Chapter Four

Supply side responses

Overview

4.1 There are two main adaptive responses available for dealing with possible future restrictions on the availability of transport fuels and accompanying high prices that are likely, should supply fall significantly short of underlying demand because of peak oil or geopolitical factors. One is to reduce or manage demand so that available supplies can be used more economically and in a way that maximises the ability of society to function and minimises disruptions to the economy. Demand side responses are considered in Chapter 5. The other response is to find other methods of obtaining supplies – in other words, a supply side response. Both responses are likely to be necessary.

4.2 Demand side measures may make a significant contribution to easing the economic disruption of restricted fuel supplies and high prices, if these come to pass, but there are some parts of the economy where fuel demand management will inevitably be difficult, at least in the short to medium term. This country's economic well-being is currently dependent on primary industries, in particular mining and agriculture, which are very liquid fuel dependent. The transport industries, which are currently also liquid fuel dependent, are also vital to economic well-being. As noted in Chapter 2, the implications for the balance of trade on increasing oil imports are also expected to rise to in excess of $20 billion per annum by 2020.[1] Accordingly, it is prudent to actively explore both demand and supply side responses to a potential oil supply crisis.

4.3 The Committee has received evidence about a number of supply side options that are theoretically available. These include:

- finding more conventional oil supplies within Australia or in Australian territorial waters;
- sourcing a proportion of fuel requirements from biofuels such as ethanol or biodiesel;
- non-conventional petroleum, producing transport fuels by liquefying coal or natural gas, or producing it from oil shales, and
- fuel shifting, for example using LPG, natural gas or hydrogen as a transport fuel.

4.4 All of these possibilities come at a cost, economic or environmental, or have limitations. There is no universal panacea, no one perfect solution. This chapter gives a broad overview of the evidence received on each topic. The Committee has formed

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1 Robinson B,(APPEA), *Proof Committee Hansard* Canberra 11 August 2006, p.3

preliminary observations about each, but leaves in-depth analysis of each for the final report.

Searching for more oil in Australia

4.5 Australia has, for several decades, been self-sufficient in oil, thanks largely to the discovery of the large oil and gas fields in the Gippsland and Carnarvon basins. As described in Chapter 2, this self sufficiency is declining. The evidence received by the Committee indicates however that there is a view, particularly amongst organisations such as Geoscience Australia, that there are prospects for discovering new oil resources within Australia and in Australian territorial waters.

4.6 Geoscience Australia told the Committee that by world standards, Australian sedimentary basins, particularly those in offshore areas, have only been lightly explored. Fewer than 9,000 exploration and development wells have been drilled in Australia, compared to about 3,000,000 wells in the United States, which has a comparable land area.[2]

4.7 The Australian Bureau of Agricultural and Resource Economics (ABARE) gave similar evidence, stating that more than half of the offshore basins that show signs of petroleum potential remain unexplored.[3]

4.8 Exploration activity for new reserves in Australia is at close to all-time lows. Information provided by the Australian Petroleum Production and Exploration Association (APPEA) shows that around 100 exploration wells have been drilled in the last year, about half of them in off-shore areas.[4] The reasons for this low level of activity include high exploration costs, a success rate that is considerably lower than in other countries and relatively small discoveries compared to other countries. As APPEA pointed out in its submission:

> The offshore Australia region success rate for commercial oil discoveries was 6.5 percent (that is on average one in fifteen exploration wells drilled in the study period resulted in a commercial petroleum discovery in offshore Australia). This compares to a global average success rate of 17 percent. …In addition to the low success rate, the average commercial discovery size in offshore Australia was small compared to other regions (28 million barrels for oil and 197 billion cubic feet for gas).
>
> The implications of the above factors is that overall, Australia rates poorly as a result of low average commercial discovery rates and relatively small discovery sizes.

4.9 APPEA was of the view that Australian policy settings need to be adjusted to improve Australia's relative attractiveness as an investment destination on a risk

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2 Wright D (Geoscience Australia), *Proof Committee Hansard* Canberra 18 August 2006, p.51.

