting in 2009 on Australia's experience with trade protection in the mid-1980s, the Productivity Commission noted that:

> *"large parts of the economy were inefficient, inward looking and inflexible. … Australia was not well placed to respond to the changes and challenges arising from rapid technological change, global integration and fiercer competition from abroad."*[32]

Overwhelmingly, Australian and international experiences of trying to protect domestic industries by restricting trade have damaged the broader economy.

Trade barriers reduce productivity and blunt companies' incentives to innovate. Protecting some industries from international prices prevents economies from shifting investment and labour to firms or industries that are more competitive. Protectionism also encourages firms to direct resources into lobbying governments, at the expense of more productive investments.

Evidence supports the view that trade protections make domestic industries less efficient:

- A recent World Bank study suggested that liberalising trade protections boosted per capita GDP growth by between 1.2 and 2.6 per cent.[33]
- A European Bank of Reconstruction and Development study showed that, as a result of a domestic quota on wheat sales in 2010-11, foreign investors held back €550 million of capital to avoid the risk of further intervention.[34]

[31] For examples, see DomGas Alliance (2012); NIEIR (2012)

[32] Productivity Commission (2009)

[33] Salinas and Aksoy (2006). The sample controlled for countries that were subject to major exogenous disruptions and its results were statistically significant under all specifications.

[34] Götz, *et al.* (2013)

Evidence suggests that while there may be benefit in protecting some infant industries,[35] such industries rarely receive assistance. Rather, large, established industries that can exert pressure on government are the ones that are helped.[36]

Further, there is no clear evidence that the gas reservation policy applied in Western Australia has delivered low gas prices for gas users. Western Australian gas prices are currently higher than those on the east coast. It is expected that in 2020, after the east coast gas market has been exposed to several years of gas exports, east coast gas prices will remain lower than west coast prices (see Table 2).

Explicit reservation policies are not the only form of industry protection that has or could be proposed by lobby groups concerned about rising process. For example, some industry groups and companies have argued for a 'national interest' or 'public interest' test.[37] This would impose an additional hurdle requirement on future LNG projects seeking regulatory approvals. However, evidence suggests that such policies do not achieve favourable economic outcomes.

In late 2012, the US Department of Energy commissioned NERA Economic Consulting to conduct an independent study of how US LNG exports could affect the public interest.[38] This study examined 13 separate scenarios, varying the outlook for the US gas supply and making a range of assumptions about gas export restrictions. In every scenario, NERA forecast that the USA would receive an economic gain from allowing LNG exports. Further, scenarios with unlimited exports always had higher net economic benefits than corresponding cases with limited exports.[39]

This suggests that there is little to be practically gained from imposing 'public interest' or 'national interest' tests for LNG export projects. Rather, such tests have the potential to impose a regulatory burden on developers and provide a platform for future lobbying by user groups.

Nevertheless, there are important actions governments should take to ensure the market works well.

2.2 Resolving the coal seam gas impasse in New South Wales

Companies[40] and government agencies[41] are both concerned that New South Wales could face a gas supply shortage between 2015 and 2017. There is no shortage of gas in the ground, but there are concerns about thet ability to get it to the New South Wales market on a peak day for gas demand.

Although New South Wales reserves are only a tenth of those in Queensland, gaining access to them could be critical if gas from

[35] In theory, protecting an infant industry can improve net welfare if it meets two criteria: a) it will eventually survive international competition without protection, and b) the discounted future benefits it will produce outweigh the present cost of protection. These are known as the Mill and Bastable tests, respectively. Harrison and Rodriguez-Clare (2010)
[36] Ibid.
[37] See: Dow (2012); Manufacturing Australia (2013)
[38] NERA Economic Consulting (2012)
[39] Ibid.
[40] Baulderstone (2013); SMH (2013)
[41] Department of Energy and Water Supply (2012); AER (2012)

the Cooper Basin is diverted to Gladstone and the pipelines from Victoria are insufficient to consistently meet New South Wales demand. Yet the concerns of farmers, landowners and environmentalists have led the government to restrict development of coal seam gas, which makes up all of the gas reserves in New South Wales.

Amid the claims and counter-claims that have accompanied these developments, industrial customers seeking secure supplies for five years or more are reporting that they cannot get contracts on the east coast "at any price".[42] In a recent Australian Industry Group survey of 31 industrial gas users seeking to renew or add to gas contracts, 10 per cent of respondents reported that they could not obtain a quote and 32 per cent indicated they could not obtain a quote at a price considered acceptable.[43] Companies such as Dow Chemicals and industry associations such as the Plastics & Chemicals Industry Association have called for a range of measures to ensure supply. [44] These include extended reservation of gas for domestic users, a moratorium on LNG exports, rebates for 'transformational industries', and greater market transparency.

But Australia has enough gas to solve this problem. New South Wales gas demand could be met by ramping up coal seam gas production to reduce drawing on conventional gas supplies, by increasing production from the Cooper Basin or by increasing the capacity of gas pipelines from Victoria to New South Wales.

With such options available, producers have suggested that concerns about a shortfall are commercial posturing. They say they are as willing as ever to write gas contracts,[45] but that customers are not prepared to make long-term commitments to underpin supply contracts. The truth is not clear but the tension is high. Unsurprisingly, the protagonists take positions that align with their commercial interests. For example, potential developers of coal seam gas projects in New South Wales have an incentive to put maximum pressure on governments to support coal seam gas development in the state.

The Australian coal seam gas sector has been slow to respond to community concerns. In New South Wales the result is a stalemate. The economic benefits of development are significant, yet the risks of inappropriate or poorly regulated development are of great concern to many members of the community. The current position is almost certainly unsatisfactory for all players.

A better response can be found in the recent creation of a Center for Sustainable Shale Development in the USA. Significant shale gas developers, including Shell and Chevron, have joined with environmental groups to create a set of standards for the use of hydraulic fracturing in the north-eastern United States. These standards will form the basis of the Center's independent, third-party certification process. Australian industry could learn from this initiative.

[42] DomGas Alliance (2013) and others
[43] AIG (2013a)
[44] PACIA (2013)

[45] A representative of Origin Energy advised that "Origin Energy is currently quoting gas supply contracts for domestic customers. The duration of these contracts can vary from less than two years to up to 10 years." Pers Comm. Origin Energy (2013).

Through the Standing Council on Energy and Resources – which includes all relevant ministers – Australian governments must come together with industry and environmentalists to develop clear and predictable guidelines for coal seam gas development. The Standing Council's recent endorsement of a national, harmonised regulatory framework for coal seam gas is a beginning.[46] Further steps are needed to resolve the impasse and the right balance must be found quickly.

2.3 Creating efficient market frameworks

The risk of supply constraints in Australia's east coast markets is real. However, these potential constraints are likely to be resolved before they materialise. The solution will be for commercial players to deliver more supply. Wholesale participants such as gas retailers AGL and Energy Australia will have to obtain supply, while industrial customers will either negotiate at higher prices or seek alternative fuels. The negotiations may prove difficult, and may come with heavy price tags in the short term. But these problems are for industry, not government, to resolve.

By contrast, market failures or barriers to the efficient supply-side response are appropriate areas for government action. The following actions will not directly reduce prices or guarantee supply. But they will improve transparency and liquidity and lead to a more mature and robust gas market.

2.3.1 Joint marketing arrangements should be tightly constrained

Many gas fields are owned by several companies, who form a consortium to develop a gas field. This structure can be effective. Project partners may invest together because they have complementary skills, because a project is too large for one company to undertake independently, or as a way of improve risk-sharing along the supply chain. An example of the last would be when an end user of gas, who is not a development specialist, takes an equity stake in a project to hedge their gas costs.

Joint venture arrangements, by themselves, do not pose a problem for gas market efficiency. Joint ventures are able to sell gas as a single entity, but are subject to constraints under the Trade Practices Act. However, in some cases the Australian Competition and Consumer Commission (ACCC) has permitted gas field consortia to jointly market and sell the output of gas fields even where there is no joint venture arrangement in place – an arrangement known as joint marketing. Joint marketing is usually justified on the ground that reduced risks and shared marketing costs lead to lower costs that are then passed on to customers.

Yet joint marketing reduces competition within the upstream gas sector by reducing the number of sellers in the market. Gas customers have argued that because there are usually only a small number of gas fields supplying any market, removing joint marketing would improve competition.

As the east coast market has matured, becoming an interconnected market with multiple suppliers from several

[46] SCER (2013)

primary fields, both the arguments for and concerns about joint marketing have fallen away. In Western Australia, however, the evolution has been slower. The ACCC has authorised joint marketing by gas developments including the Gorgon Project. In its 2009 decision, however, the Commission only gave authorisation until 2015, recognising that the market may be beginning to exhibit greater diversity and potential for competitiveness. As markets continue to grow in depth and breadth, the ACCC should be increasingly sceptical of the justification for ongoing joint marketing arrangements, with a view to ultimately removing the practice.

2.3.2 Governments should encourage greater price transparency

The setting of gas prices has historically been dominated by long-term contracts between gas producers and the wholesale market. As the gas market has developed both financially and physically, major consumers and producers have recognised the limitations of this structure in providing the best result. For example, during a period of rapid change, the lack of transparent prices makes it difficult for users to assess whether gas prices will rise and, if so, by how much.

In recent years, there has been progress towards short-term markets. This includes short-term trading markets operated by the Australian Energy Market Operator, the Victorian gas wholesale market, the national gas market bulletin board and the proposed gas trading hub market in Queensland. The first three are in place and the fourth is planned for introduction in 2014. Although it could be many years before the Australian gas market is not underpinned by long term contracts, these are all good moves.

Increasing price transparency in the gas market would have several benefits. It would help businesses manage the transition to higher gas costs by providing more reliable gas price estimates for business planning processes. It could also facilitate trading between industrial gas customers and gas retailers as it would give customers a way to benchmark prices.

An industry-led proposal to develop a gas price index was initiated in 2012 and referenced in the Commonwealth Government's Energy White Paper[47] but is currently on hold. The delay has been attributed to global concerns regarding the development and use of price indices. In a recent United Kingdom case, bankers were found to have manipulated the London Inter-bank Offer Rate (LIBOR), an interest rate index. This has sparked broader concerns about the vulnerability of price indices to manipulation. An international review of the LIBOR case will be released in the second half of 2013.

If the regulatory challenges can be resolved, and they should be, development of a price index would enhance price transparency and increase competition. Governments should play a role in providing regulatory guidance, bringing together market participants or promoting participation in developing a price index mechanism.

2.3.3 Governments should act to eliminate barriers to pipeline access

The ability to transport gas between major markets is limited to the capacity of pipelines that connect the markets. Investment in

[47] DRET (2012)

new pipelines is expensive and may not be economically justified but it may be possible to use existing infrastructure more effectively. Improving access to pipeline capacity would assist to improve competition in east coast markets.

The lack of transparency in gas markets makes the prospect of a capacity market attractive. In the current market, there is a substantial risk that a party wanting to obtain pipeline capacity and a party willing to sell would not find each other. This may occur because potential buyers do not know who owns the existing capacity or because the effort of contacting capacity holders to find a counterparty would be greater than the potential reward. A market could help facilitate efficient transactions.

Further, in the absence of a capacity market, buyers seeking pipeline capacity or sellers with spare capacity would generally buy or sell to the owner of the pipeline. This occurs because buyers and sellers have limited information on which other market participants want to trade. Because of the high cost for buyers and sellers to find each other, the pipeline owner has little incentive to offer competitive prices to buy or sell capacity. By offering an alternative mechanism to buy or sell, a market could lower the price of pipeline capacity.

By allowing for short-term capacity trading, it is also hoped that new sellers will enter into regional gas markets. For example, a gas producer may have some spare gas processing capacity for a short period. The difficulty of getting the gas to market may mean that capacity is not used. If the producer had ready access to reasonably priced pipeline capacity, it may elect to transport gas to a regional gas market to sell. By increasing the number of sellers, it is hoped that capacity markets would increase competition and lower gas prices.

