

***A Tale of Two Resources:***  
**Australia's limited oil and growing gas reserves –  
past predictions and future options.**

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**Analysis**

This contribution outlines how Australia's past public preoccupation with a finite oil resource has tended to overshadow our growing gas (and associated liquid) resource. Past predictions of imminent oil scarcity did not eventuate and may yet be avoided, given the extent of gas and other liquid (potential oil replacement) resources discovered to date. The paper challenges readers to consider greater use of our most abundant petroleum resource (natural gas and liquids) and to contemplate a future where there may be few local oil reserves and less need for them.

**Summary**

Australia has two differing petroleum resource endowments; one of limited and gradually declining oil reserves, another of significant and underutilised gas reserves and associated liquids. The latter could potentially supplement demand for crude oil and neutralise any economic impact from slowly declining oil reserves. The *Tale* told in this analysis of these *Two Resources* is that much attention has been given to the resource we have less of (oil), possibly overshadowing the significance of the resource we are most endowed with (gas and associated liquids).

Early predictions of a rapid decline in local oil reserves have, fortunately, proved to be premature but a decline is nonetheless expected. The rate at which this takes place could be gradual but some continue to suggest it will be rapid and that additional oil exploration is required to avoid the impact of such. Over the past 25 years exploration in known hydrocarbon producing areas has not located major additional oil reserves of the quality and size thought necessary to supplement existing reserves. Frontier regions are now identified by some as the best potential location of additional major oil reserves. But these areas have significant technical and commercial challenges with respect to oil potential; only the highest grade and largest oil accumulations discovered in the very near future are likely to be brought into production in the next 10-20 years.

This study challenges our collective thinking on these issues, particularly the priority which exploration for additional oil reserves has been given in public reflection on the

issue, as well as the allocation of scarce resources. In future, such a priority may be considered unwise if petroleum exploration continues to discover significant gas rather than oil reserves. Some suggest we should recognise that our energy future may not necessarily include a major oil producing industry, unlike our immediate past. It may be that liquid by-products from our major gas fields could prove to be sufficient to meet, if not greatly exceed, oil 'self-sufficiency' levels attained in the past.

The priority suggested for the discovery of additional oil reserves in Australia has implications about the nature of the society we live in and its future economic welfare. Even if nothing changes a legacy of questionable analysis exists with respect to previous petroleum resource assessment with its emphasis on declining local oil production. The oil reserves previously thought to be essential may not be required if the liquid reserves present in gas found to date are useable as a source of liquid refinery feedstock. This examination is aimed at placing some of the issues we face in perspective and points to the future potential that our abundant gas and liquid reserves may hold.

### **Introduction**

The title of this analysis, "*A Tale of Two Resources*", is unashamedly derived from the iconic work "*A Tale of Two Cities*" by Charles Dickens who began his *Tale* with the immortal words, "*It was the best of times, it was the worst of times*". In short, the time was different to our own but it has lessons that we may care to reflect upon to our benefit. Namely, the times of Dickens' *Tale* were filled with people who faced difficult choices in the midst of turbulence. While Dickens described the turmoil of revolutionary Paris, late 18<sup>th</sup> century London, and how some of the characters in his *Tale* acted nobly in trying circumstances while other did not, we have our own challenges.

While in present day Australia we do not face challenges of the type faced by the characters in Dickens' *Tale* we do face serious issues, one of the most important of which is our present and future petroleum supply. Australia's past use of petroleum has been dominated by finite local reserves of oil but an enviable record for discovery of major gas reserves, much of which remains unutilised (Powell, 2001; Lavering, 2002 a & b). Like the noble characters in Dickens' *Tale*, it remains to be seen if we can influence matters to the greater good; in our case the efficient and equitable use of our known oil and natural gas (and liquids) reserves. In doing so it also remains to be seen if we can utilise both *Resources*, to the betterment of our entire community, or instead maintain a pre-eminently oil-based petroleum industry such as we have benefited from over much of the past 40 years.

In this analysis, I hope to contrast the differing approaches that the *Two* (Petroleum) *Resources* have received. I also wish to outline some (repeated) weaknesses in our approach to predicting future petroleum resource use. Oil has been the focus of much public advocacy and predictions of declining oil reserves have been used to support measures aimed at alleviating the 'oil supply' problem (Evans, 1987). Gas, on the other hand has been less of an 'attention-grabber' but in the long term may offer the most economic advantage to the nation (AGSO, 2000; Lavering, 2002 a & b). It is also the

resource that we have proved most successful at locating and this may reflect its underlying pattern of dominant abundance in our geological inheritance from nature.