3 ABARE, *Submission* 166, p.4.

4 APPEA, *Submission* 176, p.4.

adjusted basis.[5] APPEA also sought an extension of Geoscience Australia's pre-competitive geoscientific information program.[6]

4.10 The Committee notes that the Government has introduced a number of initiatives to stimulate local exploration activity. These include:

- the introduction of a 150 per cent uplift factor in relation to Petroleum Resource Rent Tax (which APPEA described as being of 'limited interest' as it only benefits those companies who are currently producers);
- On 14 August 2006, the Prime Minister announced the allocation of an additional $76.4 million over the next five years to expand Geoscience Australia's pre-competitive data acquisition program; a review of the exploration policy framework; and $58.9 million to allow Geoscience Australia to 'to pioneer innovative, integrated geoscientific research to better understand the geological potential of onshore Australia for both minerals and petroleum.'[7]

Committee comments

4.11 It remains to be seen whether the Government's initiatives will have a significant effect on exploration activity, or if they do, whether significant reserves will be found, and if they are found, whether the cost of extraction will generate a fuel price that is competitive with the alternatives.

4.12 It is widely acknowledged that Australia will continue to use oil for transport fuel needs in the immediate future, notwithstanding the reduced demand that could be facilitated through the adoption of mandatory fuel efficiency standards, CNG, LPG and biofuels. As such, it is prudent to look for further domestic resources of both oil and gas whilst at the same time reducing demand as cited above, through investment in public transport and alternative fuels and their distribution networks. The question must be asked however of what is the appropriate level of resources that Governments and corporations should devote to exploring for more oil, instead of ways to reduce fossil oil dependence. The costs and benefits of more exploration must be assessed against the costs and benefits of other options to reduce oil dependence.

4.13 While more oil discoveries in Australia may improve the balance of payments by replacing imports, this cannot be expected to affect the price of fuel in Australia, as the oil price is set in the world market.

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5 APPEA, *Submission* 176, p.7.

6 Robinson B. (APPEA), *Proof Committee Hansard* Canberra 11 August 2006, p.9.

7 Hon. J. Howard, Prime Minister, *Statement on Energy Initiatives*, House of Representatives Hansard, 14 August 2006, p.26. Department of Prime Minister and Cabinet, *Support for Offshore and Onshore Exploration: August 2006 Update*, retrieved from http://www.dpmc.gov.au/initiatives/docs/exploration.rtf. on 01/09/2006

Biofuels

4.14 Two main biofuels are commonly mooted as alternatives to conventional oil. These are ethanol and biodiesel. These fuels are promoted by some groups for two main reasons. These are, that they reduce reliance on fossil fuels; and they are allegedly carbon neutral, being produced from renewable sources.

4.15 Ethanol is currently produced in Australia from either sugarcane, generally using molasses as a feedstock, or from grain. Ethanol is now available in Australia as a petrol blend in a limited number of locations, most visibly marketed by BP Australia as E10. A number of independent petrol retailers also sell ethanol blends, and Shell's premium fuel, Optimax Extreme, contains 5 per cent ethanol.

4.16 Biodiesel may be manufactured from a range of sources including waste cooking oils, tallow and from crops such as canola and palm oil. The Committee has received evidence from groups who consider that there are a number of other possible biodiesel sources that could be developed in Australia, for example by growing high yielding non-foodcrop plants specifically for fuel production. A limited amount of biodiesel is produced in Australia and it is not readily available, except in a very small number of locations. BP plans to market a diesel blend that is formulated in part (5 per cent) from a hydrogenated tallow product.

4.17 While there are a range of groups that actively promote the use of biofuels as an alternative to oil based products, there appear to be significant unresolved questions in relation to such fuels. However, all have a role to play in oil substitution and the transition to greater sustainability. There are issues in relation to biofuels which must be addressed and these include:

- The energy return on investment (EROI) of such fuels, significant fossil fuel inputs being required to produce them;
- Production capacity, whilst unlikely to be sufficient to provide a significant proportion of current requirements using existing technology, will satisfy a niche;
- The potential for competition between fuel production and food or textile production in land use;
- The need to ensure that oil for biodiesel is produced sustainably and does not drive tropical deforestation for palm oil plantations for example; and
- Government intervention by way of partnership or collaborative arrangement such that diesel manufacturers adjust their warranty to enable the use of more than 5 percent biodiesel in their engines. The same applies for ethanol where governments need to resolve the lack of international consistency about the level of concentration of ethanol in vehicles and in fuel storage and dispensing equipment.

