

# A LOT OF GAS

## Visions, Fantasies and Reality

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*The art of good marketing is never to tell a lie, but never tell all the truth.*

### BACKGROUND

In May 1997 the Australian Gas Association published its *Gas Supply and Demand Study* projecting high local consumption and export growth to 2030 and requiring a trebling of production (AGA 1997). How realistic are these dreams? How does projected production growth match with the best estimates of ultimate Australian gas production?

The projections were based on a "wish list" of gas consuming projects predicated upon high growth in both Asian economies and gas fired electricity generation in Australia. Western Australian projects included expansion of LNG exports, petrochemical and nitrogen fertiliser plants plus four briquetted iron and steel plants, mostly by 2010. Mining developments fuelled by gas were expected to grow.

Eastern Australian gas reserves at January 1998 were 450 billion cubic metres (bcm) with 255 bcm already produced, i.e. 705 bcm discovered (AGSO 2000). The Australian Bureau of Agricultural and Resource Economics (ABARE) expects another 255 bcm to be produced to 2009/10 (ABARE 1995). Scope for additional discoveries in these states is minimal and a pipeline from Western Australia or Darwin will be needed around 2005 when Bass Strait and Central Australia will be unable to meet growing consumption.

Unfortunately for the gas lobby the Asian Economic Meltdown from late 1997 flattened economic growth and energy consumption. Kingstream's steel plant at Geraldton has lapsed and Woodside's LNG export expansion project has only just commenced construction. The Gorgon gas project seems even further away. BHP's briquetted iron plant at Port Hedland has been a technical disaster and its future is under a cloud. Gold and nickel mining has slowed and technical problems at new laterite nickel plants are affecting profitability and performance.

However, government and industry hype still conveys a vision of unlimited gas driven growth, even if subdued compared to the days before the Asian meltdown. In Western Australia new electricity generation for growth and replacement of aging coal-fired plant seems to be focusing on natural gas as a fuel.

What is the real position on Australia's gas supplies?

Over 80 per cent of Australia's gas reserves are located off the north west coast of WA, mostly in the offshore Carnarvon Basin and in the offshore Browse and Bonaparte Basins between Australia and Timor. In the mid-1990's a new exploration and development phase began in the Carnarvon Basin which is reaching a mature development stage. The other two basins are at an early stage.

The Canberra based Bureau of Resource Sciences (BRS), now part of the Australian Geological Survey Organisation (AGSO), estimated in December 1994 that ultimate recovery (EUR) for Australia's natural gas would be 3,700 bcm on a conservative 95% probability estimate (P95) and 4,500 bcm on an optimistic 5% probability estimate (P5), with 4000 bcm most likely (BRS 1996). By the end of 1997 about 10 per cent (407 bcm) had been produced and 3,200 bcm discovered. There have been subsequent minor additions to reserves, mainly in the Carnarvon Basin and some in the Bonaparte Basin (AGSO 2000). AGSO's next report is due in January 2002.

Exploration and development slowed in 1998-99 but revived with higher oil prices from 1999 to early 2001. Subsequent low oil prices will again inhibit exploration and development. Investment in the Bonaparte Basin

has high risk due to its remoteness and the unstable political environments in Indonesia and East Timor. The petroleum fields there cross national boundaries and the resource will be shared between Australia and East Timor. In recent months the Bayu/Undan gas field in the Bonaparte Basin has moved closer to development, but has been deferred due to disputes over tax regimes with East Timor. This project was planned to connect with Central Australian gas pipelines supplying the eastern seaboard and any further delay could become critical for eastern Australian gas supply. Some 2000 km of new pipeline is required to connect with 1500 km of existing pipeline from central Australian gas fields to the eastern seaboard. The existing pipeline would need subsequent duplication.

## **WHAT GOES UP MUST COME DOWN**

For any non-renewable resource, like petroleum, production begins from nothing, rises to a peak, or several peaks, then declines and eventually ceases. What goes up must come down. But the development lobby only gives us the upside, avoiding mention of the downside like the plague. The art of good marketing is never to tell a lie, but never tell all the truth.

The US petroleum geologist, MK Hubbert, pioneered the use of the logistic equation to describe the discovery and production profiles for oil and natural gas in major petroleum provinces. In 1956 he successfully predicted the time and magnitude of the 1970 peak of US oil production in the lower 48 States. Production and discovery profiles are normally bell-shaped with the peaks occurring near the mid-point of ultimate economic production or discovery. Discovery peaks before production. The peaks for offshore development and natural gas tend to be more flattened and plateau-like due to the production constraints of offshore platforms and pipelines. It costs 5-10 times as much to transport gas than it does oil over medium to long distances.

