

## 20130822 The Trending Price of Petrol

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### Introduction

This short document looks at the affordability of petrol / diesel / LPG powered vehicles by Australians in the longer term. Historically, the price of fuel is rising at a hyper-exponential rate with a constant exponential index that steps up by about 2.5% in nominal 40 year intervals.

Currently this historical step is moving from 6.5% pa to 9.0 % pa in line with long-term historical records. This step rise now very clearly exceeds the long-term inflation rate (2 to 4 % pa) in Australia, so within a few years, most people and most businesses will not be able to afford petrol / diesel / LPG / Aviation fuels as they do now.

It is obvious that rapidly increasing transport fuel costs are becoming a disproportionately large component of the average Australian wage and of most Australian businesses. The Federal Government has to take a very strong lead by immediately funding massive transport infrastructure changes to provide Australia with far more economic transport infrastructures into the future.

Broadband Internet technology has the potential to minimise physical transport and maximise electronic transport by 2020; so working from home, remote country offices and electronic Boardrooms has a massive potential to really make non-metropolitan Australia far more productive than it is now.

Unfortunately, the National Broadband Network (NBN) was engineered along urban technologies, broadly missing the regional, rural and remote communities and farming / grazing homesteads it was originally intended to target. The prime cause of this blunder was that the NBN was incorrectly focussed to be privatised in the future!

By about 2020 long distance Road Freight (ie > 50 km) will become prohibitively expensive because of massive diesel fuel costs, and all this and associated highway infrastructure will become local distribution networks.

Long distance Rail Freight will become the national Freight transport standard by 2025, but to date most rail infrastructure has been left to ruin or privatised with an absolute minimum of maintenance. This infrastructure will require a massive investment so that Rail Freight can be transported in near linear corridors capable of over 200 km/h and utilise low-cost electric power for their motors.

International flight costs will become very expensive to the point that a second Sydney International Airport, if constructed, will quickly become a White Elephant because the patronage will quickly fall off well before 2030.

Passenger Rail services will replace road and bus/coach services, and flights between city centres, but to date these rail infrastructures are based on diesel power and /or 1500 V DC in NSW. This NSW urban infrastructure needs to be totally refurbished with near linear corridors and utilise 25 kV AC as reticulation so that it directly interfaces with the inter-city fast Rail infrastructure.

The hyper-exponential rate in the increase oil prices will continue in future decades to the point that Australia will have to proactively move off the oil economy well before 2025 or quickly recede into a second or third world economy.

### ***Tracking the Price of Petrol 1896 - 1970***

A readily available document from the AA Motoring Trust<sup>1</sup> shows the average UK price per gallon + tax content from 1896 until 2005. While the tax component is interesting (for those in the UK), the change in exponential gradient over time is far more interesting as this gives a solid lead as to the petrol price per unit volume over this long time span.

The relevance of the Australia and the UK being tied together is that economically, Australia was tied to the UK up until about 1980, so the inflation figures for both countries effectively correlated. The relevance of this economic inflation figure is that in this same period, cars became less expensive – relative to the Average annual income, and cars started to replace horses as the primary means for personal assisted human transport.

Concurrently, steam trains were replaced by electric trains and electric trams, and an extremely deceitful economic war raged within the USA until about 1937 (covertly headed by General Motors Corporation to buy up tram services and close them down – to force the general public to purchase cars.) Similarly, the trams in Sydney were covertly removed in 1957 – 1960 to force people to use fuel-powered Busses (and then, of course, buy cars).

In this time, World War 1 transpired, and the history<sup>2</sup> that we were specifically not taught “**Who Won the Oil Wars**” shows very clearly that this war was really about restructuring Turkey (the Ottoman Empire), so that the vast oil fields here could be controlled by the main Western Economic powers (USA, England, France and Germany). This reference clearly shows the petrol interest implications of WW2, and the more recent USA takeover of Iraq to secure that oil for the USA.

The highly reliable figures from the AA Motor Trust have been transferred into Excel, plotted as a time chart, and then re-plotted with a best fit curve to get a mathematical relationship. In this first time price – time chart, there were 12 missing numbers scattered in the data, so averages based on the near values were inserted to give continuity of historical figures.