Fortunately, the resource endowments in our *Tale of Two Resources* allow some latitude in our choice of future petroleum resource use. The question we should contemplate now, and in the near future, is whether we wish to maintain a nominal high level of 'oil self-sufficiency' (Lavering and Williamson, 1994) even though much of the oil produced in Australia is not refined locally. The volume of local crude produced each year is equal to 60-70 per cent of total local demand, much of it is exported for processing in overseas refineries. Thus, the aim of maximising 'local oil self-sufficiency' is redundant and no more than a nominal goal, given the actual dominance of crude oil exports and imports of refined product. Our aim should be to maximise the economic value of all petroleum resources produced; oil, natural gas and produced liquids, whether they are utilised in local markets or elsewhere.

The volume of liquids obtained from natural gas production is presently expanding with significant further expansion likely as additional gas product is exported to Asia over the next 20 years. With this as a likely outcome we will need to reflect upon why advocacy, in favour of further oil exploration, is a major public issue (APPEA, 2002), compared to expanding our use of natural gas and associated liquids (Lavering, 2002 a & b). This analysis is intended to promote some redress in the balance of these views and the path(s), which may lie ahead for us in using our *Two (Petroleum) Resources*.

### **Australian petroleum resources**

Australia's resources of oil and gas have increased significantly in the past 20 years (by 60 per cent; Hogan, 2003). In the same period a decline in crude oil (-28 per cent) has been more than compensated for by an increase in liquids present in natural gas fields (condensate increased 254 per cent, Liquefied Petroleum Gas (LPG) increased 145 per cent). This fortunate result is doubly important, as these 'liquids' are a potential refinery feedstock replacement for the dominantly light grade crude oil reserves we have been fortunate to previously discover and develop. At current rates of production, the life of current reserves of crude oil has decreased from 12 to 6 years over the past 20 years. The life of condensate and LPG reserves is currently 39 and 59 years respectively (Hogan, 2003). The extent of gas reserves has expanded significantly in the past 20 years and reserves are sufficient for another 53 year at current rates of use (Hogan, 2003) - Australia's total resources for oil and gas have increased by 184 per cent over the period 1982 to 2001 (Hogan, 2003).

The extent of our oil reserves has been oscillating over the past 20 years and reflects how the rate annual discovery and development of oil has, to a greater or lesser degree, almost kept pace with the annual rate of production. Although the share of oil in the entire petroleum resource base has decreased from 1981 to 2001 (down from 37 to 21 per cent), this really reflects the major increase in the gas and other liquid resources over that time period while oil reserves have remained at a modest level. Eventually without either a major increase in world market price for crude oil, a significant improvement in oil

recovery technology or a significant array of newly discovered oil fields, Australia's oil reserves will decline, albeit gradually. The rate at which this will take place is apt to be much slower than previous assessments have suggested (Lavering, 1990, 2002a & b).

Despite the massive expansion in recognised petroleum reserves in Australia over the past 20 to 30 years much of current (and past) attention has been focussed upon the finite extent of remaining oil reserves. One of the unique features of concern has been an expectation that current reserves are likely to undergo an imminent and rapid decline (Richards, 1974 & 1980). Yet such a decline has been slower to take place than all but a few analysts have expected (Lavering, 1990). Reasons for this appear to be the multi-faceted contributing factors which influence the life of remaining oil reserves, including market prices, recovery technology, rates of discovery and development, taxation and other regulatory arrangements, some of which previously applied to oil production (Lavering, 1990).

### **Petroleum resource forecasts**

As early as 1970 the Federal Bureau of Mineral Resources, Geology and Geophysics (BMR) estimated that that crude oil production from the then known oil fields in Australia was likely to be insignificant after 1985 (Konecki et al., 1970). In fact we can now note (in hindsight) that production from these fields actually continued to grow throughout the BMR forecast period (1970-1985) and peaked in 1986 before beginning an ongoing gradual decline. Reasons for the increased production and slower than expected decline, include changes in oil price (increases), changes in taxation, improvements in recovery technology and the discovery of additional reserves within the known fields; all of which served to significantly extend the life of the then known oil fields (Lavering, 1990).

