

The Case for a Shale Oil Industry in Australia



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Abstract

Australia has a chequered history of developing its shale oil resources. There have been significant periods of development (for example during each of the world wars) punctuated by lengthy periods of inaction. The most recent period of active development has been from the mid-1990s onwards but this proved in many ways to be a false dawn for the industry. So, given the travails that have beset the shale to liquids industry in Australia, why have some companies persisted with their efforts to unlock the oil contained within Australia's shale oil deposits? The answer is because there is an overwhelming need for the oil. As recently as the year 2000, Australia produced enough oil to be 100% self sufficient. In just 8 years this self-sufficiency has declined to 50% and on current trends by 2030 will be less than 20%. In fact, the situation becomes critical for Australia within 5 years. The paper outlines the case for Australia to develop the alternative fuels that will be needed to power its economy for the foreseeable future and makes a powerful case for why, within a decade, Australia will require commercial scale production of shale oil.

Australia needs a shale-to-liquids industry

Australia needs the timely development of a commercial-scale shale-to-liquids industry in Queensland, which would result in:

- A \$33 billion boost to Australia's Gross National Product (GNP) by 2030
- Provision of 8,000 direct long-term and up to 25,000 indirect jobs in regional Queensland
- Potential revenue to Governments of up to \$800 million a year – \$32 billion by 2050
- Provision of 73 million barrels of oil a year by 2030 – equal to 88% of Australia's conventional oil production and helping secure Australia's oil supplies for the next century
- Potential to reduce Australia's oil import costs by \$12.4 billion a year by 2030
- Production of a synthetic crude oil feedstock that could help maintain a viable refining industry in Australia

- An Australian company leading the development of breakthrough technology that *could help unlock up to 3 trillion barrels of oil in shale deposits* around the world.

Introduction

As the Honorable Martin Ferguson AM, MP, Minister for Resources and Energy, recently noted:

The energy sector is fundamental to Australia's social and economic prosperity. It underpins every form of economic activity from powering our industries to turning on the lights in our homes. The strategic management of our energy resources [is] essential to economic growth, jobs, and the prosperity and wellbeing of all Australians.¹

Queensland Energy Resources Limited and its associated companies (QER) support Minister Ferguson's assessment of the importance of energy to Australia's future.

QER would also go further and state that Australia, because of its size, geographi-

cally dispersed production base and low population density, relies heavily on efficient and reliable systems of transport, and transport relies on efficient, reliable and affordable supplies of liquid fuels. According to the International Energy Agency (IEA), among others, for at least the foreseeable future to 2030 and beyond, those fuels will be predominantly hydrocarbon-based.

Oil is the world's vital source of energy and will remain so for many years to come, even under the most optimistic of assumptions about the pace of development and deployment of alternative technology....Fossil fuels [will] account for 80% of the world's primary energy mix in 2030 – down slightly on today. Oil remains the dominant fuel, though demand for coal rises more than demand for any other fuel in absolute terms.²

QER is a Queensland-registered, integrated resources company headquartered in Brisbane. It has tenements over extensive oil shale resources throughout central Queensland and five coal seam gas exploration tenements in the Galilee Basin in Queensland. The oil shale deposits over which QER has tenement rights collectively could yield an estimated 20 billion barrels of oil, of which QER holds direct rights to approximately 15.8 billion barrels. To put this in perspective, Australia's largest conventional oil field developed to date (Bass Strait) has yielded almost four (4) billion barrels of oil³, and is now in steep production decline.

QER asks the questions "Where will Australia's future transport fuel come from, and at what cost?" The future prospects for Australia's transport fuel supply and the risks posed to Australia by declining fuel self-sufficiency are fundamentally influenced by global trends in petroleum production, and by changing regional supply and demand patterns that will see greatly increased competition for a shrinking oil resource in the South East Asian region.

The Australian petroleum refining industry, already suffering from lack of scale and the

shift to more stringent quality specifications, will come under increasing competitive pressure as feedstock supply shifts to more distant and technically less suitable crude oil sources, and as more large-scale refinery capacity with greater feedstock and product flexibility is built in eastern Asia and India.

This paper⁴ considers the potential for demand reduction through improved vehicle design and more efficient drivetrain technologies. Although there are a number of options to reduce reliance on conventional petroleum fuels, and to improve vehicle efficiency, collectively these solutions will have only a modest impact on Australia's consumption of petroleum and diesel fuel.

Empirical evidence collected over many years and in many countries shows a strong correlation between economic growth and oil consumption. If the Australian economy is to continue to grow, our transport fuel consumption will also have to rise. Policy interventions to reduce demand and improved vehicle technologies will temper, but cannot arrest, the increase in demand.

On the supply side, Australia's oil production has been falling steadily for the past decade and there is no current reason to expect this trend to change. The consequence of these two intersecting trends is that Australia faces a rapidly increasing deficit in its supply of transport fuel. Alternative fuels – including liquids produced from gas, coal and oil shale, biofuels, liquefied natural gas (LNG) and compressed natural gas (CNG) – all have the potential to make significant contributions to Australia's transport fuel supply mix. However, they face many challenges on the road to commercialisation. Corporate persistence and supportive government policies will be needed to maximise the value of the available alternatives and options.

Detailed economic analysis, undertaken by ACIL Tasman for QER, shows that successful commercialisation of alternative transport fuels would deliver very large benefits to the Australian economy – a

potential \$90 billion boost to Australia's GNP between now and 2030.⁵ Of course, there is no guarantee of success – but the size of the prize makes the options well worth pursuing.

In general, successive Australian and Queensland State Governments, no matter what their political persuasions, have consistently pursued policies that encourage rather than prohibit the development of mineral resources, with the exception of uranium.⁶ The underlying principle of mineral resource development is that greater economic and social wealth can be generated for the nation (and local communities) through extraction and processing of a resource than can be generated from leaving that resource unutilised in the ground.

Australia's liquid fuels security

In early 2009 the Australian Government released the National Energy Security Assessment 2009 report (NESA). The report states, *inter alia*:

The level of security for liquid fuel supplies in Australia will remain relatively constant out to 2023 with a risk of decline in reliability with any further rationalisation of Australian refineries..... Negative impacts include increasing concentration of production of crude oil in unstable regions and exposure to fundamentals affecting the global oil price.... In the absence of further significant discoveries, domestic crude production is assumed to increase briefly with the introduction of a number of small fields, *before returning to the long-term trend of decline* (emphasis added).⁷

On p.9 of the NESA report, Australia's security in liquid fuels is assessed as being 'High' in the period 2009 through to 2018 before being assessed as 'Moderate' by 2023. QER considers that this assessment is somewhat optimistic and that Australia confronts a greater shortfall in liquid transport fuel supply than assumed in the NESA. QER also believes that the decline in Australia's indigenous oil production will be steeper and quicker than contemplated

in the NESA. Nevertheless, there is clearly general agreement that Australia's indigenous oil production will decline and that currently there is no immediate prospect of arresting that by developing conventional oil fields.

Figure 1 graphically illustrates the actual and forecast decline in Australia's oil and condensate production (excluding liquid petroleum gas - LPG) between 2000 and 2030. It is clear that production levels, having declined steeply in 2004, are set for another period of steep decline around the years 2014 to 2015 (that is, within five to six years from now) before continuing to decline steadily over the period to 2030.

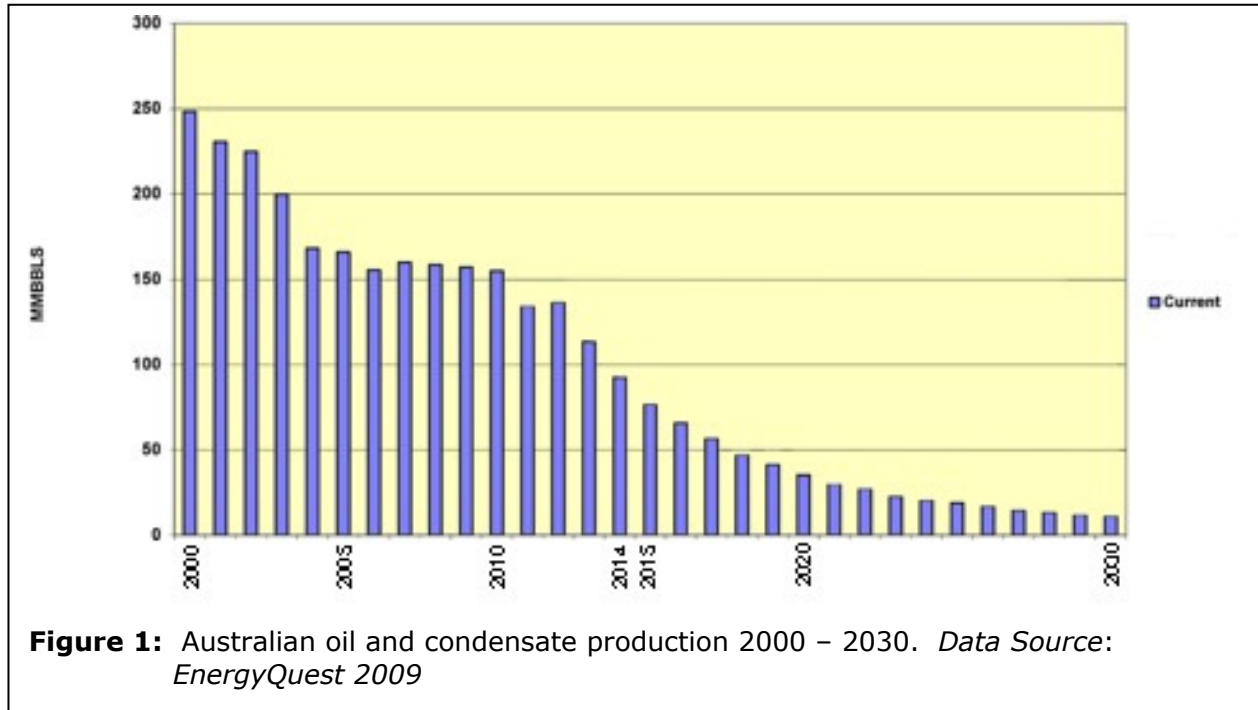
Why crude oil availability is fundamentally important to Australia

Security of oil supply to Australia is important because oil is fundamental to Australia's ongoing economic growth and hence the wellbeing of its people. This fact has been recognised by successive Australian Governments over many decades, including the current Australian Government.

Australia's got a huge challenge. We've got huge problems on the trade front, but also importantly, a real problem in terms of energy security and our economic future by 2015.⁸

Although price influences oil demand, GDP growth is the major driver of oil consumption. There is a close relationship between a country's GDP and its oil consumption, as is shown in Figure 2, which charts oil consumption against USD GDP at purchasing power parity (PPP) for the G7 countries in 2007 (excluding the USA but including Australia) plus China and India.