Figure 1 shows AGA's consumption/export projections to 2030 (the "wish list") and compares them to the 1994 BRS P95 and P5 estimates for Australian natural gas EUR by fitting the logistic equation to actual production up to 1998 plus AGA's "wish list" projected to 2020, assuming the production constraints at the peak discussed above do not apply. The peak on both EUR estimates would come around 2025. Statistically the mean estimate is the most likely, or around 4,000 bcm. Increasing the EUR by 20% (P95 to P5) does not make much difference to the timing of the peak or its magnitude! In other words AGA's 2030 demand projection could reach a peak before 2030! But their report does not give this down side. On these projections gas production would fall to current levels in 2050. AGA did not discuss the supply position after 2030, but did include some production of methane from coalfields and imports of gas from Papua/New Guinea. These quantities do not greatly alter these dates. In particular coal field methane is difficult to extract and has a different production profile to natural gas.

The production peak usually occurs before the mid-point for giant oil and gas fields, but can come later for small fields or those offshore. These variations cancel out when the data for all fields is aggregated. Hubbert's concepts are now widely accepted. Jean Laherrere has pioneered the use of the logistic equation to describe multi-peaked production profiles where there are several phases of development, as is the case in Australia.

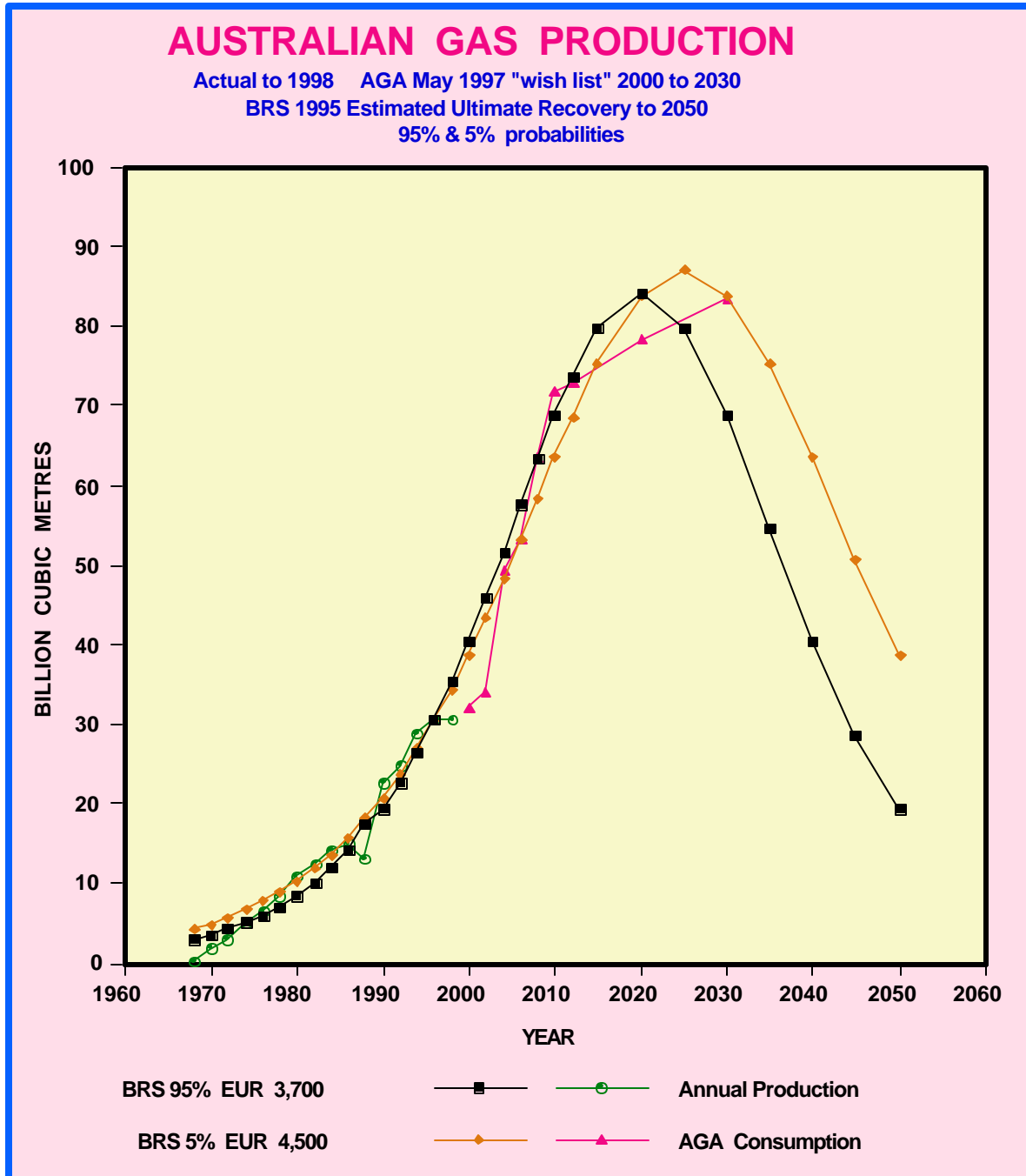
Of course the 1997 dream is already history with projects delayed and timings uncertain. The production profile will certainly be multi-peaked, is unlikely to reach 80 bcm and will be flatter at the maximum. The longer large gas consuming projects are delayed the more likely the profile will assume the character of a "bumpy plateau" at somewhat less than 80 bcm/yr. Pipeline constraints will also flatten the peak. But whatever production dream is projected it can be interpreted against EUR forecasts using variants of the logistic curve, giving the downside as well as the upside. The other half of the truth.