The Australian Energy Market Operator is considering the development of two capacity trading products: a monthly forward product and a bulletin board style capacity exchange. These products are aimed at overcoming barriers between capacity owners and potential buyers at the Wallumbilla gas hub. The Wallumbilla trading hub is planned for introduction in early 2014, coinciding with the beginning of LNG exports.

While current proposals for a capacity trading market have centred on Wallumbilla,[48] the concept could be applied to other pipelines and could be regarded as a way to improve competition in other regions. In May 2013, the Standing Council on Energy and Resources released a consultation paper on the trade in natural gas transmission pipeline capacity.[49] This process will examine ways that unused pipeline capacity may be traded.

Accelerating development of this reform is warranted to take account of the pressing need for market flexibility over the years immediately following the commencement of LNG exports.

Regulatory agencies, governments and industry groups have contemplated some of these reforms. But they are not happening fast enough. In the next four years, east coast gas demand is set to increase fourfold. The markets must mature as they grow.

[48] AEMO (2013)
[49] SCER (2013)

2.4 Share the benefits

Australian gas, as a natural resource, is owned by the Australian people. It is therefore appropriate that as LNG exports begin to expand rapidly, Australian governments should ensure that Australians are being appropriately compensated for the sale of these assets.

For the purpose of this report, tax and royalty arrangements for the natural gas industry were not reviewed. However, the argument that Australians have more to gain from trading LNG than they have to lose from higher prices assumes that appropriate tax and transfer systems are in place. Governments should ensure that this is the case.

Protectionist policies impose an implicit tax on gas producers by forcing them to sell gas at prices lower than those they could achieve in an unconstrained market. An explicit tax regime is a more efficient means of collecting revenue. It also allows more flexibility for governments to decide how to spend that revenue, whereas protectionist policies confer all of the benefits on gas users.

2.5 Challenges for industry

2.5.1 Gas Producers: ensuring supply

There are two reasons that a potential supply issue could arise in the gas market, even though there is no shortage of gas in the ground. First, there could be a problem if the market experienced a 'market failure' or if barriers impeded the efficient response of the supply side to increased demand. This is an issue for governments to address. Second, supply infrastructure may be physically unable to meet growing demand in the short term, leading to a squeeze on supply and higher prices. To ensure this latter issue does not arise, industry must quickly and visibly respond to potential infrastructure limitations.

If supply constraints push up prices for residential and small business consumers, governments will be pressured to act in counter-productive ways – by re-introducing retail price controls, for example. Therefore, it is in the self-interest of industry to demonstrate to government that it can solve the supply problem. There have been signs of such a response in announcements by Santos and Origin that specific tranches of contracted gas will be allocated to meet domestic demand.[50]

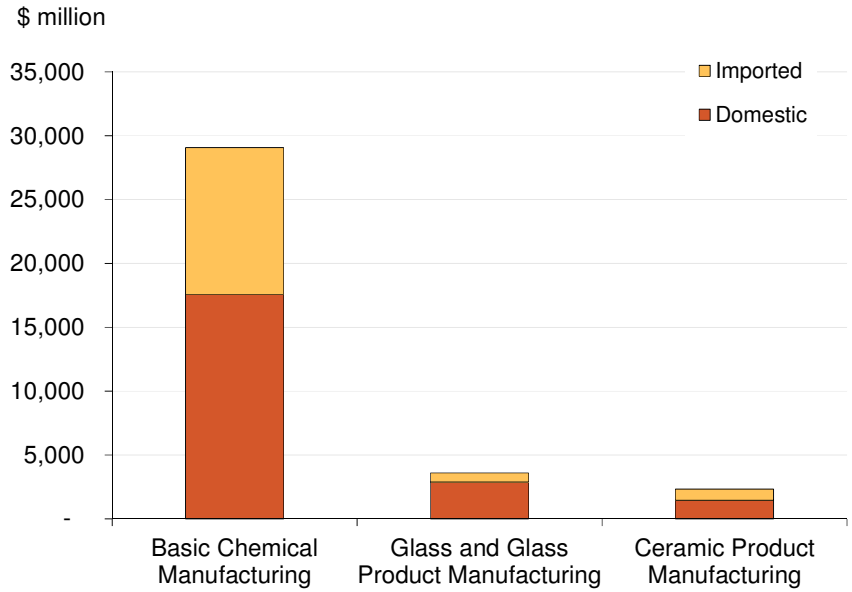
2.5.2 Gas users: adapting to higher prices

Affected industries can mitigate the impact of higher gas prices in a number of ways. They can switch to other fuel sources, pass costs on to customers or shift operations to other locations - in some cases, possibly outside Australia.

The managing director of Brickworks has noted that higher gas prices have prompted the company to use sawdust to fire a kiln in Tasmania and "methane from landfill operations at several sites on the mainland".[51] Such adaptations can mitigate the impacts of higher gas costs.

[50] Chambers (2013b); Chambers (2013a)
[51] Roberts (2013)

Figure 10: Total use value for industries sensitive to high gas prices: Australian production vs imports, 2008-09



Source: ABS (2010)

In some cases, it is not firms but the end users of a product that will ultimately bear the cost of higher gas prices. This will occur when most of the product consumed in Australia is produced domestically. In this case, producers are able to raise prices to cover higher input costs without losing sales to imported products. Figure 10 shows the total trade exposure for three industries where gas comprises over 5 per cent of total input costs. In each case, most domestic demand is supplied by domestic production, suggesting that producers will be able to raise prices to help absorb the impact of higher gas costs.

The following two chapters examine the gas industries on the east and west coasts, and how governments and industry should respond to the different challenges they present.

3. Gas on the east coast

3.1 A shifting market

For decades, eastern Australian gas markets have been relatively stable. Deals to buy and sell gas have mostly been negotiated through contracts lasting up to 20 years. These contracts have underwritten the development of large gas reserves. Major industries have benefitted from being able to secure gas supplies to align with their long-term investments.

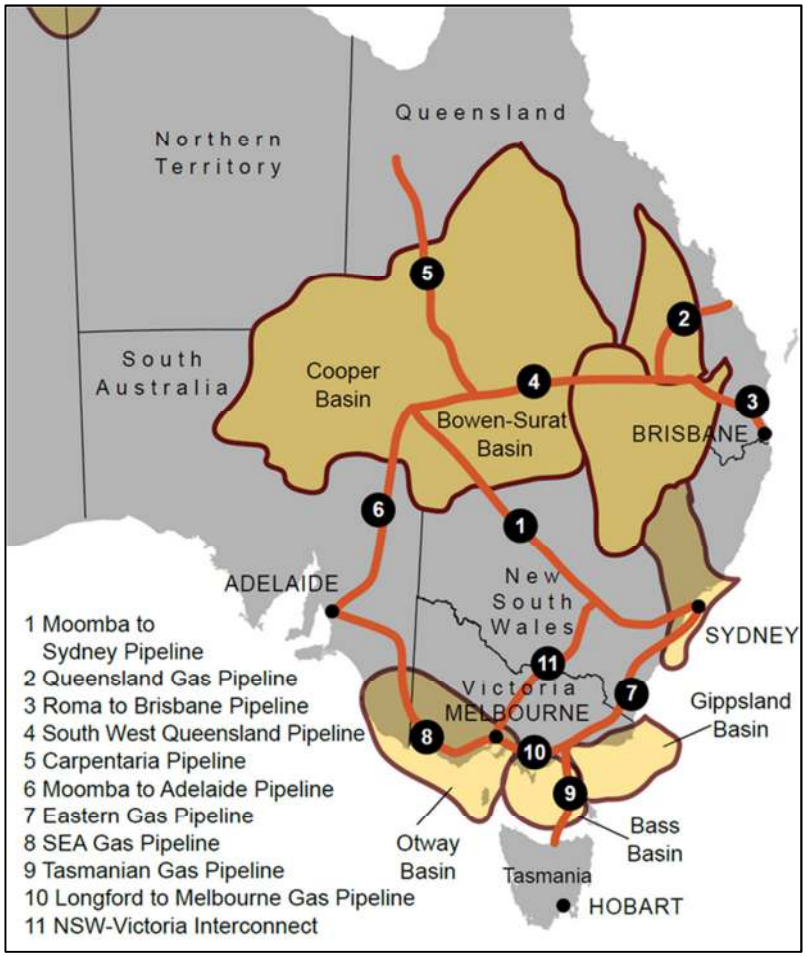
However, the beginning of east coast gas exports from 2014 is set to create higher and more volatile prices. New sources of gas are coming online and existing long-term contracts are expiring. Both government and the gas industry have roles to play in guiding the market through this period of transition.

3.2 Coal seam gas

As in the USA, Australia's east coast gas reserves have greatly increased due to the new capacity to extract unconventional gas (see Box 2 for a description of unconventional gas). While the main type of unconventional gas in the USA is shale gas, unconventional gas production on Australia's east coast is currently dominated by coal seam gas.

'Proven and probable' gas reserves more than tripled between 2005 and 2012 due to the discovery of more coal seam gas reserves, as Figure 12 shows.[52] Coal seam gas has grown from a

Figure 11: Major pipelines and gas fields in eastern Australia

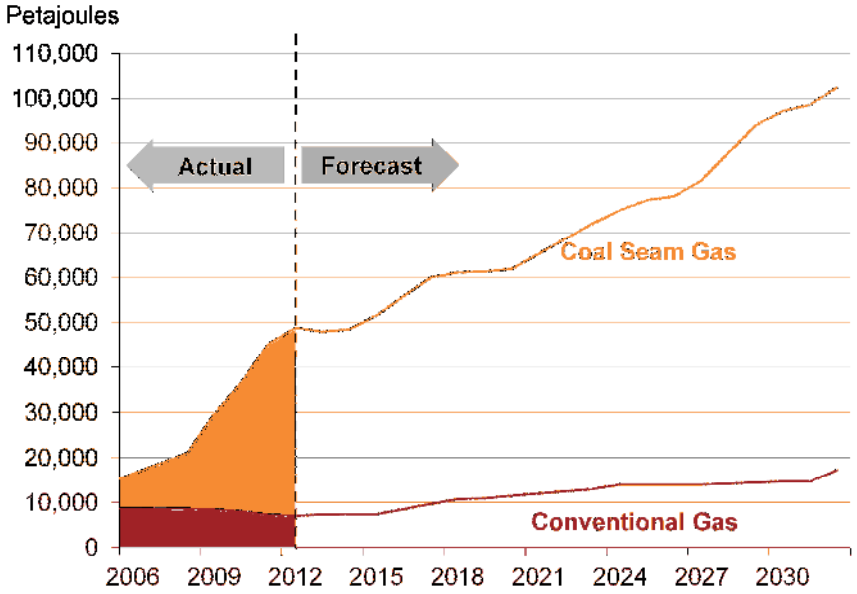


Source: Grattan Institute

[52] AER (2006); AER (2007); AER (2008); AER (2009); AER (2010); AER (2011); AER (2012)

small share of total gas reserves a decade ago to 85 per cent of east coast reserves in 2012. Based on current reserves and consumption levels, current eastern Australian gas reserves will last for nearly 70 years (see Table 1).[53]

Figure 12: 'Proven and probable' gas reserves in eastern Australia, 2006 to 2031



Source: AER (2006); AER (2007); AER (2008); AER (2009); AER (2010); AER (2011); AER (2012); AEMO (2012a)

The development of the coal seam gas industry has provoked concerns that water extracted from coal seams could pollute local water supplies, or that fracking (see Box 2) could pollute groundwater. Land-owners have objected to coal seam gas producers developing gas wells and access roads on privately owned land. In February 2013, these objections led the New South Wales Government to impose tighter restrictions on the industry and instigating a review into the state's coal seam gas activity.[54]

Restrictions on coal seam gas development in New South Wales are unlikely to materially affect the supply of gas for export projects. Of Australia's extensive coal seam gas reserves, around 93 per cent are held in Queensland. They underpin the development of LNG export projects. All the same, about 2900 petajoules of coal seam gas is available in New South Wales. If developed, this would make a material difference to New South Wales supply security and would be one way of alleviating potential supply constraints from other sources as described later in this chapter.

3.3 The export market

The east coast of Australia has vast reserves of gas, existing pipeline infrastructure and a relatively small level of domestic gas demand. These features make gas exports attractive.