4.18 Nonetheless, during the inquiry, the Committee's attention was drawn to several interesting technical innovations that may allow the wider use of biofuels,

permitting them to make a more significant contribution to the transport task, as well as potentially reducing CO_2 emissions from transport.

4.19 Among the most interesting of these is the potential use of lignocellulose to produce ethanol, whilst at the same time offering biodiversity and salinity benefits. The Western Australian example demonstrates that by identifying an endemic species such as oil mallees for possible biofuel production there are considerable benefits, including a considerable improvement in the energy return on investment.[8] Lignocellulose is woody or fibrous plant material and is available in very large quantities. A submission from an Australian research company, Microbiogen, argued that the sugar industry alone produces sufficient quantities of lignocellulose in the form of bagasse to produce enough ethanol to replace at least 10% of the Australia's oil consumption.[9]

4.20 Research is currently being conducted in several countries, including Australia and the United States, on the methods of using lignocellulose. The Committee found the Microbiogen evidence interesting, as this company appears to be making significant advances in this area. If this process can be commercialised, vastly larger amounts of feedstocks would become available for ethanol production. Microbiogen considers that the process may be viable within 2 to 3 years.[10]

4.21 Evidence was also provided to the Committee of processes under consideration in Europe for gasifying biomass and using the product for synthesising fuels using catalytic processes, and for producing biodiesel from algae.[11] However, the Committee has not received information about the economics of such processes, nor how far they are from commercialisation.

4.22 The Committee notes that the Government has set a modest target for the production of biofuels of 350 million litres by 2010. This represents less than one per cent of Australia's current use of liquid fuels for transport.[12] This should be substantially increased if we are going to move to secure Australia's energy future. The government must facilitate the achievement of such a goal through incentives to roll-out an adequate distribution network throughout the country.

Non-conventional petroleum

4.23 Technologies have been readily available for several decades for synthesising liquid transport fuels from either natural gas or from coal. During the apartheid era,

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8 H. Wu & M. Ewing, *Submission 179.*

9 Microbiogen, *Submission 92*, p.4.

10 Microbiogen, *Submission 92*, p.4.

11 Schuck S. (Bioenergy Australia), *Proof Committee Hansard* Sydney 9 June 2006, p.74

12 Demand for petroleum-based transport fuels was about 42,500 million litres in 2003-04. Department of the Prime Minister and Cabinet, *Report of the Biofuels Taskforce,* August 2005, p.36

South Africa produced all its liquid fuels from coal using the Fischer-Tropsch process and still produces 40 per cent of its fuel needs though this process.[13] There are plants under construction in several countries for producing what is known as GTL diesel (gas-to-liquids) diesel from natural gas. Both of these possibilities are under active consideration in Australia. For example the Committee received a submission and took evidence from the Sasol-Chevron company, which advocates the construction of a GTL diesel plant in Western Australia. The Monash Energy consortium, which has also given evidence to the Committee, is investigating the feasibility of constructing a coal-to-liquids plant in the Latrobe Valley in Victoria.

4.24 According to ABARE, these processes become commercially viable once the long-term oil price is above US$40-45 per barrel.[14]

4.25 The investment required for building plants to produce fuels from gas or coal is very large, and this is an obstacle to this alternative in the face of uncertainty about the longer term oil price. Sasol Chevron told the Committee that building a plant to produce 200,000 barrels of oil equivalent from natural gas would require an investment of approximately $20 billion.[15]

4.26 ABARE suggests a capital cost of US$50-70,000 per barrel of daily capacity for a coal-to-liquids plant, and US$25-40,000 for a gas-to-liquids plant. This compares with the cost of a conventional refinery of about US$15,000 per barrel of daily capacity.[16]

4.27 The evidence available to the Committee indicates that there are also environmental penalties associated with these processes, which result in substantially greater CO_2 production than conventional oil. This is because in addition to tailpipe emissions, substantial energy is consumed in the conversion process.