Over time, oil consumption has been growing more slowly than GDP in the advanced economies but with big variations. For example, over the 25 years to 2007, oil consumption fell in Germany and Italy and was stable in France. In Australia, oil consumption grew by 1.7% per annum on average, 50% of the average rate of growth in GDP of 3.4%.



Oil consumption in the USA grew by 1.2% per annum over the period, with GDP growth averaging 3.2%. Oil intensity tends to reduce over time as a result of improvements in energy efficiency and the relative decline of oil-intensive sectors compared with other sectors of the economy. Nevertheless, the economies of the industrialised first world are underpinned by consumption of oil, more particularly the consumption of relatively inexpensive and available oil supplied in adequate quantities in a timely manner.

The USA is not included in this graph because it dwarfs all other countries, in both GDP and oil consumption. However the close relationship still holds. USA GDP in 2007 was US\$13.8 trillion, 3.2 times larger than Japan and oil consumption was 7.5 billion barrels, 4.1 times larger than Japan. It should also be noted that while oil consumption grows with GDP, intensity of oil use varies between advanced economies.

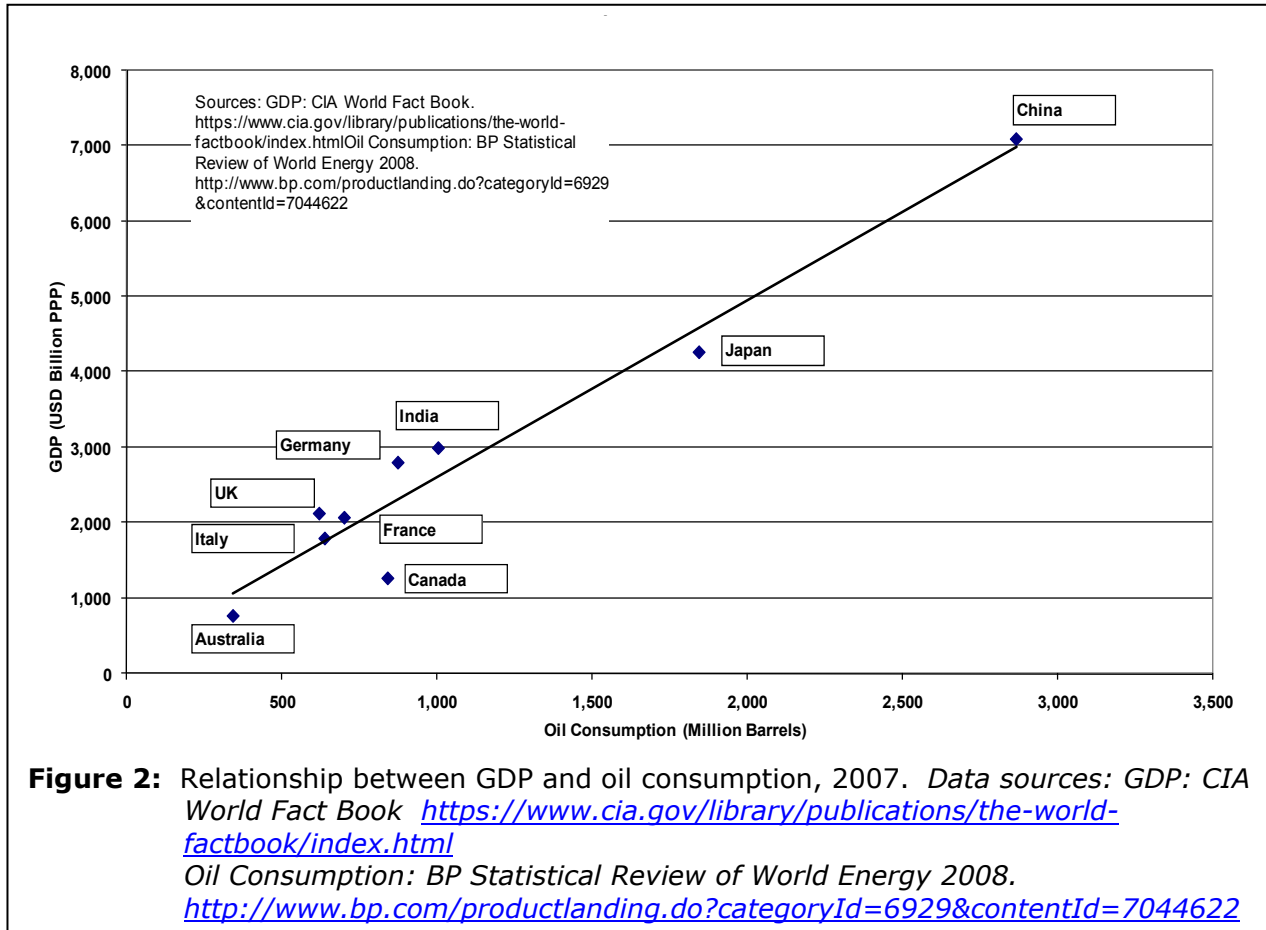
Oil is fundamentally important to Australia also for other non-economic, strategic reasons. The Australian Defence Force (ADF) currently consumes on the order of 325

million litres of diesel and aviation fuel (2.04 million barrels) per annum.⁹

The strategy and capabilities of the ADF are dependent on oil and they are exposed to the same price fluctuations that are wreaking havoc on business and household budgets.¹⁰

It is reported that the Australian chapter of the Association for the Study of Peak Oil has formed a Defence and Security Working Group comprising serving members of the ADF and public servants. The convener of the Security Working Group is quoted as saying:

The decline in global oil supplies will have profound consequences for the ADF and civil border protection agencies. Australia has recently embarked on several military and civil national security projects involving the acquisition of aircraft, vessels and land transport. These decisions and force structure are underpinned by a continued supply of cheap oil. Rapidly increasing costs of fuel will have a significant impact on budgets and capabilities.¹¹



The importance of oil for Australia's defence requirements is also recognized and reinforced in the recently released Defence White Paper:

Defence's fuel management will be improved. This will have national impacts, as Defence is a significant national user of fuel. A strategic fuel management program will be put in place to coordinate all aspects of fuel management.¹²

In addition, Defence is allocating extra funding to enhance fuel storage facilities in Townsville and Darwin.¹³

Oil remains the fundamental fuel source for the heavy vehicle transport sector in Australia. The transport sector in general accounted for 51% of Australia's oil consumption in 2008.¹⁴ With the growth in road freight forecast to double by 2020, the demand of the heavy vehicle transport sector for oil will continue to increase.¹⁵

Shortages of fuel for the transport sector, or rapidly escalating fuel prices, would have very significant impacts for almost every Australian. As the former economist for Canadian bank CIBC, Jeff Rubin, noted recently:

We've all got our eyes right now on the global financial meltdown, but I believe that oil scarcity will change the global economy even more profoundly and in the process change all of our lives – from where we work to where we live to what we eat.¹⁶

The global oil supply outlook to 2030

Australia's liquid fuel security outlook needs to be considered in the broader context of the global oil supply outlook. This submission, and the accompanying QER Report, considers this broader context out to 2030.

World oil demand is forecast to increase from about 86 million barrels per day (MMbbl/d) in 2008 to almost 112 MMbbl/d in 2030. To meet this forecast 26 MMbbl/d increase in demand, a large amount of new crude oil production capacity – in a range from 51 to 64 MMbbl/d under reasonable base line assumptions¹⁷ – will need to be developed or found and brought into production by 2030. This represents between 60% and 80% of current production levels. Purvin & Gertz (PGI) estimates that around 19 MMbbl/d of the additional production will have to come from resources that are yet to be discovered.

The amount of upstream investment required to achieve this level of oil production is extremely high. The International Energy Agency has estimated that total expenditure of \$8.4 trillion will be required between 2007 and 2030 if the forecast required level of production is to be achieved.¹⁸ *This equates to expenditure at a rate of around US\$1 billion per day every day for 8,400 days.*

The Asia Pacific region accounts for about half of the anticipated world demand growth. Asia Pacific oil demand is expected to increase by about 13 MMbbl/d by 2030, of which more than 12 MMbbl/d will need to be imported, given that production in the region is forecast to be relatively flat. This represents an 83% increase in regional oil imports over current levels. Much of the demand growth will come from China and India.

The South East Asian region, which is currently Australia's main source of oil supply, provides on the order of 66% of Australia's crude oil imports, and production is falling. Outputs from Vietnam, Indonesia, Brunei and PNG are all declining and Malaysian production is relatively stable. Modest production growth in China and India is expected – but these are the countries in which demand is growing most rapidly.

What this means is that by 2030 Australia is likely to be increasingly reliant upon importing crude oil from regions such as the Middle East, West Africa and countries of

the former Soviet Union. This will mean a changing nature of crude oil imports with a greater proportion of imports being heavier and sourer than the relatively light sweet crude oils that Australian refineries are currently predominantly geared to process. Further, sourcing increasing volumes of crude oil from these regions poses significant risks to security of supply as recognised by the Australian Government.

The Middle East will remain violent over the period to 2030....Africa is also growing in relative importance as a source of the world's energy supplies....The growth of Islamist extremist groups in North Africa and the Horn of Africa poses a risk to security regionally and beyond....The Indian Ocean will have greater significance in the period to 2030. It will become an increasingly important global trading thoroughfare, particularly for energy supplies between Asia and the Middle East.¹⁹

Australia's looming transport fuel supply deficit

Australia's production of crude oil, condensate and LPG all decreased in 2007 to 2008....experienced similar decreases over the past five years, excluding....in 2006 to 2007.²⁰

Given the global and regional context outlined previously, Australia faces very significant challenges in meeting its energy transport needs in the near term and those challenges will increase greatly in the longer term.

These challenges are driven by:

- Growing demand for transport energy, which is expected to rise by more than 37% between 2010 and 2030; and
- Declining local production of oil and other petroleum liquids which on current forecasts – and making due allowance for new discoveries and increased condensate production associated with LNG developments – is expected to fall from 248 million barrels in 2000 to 132 million barrels by 2020 and to 83 million barrels

by 2030 (See Figure 3). *On this basis, by 2030 Australian production will have fallen to one-third of its level in 2000.*

The forecast production levels out to 2030 assume that Australia brings on stream a new field equivalent in size to the Exmouth-Plateau field (approx. 70 to 80 million barrels) every two years from 2014 to 2027. Although this is consistent with historical experience, it is nevertheless an assumption that these fields are in existence and can be discovered and brought into production within short time frames. It is not assumed that a very significant field of the scale of, for example, a Bass Strait, will be discovered and brought into production between now and 2030.