Gas exports are forecast to occur for the first time on the east coast from late-2014 and are expected to have a dramatic effect on the market. Between 2013 and 2017, east coast gas demand

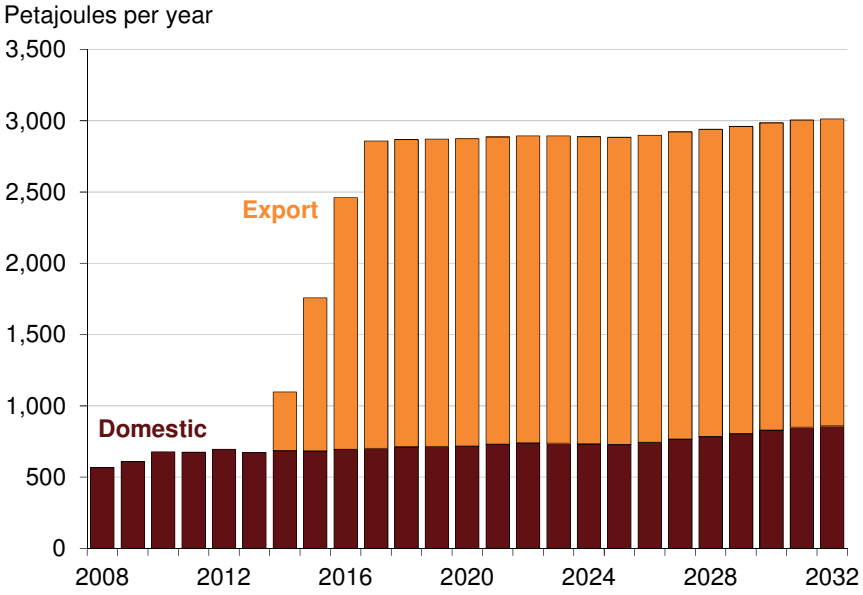
[53] AER (2012); AEMO (2012a)

[54] The Hon Barry O'Farrell (2013)

is forecast to increase fourfold: from about 700 to 2800 petajoules a year.

Figure 13 provides the Australian Energy Market Operator's most recent forecast for east coast gas demand over the next two decades. The scale of LNG development is immense. The five LNG trains that are under construction in Queensland are forecast to require $50 billion of capital expenditure. A further three trains are forecast to be developed before 2018.

Figure 13: Forecast gas demand for eastern Australia



Source: AEMO (2012a)

Four main groups are developing LNG terminals:

- Queensland Curtis LNG is owned by QGC, a wholly owned subsidiary of the UK oil and gas company, BG Group.[55] QCLNG has committed to developing two LNG trains, which will start exporting gas in 2014.
- Australia Pacific LNG is a joint venture between Australia's Origin Energy (37.5 per cent), ConocoPhillips from the USA (37.5 per cent) and China's Sinopec (25 per cent).[56] APLNG is developing one LNG train, which will commence exports in 2015, and is expected to develop a second train by 2016.
- Gladstone LNG is a joint venture between Australian gas producer, Santos (30 per cent), Malaysia's Petronas (27.5 per cent), French firm Total (27.5 per cent) and Korean KOGAS (15 per cent).[57] GLNG is developing two LNG trains, which will start exporting gas in 2015.
- Arrow LNG is a joint venture between Dutch firm Shell and Chinese firm PetroChina.[58] The two firms own equal shares in the project. Arrow LNG has proposed to develop two LNG trains but has not committed to the projects. It has been suggested that if domestic gas prices rise, Arrow LNG may

[55] QGC (2013)
[56] APLNG (2013)
[57] Santos (2013)
[58] Arrow Energy (2013)

forego developing LNG trains to sell gas to other LNG projects or gas users.[59]

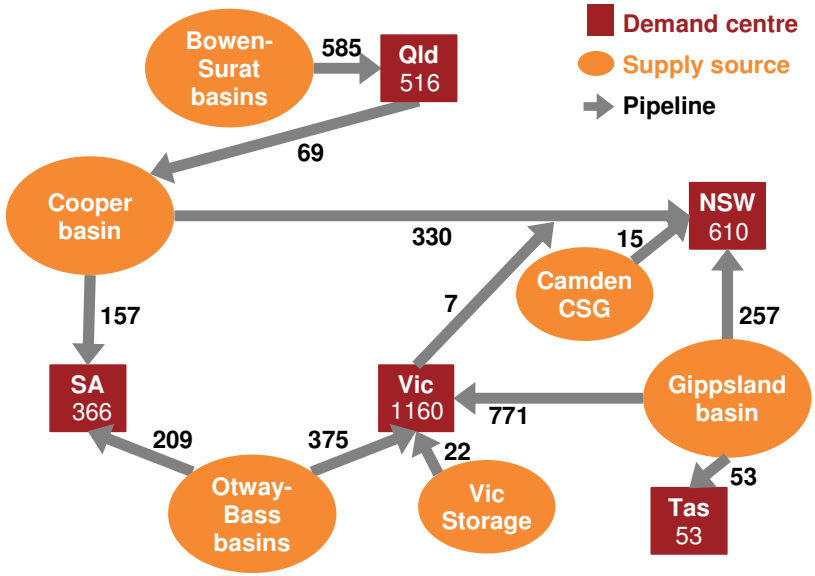
3.4 Pressure points

Projects being developed on the east coast are the world's first LNG projects to depend on coal seam gas as the source of supply. While conventional gas may be extracted from a single well, coal seam gas is produced from thousands of much smaller wells over wide areas. Each well may have its own production challenges. This makes it harder for producers to predict output from a coal seam gas field, relative to a conventional field.

The consequences of delays in production to supply LNG exports could be severe. If coal seam gas wells do not deliver as much gas as planned, LNG projects may seek to source extra gas from the domestic market. This could put further pressure on domestic gas prices, on top of the price pressure from linking to global markets and higher production costs.

Figure 14 illustrates gas flows in eastern Australia on 8 June 2011 – that year's peak day for aggregate gas demand. This analysis illustrates the challenge for the east coast market in coming years.

Figure 14: Gas flow in eastern Australia on 8 June 2011 (terajoules)

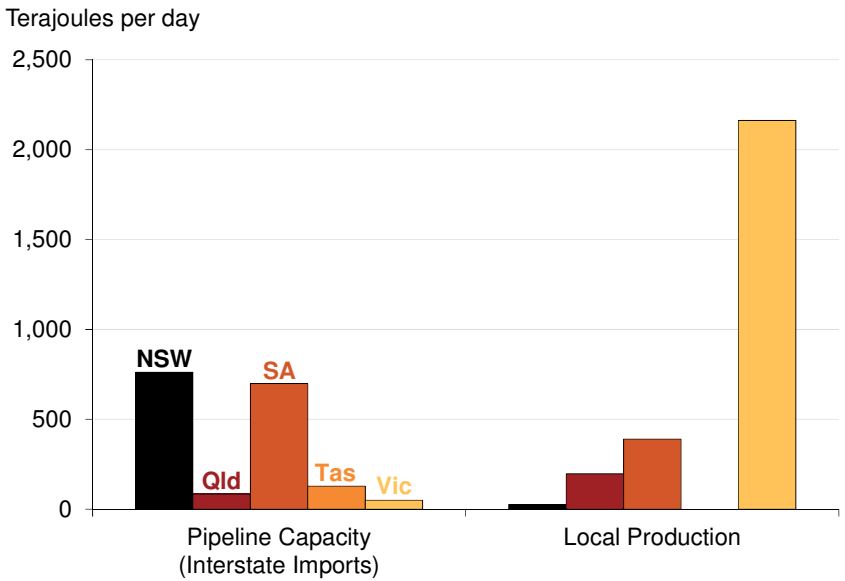


Source: National Gas Market Bulletin Board (2013) and Grattan Analysis

New South Wales relies more than other markets do on gas imports from other states, as Figure 15 shows. It has lower levels of gas production capacity than any state except Tasmania. Instead, it imports gas from other states via pipelines. The approach has worked so far, yet the lack of local production leaves New South Wales more exposed than other states in the event of an east coast supply constraint.

[59] Macdonald-Smith (2013)

Figure 15: Daily capacity of gas infrastructure by state, 2012



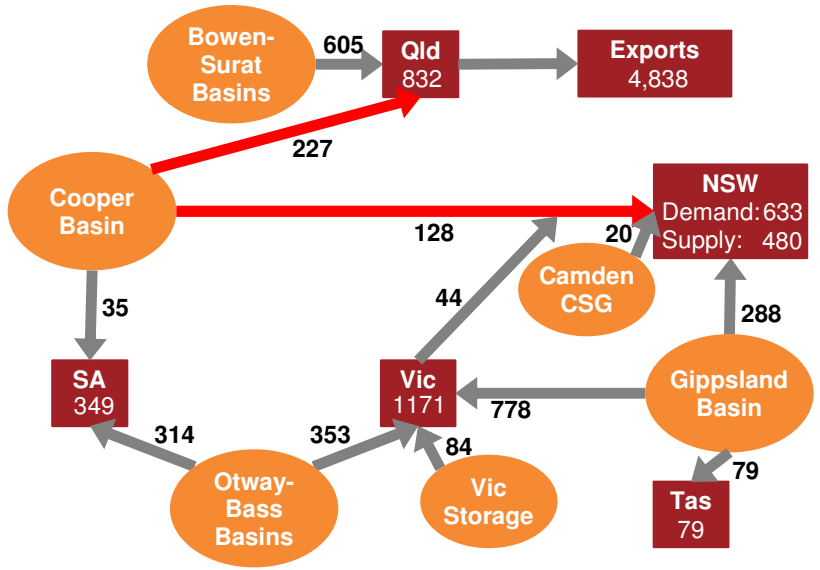
Source: Core Energy Group (2012)

3.4.1 Potential constraints in New South Wales

To illustrate how gas markets on Australia's east coast could become constrained, Figure 16 shows possible gas flows on a peak gas day in 2016.

We have assumed that no new coal seam gas fields or new processing capacity have been developed, and that the flow direction for the pipeline linking the Cooper Basin to Queensland has reversed: rather than sending gas to southern markets, gas exporters are now sending it north to supply Queensland LNG facilities.

Figure 16: Possible gas flow on a peak gas day in 2016 (terajoules)



Note: Supply to New South Wales is constrained by processing capacity at Cooper, which is assumed to be 390 terajoules a day. Supply from the Victorian storage facility may be lower if operators can anticipate demand and increase the flow of gas from the Otway Basin. Export demand is based on the average daily requirement to supply 1,766 petajoules of export demand for 2016, as per AEMO's planning case forecast. It is assumed that export demand is supplied from additional gas fields (not shown).

Source: National Gas Market Bulletin Board (2013) and Grattan Analysis

On this hypothetical day, New South Wales experiences a supply shortfall of around 150 terajoules, over one sixth of its forecast

daily demand. This is the result of constraints on gas processing capacity at the Cooper Basin now that over half of the gas being produced there is flowing into Queensland.

3.4.2 Getting gas to New South Wales

The analysis presented in Figure 16 does not imply that gas supplies will necessarily fall short in New South Wales – only that a shortfall is a real possibility if action is not taken. There are a number of solutions that could be implemented before the issue becomes severe. Supply constraints are only likely to emerge on days when demand for gas is high, so solutions that do not involve major expansions or expenditure are particularly attractive.

Coal seam gas developments

As Section 2.2 sets out, governments, industry and community groups need to resolve the impasse on coal seam gas development in New South Wales. If coal seam gas can be developed, it could produce more than enough gas to meet the additional gas demand in New South Wales on a peak day.

If it is determined that coal seam gas development poses unacceptable risks or cannot win community acceptance, then alternatives are available. However, companies may be unwilling to invest in other solutions if they believe that approval of coal seam gas developments is imminent. The Commonwealth and New South Wales governments need to provide clarity and certainty to industry.