The realism of the gas lobby's dreams must be questioned from both the demand and supply sides. What are the implications for proposed steel mills, power stations and chemical plants? Are the promoters, financiers and shareholders aware that available gas may decline so soon? Will gas become a major transport fuel? Are government agencies, economists and politicians aware? Is the public aware?

## NATURAL GAS AND TRANSPORT

Oil based fuels drive the transport system and are an essential input to agriculture, construction and mining. Transport consumes 60% of the world's oil supply. These industry sectors were expected to consume petrol and diesel equivalent to 28.5 bcm of gas in 2000, or 80% of Australian gas production (ABARE 1995). Fuels based on natural gas are the only ones that can readily replace oil for land transport using existing engine technology, but only at a price.

FIGURE 1



Australia has consumed about half of its EUR of conventional cheap-to-produce crude oil and our self-sufficiency is expected to decline rapidly over the next decade. Barry Jones, Executive Director of the Australian Petroleum Producers and Exploration Association (APPEA), quoting an AGSO source in a paper to an Australian Institute of Energy conference in November, said that there was a 50% chance that Australia's oil self-sufficiency would decline from its present 85-90% down to 55% in 2008-10, (Jones 2001, Powell 2001). A growing proportion of production will be liquids (light oils) stripped from natural gas. Further declines can be expected post 2010. He said relying on imports would lead to a huge loss of budget revenue, a major increase in the cost of imports and damage the Australian oil refining industry. He drew attention to forecasts that production of conventional world oil was expected to peak around 2010, commencing with the current peaking of non-Persian Gulf oil - the reason why oil prices soared last year (Campbell 1997, Campbell & Laherrere 1995). The five Persian Gulf producers have 60% of the world's remaining cheap oil and currently supply 30% of production. Les Magoon of the US Geological Survey has summarised the situation in *Are we Running out of Oil?*, a poster on the USGS website, giving relevant references (Magoon 2001). Les Magoon was the Petroleum Exploration Society of Australia's Distinguished Speaker for the year and was recently in Perth. The imminent peaking of world oil is now openly discussed in the leading petroleum industry journals.

Since the mid-1980's over half the world's oil supply growth has come from Persian Gulf countries turning on wells shut down in the early 1980's, when world consumption fell while production expanded in Alaska, the North Sea and elsewhere. The remaining new oil has come from expensive sources in ever smaller fields outside the Persian Gulf. Low oil prices since 1985 have decimated industry profit margins and eroded the wealth of OPEC oil producers and forced a downsizing of the oil exploration and development industry. In late 2000 the last of the spare Persian Gulf oil production capacity from the 1980's was turned on - only Saudi Arabia had limited spare capacity left (Magoon 2000). A slowing global economy in 2001 and the aftermath of the terrorist destruction of the World Trade Center in New York on 11 September has reduced oil consumption and oil prices have fallen to 60% of their December 2000 level. However, this will lead to under-investment in oil development in the Persian Gulf countries just when it should be expanding to meet supply in the middle of the decade.

Barry Jones also says these September 11 events have enormously increased the political risk for oil supplied from the Persian Gulf and the possibility of supply disruption - the only region now capable of growing production for a limited period to both replace decline elsewhere AND increase supply. The United States is particularly at risk, being the world's largest consumer and importer of oil.

Jean Laherrere (2001), in a paper presented to a seminar at OPEC's September meeting, also summarised comprehensively the status of oil and some natural gas discovery and production trends around the world.