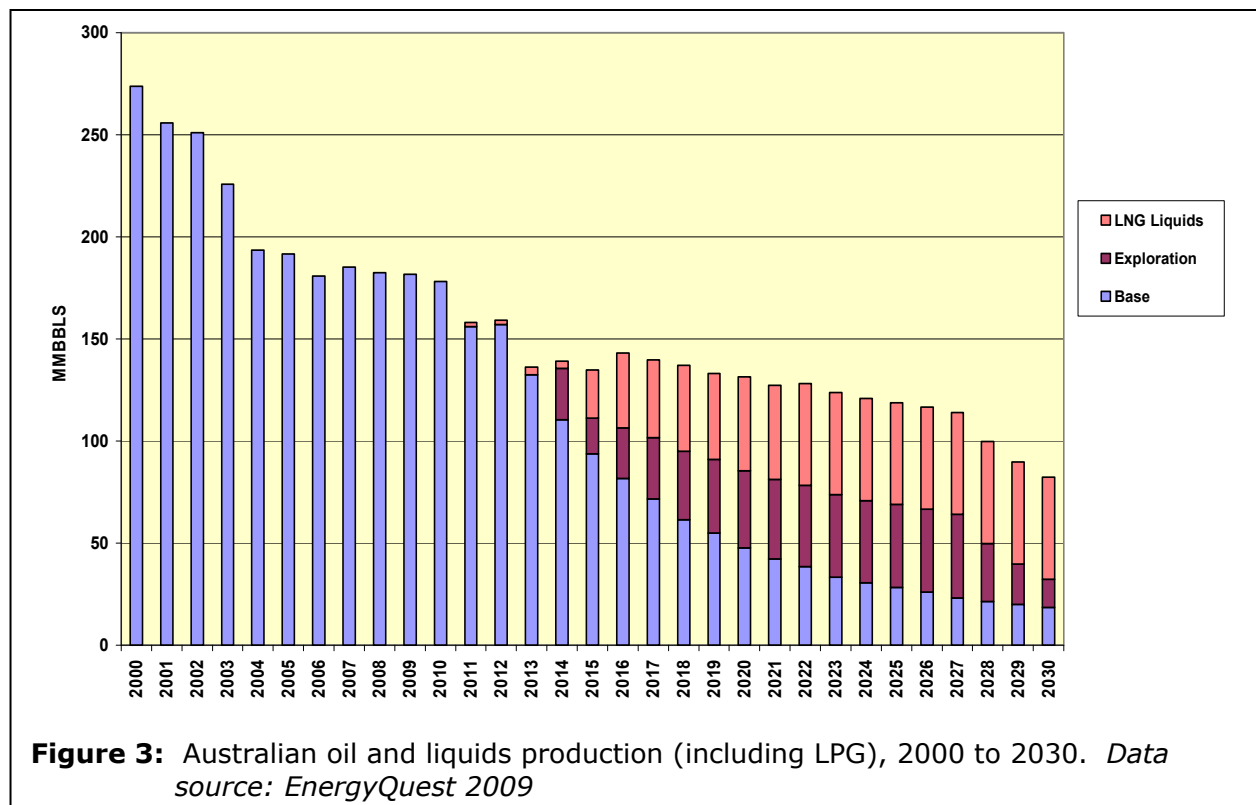
Notwithstanding the steep fall in oil prices since mid-2008, expectations are that oil prices will recover and are likely to rise in real terms over the next 20 years (see Figure 4), driving up the unit costs of imports.

Purvin & Gertz have developed oil price scenarios ranging from a low case of US\$59/bbl in 2030 (constant 2008 dollars)

to a high case of \$145/bbl, with a mid-range Base Case of \$103/bbl. Data maintained by the USA Energy Information Administration (Financial Reporting System Public Data) points to a continuing increase in the costs of finding, developing and producing new oil. This implies a need for higher oil prices to justify investment in new production capacity, and provides fundamental support to the forecasts of rising oil prices portrayed in Figure 4.

Further, the forecast of a rebounding in the price of crude oil is supported by recent research conducted by McKinsey & Company.

As of late April 2009, the price of oil stood at around \$50 a barrel – down from a high of nearly \$150 a barrel in July 2008, though many observers doubt that oil demand will rebound enough after the current economic downturn to prompt another price shock. However, research from the McKinsey Global Institute conducted in 2008 and 2009 reveals the potential for a new spike in the



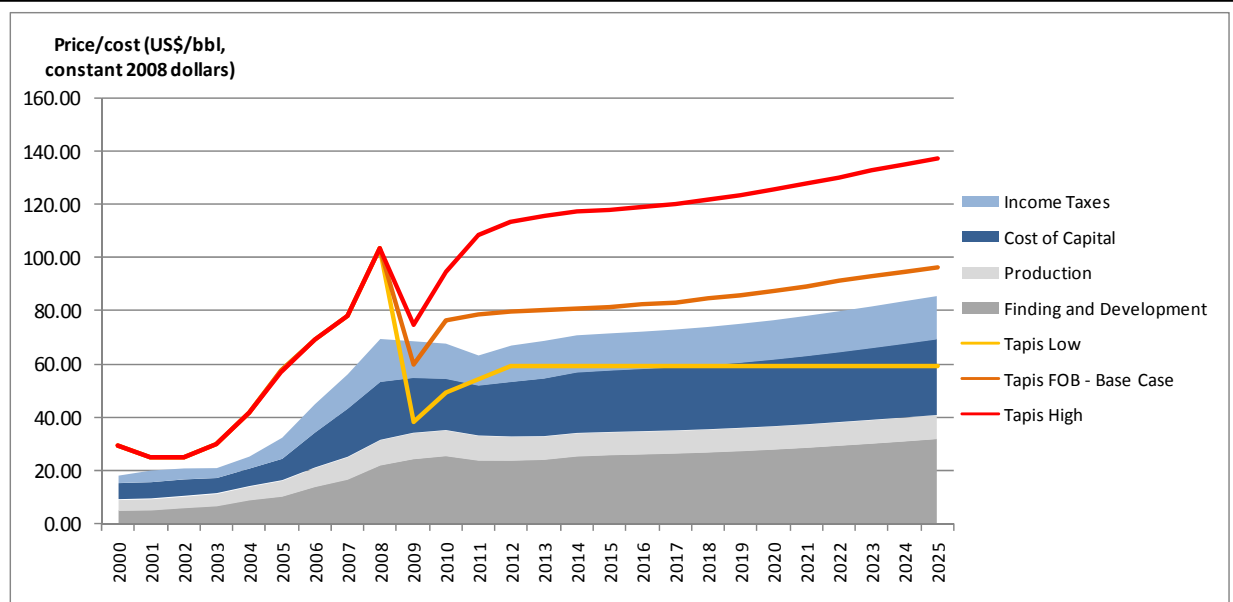


Figure 4: Forecast price scenarios for Tapis crude, compared to cost forecasts. *Data source: Forecast price scenarios by PGI; production cost analysis from U. S. Energy Information Administration*

price of oil between 2010 and 2013.²¹

In addition, Australia's refinery capacity is aging, and lacks economies of scale and operational flexibility compared with large, export oriented modern refineries being built elsewhere in the Asia Pacific region.

The cost of Australia's looming oil supply deficit

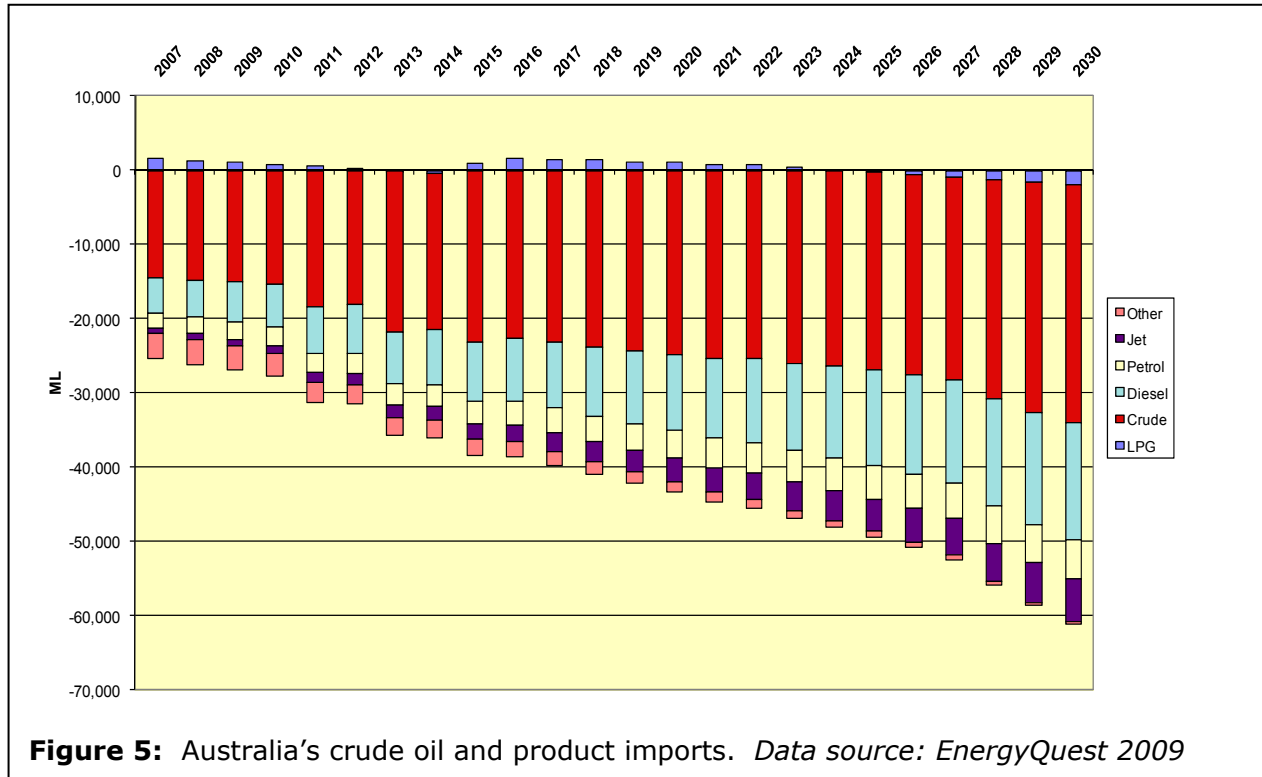
The combination of rising demand and dwindling supply means that the gap between local supply and demand is growing rapidly – with direct consequences for self-sufficiency and the required level of product imports. Increased reliance on imports – and in particular on imports from supply sources that are more distant and less geopolitically stable – also has important implications for security of supply.

In preparing this paper, QER considered two alternative demand scenarios. A Reference Scenario adopts reasonable baseline expectations about oil and liquids demand, whereas an alternative scenario sees demand reduced through a combination of high oil prices and strong government policies to reduce greenhouse gas

emissions from transport. Under both scenarios, the anticipated annual supply gap widens dramatically, from about 175 million barrels at present to 325 million barrels in 2030 under the low growth alternative demand scenario, and to 390 million barrels under the reference demand scenario.

Figure 5 illustrates the growing annual import requirements, of which crude oil and diesel account for the major part. The costs associated with these imports are very large, rising from a net outflow of around \$20 billion in 2008 to \$92 billion by 2030 under Base pricing assumptions up to almost \$130 billion under High pricing assumptions.