4.28 Sasol Chevron however claimed that on a well to wheels basis, its technology for producing GTL diesel is on a par with conventional oil:

> Sasol Chevron, ConocoPhillips and Shell International Gas commissioned a study by Five Winds International to report on the Life Cycle Analysis of GTL production. The study found that production and use of GTL fuel can contribute less greenhouse gas and reduced emissions to the atmosphere than production and use of conventional diesel fuel.[17]

4.29 The Committee has not verified these claims or the basis on which they are made.

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13 Sasol Chevron, *Submission* 54, p. 4.

14 Australian Commodities, June 2006, p. 306.

15 Sasol Chevron, *Submission 54*, p.11.

16 Australian Commodities, June 2006, p.306.

17 Sasol Chevron, *Submission 54*, p.9.

4.30 The Monash Energy coal-to-liquids proponents propose to build a 60,000 barrels per day plant (at a cost of $5 billion) with a projected commissioning date of 2016. The Company intends to rely on CO_2 geo-sequestration to manage the expected high CO_2 emissions. The company claims that this project would have significant economic benefits, including avoiding $80 billion in oil imports over 50 years, spending $20 billion on goods and services (mainly within Australia); and paying $15 billion in corporate income tax.[18]

Committee view

4.31 While coal-to-liquids, gas-to-liquids and other options such as producing transport fuels from oil shales may technically meet a large proportion of Australia's transport fuel needs, the Committee notes that their price will be significantly impacted by the imposition of a price on carbon dioxide emissions. The risk associated with investment in an uncertain regulatory environment coupled with uncertainties about the longer term oil price may make them less appealing to investors. Coal-to-liquids, if it is to avoid greatly increasing Australia's already substantial emissions of CO_2, must rely on geo-sequestration of carbon dioxide, a technique which is as yet unproven in this country and which is unlikely to be economically viable in the absence of a price on carbon. At this stage it is not possible to determine the cost of geo-sequestration, and therefore to determine what the comparative cost of coal-to-liquids as compared to other alternative fuels may be. Even with geo-sequestration, coal to liquids as a fuel generates comparable tail pipe emissions with conventional oil, therefore providing no overall benefit at considerably higher price. These are substantial risks.

Gaseous fuels – natural gas, LPG and hydrogen

4.32 While Australia has limited and declining supplies of conventional oil and now has to import oil to meet demand for transport fuel, it is endowed with large amounts of natural gas, which is principally methane. Supplies are estimated to be sufficient to last at least a hundred years at the current rate of use. Other hydrocarbon gases such as propane and butane are also commonly found in association with natural gas, as well as the condensate which now makes up a significant proportion of Australia's oil reserves.

4.33 The Committee received evidence from a number of witnesses that advocated the use of these gaseous fuels as a substitute for imported oil. Natural gas was also suggested as a bridging fuel to a hydrogen based transport system. Proponents argue that using locally produced gaseous fuels could have significant economic benefits by reducing the impact on the balance of payments that will otherwise result from the inevitable decline in oil self-sufficiency. They also argue that using domestically produced gaseous fuels would provide a degree of energy security by reducing dependence on oil produced in the Middle East. Further, they point to environmental

18 Monash Energy, *Submission 58.*

benefits of using these fuels, as they generally burn cleaner than oil products and produce less CO_2 for each unit of energy supplied. The three principal gaseous fuels commonly discussed are natural gas, liquid petroleum gas (LPG) and hydrogen.

Natural gas

4.34 Natural gas (methane) can be successfully used as a transport fuel, but its use in Australia for this purpose is very limited. The Asia Pacific Natural Gas Vehicles Association (ANGVA) was amongst several who advised the Committee of considerably wider use of natural gas as a transport fuel in other countries. The ANGVA said that in Brazil, there are in excess of 1 million natural gas vehicles on the road; and that the European Union had set a target for 10 percent of vehicles to run on this fuel by 2020.[19] Similarly, Motive Energy stated that the market penetration of natural gas vehicles was up to 30 per cent in some countries.[20]

4.35 Natural gas can be used in both diesel and petrol engines. Both require extensive modification, but the technology is regarded as mature. Cummins Australia[21] told the Committee that it now has in excess of 12,000 gas engines (ie: heavy diesel engines built specifically to operate on gas) in operation around the world. The market penetration of natural gas in the heavy vehicle fleet in Australia is however minimal, although the Committee is aware that a number of public authorities are trialling the use of natural gas buses, and Boral is using natural gas to power some of its shorter haul trucks such as concrete agitators.