Getting gas from the Cooper Basin

Figure 16 also shows how the Cooper Basin reached the limit on the amount of gas it can produce on our hypothetical peak day. At present, processing capacity is around 390 terajoules of gas a day. Figure 14 shows that this capacity, supplemented with gas flowing from Queensland, was enough to supply South Australia and New South Wales on the busiest day in 2011. Yet by 2016 Queensland is forecast to require imports from the Cooper Basin, rather than being predominantly a source of supply.

Companies are already working to address this issue. In May, Santos, a gas producer with a large stake in the Gladstone LNG export project, announced that it would expand production capacity at the Cooper Basin to 550 terajoules per day by 2015,[60] an increase of 140 terajoules. This is a substantial increase in capacity and will assist in managing demand in New South Wales.

Increasing production in Queensland

The analysis in Figure 16 assumes that capacity on the pipeline flowing from the Cooper Basin to Queensland is fully utilised. This includes the 85 terajoules of capacity now available, plus an extra 142 terajoules forecast to be available from 2015.

Alternatively, if more gas can be supplied from coal seam gas fields in Queensland it may be possible to reduce the amount of gas flowing from the Cooper Basin. This can only occur if producers in Queensland have enough resources to develop more gas fields, recognising the extensive developments already

[60] Santos (2013)

underway in Queensland to supply gas for exports. It would also require higher gas prices in New South Wales as a commercial incentive for gas producers to divert the gas, and to underpin higher development costs in Queensland.

Increasing pipeline capacity from Victoria

More gas could be supplied to New South Wales by increasing the capacity of pipelines flowing from Victoria. The Eastern Gas Pipeline is almost 800 kilometres long and can carry 288 terajoules a day.[61] Expanding this pipeline would increase this capacity. Yet it is unclear whether an expansion could deliver gas to New South Wales in time to assist with potential supply constraints, or if remaining gas reserves in the Gippsland Basin would justify investment in gas transmission infrastructure.

An alternative is to expand the capacity of the New South Wales-Victorian Interconnector, a pipeline that connects the Victorian Gas Transmission Network to the New South Wales gas network. The interconnector can currently supply up to 44 terajoules of gas a day to New South Wales on a peak day. APA Group, the gas transportation business that owns the pipeline, has proposed to expand this capacity. While an expansion of the interconnector would not independently resolve a large supply shortfall in New South Wales, it may assist in managing demand at the margin. The expansion project is expected to be completed in 2014.[62]

Gas storage

In Victoria, a gas storage facility in Dandenong stores gas as LNG. It can be filled on days when gas demand is low and used to augment gas supplies on days when demand is high. Gas retailer AGL is developing a similar facility in Newcastle. Due to open in 2015, it will be able to supply up to 120 terajoules a day to the New South Wales market.

Reducing demand

In the absence of new supply, the New South Wales gas market will revert to the default mechanism for balancing supply and demand: higher prices. If gas shortages emerge, prices will rise and demand can be expected to fall. That will cause gas-fired generators to run less often, particularly if other power generators are available to meet the state's electricity requirements. If prices rise further, commercial gas users may reduce gas use, switch to alternative fuels, or even close down operations.

[61] Core Energy Group (2012)
[62] AEMO (2012c)

4. The West Australian gas market

4.1 A very different market

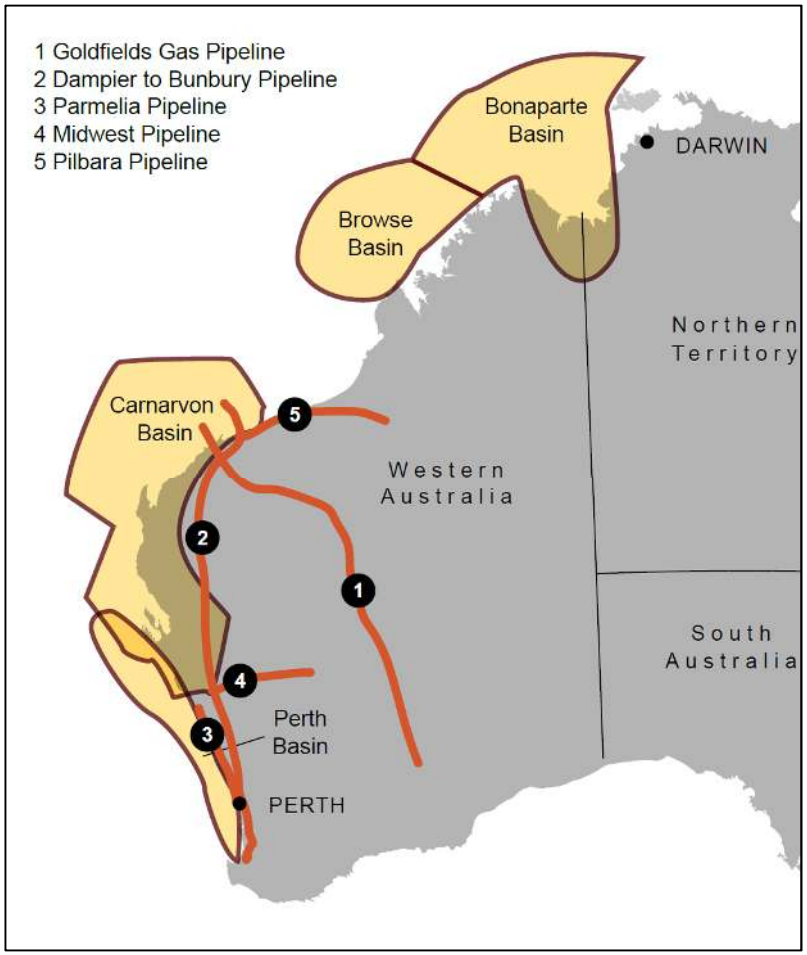
Western Australia has huge reserves: around 90,000 petajoules, or 64 per cent of the 'proven and probable' gas reserves in Australia.[63] Most of them are conventional gas fields, located in deep water off the coast of northern Western Australia. The fields are very large, but more expensive to reach than conventional onshore or shallow-water gas fields. Developing them requires significant scale: in many cases they are viable with contracts in the export market but not to meet domestic demand alone.

Western Australia started exporting gas in 1989 from the North West Shelf project in the Carnarvon Basin.[64] This project alone produces about six per cent of all global LNG exports.[65] The Western Australian gas market is physically separate to the east coast market. It confronts different challenges. It has fewer buyers and sellers, large distances between major gas fields and demand centres, and fewer major transmission pipelines.

The recent surge in global demand for gas has led to massive new investment in LNG projects in Western Australia. Projects worth at least $116 billion are underway and more are in the advanced planning stage. Western Australia's gas exports will increase by close to 70 per cent by 2017, as Figure 18 shows.

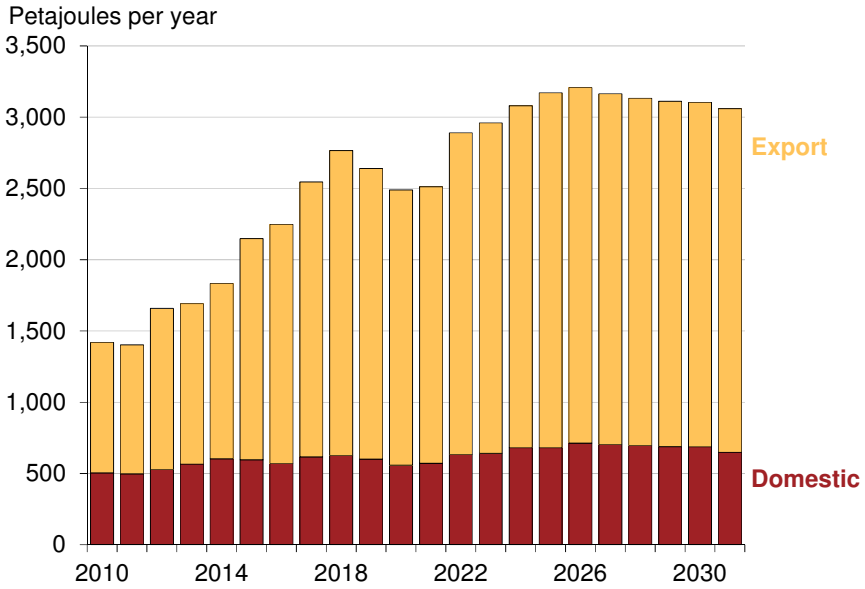
[63] AER (2012), p87
[64] The NWS is a joint-venture of six participants: Woodside Energy, BHP Billiton Petroleum, BP Developments Australia, Chevron Australia, Japan Australia LNG (MIMI), and Shell Development (Australia)
[65] BREE (2012c)

Figure 17: Major pipelines and gas fields in Western Australia



Source: Grattan Institute

Figure 18: Forecast gas demand for Western Australia, 2010 to 2031



Soures: ACIL Tasman (2011); Government of Western Australia (2012a)

4.2 Recent concerns about price and supply

When the North West Shelf project began exporting gas in 1989, domestic gas prices did not increase immediately. In part, this reflected much lower prices in major export markets. Japanese prices were around $5 a gigajoule, compared with around $16 a gigajoule today.[66] But prices were also shaped by a major deal in which the State Government committed to buy a large volume of gas from the North West Shelf project.[67] The deal made the project possible and enabled a major expansion in Western Australia's gas market. But the contracted volumes were very generous, exceeding local demand.[68] This helped to keep prices low, compared with export prices, as shown in Figure 19.

Since the mid-2000s the domestic market has been under strain. Western Australia's minerals boom has driven growth in demand, gas production costs have increased due to higher input costs and some fields have been depleted. Moreover, in the coming years the North West Shelf project will complete its original obligation to supply gas to the domestic market. Without new domestic contracts it could supply no gas to the domestic market after about 2020.[69] Prices have risen sharply, from an average $2 to $3 a gigajoule to new contracts at around $8 to $9 a gigajoule. Some short-term deals have been reported as high as $15 a gigajoule.[70]

[66] OECD (2013)

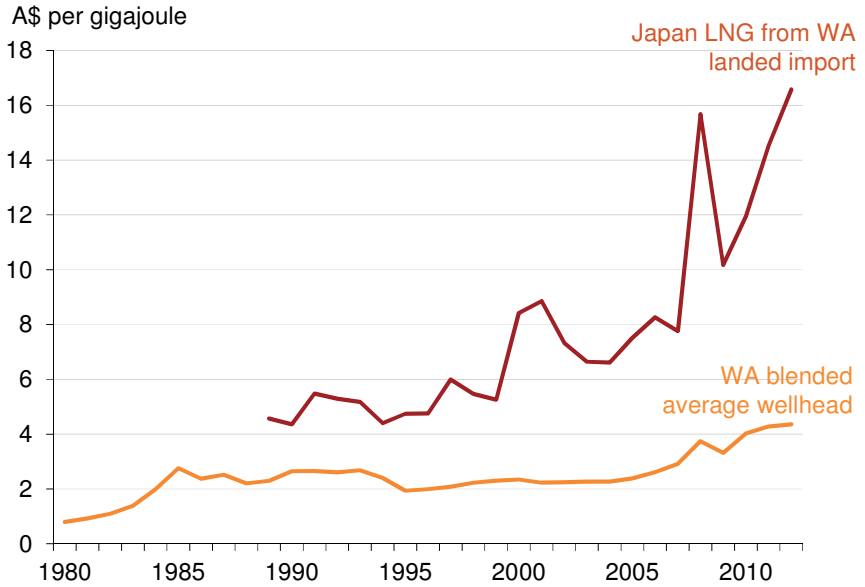
[67] Under the 1979 deal the State Electricity Corporation of Western Australia (SECWA) contracted with the NWS partners to purchase 3,023 petajoules of gas, with a further 2,041 petajoules reserved for domestic use, subject to commercial viability of production. In addition, SECWA built gas-fired power stations, developed the Dampier to Bunbury Natural Gas Pipeline to connect the NWS project to major demand centres in the south, and agreed to market the gas to Alcoa and other users. SKM (2011)

[68] Ibid.