A series of oil industry predictions in 1974, and thereafter, suggested that within five years Australia's major oil fields would deplete rapidly (Richards, 1974, p. 7). Some suggested there wasn't enough time to find and develop new oil fields before 1980 to avoid the shortfall in oil production (*ibid*). While no significant major new fields were subsequently discovered the sharp decline in production from known oil fields did not eventuate and since 1986 has been a very gradual process rather than a rapid one.

Knights (1975) also suggested that oil supply in Australian would decrease after 1976 and that the oil import bill could soar to over \$1300 million by 1978. The massive decrease in local supply forecast by Knights didn't come about and no significant oil import bill eventuated. In subsequent years of the 1980s oil exports from the fields already discovered actually provided a major boost to Australia's trade figures rather than being an underlying cause of any major trade imbalance.

In 1978 Esso provided a more subdued but still pessimistic outlook; they concluded that production from the existing fields had reached a plateau and unless there were new discoveries Australia would be importing over 80% of its oil requirements by 1990 (Esso, 1978, p. 17 & 23). That prediction was repeated in 1979 (Esso, 1979).

A subsequent prediction by Richards (1980) suggested that domestic oil supply would decrease by 1985 unless new discoveries were made. He noted that "the supply of oil from existing discoveries is a soundly based forecast and can be viewed with some certainty" (Richards, 1980, p.2).

In November 1980 without any significant new oil fields being discovered, Esso upgraded their forecast to 57% of oil coming from imports by 1990 and shifted the 80% estimate of oil imports to 2000 (Esso, 1980, p.22). The improved oil production forecast between 1990 and 2000 was, according to Esso, now going to come from Queensland oil shale resources. Esso had obtained rights to evaluate major deposits in the region in 1980 but they were not actively pursued after the mid 80s. This possible source of oil production (oil shale) disappeared from their subsequent predictions with little comment or qualification.

In November 1984 with a pessimistic outlook now hanging over their oil shale interests Esso again revised their outlook and suggested that oil self sufficiency would decline from a high of 85% in the mid 80s to under 60% by 2000 (Esso, 1984, p. 16). A subsequent analysis by John Schubert, the then Esso Chairman (Schubert, 1989), revealed that the bulk of additional oil supply not predicted by Richards (1980) had come from the major oil fields of Bass Strait, despite the previous 1980 prediction that "it is unlikely that the supply of oil from existing fields will change" (Richards, 1980). Schubert (1989) also noted that the major oil fields of the Gippsland Basin reached peak productivity in 1986 and that the evident decline from these fields would continue for the rest of their productive life (15-20 years).

One of the few industry forecasts which suggested that an increase in oil production from know fields would take place was made by McArdle (1991, p. 16). In 1991 he predicted suggested that oil production would increase in the mid 1990s - an outcome which subsequently proved correct. Lavering and Williamson (1994) in their assessment of oil and condensate (gas liquids) production for the period of 1994-2005 noted a similar increase as a possibility.

But the petroleum industry has not been alone in forecasting a rapid decrease in oil production. From the early 1980s onwards, the Bureau of Mineral Resources, Geology and Geophysics issued periodic oil production forecasts, each outlining a potentially rapid decline in existing oil production, even though subsequent forecasts showed oscillating, or even increases in production, in the intervening period (Forman, 1984, 1985, 1986, 1987 & 1988).

Ministerial speeches to the national petroleum industry conference (the March-April APEA Conference (*now APPEA*)) have also referred to BMR forecasts of declining oil self-sufficiency being likely in each subsequent 5 to 10 year period (Evans, 1987). Hence the forecasts appear to have achieved acceptance at the highest levels making critical review of the process problematical. ABARE (Naughton et al. 1989; Hogan & Naughton, 1990) took the 'rapid oil decline' argument further and estimated that Australia would

only produce around 28% of its oil needs by 2000, compared with 84% in 1988, resulting in a massive overrun in balance of payments and a significant economic downturn as result. We can now look at such forecasts with a degree of either amusement or amazement as to their waywardness, compared to the reality we have been able to experience since they were made.

### **Oil production in Australia**

One interpretation (Lavering, 1990) did offer a different view from the dominant one of a 'rapid decline' in oil production. Instead, it suggested that local oil production would be determined by a range of factors such as exploration, production and development rates, world oil prices, taxation and recovery technology (Lavering, 1990). This view was based on an assessment that the Australian oil resource base is more dynamic than commonly inferred by previous analysis. It has been a reliable indicator of oil production trends over the past 12 years (Lavering, 2002 a & b). Since 1990, most official projections continued to predict an imminent decline in local oil reserves unless major new discoveries are made (Powell et al, 1990; BMR, 1991; BRS, 1993, 1994, 1996 & 1997; AGSO, 1999 & 2000; Powell, 2001).