Australia's response to the looming transport energy shortfall is likely to comprise a mix of strategies, targeting both supply-side and demand-side responses. The most significant of these strategies is likely to be associated with the potential for take-up of alternative fuels with complementary development of drivetrain technologies within the Australian transport sector also making a contribution.



It is always an option to just keep importing more oil. However, some of the problems associated with pursuing just this option in isolation of developing Australia's indigenous alternative fuel resources can be summarised as follows:

- It presumes that there will be oil available at an affordable price and that Australia can continue to afford to pay that price.
- It presumes that Australia is able to continue to source sufficient volumes of the lighter, sweeter crude oils that Australian refineries are predominantly configured to process. [See Figure 6 for a graphical comparison of regional oil fields in terms of sulphur content and API Gravity].
- It presumes that the environmental footprint of producing and importing crude oil from sources such as West Africa and countries of the former Soviet Union is lower than the environmental footprint of producing crude oil (or synthetic crude oil) in Australia.²² See

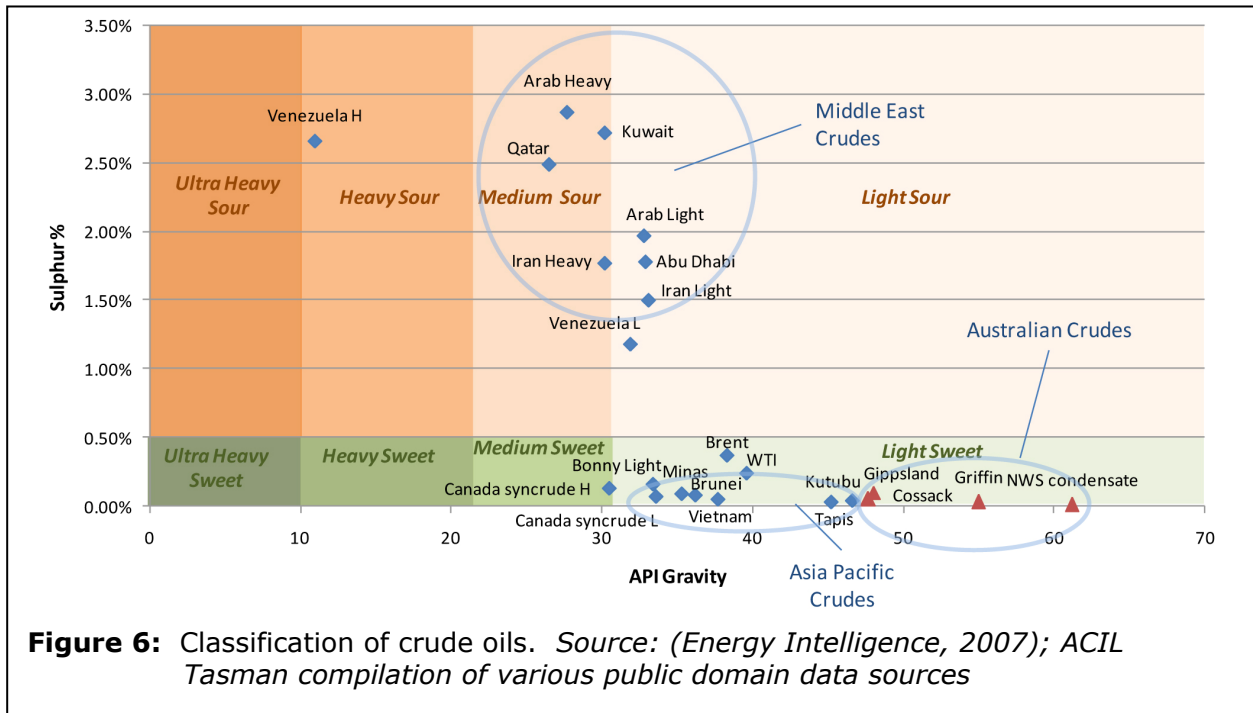
Figure 7 for an indication of the level of stranded gas flaring around the world.

- It does little if anything for ensuring Australia has security of supply in the event of either an emergency or armed conflict.
- Oil imports will likely be increasingly at risk of piracy; already this year there have been more than 60 instances of piracy on large ships, including oil tankers travelling through the Straits of Hormuz and the Indian Ocean.

Figure 8 outlines a reasonable forecast of the *annual financial burden to Australian taxpayers* that could confront Australia in 2030 and beyond if there is over-reliance upon importing crude oil to meet the looming shortfall in liquid transport fuels.

The importance of Australia's oil refining

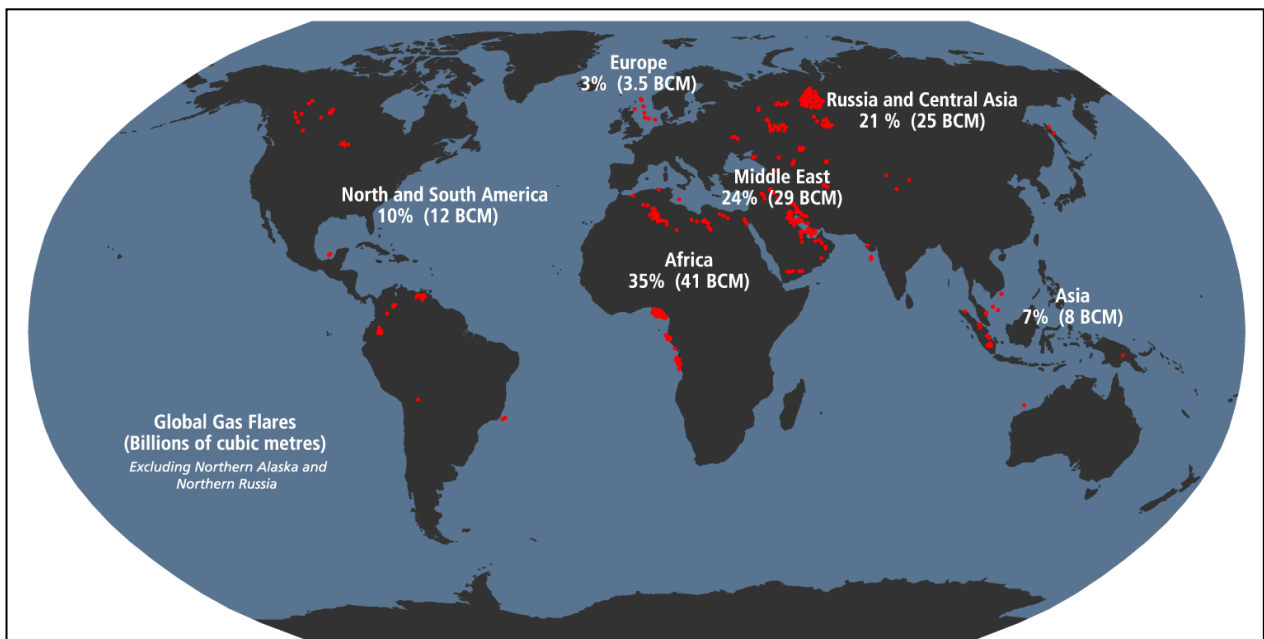
Australia's oil refining industry has a history spanning more than 50 years, but over the past two decades its refining capacity has decreased, with a reduction

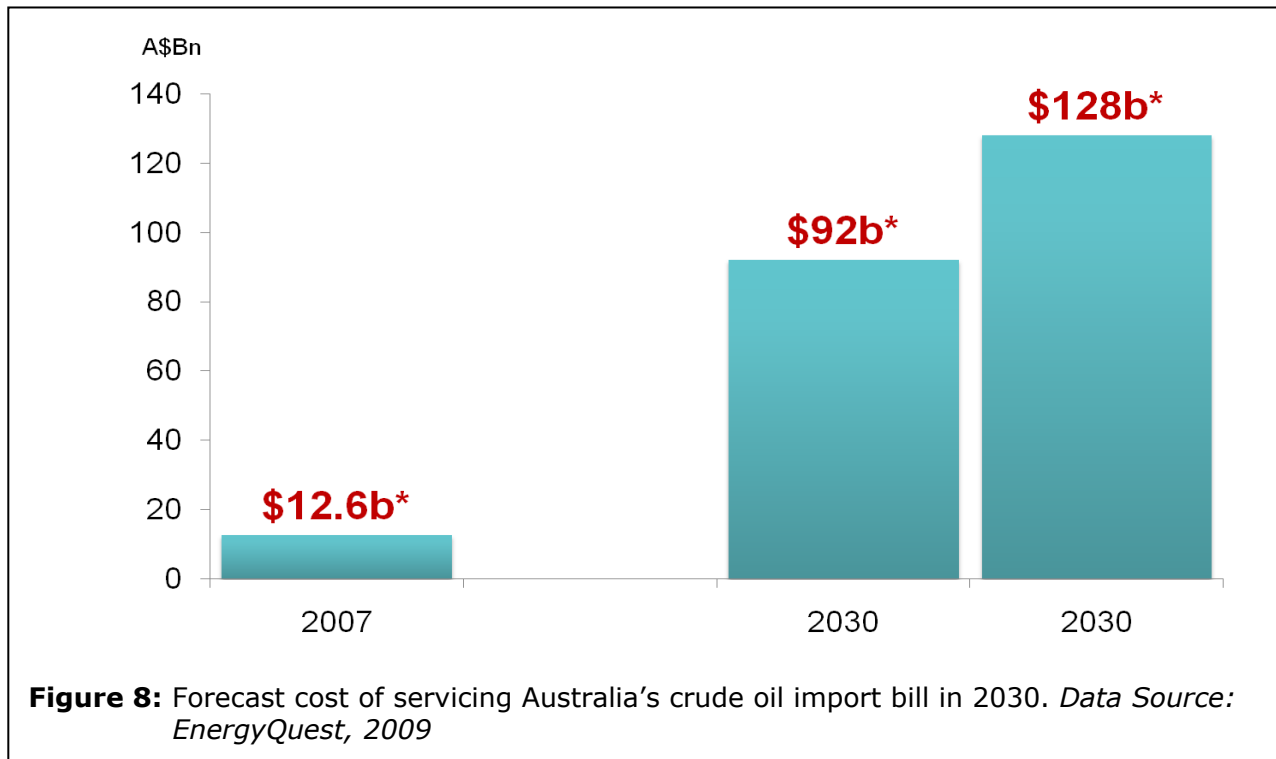


from 10 operating refineries in 1980 to eight in 2009.

