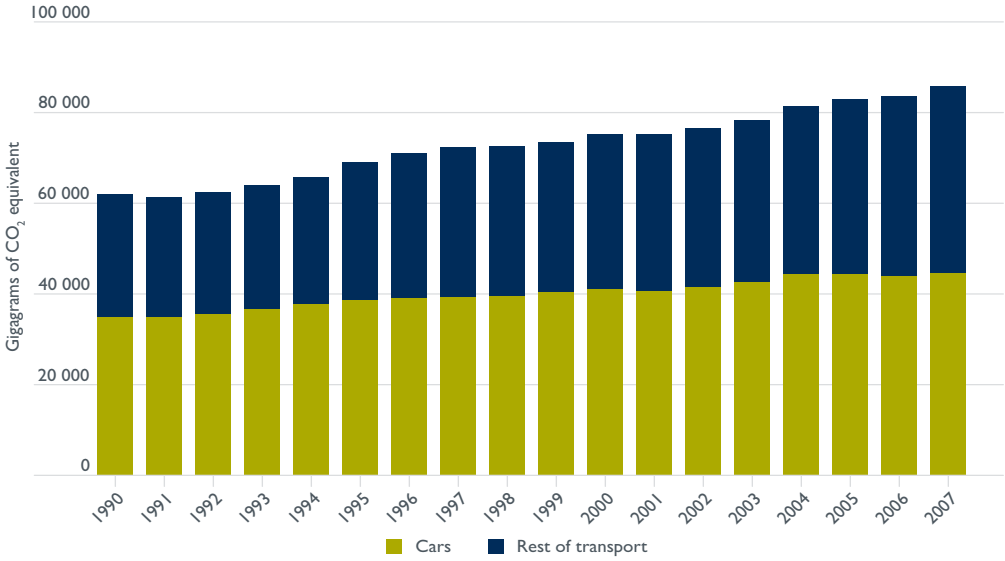
BITRE Briefing – 1

Australian Government
Department of Infrastructure, Transport, Regional Development and Local Government
Bureau of Infrastructure, Transport and Regional Economics

How do fuel use and emissions respond to price changes?

- The major liquid fuel uses in Australian domestic transport are associated with cars (52 per cent), trucks and light commercial vehicles (33 per cent), rail (3 per cent) and aviation (8 per cent).
- The specific fuels used in Australian transport are petrol (52 per cent), diesel (32 per cent), liquified petroleum gas (6 per cent), avtur (8 per cent) and other fuels (2 per cent).
- As almost all of these fuels are derived from petroleum sources, fuel use is employed as a proxy for emissions in the following discussion. In the future, with changes in energy sources, this might not necessarily be a good measure.
- The long-run growth trends for transport in Australia are driven by population increase (the primary driver for car travel) and by increases in income (the primary driver for trucking, rail and aviation). In the past, steady growth in income and population, coupled with low fuel prices, has meant fairly steady growth in Australian transport fuel use of about 2 per cent per year.
- Greenhouse gas emissions from car travel have grown below this average rate (1.4 per cent a year from 1990 to 2007), while truck/light commercial vehicle emissions have increased at a higher rate (2.6 per cent a year over the period) and aviation emissions higher again (5.3 per cent a year) (see Figure 1).
- Higher fuel prices, if sustained, will result in lower fuel use and emission growth rates in the future, though the observed trend will reflect the net outcome of all of the main drivers, i.e. prices (a likely 'downward' influence), technological change (also a likely downward influence), together with population growth and income growth (both strong 'upward' influences).
- Against this background, BITRE has estimated the responsiveness of fuel use to price, in the course of its empirical modelling of the transport task and greenhouse emissions, drawing on the academic literature and its own work.