4.36 Natural gas has both advantages and disadvantages as a transport fuel. Its advantages include its ready availability, gas being reticulated to 70 per cent of Australian urban areas; its relative abundance; price stability; and considerable environmental advantages. Disadvantages include the weight and size of cylinders necessary to store the gas on board; limited range; a considerable energy cost associated with compressing and liquefying gas where it is used as liquefied natural gas (LNG), and the cost of conversion.

4.37 The absence of refuelling and distribution infrastructure is a considerable obstacle to its wider use. As a consequence, there are very few natural gas cars or trucks in operation. Ford Australia told the Committee that it did a number of trials with compressed natural gas cars, but found that the size of the tanks that were necessary to give adequate range significantly intruded on luggage space, and range was limited.[22] The Committee is aware that some countries have experimented with home refuelling facilities, and these may offer a way to address the refuelling question.

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19 Asia-Pacific Natural Gas Vehicles Association, *Submission 75*, p.1..

20 Motive Energy Pty Ltd, *Submission 64*, p.17..

21 Cummins South Pacific, *Submission 84*, p.2.

22 Mr R. Scoular (Ford Motor Company of Australia Ltd), *Proof Committee Hansard,* 11 August 2006, p.32.

4.38 The Committee is of the view that it would be prudent to put in place measures to encourage the rapid take-up of natural gas in the transport fuels mix. Several submissions offered suggestions of what measures could be put in place, in addition to the existing Alternative Fuels Conversion Program, if the Government wished to encourage the wider use of this fuel. These will be explored in more detail in the final report, but measures to encourage the provision of infrastructure and excise and pricing questions are critical and must be addressed.

Liquefied Petroleum Gas (LPG)

4.39 LPG is comprised of varying proportions of propane and butane. It can be produced as a result of the oil refining process, but also occurs naturally in oil and gas wells, where it can be readily separated out from other gases.

4.40 LPG's principal advantage over natural gas is that it liquefies readily and does not have to be stored under refrigeration to remain a liquid. Consequently, it can be stored in smaller and lighter cylinders than natural gas, and offers superior vehicle range. It also offers environmental advantages over liquid fuels, but its combustion produces more CO_2 than natural gas.

4.41 Australian LPG resources are claimed to be relatively abundant, although not as extensive as natural gas. The Australian Liquefied Petroleum Gas Association (ALPGA) told the Committee that substantial reserves of LPG will continue to be available until at least 2020. ABARE estimates that Australia's demonstrated LPG reserves are currently 210 gigalitres, less than the estimated condensate reserves of 247 gigalitres.[23]

4.42 The market penetration of LPG is supported by extensive infrastructure, over 3,500 filling stations being available.[24] The Committee notes the recent Government initiatives to encourage motorists to take up this fuel by paying a subsidy of $2000 for a conversion and $1000 towards the cost of a new vehicle with LPG fitted.

4.43 The Committee agrees that LPG may be a suitable substitute fuel for petrol in some vehicles, but questions whether supply is sufficient to support a large proportion of the current fleet being converted to operate on it. This and other issues will be examined more extensively in the final report.

Hydrogen

4.44 Hydrogen is often put forward as an alternative transport fuel, although it is more correctly described as an energy carrier. Theoretically, a vehicle fuelled by hydrogen would have zero emissions. However, what is often overlooked is that hydrogen does not occur naturally and must be produced as part of a manufacturing process. It can be produced by reforming natural gas, coal or biomass, or by

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23 Department of Industry, Tourism and Resources, *Energy in Australia 2005.*

24 ALPGA, *Submission 91*, p. 5.

electrolysis, but currently, substantial CO_2 emissions accompany all of these methods of producing this fuel.

4.45 There are formidable technical issues to be overcome before hydrogen could be widely used as a transport fuel. These include the very large amounts of energy required to compress it and maintain it in a liquid state suitable for transport fuel use, storage problems arising from its propensity to leak through the walls of metal pipes and tanks, the lack of a source of supply, and a complete lack of distribution infrastructure. In the Committee's view it is a fuel that might be considered in the distant future, but is not a useful option to consider in Australia's current or medium term transport fuels mix.