There are four integrated international oil companies that operate seven refineries in Australia: BP Australia (BP), Caltex Australia (Caltex), Mobil Oil Australia (Mobil) and the Shell Company of Australia (Shell). In

addition, Inland Oil Limited (IOL) operates a very small refinery in SW Queensland. Total refining capacity is 741,000 barrels per day, or 117 million barrels per annum.²³ Although the Australian refining industry underpins the competitiveness of liquid fuel intensive industries such as mining, agriculture and transport, supports





9,000 direct jobs, generates \$47 billion in gross revenue and \$15 billion in excises, it contributes a relatively modest 0.2% of GDP.²⁴

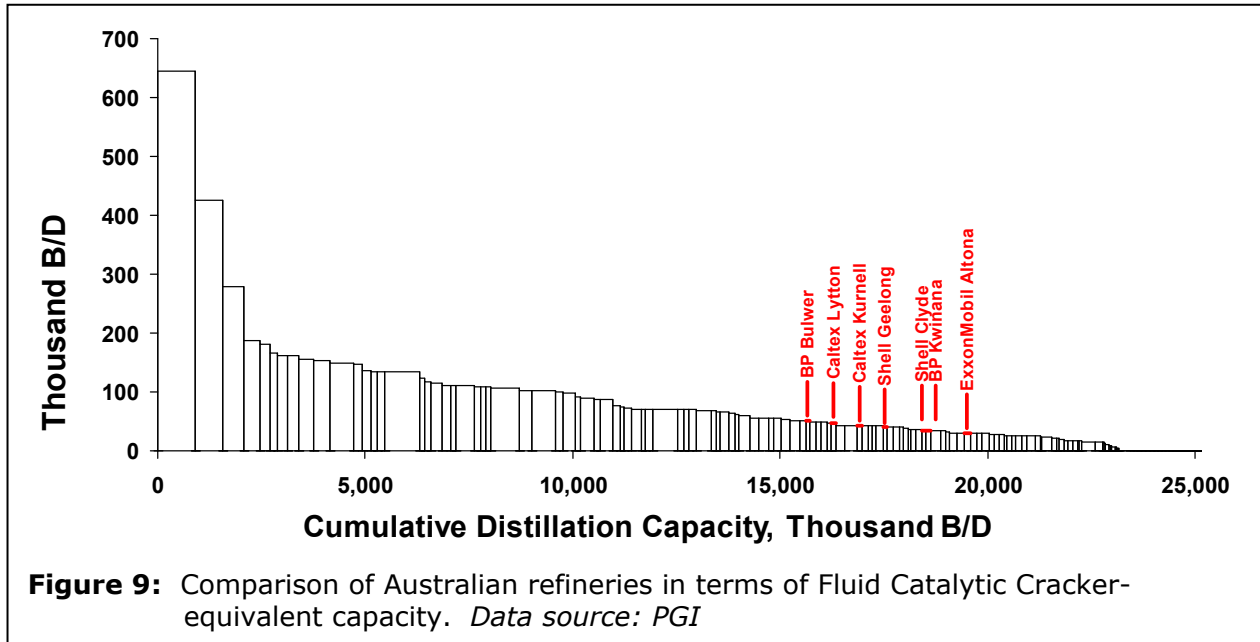
However, it would be erroneous to presume on the basis of this relatively small contribution to GDP that Australia does not need an oil refining industry. Around the world there are 102 countries with an oil refining capacity, and with very rare exceptions there is no first world industrialised nation that does not possess refining capability.²⁵ Figure 9 illustrates the position of Australia's refineries in the global industry.

One of the more significant benefits from maintaining a refining capacity within Australia is the cost differential between importing crude oil compared with importing finished products. For example, the forecast landed price in Brisbane for crude oil from Singapore in 2030 is \$232.15 per barrel whereas the forecast price for diesel is \$264.07 per barrel – a differential of \$32 per barrel.²⁶

Countries maintain a viable oil refining capability not only because there are significant economic benefits arising from having their own refining capability, but also because of broader non-economic considerations relating to national security and security of supply. There are, however, significant clouds on the horizon for Australia's refining industry.

The overriding drivers which may contribute to the decline in the Australian refining industry generally relate to the actions of government. The refining industry relies on certain policy endorsements for it to remain competitive in the world and regional industry. Conversely, there are other potential policies that the Government has implemented or has signalled its intention to implement (to various degrees), which can impact negatively on refining in Australia.

Australia has adopted, and is set to adopt more stringent, cleaner fuels specifications set by European standards such as low sulphur in diesel and gasoline. By 2009, most refiners had invested, at a significant cost, in hydrotreating and benzene hydro-



generating equipment to reduce sulphur levels in fuels. With further fuel specification changes mandated in Australia over the coming years, this may place further pressure on Australian refineries. Secondly, an increasing number of the larger scale and more cost efficient Asian refineries are in a position to supply fuels to Australian standards. The new refinery expansion at Jamnagar, north-west India, is one such refinery. This, some Australian refiners believe, will pose a competitive threat to refineries in the region and Australian refineries through placement of cheaper crude oil imports into Australia.

State governments are imposing stricter environmental regulations on refineries, especially as residential areas are increasingly encroaching on land closer to refineries as part of the urban sprawl. Climate change and the Carbon Pollution Reduction Scheme (CPRS) are major issues for refiners. Refiners are exposed to the international competition against other regional refineries in countries that do not have similar carbon costs to those proposed for Australia.

The Department of Resources, Energy and Tourism recently completed a study into Australia's Liquid Fuel Vulnerability. The report was completed by ACIL Tasman in

November 2008 and the following observations were made in relation to the potential of future refining in Australia:²⁷

... some stakeholders expressed the view that Australian refineries could come under increasing competitive pressure from lower refining margins and larger scale overseas refineries. Australian refiners consulted by ACIL Tasman were unanimous in the view that refining margins would come under downward pressure with the expansion of refining capacity in the Asian region.

According to comments by the Managing Director of Caltex, Mr. Des King, "...at least two of Australia's remaining seven oil refineries are likely to close within the next decade because they will not be able to compete with surplus Asian refined petroleum products".

Some stakeholders expressed the view that the previously observed trend of redundancy in Australian refining capacity would continue as more Australian oil refineries were closed because they were uncompetitive with larger scale refineries overseas.

In addition to refining capacity (as measured by the crude oil distillation unit capacity), refinery efficiency, and ultimately

margins, are impacted by competition from refineries that have invested in capacity to process lower grade (generally heavier and more sour) crude oils into higher value transport fuels. These can be described as *complex refineries* and over recent years they have generated higher margins than the less sophisticated *topping refineries*. BP estimates the average cracking margin for Singapore refineries since 2003 has been around US\$5/barrel.²⁸

QER firmly believes that it is in Australia's national interest to maintain a viable refining capacity in this country and that the Australian Government should actively pursue policies that facilitate such an outcome.

The need for Australia to develop alternative fuels

Alternative fuel sources including gas to liquids (GTL), coal to liquids (CTL), shale to liquids (STL), biofuels such as ethanol and biodiesel, LNG and CNG have the collective potential to make significant contributions to Australia's fuel supply mix by 2030.

Each of the alternatives has different potential to contribute in terms of volume and timing of commercial development. Some options have practical or economic limitations to their likely uptake whereas others have greater volumetric potential but may face greater challenges in relation to technology development and commercialization. For example, extraction of oil from shale is well known but the question remains what is the best method from both economic and environmental perspectives. In the late 1990s and early 2000s, Southern Pacific Petroleum and Central Pacific Minerals produced more than 1.5 million barrels of ultra-low sulphur naphtha and low sulphur fuel oil from the Stuart oil shale deposit located just north of Gladstone in Queensland. However, for a variety of reasons, the commercialization of the industry did not proceed at that time.

All alternative fuel options are potentially valuable and all deserve the attention of political leaders, policy makers, industry

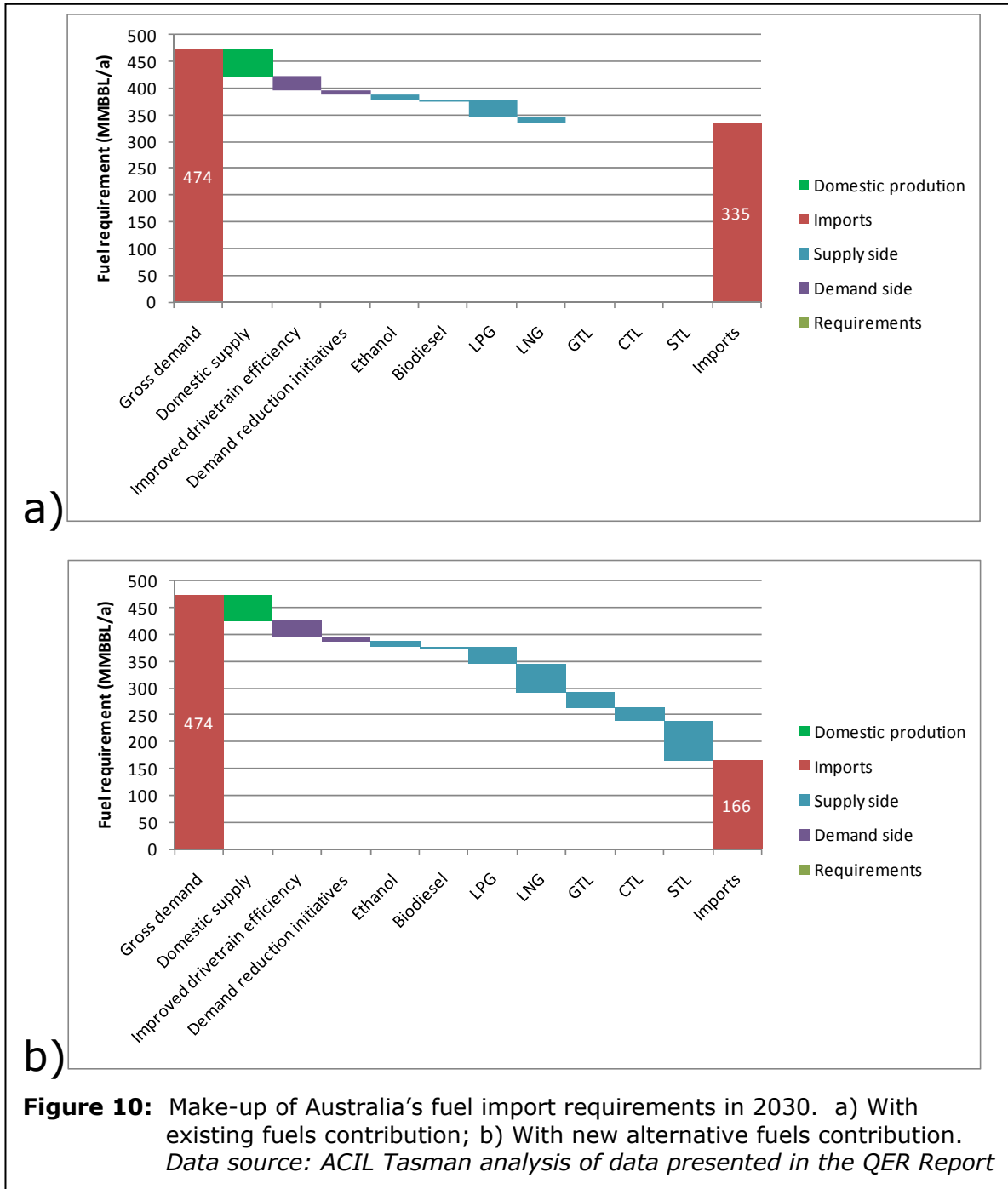
participants and consumers to ensure they are given the opportunity to progress through normal channels of technological and commercial demonstration, and to proceed to commercial development on their merits, subject to successful clearance of normal environmental and other regulatory hurdles.