Figure 1 Australian transport greenhouse gas emissions



Source: BITRE (forthcoming). *Greenhouse Gas Emissions from Australian Transport to 2020: 2007 Base case.*

- Price responsiveness takes two forms: a short-run and a long-run response. The long-run response (arguably, from a climate change policy perspective, still only a 'short-to-medium term' response) is only completed after 10 to 20 years. It involves changes in car, truck, aircraft and other transport fleets. Australia, in contrast to European countries, has not had a period of elevated fuel prices for longer than seven years (in the late 1970s and early 1980s). Moreover, as a major energy economy, Australia's rising exchange rate provides a 'cushion' at times of high oil and other energy prices. Before 2003, real petrol prices were basically flat for 15 years but from 2003 to 2008, real petrol prices have increased 63 per cent in real terms (to $1.70 per litre in mid-2008) and both short- and long-run responses have only just started to come into play.
- In the short run, **car fuel use** declines about 1.5 per cent with a 10 per cent increase in the petrol price. This rises to about a 4 per cent decline when long-run demand and technology adjustments are made. As the average age of the car fleet is about 10 years, the long run stretches to 15 years and beyond. It is possible that the long-run responsiveness to radically higher fuel prices could even be greater, given threshold effects on consumer choices and technological development. International studies have suggested a response to significantly higher fuel prices of up to —0.7, combining demand and supply side (technology) changes (see References).
- Increases in fuel prices affect the long-run trend in car fuel use through vehicle size choice, vehicle fuel efficiency choice, vehicle fuel type choice, technology choice, mode choice, and residence location choice.
    - Car (including 4WD) size choices in the last four years have swung from 30 per cent large vehicles in 2003 to 24 per cent in 2005 and 18 per cent in 2007. In conjunction with car fuel efficiency choices within size category, this has meant a reduction in new car fuel use from 9.7 litres per 100 km in 2003

to 9.5 litres per 100 km in 2005 and 9.0 litres per 100 km in 2007—this is in response to petrol prices rising 25 per cent in real terms (to a year average of $1.27 per litre in 2007).

  - A diesel vehicle is far more fuel efficient than a conventional petrol vehicle (of comparable size), and the diesel share of new vehicle sales rose from 5 per cent in 2005 to 9 per cent in 2007. With lower liquid petroleum gas (LPG) fuel taxation, LPG vehicles' share of light vehicle sales has risen from 0.2 per cent in 2005 to 0.6 per cent in 2007. The advent of conversion subsidies has seen additional existing vehicles being switched to LPG.
  - The new hybrid technology has also been favoured as petrol prices have risen. Hybrids were 0.2 per cent of sales in 2005, but increased to 0.6 per cent in 2007.
  - Mode choice is also relevant to transport and especially car fuel use. In the last few years, use of urban public transport has grown significantly above the trend of the last 30 years (when urban public transport only kept up with car travel growth in the cities and comprised around 9 per cent of total passenger-kilometres travelled).
  - In the very long-run, households and businesses may change location in sufficient numbers that city population densities increase, with resulting greater opportunities for connectivity to major urban public transport facilities and somewhat higher mode shift away from car use.

- **Truck fuel use** is more price-inelastic over the long term than car fuel use. Freight costs comprise 5 to 10 per cent of final goods costs and even at current (June 2008) freight rates, fuel use accounts for only about 30 per cent of freight rates. There is also a very low elasticity of substitution between long distance road and intercapital rail. Trucking fuel use (and activity) also increases more strongly with economic and income growth than does car fuel use.
- **Bulk rail fuel use** (most of rail freight) has a growth trend driven largely by commodity export increases and is thereby closely linked to world economic growth. It has a very low response to changes in its fuel costs, as these are built into export prices very rapidly.
- **Aviation fuel use**, like road freight and light commercial vehicle use, is considerably faster growing than car fuel use, as aviation travel responds strongly to rising incomes and economic growth.
- Nevertheless, for **domestic aviation fuel use**, a 10 per cent increase in aviation turbine fuel prices could be expected to result in a 2 per cent decline in passenger travel.
- **International aviation fuel use** is more fuel price elastic, reflecting the more 'discretionary' character of some tourism, business and family reunion travel; a 10 per cent increase in aviation turbine fuel could potentially result in a 6 per cent decline in passenger numbers.
- **In summary**, transport fuel use responds negatively to price increases (in both the short and the long run), and positively to population and income increases. These effects differ across modes. In the following section, we examine how these different drivers have combined to influence fuel use trends in Australia and the US.