[69] Calculation by SKM (2011). The NWS Joint Venture has indicated that it expects to continue supplying some domestic gas, but less than it has historically. In a State Parliament inquiry into domestic gas prices, the Parliamentary Committee accepted a supply scenario where the NWS continues to supply 600 terajoules per day until 2020, declining to 300 terajoules per day in 2030. Economics and Industry Standing Committee (2011)

[70] SKM (2011)

Figure 19: Blended average* Western Australia wellhead gas prices and Japan LNG import price from Western Australia, 1980 to 2012



*Notes: * Blended average combines operating gas contracts, some of which were set when prices were substantially lower. Japan prices shown are for landed gas and include transport and liquefaction costs. Historical data for these costs is not readily available. Currently they run at about $5 per gigajoule, but they would have been substantially lower in the past.*

Source: OECD (2013); Government of Western Australia (2012b); RBA (2013)

The domestic market needs to bring on new sources of supply. Western Australia has plenty of gas, but some gas users have raised concerns that LNG producers will put foreign buyers first, and fail to meet the needs or timing of smaller local customers.

To help address this, the Western Australian State Government has intervened in the market. In 2003, the Government imposed a requirement on the large Gorgon project to supply 2,000 petajoules of gas to the domestic market over the life of the project. In 2006, the Government formalised a policy to reserve gas for domestic use. Under the policy, the Government negotiates for 15 per cent of output from LNG projects to be reserved for sale in the domestic gas market.[71]

4.3 Reserving gas is not the answer

The key problem with the domestic gas reservation policy is that government overrides the market and sets the volume of supply. This has risks. In particular, government could force too much gas into the domestic market. Suppliers will have less flexibility to adjust how much gas they supply, and will be forced to compete with one another to sell this gas into the market. This will push prices down and could restart the cycle of poor outcomes that followed the deal with the North West Shelf project.

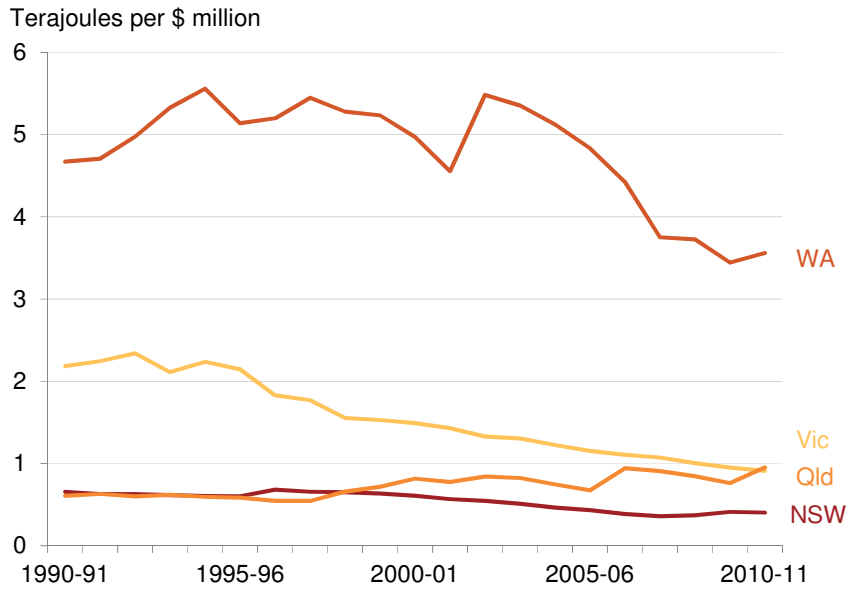
As the following section describes, years of low prices discouraged producers from developing new gas fields, leading to little competition and supply constraints.

[71] Developers are not explicitly required to sell their gas in the domestic market. But they must commit to building the domestic infrastructure necessary to meet their domestic commitments, such as processing plant and pipelines, and they must make domestic gas available from the date that exports commence. Gas swaps and negotiating access to existing infrastructure are permitted. Government of Western Australia (2006); Government of Western Australia (2012c)

4.3.1 How oversupply eventually led to high prices

The Western Australian economy became very gas intensive as a result of the North West Shelf deal (Figure 20). With ample supply and low prices, gas consumption rose fivefold from around 35 to 150 petajoules each year in the decade after the early 1980s. The State Government paid for the gas whether it was consumed or not. It was effectively a transfer from state taxpayers to industrial gas consumers.

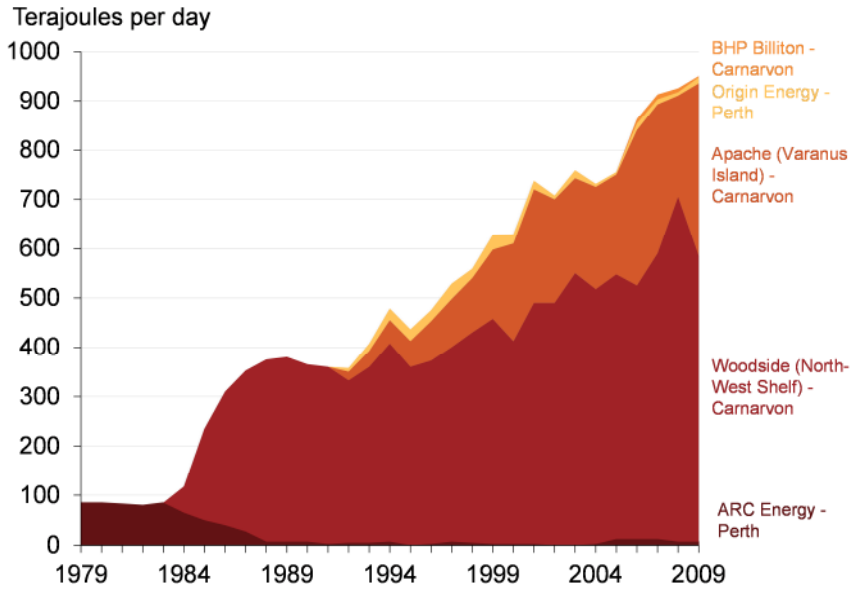
Figure 20: Gas consumed per dollar of state product



Source: BREE (2012a)

Eventually the surplus gas led to the development of more gas-fired power generation.[72] Yet low prices also helped to limit competition in the gas market to just a few suppliers. During the 1990s, the North West Shelf project supplied most domestic gas, with the balance coming from a small number of alternative producers, as Figure 21 shows.

Figure 21: Western Australia domestic gas production



Source: APPEA production statistics, reproduced in SKM (2011)

[72] SKM (2011)

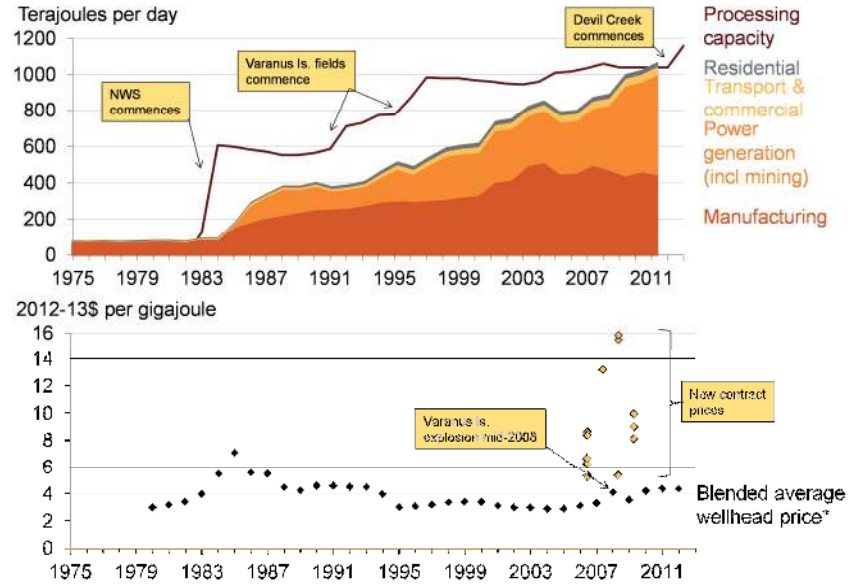
During the late-1990s and 2000s, there was very little investment in domestic gas processing capacity in the Western Australian market, as Figure 22 shows. Ample supply and low prices discouraged gas producers from developing new infrastructure. Lack of investment in new gas supply capacity was not a problem while existing capacity could adequately supply the market. But in the last decade several factors combined to increase demand and decrease supply. The gap between gas consumption and capacity to supply shrank to nothing and new contract prices jumped sharply (Figure 22).

From the mid-2000s, Western Australia's minerals boom accelerated growth in domestic demand for gas. An expansion project increased the capacity of the Dampier to Bunbury pipeline, which also enabled large industrial customers to take more gas.[73]

At the same time, competition among suppliers shrank. Several of the smaller gas fields in the Perth and Carnarvon Basins were depleted.[74] As a result, two-thirds of Western Australia's domestic gas supply came from the North West Shelf project between 2009 and 2012. Close to a third came from Varanus Island, a separate gas processing facility in the Carnarvon Basin.

In 2011, a Western Australian parliamentary inquiry into higher gas prices found that a lack of gas processing capacity had been a major factor.[75] The Inquiry also highlighted that companies were struggling to agree on terms for new contracts. The state has an abundance of gas, but the market is in transition, and the difficulty reflects different expectations of price, volume and contract length.

Figure 22: Western Australia domestic gas processing capacity, consumption and prices



Note: Prices spiked when the NWS came online in 1984. This may reflect uncertainty about the marginal cost of production before the project was completed.
Source: APPEA (2010); BREE (2012a); Government of Western Australia (2012b); SKM (2011)

[73] The pipeline's owners had been in financial difficulty over about 2000-05, and the pipeline was not expanded during that period. Economics and Industry Standing Committee (2011) p36.
[74] Ibid. p6
[75] Ibid.

4.3.2 Oversupply could happen again

The market did respond to higher prices, however. New processing capacity has come online at Devil Creek this year and a similar-sized facility is well advanced at Macedon.[76] The North West Shelf is also investing, having committed $5 billion to recover low-pressure gas from fields in the Carnarvon Basin.[77] All are intended for the domestic market, and all were committed to in 2008-10, after prices rose. A conservative estimate puts domestic gas supply investments since 2008 at $7.5 billion.[78]

Several new LNG facilities will start producing gas in the next few years with scope to supply domestic customers. Given the right price, there is no reason to expect they would not do so. However, if the Government strictly applies the domestic gas reservation policy they will have little choice. What happens next depends on how the policy is enforced.

In 2012, the Government's Strategic Energy Initiative confirmed its commitment to reserving gas for the domestic market and tightened the policy's requirements.[79] So far the Government has negotiated domestic agreements under the reservation with the Pluto and Wheatstone LNG projects, both of which will supply 200 terajoules a day. The Gorgon LNG project is due to start supplying the domestic market with 150 terajoules a day in about 2015.[80]

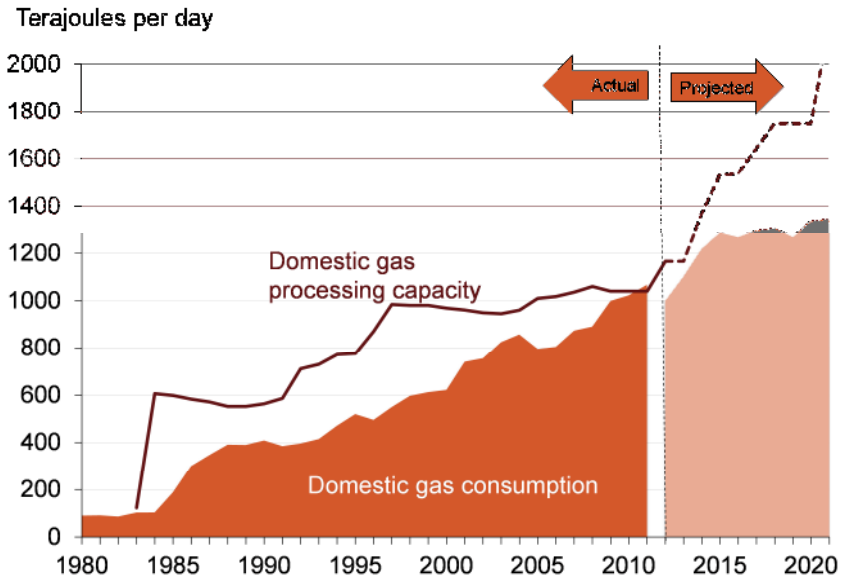
Figure 23 illustrates the case where all LNG projects currently under development build new processing facilities sufficient to deliver 15 per cent of their output to domestic users. In this case the market would rapidly return to surplus capacity. The Government has implied that this would not occur, saying that it will apply the gas reservation policy flexibly, to manage supply and individual project circumstances.[81] But getting the right balance between supply and demand will be difficult, and will always be so for any government. This is especially the case when government has a strong incentive to keep prices low. The problem is best left for markets to solve.