Figure 10 illustrates how a combination of demand-side initiatives and alternative fuel developments could act to reduce the size of Australia's transport fuel deficit, and so to limit the economic costs associated with a rapidly increasing fuel import bill.

The upper panel of Figure 10 shows the makeup of Australia's fuel supply in 2030, in the absence of any new development of alternative fuels. Demand side initiatives relating to improved vehicle efficiency, drivetrain improvements and other demand reduction strategies such as increased use of public transport and modifications to patterns of vehicle usage will make modest but significant contributions of around 35 million barrels equivalent. Established alternatives to conventional fuel – ethanol, biodiesel, LPG and LNG – will collectively contribute about 53 million barrels equivalent. Together these sources will reduce the gross import requirement from 424 to 335 million barrels per year.

There is, of course, no guarantee that all of these technologies will pass all technical and commercial hurdles and so be able to yield the contributions indicated. However the analysis clearly shows that the quantum of the potential contributions, when compared to other demand and supply side options, is such that each of these technology options deserves to be given the opportunity to proceed and encouraged to pursue their respective development pathways.

The lower panel of Figure 10 shows how new alternative fuels – GTL, CTL and STL together with increased application of LNG – could act to reduce the net import requirement if each technology proved able to deliver commercially the quantities of product that the analysis in this report in-



dicates might be reasonably achievable. Altogether, alternative fuel sources show the potential to contribute the equivalent of about 222 million barrels per year, reducing import requirements from 335 to 166 million barrels.

The potential contribution of alternative energy sources to total fuel supply in Aus-

tralia is graphically illustrated in Figure 11, which shows that if CTL, GTL and STL can all be developed to the realistic levels and timeframes outlined in this study, they could see total Australian liquids production returned to about 20% above 2008 levels by the year 2030. In the absence of those alternatives, the outlook is for a

continued decline in production to about 45% below year 2008 levels.

Economic benefits of developing a shale-to-liquids industry

QER’s development plans for a commercial scale STL industry in Australia envisage producing 73 million barrels of oil a year by 2030, potentially accounting for upwards of 20% of Australia’s total oil production by then, even taking into account the development of other alternative fuels.

Capital expenditure required to achieve this is in the order of \$20+ billion over more than a decade of construction of processing plants and mining operations, involving the generation of upwards of 3,000 jobs during construction and up to 8,000 direct long-term jobs. Moreover, these jobs would be in regional Queensland centres, such as Gladstone, where they are needed and where the economic benefits of such employment numbers are magnified compared with major metropolitan centres.

In addition, at production levels of 200,000 barrels a day, QER’s planned operations would generate combined excise, royalty

and other taxation payments to the Australian and Queensland Governments of up to \$800 million per annum.

Put simply, Australia can ill afford not to develop the oil shale resources with which this country has been blessed.

It is important to recognise that Australia’s import parity pricing policy does not imply that we should be indifferent (at least from an economic perspective) to future levels of oil imports. The economic consequences of reliance on imports are quite different from those associated with higher levels of local oil production (whether conventional or alternative fuels).

There is no doubt that Australia possesses the oil shale resources to potentially support a very substantial industry. The volume of oil potentially available from oil shale development is very significant, and to a very large extent the exploration has already been done. Thus, exploration costs, which are significant for the development of new conventional oil fields, are already largely sunk costs for the oil shale industry.

Deposits of oil shale exist in the coastal

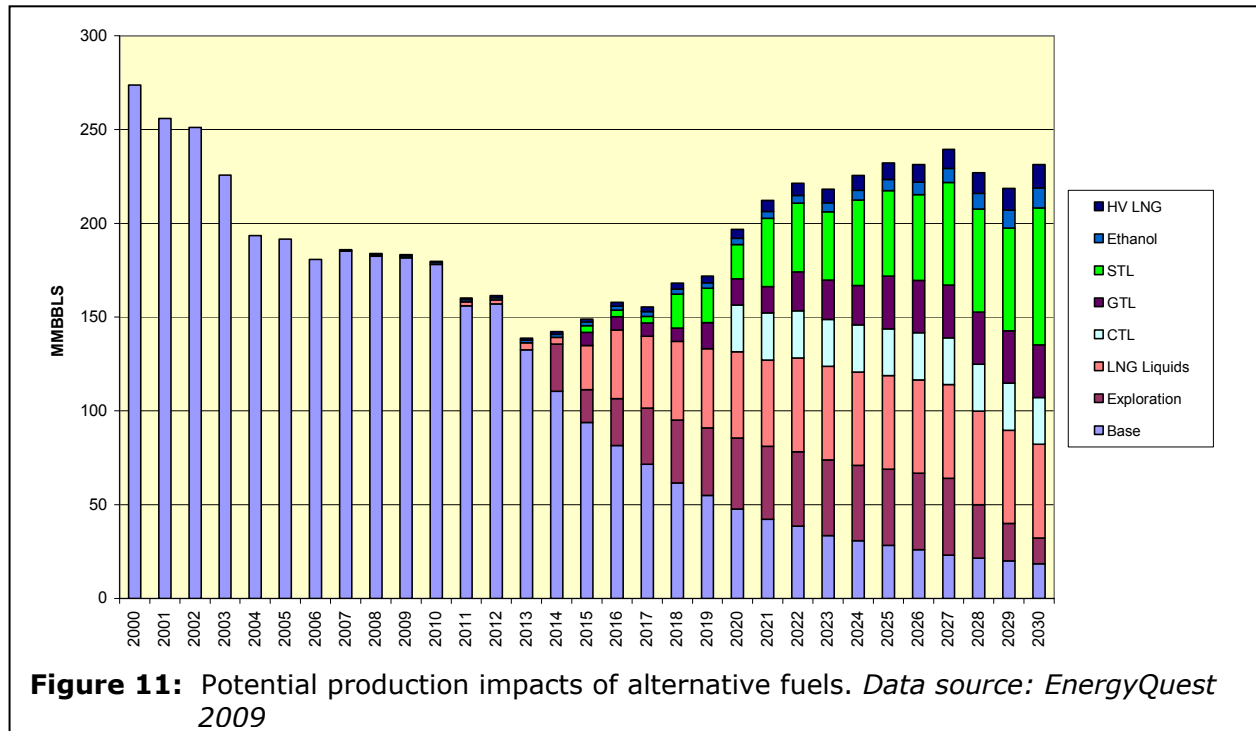


Figure 11: Potential production impacts of alternative fuels. *Data source: EnergyQuest 2009*

strip between Proserpine and Bundaberg in Queensland. The Queensland Government and others have estimated that this area alone could possibly yield more than 4629 gigalitres (or approximately 27.774 billion barrels) of oil – which is around 46 times Australia’s initial crude oil reserves.²⁹

It is in this context of volumetric availability that this submission and the accompanying QER Report provides an analysis of the *with* and *without* alternative fuel scenarios using a general equilibrium model of the Australian economy that provides a means of measuring the potential economic impacts of alternative fuels. Two scenarios were compared to a *no alternative fuels development* reference case:

- All alternative fuels become available and contribute in accordance with the estimates of potential size and timeframes outlined in this study (**all alternative fuels scenario**)
- CTL and GTL alternatives are developed but policy prescriptions prevent devel-

opment of STL (**Without STL scenario**).

Under the **all alternative fuels** scenario, real GNP in 2020 is projected to increase by 0.26 per cent, or \$4.1 billion per year relative to the reference case (Figure 12). All monetary values are reported in Australian dollars for this discussion. By 2030, real GNP is projected to increase by 0.6 per cent, or \$12.4 billion per year relative to the reference case. Assuming a real discount rate of 6%, the net present value of the stream of GNP benefits is projected to be approximately \$90 billion (in real 2008 terms).

Under the **Without STL** scenario the potential GNP benefits at 2030 are reduced by AUD\$5.4 billion relative to the **all alternative fuels** scenario. Compared to the reference case this scenario yields a net present value of the stream of GNP benefits of approximately AUD\$57 billion – \$33 billion less than the **all alternative fuels** scenario.

The analysis provides other estimates of economic impact, including changes in Australia’s real gross domestic product

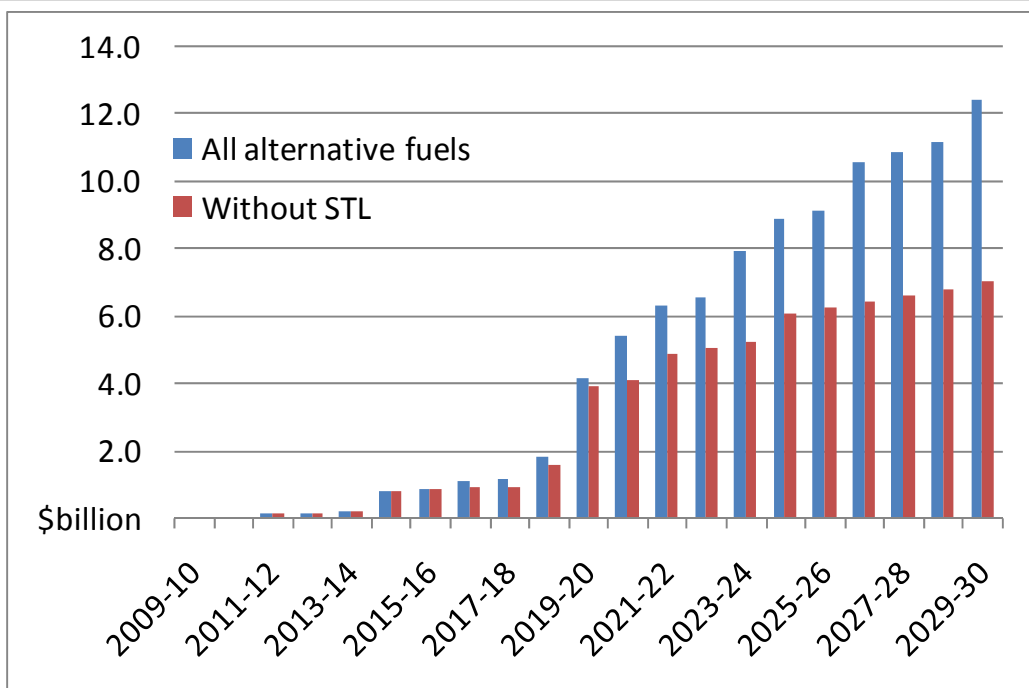


Figure 12: Impact of availability of alternative fuels on GNP. Data source: ACIL Tasman analysis

(GDP), national consumption, exports, imports and exchange rate effects. The analysis also addresses the costs of delays to STL development by comparing the Base Case with a scenario in which current policy constraints on development of STL are removed. The results in terms of impacts on GNP are illustrated in Figure 13.