Recent transport fuel use in two countries: Australia and the United States

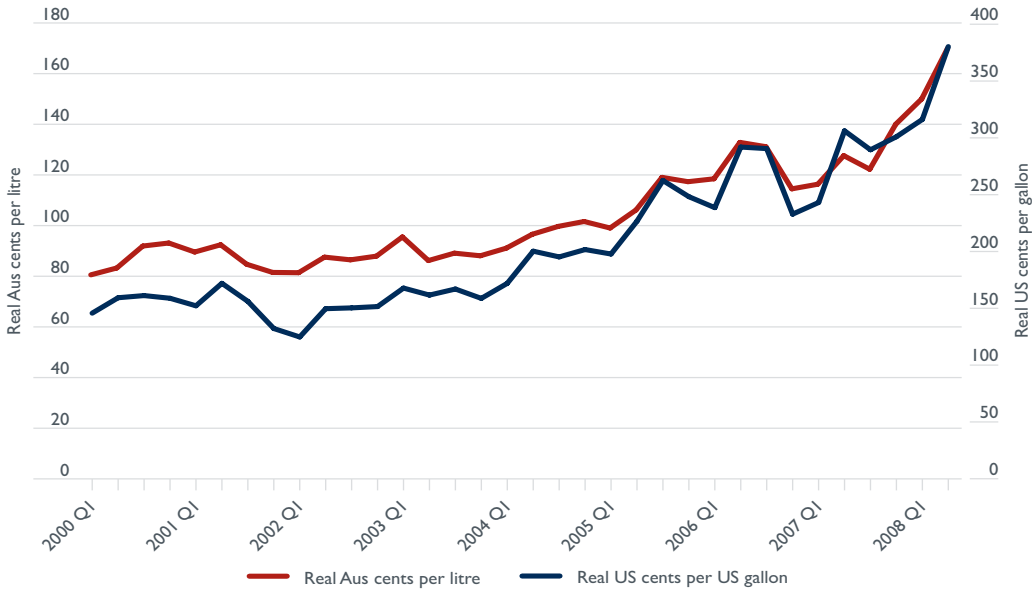
- The rapid increase in global fuel prices has led to declines in fuel use in Australia and the US. However, there are three reasons to suppose that responses in Australia and the US would differ:
  - Firstly, the US dollar has declined 10 per cent in value since 2004 against a basket of western currencies (Special Drawing Rights or SDRs). In contrast, the Australian dollar has appreciated nearly 14 per cent in the same period. Thus, while the 'landed' real oil price in Australia rose 2.6 times from 2004 to mid-2008 (from $A47 per barrel to $A122 per barrel—see Figure 2), in the US it rose 3.3 times (from $US35 per barrel to $US117 per barrel).
  - Secondly, in the US and Australia, the tax component of the retail petrol price has been effectively constant. However, the levels of taxation are quite different. The percentage change in price as a result of a 1 per cent increase in oil prices is greater in the US than in Australia due to the smaller tax wedge there. Gasoline in the US has about 47 cents US per gallon State and Federal tax (equivalent to about 12.5 Australian cents per litre), while in Australia, State and Commonwealth taxes are about 51 Australian cents per litre. The non-tax components of petrol in both countries are more comparable, at about 363 US cents per gallon (equivalent to about 100 Australian cents per litre) in the US, and 119 cents per litre in Australia. The upshot to the difference in tax levels is that Australia has a much higher petrol price but with a much greater percentage of this price insulated from changes in landed world oil prices.

Figure 2 Real oil prices in Australia and the United States

Sources: Energy Information Administration (http://tonto.eia.doe.gov/dnav/pet/pet_cons_psup_dc_nus_mbbl_m.htm). Release Date: 6/30/2008 and Reserve Bank of Australia (http://www.rba.gov.au/Statistics/Bulletin/F11hist.xls)

– The tax differential factor combines with the first factor, the appreciation of the Australian dollar versus the depreciation of the US currency. Thus although world oil prices rose 3.4 times from 2004 to 2008 in SDRs (equivalent to a movement from $US38.25 per barrel in 2004 to $US145 per barrel in 2008), US gasoline prices rose 2.6 times while Australian petrol prices rose only 1.8 times (see Figure 3).