In a fairly well controlled economy, the average inflation rate is typically between 2% and 4% annually. Between 1896 and 1970 petrol pump prices effectively rose by about 3% pa compound overall. The petrol price curve for this time is very close to the annual inflation rate in the UK (which very closely parallels that in Australia over this period).

It is obvious that WW1 (1914 – 1918 through to 1923) had a traumatic effect on the stability of the oil prices in the UK (and Australia), leading into the depression of 1928 – 1934, but after then the prices in WW2 were heavily controlled through the Korean (Communist force) war where prices again aligned by about 1960. From 1960 through to 1970 petrol pump prices very closely track the UK petrol price.

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<sup>1</sup> [http://www.theaa.com/public\\_affairs/reports/Petrol\\_Prices\\_1896\\_todate\\_gallons.pdf](http://www.theaa.com/public_affairs/reports/Petrol_Prices_1896_todate_gallons.pdf)

<sup>2</sup> “Who Won the Oil Wars”, Andy Stern, Collins & Brown, London, 2005, ISBN: 1-84340-291-2

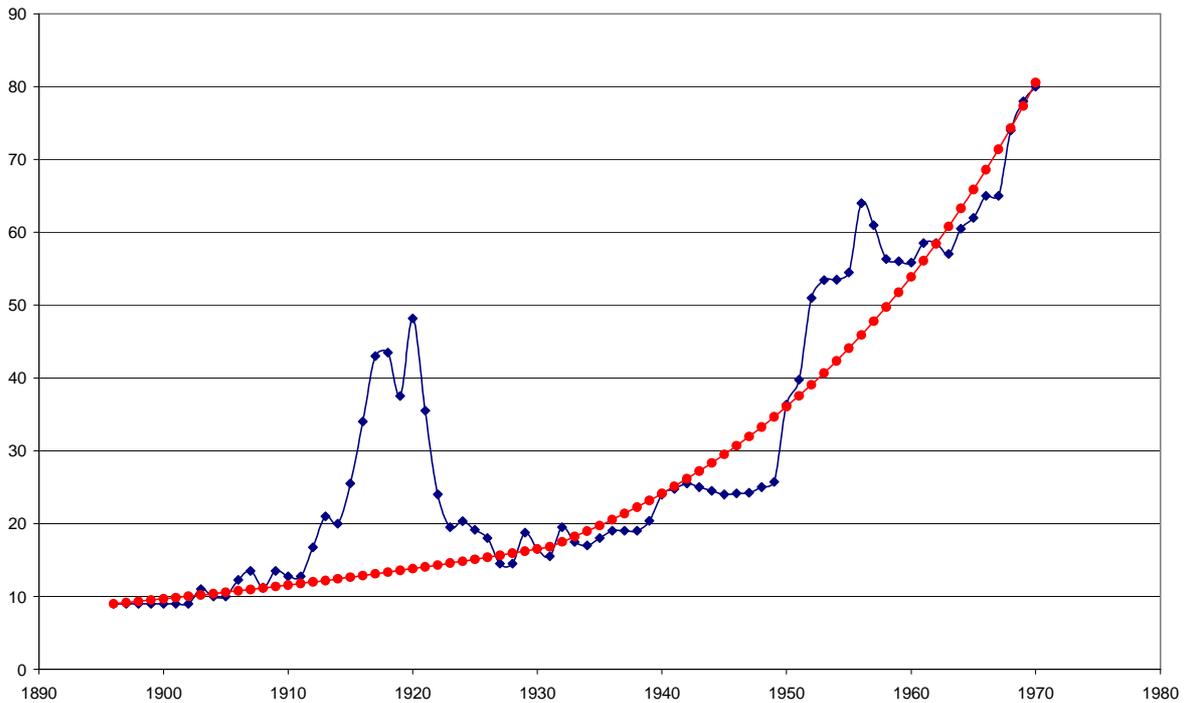


Fig 1: UK Petrol Prices 1896 - 1970

Figure 1 shows that the mathematical curve is based on an incremental stepped (hyper) exponential curve, where from 1896 to about 1932 the annual increase was 1.8% pa but from 1932 the annual rate step-jumped by 2.30 % to a consistent 4.1 % pa onwards to keep alignment with the historical values through to 1970.