4.4 What should government do next?

While Western Australia has significant differences to the eastern states, the same principles apply. The Government should seek to develop and support efficient gas market frameworks.

[76] Although the gas fields they will draw on are small compared with some LNG projects, they are still expected to deliver about 400 terajoules a day at full capacity (North West Shelf has delivered 600 terajoules a day).
[77] North Rankin redevelopment project. Woodside (2013)
[78] Devil Creek, Macedon and North Rankin. Does not include the North West Shelf's Greater Western Flank project (which may export), or the Gorgon, Wheatstone or Buru projects (will/may operate under the gas reservation policy).
[79] The updated policy requires a firm 15% of output over the life of the project, as distinct from 'up to 15%', the wording in the 2006 policy. Added to this, domestic supply must commence at the same time as LNG exports. Government of Western Australia (2012c)
[80] The Gorgon project has its own legislation that requires domestic supply. The Pluto and Wheatstone agreements have been claimed as successes for the reservation policy, although it is plausible that they or similar projects would have occurred without the policy in place. Eg DomGas Alliance (2013)
[81] Government of Western Australia (2012c)

Figure 23 Western Australia actual and projected domestic gas consumption and gas processing capacity



Notes: Projected domestic gas consumption is the 'High gas supply' scenario in ACILTasman's modelling for the Western Australian Government (reference below). Projected processing capacity assumes the following LNG projects add capacity for 15 per cent of expected output: Macedon (2014), Spar (2016), Icthys (2016), Gorgon (2016), Wheatstone (2016), Devil Creek expansion (2017), Pluto (2018), Gorgon 2 (2021) and Browse (2021). Perth Basin fields Beharra Spings, Dongarra-Mondarra and Woodada decline to zero by 2015. Does not include North Rankin or Buru Energy projects.

Source: APPEA (2010); BREE (2012a); Government of Western Australia (2012b); SKM (2011); ACIL Tasman (2011)

4.4.1 Let the market operate

The Western Australian Government should end the gas reservation policy and allow the market to balance supply and demand. Forcing producers to commit to the domestic market could repeat history.

Too much supply would again push gas prices down. This might seem attractive, but artificially low prices are bad for the gas market. Artificially low prices limit competition between producers and suppress incentives to develop alternative sources of supply. In the longer-term the market would bring on new supply, but as recent experience has shown, prices would have to rise sharply. Shortages are possible.

Artificially low prices are also bad for the economy. Supporting businesses through low-priced gas might seem attractive. But it is effectively a subsidy for gas users, paid for by gas producers. Some of those users will struggle to compete when gas prices rise. The Western Australian economy would be better off developing industries that are highly competitive.

LNG exporters should still 'pay their dues' for access to Australia's natural resources. Governments should ensure that a portion of the benefits from gas exports is shared across the community. Reserving gas is poor tool for this, because there is little scope to target those most in need. Instead, the Commonwealth and Western Australian Governments should ensure that there is an efficient tax regime in place for the gas industry, and that the gains are distributed appropriately.

Choosing to end the reservation policy will involve some pain. Gas will go to its highest-value use and, in the short-term, prices will rise to 'export parity' levels. Gas users will need to adjust, by being more efficient, switching fuels or passing on some costs. Some businesses may not stay in the state. But in the longer-term the market will have sustainable prices, more competition and greater security of supply.

4.4.2 Review joint marketing arrangements

Joint marketing reduces competition in the upstream gas sector by reducing the number of sellers in the market. In 2009 and 2010 the ACCC authorised joint marketing arrangements for the Gorgon and North West Shelf projects until 2015. It argued that temporarily allowing joint marketing would help to relieve pressure on domestic gas supplies by bringing more gas into the domestic market and avoiding delays in the Gorgon development.[82]

Over the coming years several new projects will come online. This will increase competition and relieve some or all of the supply constraints on which the joint marketing authorisations were based. If this happens, the ACCC should move toward eliminating joint marketing arrangements.[83] Doing so would increase competition further still, a good thing for a maturing market. The fact that smaller projects in Western Australia have been able to market their gas separately suggests that joint marketing is not essential for larger gas producers.

4.4.3 Consider a capacity market for pipeline access

Increasing access to pipeline capacity could improve competition. The Dampier to Bunbury Natural Gas Pipeline ships about 90 per cent of state's gas at some point between production and use.[84] But there is no transparent mechanism to support competitive short-term access to pipeline capacity. The pipeline is fully contracted to at least 2019, and the owner expands capacity only when it has long-term contracts for new supply.[85] This constrains short-term supply that could deliver more gas onto the market.

The Western Australian Government recognised the problem in the Strategic Energy Initiative 2031 but only committed to "encouraging the owners of major gas pipelines to consider options for increasing the practical capacity of their infrastructure through offering more flexible access contracts."[86] The Government could go further and facilitate the development of a platform for trading pipeline capacity.

Pipeline capacity trading could help potential buyers and sellers to find each other and negotiate a price. This would assist in making the capacity market more competitive. Such a mechanism could take a form similar to the capacity market being developed by the Australian Energy Market Operator on the east coast.

[82] ACCC (2009); ACCC (2010)
[83] Joint-marketing authorisation might be retained for companies with a very small stake in a joint venture.
[84] Economics and Industry Standing Committee (2011)
[85] In 2004, the Dampier Bunbury Pipeline negotiated the right to charge a higher price for pipeline access than regulation would normally allow. The deal was done outside of the regulatory regime to get the pipeline out of administration. Adding spare capacity on the pipeline now would push prices down. Access would be at a lower regulated price and that would, under the terms of the negotiated standard shipper contract, flow on to all other shippers ibid. p139
[86] Government of Western Australia (2012c)

5. Carbon emissions and gas-fired power generation

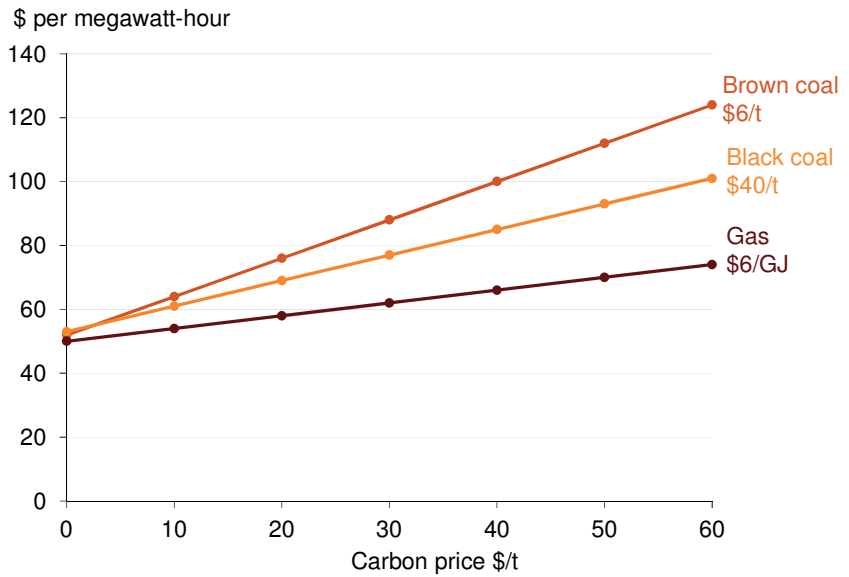
About a third of the gas consumed in the Australian economy is used to generate electricity. Once converted to electricity, gas-fired generation supplies about 19 per cent of our power.[87] The rest is generated from black coal (46 per cent), brown coal (22 per cent), renewable energy (10 per cent) and oil and other fuels (2 per cent).

In 2010 the Australian Bureau of Agricultural and Resource Economics predicted that gas-fired generation was about to increase rapidly.[88] The growth would be driven by several factors: cheap gas, a carbon price that would make coal generation more expensive than gas, and increased demand for electricity due to population growth and higher levels of energy consumption.

Figure 24 explains why gas would have been favoured to meet new demand, even with a relatively modest carbon price. It shows the cost of electricity that new fossil-fuel power plants would require at different carbon prices.

Unlike renewable energy sources such as solar and wind, gas-fired power stations produce carbon emissions. Yet for each unit of electricity produced, a new gas-fired power station will produce about half the emissions of a black coal power plant and a third of those of a brown coal power station.

Figure 24: Required electricity price to justify new fossil fuel power plant construction, at various carbon prices



Source: Grattan Analysis

Despite these advantages, the 'dash for gas' isn't happening. There are three reasons why. Electricity demand has been falling, rather than growing. Second, since about 2008, legislation to support renewable energy is forcing additional renewable energy into this shrinking market. Third, higher gas prices rule out switching from existing coal to existing gas power stations.

[87] BREE (2012a)
[88] Syed, *et al.* (2010)

The change has important implications for policy makers. It has particular implications for how we reduce emissions of carbon dioxide in coming years, and for managing the longer-term process of transforming our power generation infrastructure to use less carbon-intensive fuels.

5.1 Falling demand means no new capacity is needed

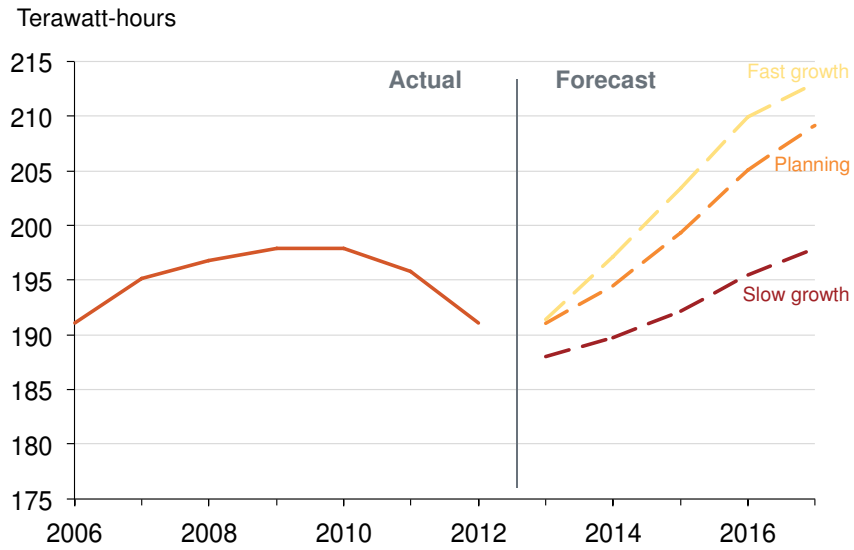
Electricity demand forecasts from as recently as late last decade showed steady growth well into the current decade. Yet since 2008 demand has fallen, as Figure 25 shows. This is due to a number of factors, including reduced demand across all sectors as higher electricity prices bite, lower manufacturing output, and the rapid uptake of solar PV systems, driven by state-based support policies.

Figure 25 also shows the most recent published forecasts for electricity demand under a range of scenarios. Data collected since these forecasts were published suggest the falling trend is continuing and that electricity demand will be at the lower end of the forecast range. The prospects for new gas-fired power stations look very poor for at least a decade.

5.2 Gas is not the cheapest option

Higher gas prices will also result in existing gas-fired generators operating less often. Figure 26 illustrates why. With low gas prices and a carbon price of at least $30 a tonne of carbon dioxide, existing gas fired generators are cheaper to operate than black or brown coal-fired generators. However, with high gas prices and low carbon prices brown coal provides the cheapest electricity, followed by black coal.