Figure 3 Real petrol/gasoline prices in Australia and the United States

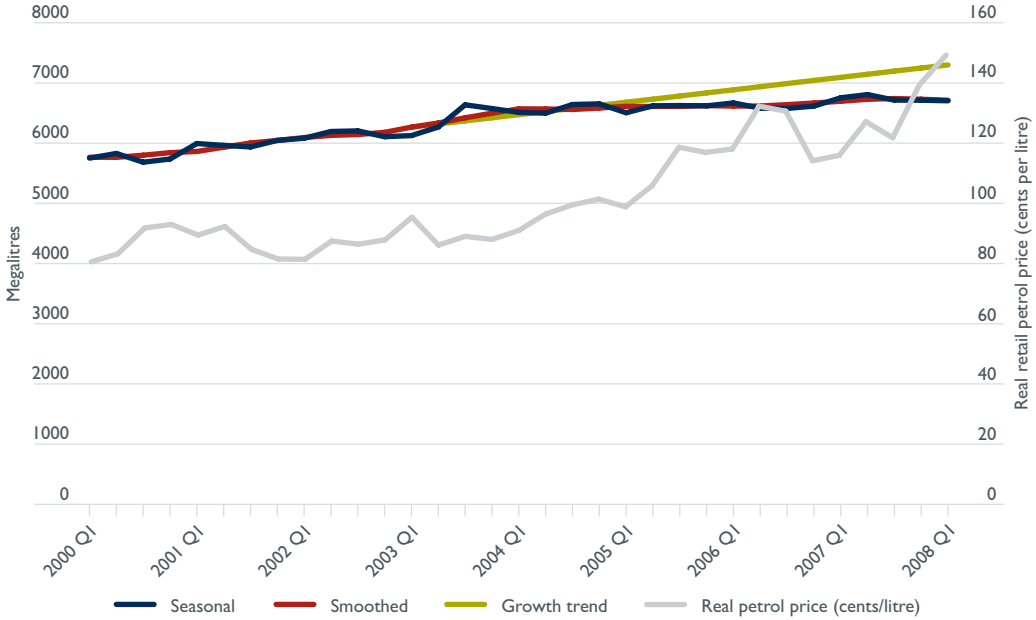


Sources: ABARE Mineral Statistics (various quarters) and Energy Information Administration (http://tonto.eia.doe.gov/dnav/pet/pet_cons_psup_dc_nus_mbbl_m.htm). Release Date: 6/30/2008

– The third reason for differing changes in sales of Australian petrol verses US sales of gasoline lies in the differing economic growths of both countries recently. Since mid 2007, US annual economic growth has slowed from 2.6 per cent to 1.6 per cent. In the same time frame, Australian economic growth went from 3.7 per cent to 3.6 per cent.

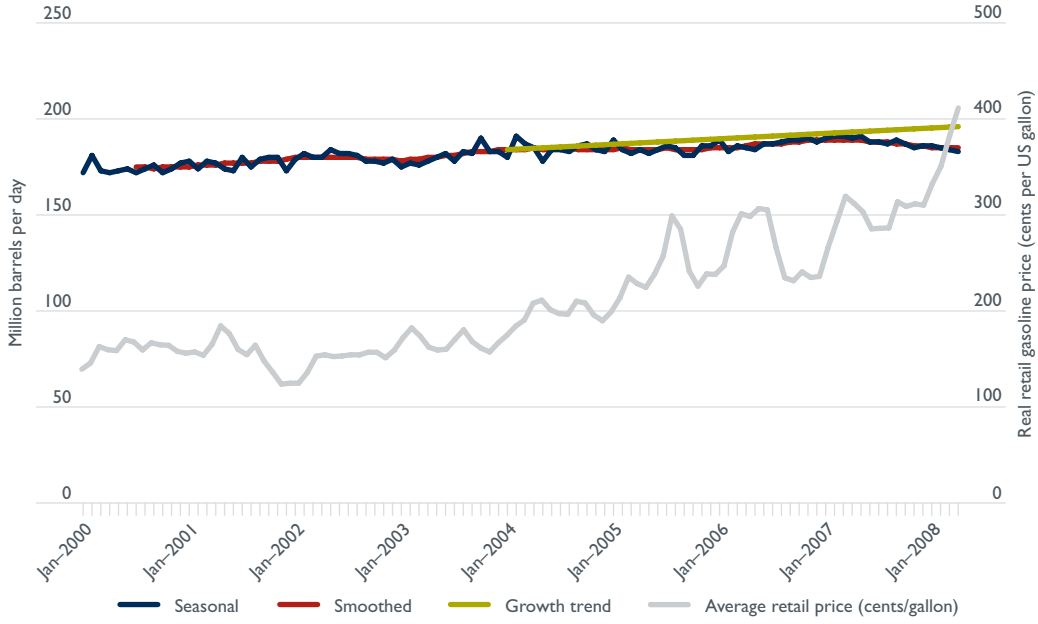
- Thus all three factors, currency movements and differential taxation rates, which meant a lower increase in petrol prices in Australia, and lastly higher economic growth in Australia should tend towards producing less of an effect on fuel use in Australia.
- Figures 4 and 5 show the recent evidence of declines in the use of gasoline and petrol (the Australian term) in the two countries. The Australian figures include automotive Liquefied Petroleum Gas (LPG) as there has been increased conversion of existing cars due to subsidy arrangements for both vehicle conversion and fuel use. Also included is car diesel use, as there have been continued additions of diesel cars to the fleet.