*Jones (2001) also discussed some alternative fuels and options for Australian land transport and concludes that a shift to gas-based fuels is the key along with transport demand management initiatives. He said this transport fuel issue was a far more important and urgent energy issue than electric power industry reform for lower prices through increased competition and needed urgent attention from governments (West Australian 2001).*

Clearly gas consumed by transport and agriculture should soon increase rapidly, adding to the pressure on supply. AGA's demand projections made negligible allowance for these sectors. Enough gas needs to be reserved to support Australian agriculture and transport through to mid-century when both sectors will have to survive without dependence on oil based fuels. By then world oil production is likely to be one quarter of present levels and world natural gas well past its peak, both with higher production costs than at present.

## **CARNARVON, BONAPARTE AND BROWSE BASINS**

These basins are offshore. The Carnarvon Basin in WA is between Exmouth and Port Hedland. The Bonaparte Basin is in the Timor Sea between the Kimberley's and Timor. The Browse Basin lies to the south west of the Bonaparte Basin off the Kimberley coast. About 50% of Australia's likely EUR for gas will

come from the Carnarvon Basin, 30% from the Browse and Bonaparte Basins, the rest from Gippsland and Central Australian fields (AGSO 2000).

AGSO estimates for the EUR of Australian gas need to be qualified. Some will be very expensive. Scott Reef and Brecknock fields in the Browse Basin are 400 km north of Broome in water up to 1000m deep, 600 bcm or 15%.

Scarborough on the Exmouth Plateau in the Carnarvon Basin is 270 km north west of Onslow in water 900m deep, 230 bcm or 6%.

The Gorgon-Chryasor fields are 150 km north of Onslow, mostly in water up to 800m deep, 600 bcm or 15% (DRD 2001).

Much of the undiscovered gas is likely to be in such deep water. Bayu-Undan (100 bcm) in the Timor Sea is 500 km from Darwin in moderately deep water. These deep water projects will be expensive to explore, develop and operate even with advances in technology, which is why the APPEA is lobbying for an exemption to wellhead taxes on production and accelerated depreciation in the tax system. Drilling costs are \$5-8 million in water up to 200m deep, ten times onshore well costs, and \$40-50 million in waters 1500m deep (Bulletin 1996). Floating platforms are used anchored to the ocean floor with cables. The risks are high, one such platform recently sank off Brazil shortly after commissioning. Around 40% of Australia's remaining gas is likely to come from fields in deep water.

Campbell (1997) says deep water economics for oil depends on very high flow rates per well and finely tuned operations that have a short life. Operations are risky and prone to massive damage if small things go wrong. These are marginal operations that are even more risky when gas is the main product.

*Gorgon-Chryasor gas contains 12-15 per cent carbon dioxide. Its release to the atmosphere would significantly increase Australia's greenhouse gas emissions and it is not clear how to dispose of this and at what cost. It is quite common for raw natural gas fields to have a significant carbon dioxide content.*

Remaining Australian gas will be more expensive than current supply due to the higher cost of deep water gas and the long distances for transport to southern and eastern markets.

## **NEW FRONTIERS**

AGSO has started evaluating new frontiers (AGSO 2000). Their next report (January 2002) is expected to rank the prospectivity of unexplored or sparsely explored sedimentary basins in Australia (Powell 2001). Preliminary surveys have been made offshore on the Lord Howe Rise, the Norfolk Ridge, the Tasman Rise, the Kerguelen Plateau and the Townsville Trough east of the Great Barrier Reef. All these sites are in water up to 2,000m deep, are up to 800 km offshore and would be even more expensive to develop if hydrocarbon source rocks are present at all and suitable sealed giant reservoirs exist. The Lord Howe Rise is between Lord Howe Island and New Caledonia. The Norfolk Ridge is near Norfolk Island, the Tasman Rise south of Tasmania. The Kerguelen Plateau is in the Southern Ocean on the edge off Antarctica.

## **CONCLUSION**

Statements on petroleum reserves and likely new discoveries are often political statements not to be taken at face value. Remember when production growth is projected there is always a down side. And on the downside net energy shrinks, the difference between gross energy output and the energy consumed in producing it - the useable energy produced, the parameter that matters. Production might still be profitable to the company but not so beneficial to the community. Most remaining gas in Australia will be more expensive to produce and deliver to markets. A major new use for transport will rapidly emerge challenging the current agenda for gas consuming industries and LNG export.

Many questions must be asked to get at the truth behind statements on reserves and expected new discovery, to determine what has NOT been said. When this is done a more sober appreciation of our gas future is obtained.

#### **ACKNOWLEDGMENTS**

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