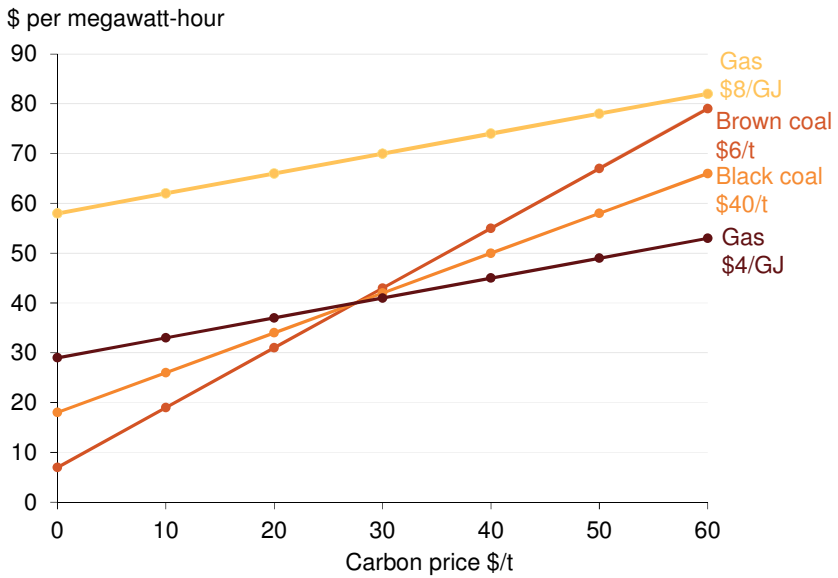
Figure 25: Electricity demand forecasts for eastern Australia, 2006 to 2017



Source: AEMO (2012b)

In the wholesale electricity market, output from power plants is adjusted continuously to ensure that supply meets demand. During periods of high electricity demand, prices rise and power stations produce more. The analysis in Figure 26 does not mean that the plants with higher costs will cease to operate entirely. However, power stations that face higher operating costs are likely to run less often.

Figure 26: Required electricity price to justify running fossil fuel power plants, at various carbon prices



Source: Grattan analysis

The ability of black or brown coal power to substitute for gas-fired power in most circumstances may be good news for electricity customers. It means that higher gas prices are unlikely to substantially increase electricity prices. But it is not good news for carbon emission levels.

5.3 Renewable energy is favoured under current policies

Gas-fired generation has also been affected by the Renewable Energy Target, which requires energy retailers to buy more than 20 per cent of their electricity from renewable energy sources by 2020. The result of the policy has been rapid deployment of wind-powered electricity. This has reduced demand for other types of generation, including gas-fired power.

5.4 The future for gas-fired generation is uncertain

The future of gas-fired generation in Australia is highly uncertain. Figure 27 shows a recent forecast for demand for gas-fired generation in eastern Australia. The Planning Scenario is based on medium economic growth, stable coal prices and the current emissions reduction target of 5 per cent below 2000 levels by 2020. The Slow Change Scenario is based on slower economic growth, falling coal prices and an effective collapse in the carbon price.

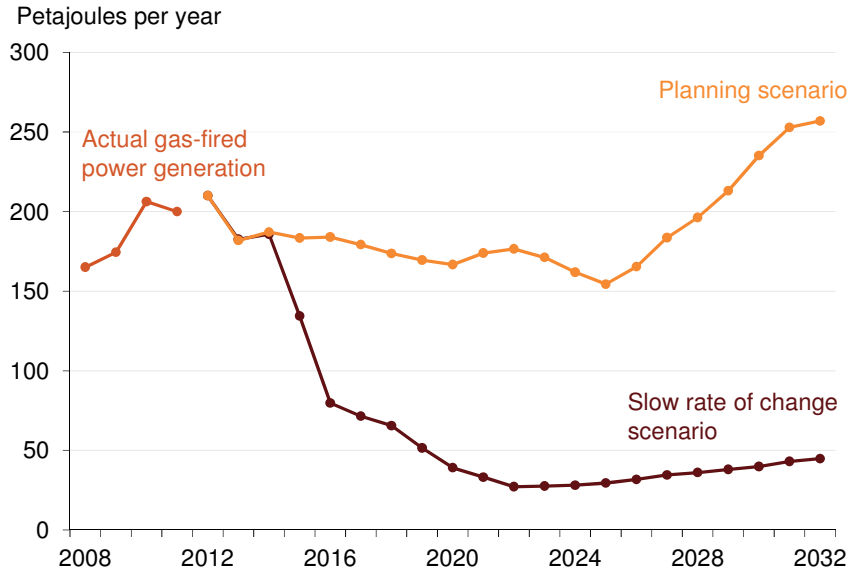
Future developments could reignite the 'dash for gas' in Australia. These developments could include a return to electricity demand growth, stronger and more secure targets under climate change policies, lower gas prices or a major reduction in the Renewable Energy Target. In the absence of such changes, the low-emissions potential of gas will remain unfulfilled in Australia.

5.5 Global gas demand will be linked to carbon policies

Globally, fossil fuels are far from finished. Unconventional extraction methods have replenished global reserves of oil, gas and other fuels that have the potential to produce a large amount of carbon emissions. Concerns about "peak oil" – where prices rise rapidly as all available oil reserves are depleted - have receded and global gas resources could supply current demand

for over 200 years.[89] These developments may take the world into a new phase of abundant fossil fuel supplies.[90]

Figure 27: Outlook for gas demand for electricity generation in eastern Australia, 2008 to 2032



Source: AEMO (2012a)

While this is good news for a rapidly developing, energy-hungry world, it could be very bad news for global climate change policy. Where gas replaces coal-fired power generation, it will lower global carbon emissions. Where it replaces nuclear energy, emissions will increase. Low-cost, gas-fired generation may even mean less investment in renewable energy. It is unclear what the net result for carbon emissions will be.

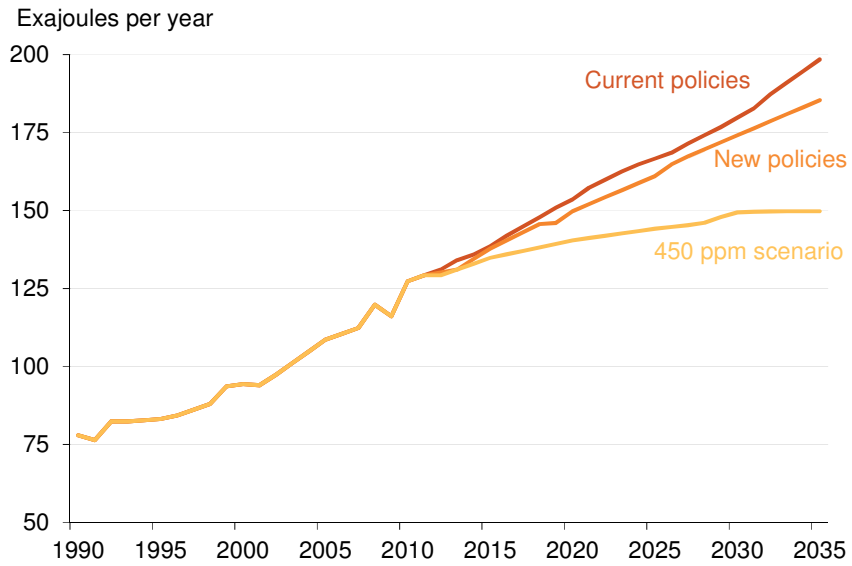
While the Australian 'dash for gas' is not occurring, the global story is different. In the US, low shale gas prices have triggered a shift away from coal and towards gas-fired power generation. This has helped to reduce US greenhouse gas emissions.[91]

In Japan, nuclear power stations were closed following a 2011 nuclear disaster. As a result, demand for gas-fired power generation has risen, despite higher gas prices. Whether this continues will depend on global action towards reducing carbon emissions.

Figure 28 shows the range of forecasts for global gas demand developed by the International Energy Agency. The three scenarios feature different assumptions about global action to address climate change.[92] Current international climate negotiations aim to limit average global temperature increases to two degrees centigrade.[93] Under this scenario, global growth in gas demand would peak and flatten by about 2030.

[89] IEA (2012)
[90] Helm (2013); Carbon Tracker Initiative (2013)
[91] EPA (2013); EIA (2011)
[92] IEA (2012)
[93] World Bank (2012)

Figure 28: World natural gas demand under different carbon policy scenarios, 1990 to 2035



Source: IEA (2012)

The role of gas-fired generation in meeting future global energy demand will depend on the development of affordable carbon capture and storage technology that can be used alongside gas fired generators. At present it is unclear whether the technology can be implemented in an affordable, reliable manner. If it can, gas-fired generation may continue to grow strongly, even in a carbon-constrained world.

6. References

ABS (2010) *5209.0.55.001 - Australian National Accounts: Input-Output Tables - Electronic Publication, Final release 2006-07 tables*, Input Output Multipliers, accessed 16 June 2013, from http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/5209.0.55.001Main Features4Final release 2006-07 tables?opendocument&tabname=Summary&prodno=5209.0.55.001&issue=Final release 2006-07 tables&num=&view

ABS (2011a) *4442.0 - Family Characteristics, Australia, 2009-10* Households, families and persons, Selected characteristics, 1997, 2003, 2006–07, 2009–10 accessed 16 June 2013, from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4442.02009-10?OpenDocument

ABS (2011b) *6530.0 - Household Expenditure Survey, Australia: Summary of Results, 2009-10*, HES 2009–10 Detailed tables, accessed 16 June 2013, from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6530.02009-10?OpenDocument

ACCC (2009) *Determination: Applications for authorisation lodged by Chevron Australia Pty Ltd, Chevron (TAPL) Pty Ltd, Mobil Australia Resources Company Pty Ltd and Shell Development (Australia) Pty Ltd in respect of the joint marketing and sale of natural gas from the Gorgon Gas Project for supply in Western Australia*, C2009/979, Australian Competition and Consumer Commission

ACCC (2010) *Determination: Applications for authorisation lodged by BHP Billiton Petroleum (North West Shelf) Pty Ltd, BP Developments Australia Pty Ltd, Chevron Australia Pty Ltd, Japan Australia LNG (MIMI) Pty Ltd, Shell Development (Australia) Pty Ltd and Woodside Energy Ltd in respect of the joint marketing activities for the sale of domgas in Western Australia from the North West Shelf Project and to administer existing gas supply contracts*, C2010/344, Australian Competition and Consumer Commission

ACIL Tasman (2010) *Gas prices in Western Australia*, Review of inputs to the WA Wholesale Energy Market, accessed 16 June 2013, from http://www.imowa.com.au/f2138,484255/484255_ACIL_Tasman_Final_Report_-_Updated.pdf

ACIL Tasman (2011) *Energy futures for Western Australia - Scenario development and modelling outcomes* Prepared for the Office of Energy

ACIL Tasman (2012) *Fuel Cost Projections*, Updated natural gas and coal outlook for AEMO modelling, accessed 16 June 2013, from http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CCoQFjAA&url=http%3A%2F%2Fwww.aemo.com.au%2FConsultations%2FNational-Electricity-Market%2FOpen%2F~%2Fmedia%2FFiles%2FOther%2Fplanning%2FFuel_cost_projections_Natural_gas_and_coal_outlooks.ashx&ei=6PumUZ-eGYfbkQWEioDgDQ&usg=AFQjCNGR2ah8mGOLHL8XJmqv9DWsNQiZTg&sig2=HjzPSbOztzz8HKqfIGMtPg

AEMO (2011) *Gas Statement of Opportunities*, Australian Energy Market Operator

AEMO (2012a) *Gas Statement of Opportunities*, Australian Energy Market Operator

AEMO (2012b) *National Electricity Forecasting Report*, Australian Energy Market Operator

AEMO (2012c) *Victorian Gas System Adequacy*, Australian Energy Market Operator

AEMO (2013) 'Development Work', accessed 16 June 2013, from http://www.aemo.com.au/Gas/Market-Operations/Gas-Supply-Hub/Development-Work