A recent and very different outlook for future oil production has been outlined by Hogan (2003) from the ABARE organisation. Hogan notes that in the period from 1965 to 2000 total oil and gas production in Australia has increased from very low base of 19 to 2940 petajoules and projected this would further increase by the year 2220 to 4610 petajoules. Hogan's forward projection outlines how the 2001-2 oil and liquids production level of 1470 petajoules is set to decline only marginally by year 2020 to 1429 petajoules, a marked contrast to the recent AGSO (2000) projection over the same period.

Australia's production of oil increased significantly from 1965 to 1975 with the discovery and development of the offshore oil (an gas) fields in Bass Strait (Gippsland Basin) in waters adjacent to Victoria (oil production was 25 gegalitres in 19971-2). Oil production from these and other fields levelled off and declined (prematurely) by the late 1970s due to a differential (lower) return coming from production of 'old' oil (discovered before 17/9/1975) compared 'new' oil (discovered after 17/9/1975) and a lack of access to export markets. Oil production increased again in 1983 to 36 gegalitres with the removal of the export ban and a reduction in the differential taxation applying between 'new' and 'old' oil (Lavering, 2002a & b).

Despite repeated BMR/BRS/AGSO predictions of an imminent decline, local oil production increased further in the mid-1990s and 2000-01 (to 43 gegalitres). ABARE (Hogan, 2003) suggests that in the near future local oil production will level off, averaging 37 gegalitres over the period 2002-03 to 2019-20. As such oil and other liquids production is likely to be more responsive to the conditions applying under world markets; far more than was historically the case, particularly before late 1980s when a range of regulatory and discriminatory pricing and taxation measures hindered production from some of the most productive oil fields (Lavering, 1990; 2002 a & b).

## Frontier oil exploration

A recent study by Powell (2001) repeated the approach of BMR/BRS/AGSO's previous predictions of imminent oil production decline but also acknowledged the role of new technology in developing production from oil fields which may have been uncommercial if they had been discovered 30 or more years ago. Powell (2001) also argues that any future avoidance of a shortfall in oil supply will have to come from a new oil province in a frontier basin. Maintaining exploration effort in areas of existing oil production is also considered important in his view. Previous assessments have tended to view the areas of existing oil production as having most to offer in terms of undiscovered oil potential (Lavering & Williamson, 1994) and the cost and logistical challenges of frontier regions may be significant (Lavering, 2002a & b).

Current discovery rates for additional oil reserves are not encouraging; they are in decline in many established oil producing regions of Australia and are negligible in frontier areas, despite some very high cost programs currently being undertaken in deepwater regions of the continental shelf. The few frontier exploration programs presently underway may reflect the workings of resource rent taxation offsets rather than being due to oil prospectivity alone. It remains to be seen if current or future exploration efforts in frontier regions are more successful than the technically disappointing results evident from previous major deepwater exploration programs such as that on the Exmouth Plateau of Western Australia (1977-1980).

With the technical and logistical challenges which frontier exploration present, only sustained high world oil market prices are likely to generate sufficient long-term incentive for explorers to undertake a thorough evaluation of such regions. Any attempts to encourage exploration without a major change on the world oil market may result in allocative inefficiency in the use of scarce resources. Encouraging oil exploration in frontier regions is unlikely to overcome a fundamental geological challenge to the underlying resource base of our continent – namely, Australia may actually be gas-rich rather than being well endowed with crude oil (Henry, 1974; Lavering & Williamson, 1994). So for geological reasons alone additional commercial oil reserves in frontier regions may be difficult to locate or costly to develop. The results evident to date suggest this is the case for most of the readily accessible geological regions that have been subjected to some form of petroleum exploration activity or analysis (Henry, 1974).

At present and in the past, petroleum exploration in frontier regions of the Australian continent and offshore shelf have, at best, yielded uncommercial gas resources (Lavering & Williamson, 1994). No ongoing program of pre-competitive surveying or investigation is likely to overcome the cost barriers which current technology and market conditions provide. It may be in the future that such barriers can be overcome but the benefits of searching in such regions will not be readily evident until world market prices greatly increase for a prolonged period.