Figure 4 Australian petrol/LPG/car-diesel fuel use and retail petrol price



Source: ABARE Mineral Statistics (various quarters).

Figure 5 US gasoline fuel use and retail gasoline price



Source: Energy Information Administration. (http://tonto.eia.doe.gov/dnav/pet/pet_cons_psup_dc_nus_mbbl_m.htm). Release Date: 6/30/2008.

- There are three interesting findings implicit in Figures 4 and 5:
  - Firstly, the decline in fuel use with higher prices and lower growth must be measured against the business-as-usual 'growth trend' (as indicated by the green lines).
  - Secondly, the short-term effect is noticeable through small in both countries (as would be expected).
  - Thirdly, although the price increase in Australia was smaller, the Australian decline in fuel use is in fact greater than that in the US (8.2 percent below business-as-usual for Australia, versus 6.4 per cent for the US). This demonstrates that fuel use responsiveness to fuel price change is quite idiosyncratic across countries, probably because of differences in the timing of the price increases, and differing income levels, car dependencies, public transport alternatives, fuel expenditures as a proportion of average household incomes, economic growth patterns, etc.
- But over the long run, fuel prices do have an effect. As in the 1970s, when prices rise dramatically and are expected to continue high, a longer-term process of adaptation is set off. This results in fuel conservation, non-transport fuel switching, changes in fleet composition, and in the development and marketing of alternative fuel and vehicle technologies.
- It is possible that the recent oil price increases have set off such a process and that if oil prices remain on an upward trajectory, the adaptation process may still have a long way to run.

References

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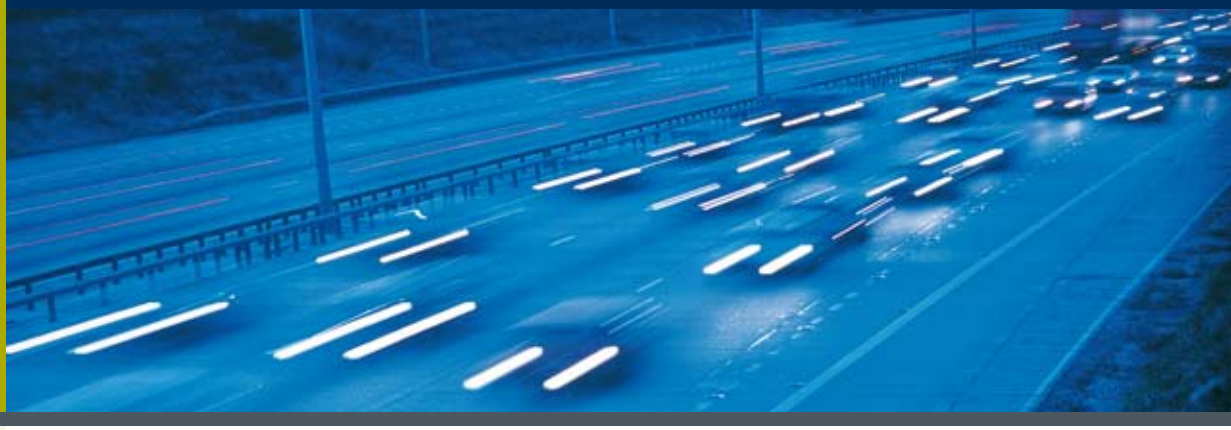

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