Relative to the reference scenario, real GNP in 2020 under the **With STL 5 years earlier** scenario is projected to be 0.41 per cent, or \$6.5 billion above the reference case. The net present value of the stream of GNP benefits over the period to 2030 is then projected to be approximately \$107 billion (in real 2008 terms) – approximately \$17 billion higher than the **all alternative fuels** scenario and \$50 billion higher than the **Without STL** scenario.

The indicated benefits are conservative in that the assessed benefit streams have been truncated at year 2030. Because investments in alternative fuel production made between now and 2030 are likely to have a productive life extending well be-

yond 2030, they will continue to deliver benefits compared to the reference case without alternatives to 2040 and beyond. Indeed the annual value of benefits can be expected to increase in real terms beyond 2030 as Australia’s production of conventional fuels continues to decline.

Addressing the challenges in developing a commercial shale to liquids industry

It is widely recognised that there are significant challenges to the development of a shale-to-liquids industry on a commercially viable scale in Australia. This is not to say that Australia has not had such an industry in the past – most notably during the two world wars of the twentieth century. However, in the years subsequent to both world wars when oil again became more widely available and prices tended to reduce in real terms, the relative cost differential in development of shale oil vis-à-vis conventional oil precluded the continued viability of the industry in this country.

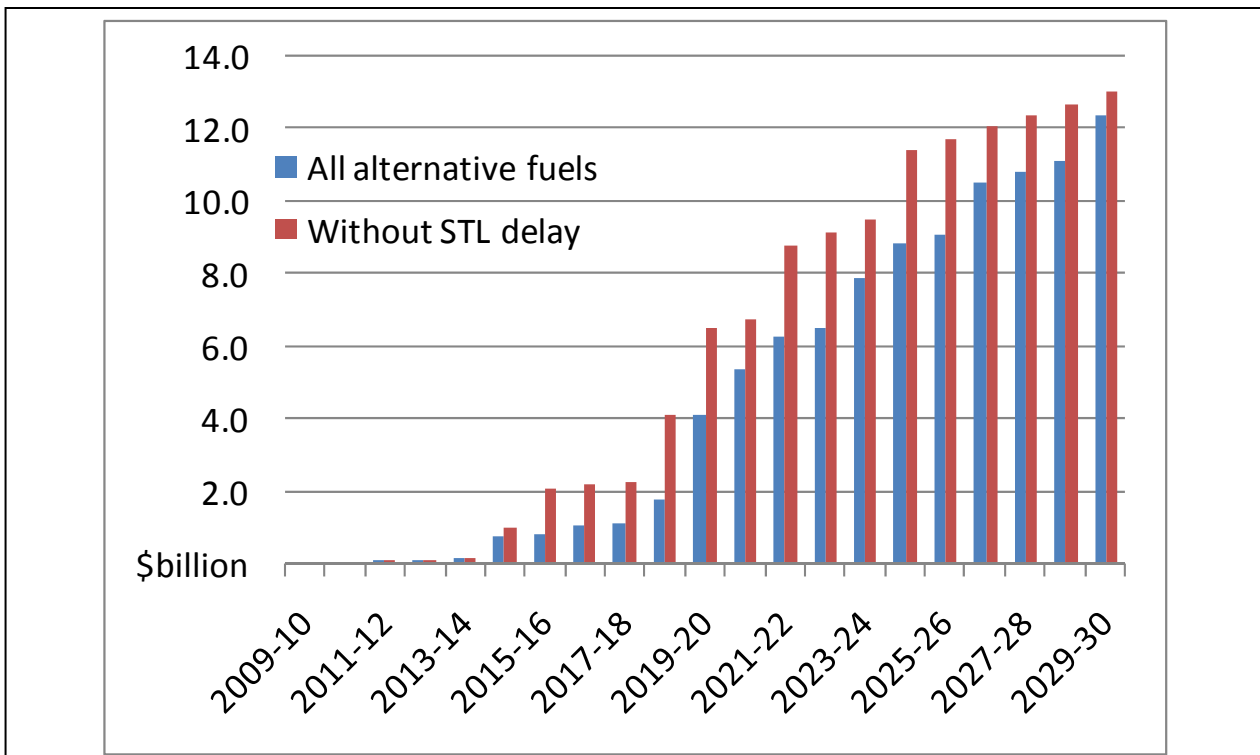


Figure 13: Impact of bringing forward availability of STL by 5 years. Data source: ACIL Tasman in the QER Report

In February 2007 the Senate Standing Committee on Rural and Regional Affairs and Transport released its final report on Australia's future oil supply and alternative transport fuels. *Inter alia*, that report made a number of interesting statements and conclusions relating to the production of synthetic crude oil from oil shale:

There are, however, a number of economic, technological and environmental impediments to the commercialisation of oil shale as a future source of oil.... [The] process is energy intensive, resulting in high levels of greenhouse gas emissions....³⁰

The issue of comparative greenhouse gas emissions is addressed in detail in this submission. This issue is considered an 'STL industry' issue that can be appropriately addressed within the scope of this paper, whereas other environmental and socio-economic issues associated with developing a specific STL project (for example, water use, noise impacts, stack emission points or employment impacts) are more appropriately addressed through a formal environment impact assessment process.

Perhaps the principal barrier over the years to commercial scale development of Australia's oil shale resources has been the cost of development relative to that required for development of conventional oil.

The committee sought information from several sources about the economics of shale oil production. Dr. Brian Fisher, Executive Director of ABARE said that if CO₂ emissions were internalised, the cost of producing shale oil is 'about \$US70-\$US95 a barrel, so shale oil is a long way out of the money at this stage'.³¹

This conclusion is also addressed in the submission and the accompanying QER Report, which sets out realistic forward crude oil price forecasts that are consistent with or above the price range referenced by Dr. Fisher from about 2012 through to 2030. It is QER's contention that project proponents will be best placed to undertake project specific economic analysis and

that such analysis will be made available as a matter of course through normal environmental impact assessment processes.

QER is heartened by the conclusion of the Senate Committee:

The committee notes that shale oil could theoretically make a significant contribution towards meeting Australia's transport fuel requirements. However, there are formidable technical issues to be resolved before this is likely to take place. The committee particularly notes Dr Brian Fisher's assessment...³²

QER considers it is important to note that the Senate Committee was more interested in the economic rather than perceived environmental barriers to developing Australia's oil shale resources.

Greenhouse gas life cycle assessment of STL and other heavy transport fuels

There is no doubt that the development of Australia's transport fuel security, achieved through a combination of imports, fuel efficiency gains and development of alternative fuels, must also be achieved with due regard to greenhouse gas implications. In his foreword to the NESAs, the Minister for Resources and Energy noted, *inter alia*:

Maintaining secure energy supplies requires careful balancing of many policy objectives: facilitating timely and appropriately sized investment in the energy sector; moves to a lower carbon economy; ...³³

As noted above, the Senate Standing Committee on Rural and Regional Affairs and Transport received submissions arguing that development of shale oil *is energy intensive, resulting in high levels of greenhouse gas emissions*.³⁴

In order to better understand the relativity of STL production compared with conventional oil and other alternative fuels, QER recently commissioned RARE Consulting to prepare a detailed assessment of the relative differences in the greenhouse gas emissions intensity of a range of alterna-

tives to conventional diesel for heavy-duty vehicles in Australia.³⁵

The assessment resulted in the identification of a range of greenhouse gas intensities for each of a number of different transport fuels considered. The result of this analysis, together with the median greenhouse gas intensity and greenhouse gas variance relative to ultra low sulphur diesel (Australian average blend), is illustrated in Figure 14.

As can be seen from Figure 14, the STL blend finished product compares well with other products. Shale oil is not used in vehicles in its synthetic crude form or as a 100% shale-derived diesel but would realistically be blended with imported crude oil to produce ultra low sulphur diesel. Current refinery limitations in Australia suggest that diesel will not be derived from 100% shale oil (a medium sweet synthetic crude oil). This is the same situation for any crude oil produced as refineries blend crude oils to produce a range of finished

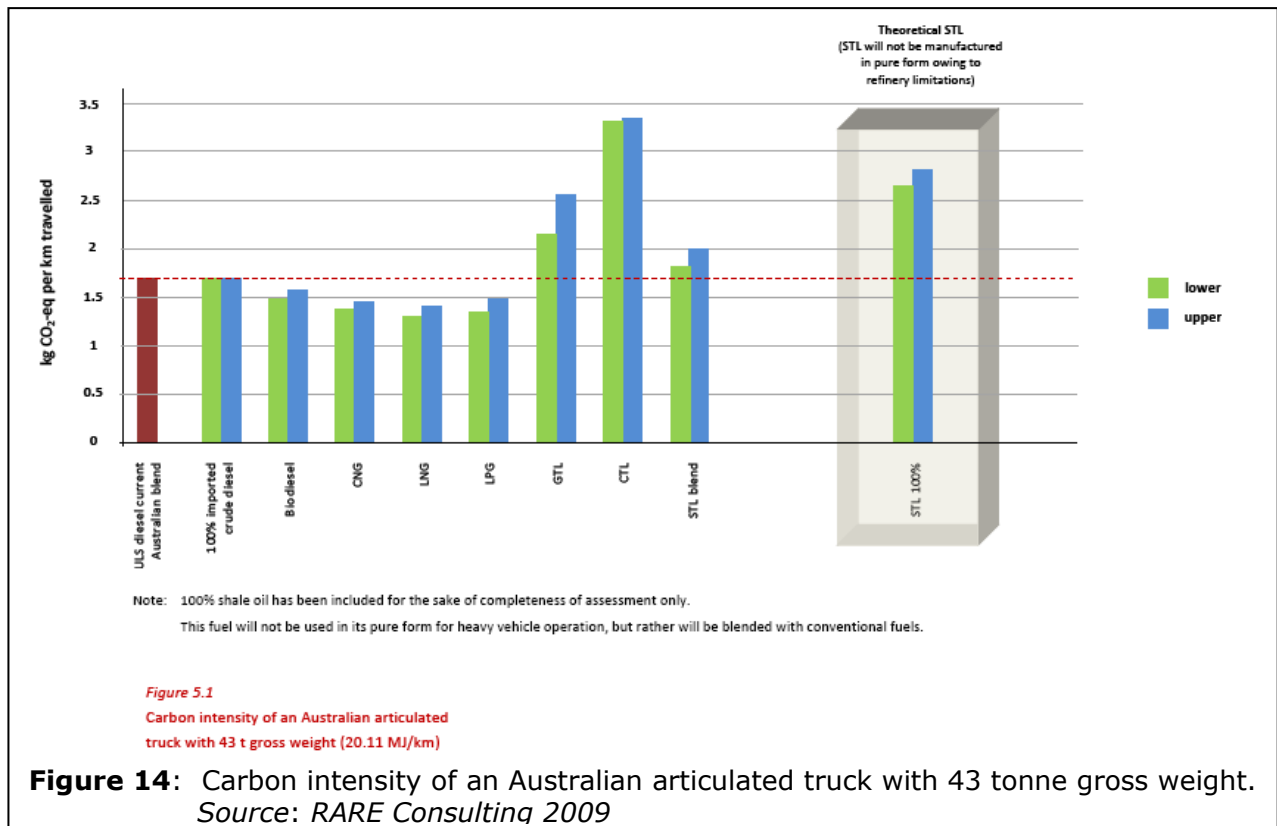
products.