AER (2006) *State of the Energy Market*, Australian Energy Regulator

AER (2007) *State of the Energy Market*, Australian Energy Regulator

AER (2008) *State of the Energy Market*, Australian Energy Regulator

AER (2009) *State of the Energy Market*, Australian Energy Regulator

AER (2010) *State of the Energy Market*, Australian Energy Regulator

AER (2011) *State of the Energy Market*, Australian Energy Regulator

AER (2012) *State of the Energy Market*, Australian Energy Regulator

AIG (2013a) *AIG Energy Stakeholder Survey*,

AIG (2013b) 'Manufacturing malaise continues', accessed 16 June 2013, from http://www.aigroup.com.au/industrynewsletter - Box1

APLNG (2013) 'Project partners', accessed April 2013, from http://www.aplng.com.au/about-project/project-partners

APPEA (2010) *Economics and Industry Standing Committee Inquiry into Domestic Gas Prices - Australian Petroleum Production and Exploration Association*, Parliament of Western Australia

Arrow Energy (2013) 'Our Company,' accessed April 2013, from http://www.arrowenergy.com.au/our-company

Australian Council of Learned Academies (2013) *Engineering Energy: Unconventional gas production*, A study of shale gas in Australia

Baulderstone, J. (2013) *Natural Gas: A balanced energy solution for NSW*, Santos, accessed 16 June 2013, from http://www.santos.com/library/130410_A_balanced_energy_solution_for_NSW.pdf

Bethune, G. (2013) *Australia's golden age of gas dawns*, accessed 16 June 2013, from http://www.energyquest.com.au/uploads/docs/0607_bethune.pdf

BREE (2012a) *Australian energy statistics data*, Bureau of Resources and Energy Economics

BREE (2012b) *Australian Energy Technology Assessment*, accessed 16 June 2013, from http://www.bree.gov.au/documents/publications/aeta/Australian_Energy_Technology_Assessment.pdf

BREE (2012c) *Gas market report*, Bureau of Resources and energy economics

Carbon Tracker Initiative (2013) 'Carbon Tracker', from http://www.carbontracker.org/team/contact/about-us

Chambers, M. (2013a) 'Beach Energy to sell $1.5 bn of natural gas to Origin Energy', *The Australian,* 11 April 2013, from http://www.theaustralian.com.au/business/mining-energy/beach-energy-to-sell-15bn-of-natural-gas-to-origin-energy/story-e6frg9df-1226617726329

Chambers, M. (2013b) 'Santos reserves NSW gas for domestic use', *The Australian,* 10 April 2013, from http://www.theaustralian.com.au/business/mining-energy/santos-reserves-nsw-gas-for-domestic-use/story-e6frg9df-1226616250393

Core Energy Group (2012) *Review of Gas Facilities: Existing and New*, Australian Energy Market Operator

Denniss, R. (2012) *The use and abuse of economic modelling in Australia*, The Australia Institute, accessed 16 June 2012, from https://http://www.tai.org.au/index.php?q=node%2F19&pubid=950&act=display

Department of Energy and Water Supply (2012) *2012 Gas Market Review: Queensland*, State of Queensland

Dicolo, J. A. (2013) 'Natural Gas Blazes a Path to Higher Prices', *The Wall Street Journal,* 5 April 2015, accessed 16 June 2013, from http://online.wsj.com/article/SB10001424127887324373204578374773681881796.html

DomGas Alliance (2012) *Australia's Domestic Gas Security*, accessed 16 June 2013, from http://www.domgas.com.au/pdf/Alliance_reports/DomGas Report 2012.pdf

DomGas Alliance (2013) *WA Domestic gas market outlook: 2013-2020*, from http://www.domgas.com.au/pdf/Alliance_reports/WA DOMESTIC GAS MARKET OUTLOOK-FINAL-Feb 2013.pdf

Dow (2012) *Australia's Energy Opportunity: In the National Interest*, accessed 16 June 2013, from http://www.dow.com/advanced-manufacturing/pdf/australia/Dow_Factsheet_Canada.pdf

DRET (2012) *Energy White Paper*, Department of Resources Energy and Tourism

Economics and Industry Standing Committee (2011) *Inquiry into Domestic Gas Prices* Parliament of Western Australia

EIA (2011) *Emissions of Greenhouse Gases in the United States*, Energy Information Administration, US Deptartment of Energy

EIA (2012) 'What is shale gas and why is it important?', accessed 16 June 2013, from http://www.eia.gov/energy_in_brief/article/about_shale_gas.cfm

EIA (2013a) *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, accessed 16 June 2013, from http://www.eia.gov/analysis/studies/worldshalegas/

EIA (2013b) 'US Natural Gas Citygate Price', accessed 16 June 2013, from http://www.eia.gov/dnav/ng/hist/n3050us3M.htm

EnergyQuest (2012) *Energy Quarterly, August 2012*,

EPA (2013) *Inventory of US Greenhouse Gas Emissions and Sinks 1990-2011*, US Environmental Protection Agency

Götz, L., Glauben, T. and Brümmer, B. (2013) 'Wheat export restrictions and domestic market effects in Russia and Ukraine during the food crisis', *Food Policy*, 38, p 214-226

Government of Western Australia (2006) *WA Government Policy on Securing Domestic Gas Supplies*, Department of Industry and Resourcesfrom 130614 Gas report v5.4 w refs.docx

Government of Western Australia (2012a) *Fact Sheet: Western Australia LNG*, Department of State Developmentfrom http://www.dsd.wa.gov.au/documents/fact_Sheet_Western_Australia_LNG_November_2012.pdf

Government of Western Australia (2012b) *Quantity and value of minerals and petroleum*, from http://www.dmp.wa.gov.au/1521.aspx

Government of Western Australia (2012c) *Strategic Energy Initiative Energy 2031 - Building the pathways for Western Australia's energy future*, Department of Finance - Public Utilities Office

Harrison, A. and Rodriguez-Clare, A. (2010) *Foreign Investment and Industrial Policy for Developing Countries*, in Handbook of Deveopment Economics vol 5, North-Holland

Helm, D. (2013) *The Carbon Crunch How We're Getting Climate Change Wrong - and How to Fix It*, Yale University Press

IEA (2012) *World Energy Outlook* International Energy Agency

Incitec Pivot (2012) *Annual Report 2012*, accessed 16 June 2013, from http://investors.incitecpivot.com.au/phoenix.zhtml?c=170340&p=irol-reportsannual

John Williams Scientific Services (2012) *An analysis of coal seam gas production and natural resource management in Australia*, Issues and ways forward, accessed 16 June 1013, from http://www.wentworthgroup.org/uploads/An analysis of CSG production and NRM in Australia Oct 2012 FULL.pdf

Kehoe, J. (2013) 'Shale gas a trigger for major reform: McKibbin', *Australian Financial Review,*

King, S. (2013) 'A gas reservation scheme is protectionism in disguise', *The Conversation,* 30 January 2013, accessed 16 June 2013, from http://theconversation.com/a-gas-reservation-scheme-is-protectionism-in-disguise-11810

Klinger, P. (2013) 'Gorgon gas sales fall short', *The West Australian,* 29 May 2013, accessed 16 June 2016, from http://au.news.yahoo.com/thewest/a/-/breaking/17368370/gorgon-gas-sales-fall-short/

Liveris, A. (2013) 'Lack of an energy policy will hurt our economy', *The Australian,* 28 May 2013, accessed 16 June 2013, from http://www.theaustralian.com.au/business/opinion/lack-of-an-energy-policy-will-hurt-our-economy/story-e6frg9if-1226651688339

Macdonald-Smith, A. (2013) 'Origin and Arrow in talks over LNG project', *Australian Financial Review,* 27 May 2013,

Manufacturing Australia (2013) 'Manufacturing Australia Welcomes Government Gas Market Analysis: All Options Must Be Explored In National Interest', accessed 16 June 2013, from http://www.manufacturingaustralia.com.au/news/news-releases/manufacturing-australia-welcomes-government-gas-market-analysis-all-options-must-be-explored-in-the-national-interest/

National Gas Market Bulletin Board (2013) *Gas flow data*, from http://www.gasbb.com.au/viewArchive.aspx?node=archive

NERA Economic Consulting (2012) *Macroeconomic Impacts of LNG Exports from the United States*, accessed 16 June 2013, from http://energy.gov/fe/services/natural-gas-regulation/lng-export-study

NIEIR (2012) *Large scale export of East Coast Australia natural gas: Unintended consequences*, A study of the national interest effects of the structure of the Australian gas industry., accessed 16 June 2013, from http://www.aigroup.com.au/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/LIVE_CONTENT/Publications/Reports/2012/Gas_report_FINAL.pdf

OECD (2013) *Dataset: Natural gas import costs by importing country and by origin*, Liquified Natural Gas (LNG), Japan from Australia

PACIA (2013) *Adding value: The critical, enabling role of the chemicals and plastics industry for Australia's future*, Plastics & Chemicals Industries Association

Philips, M. (2012) 'Is Natural Gas Too Cheap to Drill?', *BloombergBusinessweek,* 17 April 2012, accessed 16 June 2013, from http://www.businessweek.com/articles/2012-04-17/is-natural-gas-too-cheap-to-drill

PIRA (2013) *Scenario Planning Service Quarterly Update, May 2013*, PIRA Energy Group

Productivity Commission (2009) *Submission to the House of Representatives Standing Committee on Economics: Inquiry into Raising the Level of Productivity Growth in Australia*, accessed 16 June 2013, from http://www.pc.gov.au/__data/assets/pdf_file/0005/91382/productivity-growth.pdf

QGC (2013) 'Who we are', accessed April 2013, from http://www.qgc.com.au/who-we-are.aspx

RBA (2013) *Exchange rates - Monthly - Table F11*, Reserve Bank of Australia

ROAM Consulting (2011) *Projections of Electricity Generation in Australia to 2050*, accessed 16 June 2013, from http://archive.treasury.gov.au/carbonpricemodelling/content/consultants_reports/ROAM_Projections_of_Electricity_Generation_in_Australia_to_2050_20110803.pdf

Roberts, P. (2013) 'Gas crisis looms for manufacturing, says Brickworks', *Australian Financial Review,* 21 January 2013, accessed 16 June 2013, from http://www.afr.com/p/national/gas_crisis_looms_for_manufacturing_lxnA82K5smXZcLUIHE4cgJ

Salinas, G. and Aksoy, A. (2006) *Growth before and after trade liberalization*, World Bank policy research working paper 4062, World Bank

Santos (2013) 'Project partners', accessed April 2013, from http://www.santosglng.com/the-project/partners.aspx

SCER (2013) *Regulation Impact Statement: Gas Transmission Pipeline Capacity Trading*,

SKM (2011) *WA domestic gas market analysis for the strategic energy initiative*, SKM report to the Office of Energy

SKM MMA (2011) *Carbon Pricing and Australia's Electricity Markets*, accessed 16 July 2013, from http://archive.treasury.gov.au/carbonpricemodelling/content/consultants_reports/SKM_MMA_Carbon_pricing_and_Australias_electricity_market_20110804.pdf

SMH (2013) 'NSW will face gas crisis, says AGL', *The Sydney Morning Herald,* 10 April 2013, accessed 16 June 1013, from http://www.smh.com.au/nsw/nsw-will-face-gas-crisis-says-agl-20130410-2hlyv.html

Spectator, B. (2013) 'US approves LNG export plant', 18 May 2013, accessed http://www.businessspectator.com.au/news/2013/5/18/resources-and-energy/us-approves-lng-export-plant, from 16 June 2013

Syed, A., Melanie, J., Thorpe, S. and Penney, K. (2010) *Australian energy projections to 2029-30*, ABARE research report 10.02 prepared for the Department of Resources, Energy and Tourism, Austalian Bureau of Agricultural and Resource Economics

The Hon Barry O'Farrell (2013) *Tough new rules for coal seam gas activity*, Premier of NSW Media release - 19 Februrary 2013, State Government of New South Wales

Woodside (2013) 'North Rankin Redevelopment', from http://www.woodside.com.au/Our-Business/North-West-Shelf/Projects/North-Rankin/Pages/default.aspx

World Bank (2013) *World Bank Commodity Price Data (Pink Sheet)*, from http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:21574907~menuPK:7859231~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html