## Future issues

Despite the ongoing and repeated predictions of imminent oil supply shortfall, a rapid decline in local oil production has yet to eventuate and may prove irrelevant if production of liquids from gas fields continues to expand. No major new large oilfields considered essential to avoid a decline have been identified since the early 1970s. At best only modest fields have been discovered and brought into production. The discovery and development of modest sized oil fields as well as changes in world oil market prices, improvements in technology and deregulation of the local industry have 'discovered' the necessary oil reserves required to avoid past projected shortfalls in supply. Local oil supply and reserves have thus been more technically and economically 'flexible' than official forecasts have proposed. In the long term, the liquid content of our major gas fields represents a significant resource from which future petroleum liquid supply (an oil substitute in refinery feedstock) might be sourced if that is a viable and rational economic use of the resource.

There is some merit in the argument that long-term development of our underutilised gas reserves for domestic and export markets represents an economic benefit which has been postponed by the availability of local oil resources. Gas development represents, in the minds of some, part of a logical transition from an oil-based economy to a gas based one, a transition which is gradually taking place both in Australia and around the globe.

Long term world oil prices are a key indicator of when and to what extent the available oil and gas resources can be utilised and developed. Gas resources remain a significant asset on which future natural economic advantage may be based. The possibility of exploring for oil in (high cost) frontier areas has proved to be problematic in the past with results that have been disappointing. In the future, frontier regions areas may provide some positive results albeit at high relative cost.

The long-term pattern of oil resource use in Australia which maximises economic welfare is to likely to follow that set by open and competitive world oil and gas markets. World market conditions will provide the most efficient long-term signals as to when it is appropriate to develop either oil from high cost frontier areas, or make the long-term transition to development of our natural endowment in gas resources.

## Conclusions

The *Tale of our Two Resources* is incomplete in that we know what has happened in the past but the future will always carry with it a degree of risk and uncertainty. What I have hoped to give in this account is attention to those issues which may be useful in facing the future. Thus our *Tale* is in progress and, unlike Charles Dickens' *Tale*, we can't yet look back with hindsight on all the facts and give each a universal value. This analysis is thus partial and comparative because we don't yet know the full extent and nature of our *Two Petroleum Resources*. That will only be fully known when the resource is fully discovered.



The future of our *Tale of Two Resources* will be 'written' by the decisions we make about their use and subsequent decisions made by those who inherit this island continent we leave for them. But some of the lessons of Dickens' *Tale* may be useful in the process of reflection on our plight. Choices we make will have implications for our society as well as its future economic welfare. In our choice we could give priority to the maintenance of an oil-based exploration and production industry which has served us well in the past, or we could adjust to using the resource base we have already located in relative abundance and which we could utilise to a greater extent than has been the case in the past (natural gas).

We have two differing petroleum resource endowments that we know about and currently have access to; one of limited and (slowly) declining oil reserves, another of significant and underutilised gas reserves. What is evident in this account of our *Tale* (so far) is that over the past 30 years, or so, favoured methods of predicting the future pattern of petroleum use have provided limited return. At the same time considerable attention has been given to the resource we have least of (oil), with less attention being given to the resource we are now most endowed with (gas and associated liquids).

In this analysis some of the weakness of our previous approaches to our petroleum resources, particularly the oft-repeated predictions of 'an imminent decline in local oil production' are highlighted. Whether we chose to change such an outlook has implications about the type of society we live in and the future level of economic welfare we may, or hope, to enjoy. We have a legacy to overcome if we are to ensure that effective use of our petroleum resource is socially equitable, economically efficient and generates the maximum economic welfare possible for the entire Australian community.

To ensure these goals are attained we will have to overcome a legacy of devotion to poor methods and limiting our options by giving preference to the search for one resource (oil). We should seek to maximise the wealth and welfare of the nation by allocating resources to full utilisation of all parts of the petroleum resource evident to date, much of which is in the form of natural gas and associated liquids.

In his *Tale* Dickens displays a rare skill and understanding of the frailty of the human condition; what it can deal with and what it cannot control. Fortunately, Dickens' *Tale* ends with reflection upon what had happened in turbulent times so that lessons could be learnt and wisdom acquired for future usage. May the choice(s) we make in our *Tale* of future petroleum resource use be like Dickens' reflection at the end of his *Tale*, may ours be one(s) that make a positive difference to our community and its long-term welfare.

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