Accordingly, the above analysis is based on an assumption of ultra low sulphur diesel being refined from a blend of:

- (a) 15% shale oil, 17% domestic and 68% imported crude and
- (b) 32% shale oil and 68% imported crude.

Note that the production of ultra low sulphur diesel from the higher shale oil blend may be constrained by current limitations in Australian refinery capability.

It should be noted that the greenhouse gas intensities reflected in Figure 14 have been derived for fuels on the basis of likely composition at the point of dispensing into the vehicle. The current Australian Greenhouse Gas Accounting Standards do not require the inclusion, or even measurement, of the on-farm greenhouse emission component in the growing of biofuels crops, therefore resulting in an artificially low total greenhouse footprint for biofuels



and biodiesels.

Inevitably, shale oil will need to be blended with conventional crude oil (imported or domestically sourced) to produce diesel at a ratio in the vicinity of 15% shale oil to 85% conventional crude. As Figure 14 illustrates, development of STL should not be 'ruled out' by policy makers on GHG emission grounds.

QER recognises that greenhouse emissions arising from burning of the fuel derived from STL is only part of the story. As such, QER is currently working on a range of additional research projects aimed at minimising the greenhouse gas output from the processing technology as well as mining operations, together with examining a range of possible offset or other mitigation options that may be considered and adopted. To this end, QER is currently a member of the Co-operative Research Centre for Greenhouse Gas Technologies (the CO2CRC) and has engaged a range of independent consultants to assist in this ongoing work, among which are CSIRO, HATCH Engineering and Ross Smith Energy Group.³⁶

QER continues to progress conceptual plans for a commercial STL industry plant and the company fully anticipates making significant further process improvements to minimise CO₂ and other emissions. The company is currently considering construction of a small-scale Technology Demonstration Plant at the Stuart site, which will be 'carbon capture ready'.

It is worth noting also that the GHG issue, referred to in the February 2007 report of the Senate Standing Committee on Regional and Rural Affairs and Transport, was raised at a time before Australia had developed a national response to climate change. Although the specific design of Australia's emissions trading or GHG reduction scheme is yet to be finalized, it appears reasonably clear that any such scheme (CPRS or otherwise) will involve national targets and will cover transport fuels in some way, so that there need not be an additional GHG restriction imposed

on the energy sector. In short, government should leave its fuel options open and allow alternative fuels to develop knowing that the CPRS will be designed to address the issue of GHG emissions in respect of fuels from whatever source.

Conclusions

QER remains firmly committed to developing a commercial STL industry based on Queensland's very significant oil shale resources. QER also intends to further develop its surface retort technology and demonstrate to governments, regulators and communities that oil shale can and should be developed in an environmentally and economically sustainable manner.

QER would like to highlight the following:

- Development of a commercial STL industry can generate **an additional \$33 billion dollars for Australia by 2030.**
- A commercial STL industry has the potential to **create 8000 direct long-term jobs in regional Queensland** and up to 25000 additional jobs through multiplier effects.
- The Australian and Queensland Governments could collectively receive up to **\$800 million per annum in royalty and other payments** from a commercial STL industry.
- Australia's level of conventional transport fuel production will continue to fall while at the same time demand will continue to rise, resulting in an ever-widening supply gap. As a result, **Australia's levels of self sufficiency in transport fuel supply will, under "business as usual" assumptions, fall from around 55% at present to less than 20% by 2030.**
- **In the absence of alternative fuel developments**, the supply gap will have to be met by imports. This will not only **expose Australia to rapidly increasing import costs** (with adverse implications for balance of trade and other economic indicators), but will also result in a reduction in security of supply.

- **Security of supply will be diminished because of increasing reliance on imports.** Reduced production and strongly rising demand in the Asia Pacific region means that more oil and product will have to be imported from outside the region. Long supply chains are inherently more expensive and more risky. Furthermore, more supply will need to be obtained from sources that are politically unstable and where reliability of supply may be more in question. Less secure supply has a number of implications, not least of which are economic; each instance of a supply constraint, interruption or forced recourse to more expensive alternatives has adverse consequences for the efficiency and competitiveness of Australian producers and for Australia's economic performance. These costs have not been factored into the economic analysis presented in this submission or the QER Report – but they are real and highly material. Significant energy supply interruptions or constraints can have economic costs running into billions of dollars.³⁷
- **Reduced availability of light, sweet crude in the Asia Pacific region will adversely affect operation and competitiveness of Australia's refineries,** which already face considerable competitive pressures.
- **Demand side responses** including improved vehicle efficiency and better drivetrain technologies, while offering worthwhile benefits, **will make very limited inroads into the supply deficit.**
- The development of **a viable STL industry in Australia has the potential to contribute 200,000 barrels per day**

(73 million barrels per year) to Australia's oil production.

- Development of alternative fuel supply in Australia on this scale could yield large economic benefits, of the order of \$90 billion in net present value terms based on differences in gross national product to 2030. **STL development alone has the potential to boost Australia's GNP by around \$33 billion by 2030.** These benefits could be further increased by bringing forward development of STL technology, which is currently subject to policy constraints.

Recommendations for Governments

1. Federal and State Governments should recognize that Australia has significant alternative fuel resources capable of being developed, and that development of these resources should be facilitated through appropriate policy, regulatory and taxation mechanisms.
2. Federal and State Governments should support the responsible development of Australia's oil shale resources in the national interest, recognizing that a commercial STL industry has the potential to boost Australia's GNP by \$33 billion over the next 20 years, and create 8000 direct long-term jobs, and acknowledging the contribution that an STL industry can make to providing fuel for Australia's heavy transport sector,.
3. Federal and State Governments should recognize that it is in Australia's national interests to maintain a viable oil refining capacity in this country and actively pursue policies that facilitate such an outcome.

¹ Hon Martin Ferguson AM MP Minister for Resources and Energy, Minister for Tourism foreword to the National Energy Security Assessment 2009

² World Energy Outlook 2008, International Energy Agency, 2008, pp.37 - 38

³ Exxon Mobil website:
www.exxonmobil.com.au/Australia-English/PA/about_what_gipps_bs.aspx

⁴ This paper draws from a number of sources, among which is a more comprehensive paper Australia's Future Transport Fuel Supply Options (2009) prepared for QER by consultants Purvin & Gertz Inc., EnergyQuest, RARE Consulting and ACIL Tasman

⁵ Australia's Future Transport Fuel Supply Options (2009) prepared for QER by consultants Purvin & Gertz Inc., EnergyQuest, RARE Consulting and ACIL Tasman

⁶ However, in 2008 the Queensland Government placed a 20-year moratorium on development of the largest oil shale resource deposit near Proserpine and a general two-year review of the industry during which time no oil shale tenements other than exploration licenses will be granted.

⁷ National Energy Security Assessment 2009, p.10

⁸ Hon Martin Ferguson AM MP, Minister for Resources and Energy, Minister for Tourism, speaking on the ABC 7.30 Report, 21 February 2008

⁹ "Fighting on Empty", Sean Hobbs, *The Diplomat*, September 2008, p.36

¹⁰ "Ibid.",

¹¹ "Ibid."

¹² *Defending Australia in the Asia Pacific Century: Force 2030*, Defense White Paper 2009, Section 15.29, p.124

¹³ *Ibid.* p.122

¹⁴ ABARE Resource Outlook 2008

¹⁵ Bureau of Industry Transport and Resource Economics cited by RARE Consulting 2009

¹⁶ Quoted in 'Peak oil crisis guides recovery', Paul Syvret, *The Courier-Mail*, 27 May 2009, p.2

¹⁷ The lower estimate was developed by PGI; the higher estimate was published by the International Energy Agency in its World Energy Outlook 2008.

¹⁸ World Energy Outlook 2008, p. 323

¹⁹ *Defending Australia in the Asia Pacific Century: Force 2030*, Defense White Paper 2009, pp.36 - 37

²⁰ Energy in Australia 2009, Australian Bureau of Agricultural and Resource Economics (2009), p.53

²¹ "Why Energy Demand Will Rebound", S. Nyquist and J. Rosenfeld, *The McKinsey Quarterly* (May 2009)

²² It is estimated for example that flaring from refineries around the world adds about 1,400 million tonnes of CO₂ equivalent emissions each year – more than double Australia's entire annual emissions. Source: World Bank 2006

²³ *Energy in Australia 2009*, ABARE, p.63

²⁴ Australian Institute of Petroleum submission to Department of Climate Change, September 2008, (www.aip.com.au)

²⁵

www.en.wikipedia.org/wiki/List_of_oil_refineries

²⁶ *Australia's Future Transport Fuel Supply Options*, Table 23

²⁷ *An Assessment of Australia's Liquid Fuel Vulnerability*, ACIL Tasman, November 2008, pp. 82 to 83

²⁸ Quoted in *Australia's Future Transport Fuel Supply Options*, p.115

²⁹ Senate Standing Committee on Rural and Regional Affairs and Transport Final Report on *Australia's future oil supply and alternative transport fuels* (February 2007), p.116

³⁰ Senate Standing Committee on Rural and Regional Affairs and Transport Final Report on *Australia's future oil supply and alternative transport fuels* (February 2007), p.116

³¹ *Ibid.* p.117

³² Senate Standing Committee on Rural and Regional Affairs and Transport Final Report on *Australia's future oil supply and alternative transport fuels* (February 2007), p.118

³³ National Energy Security Assessment 2009, Minister's Foreword, p.2

³⁴ Senate Standing Committee on Rural and Regional Affairs and Transport Final Report on *Australia's future oil supply and alternative transport fuels* (February 2007), p.116

³⁵ *Greenhouse life cycle assessment of heavy vehicle fuels in Australia*, RARE, May 2009

³⁶ Further information on current research projects being undertaken by QER is available from the company.

³⁷ For example, the recent interruption to Western Australian gas supplies as a result of an explosion at the Varanus Island gas plant has been estimated to have cost the WA economy \$2.5 billion (Senate Standing Committee on Economics, Matters relating to the gas explosion at Varanus Island, Western Australia, December 2008).