In reality, petrol prices since 1932 have tracked much closer to 4.1% pa compound.

This mathematical fit covers more than 70 years with two distinct exponential values over two distinct nominal 40-year intervals that accurately tracks and predicts supply and demand into the future using this nominal 40-year interval.

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### ***Tracking the Price of Petrol 1970 – 2004***

The next phase of this price tracking is from 1970 through to 2004, as shown below in Figure 2, where again the AA Motor Trust prices can be matched very closely by an exponential relationship based on a starting value of 60 and with a step ratio of 1.065 or 6.5% pa.

This chart is quite interesting because the annual rate of increase in petrol prices is about 6.5% pa where before 1970 the rate of increase was about 4.1% pa before 1970.

The problem is that more people, businesses, countries and industry are using petrol / diesel / plastic products and concurrently, the oil resource is becoming far scarcer. This compounding demand on a reducing (or more expensive supply) is forcing the prices up at a much faster rate than in earlier times.

Oil is no longer readily available as a “gusher”, the North Sea Oil area began to dry up and give gas, off-shore drilling is now commonplace and frankly, oil is becoming far more expensive to find and produce.

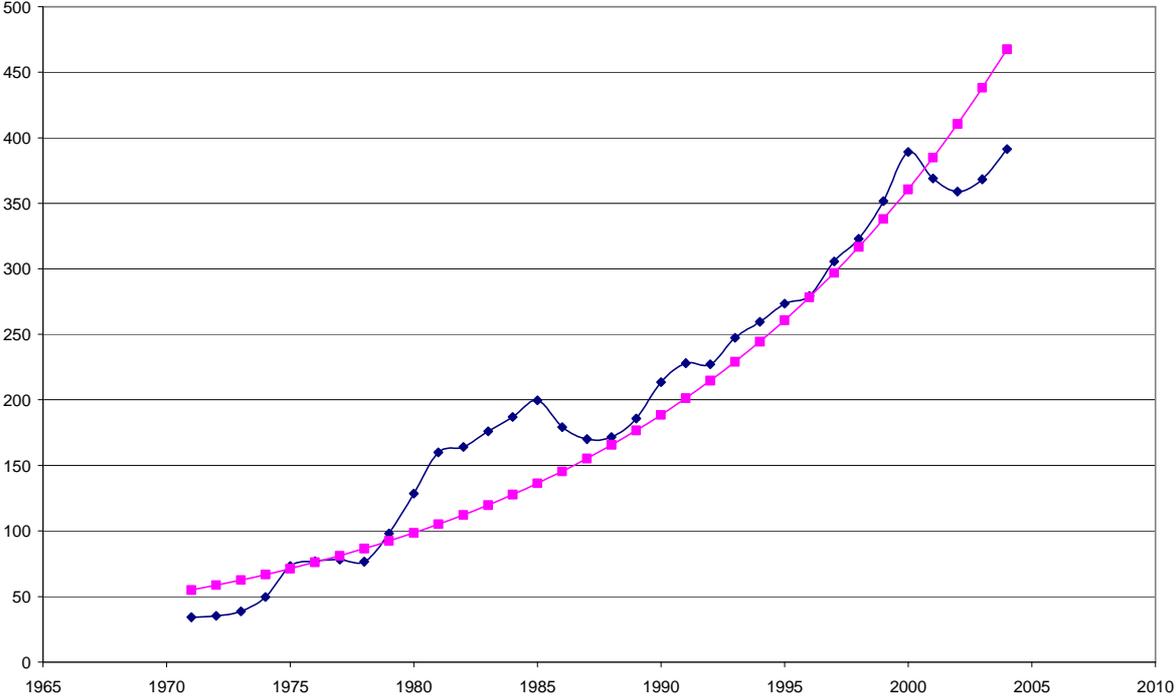


Figure 2: Oil Prices in the UK 1970 - 2004

Looking more closely at the chart above, the highs and lows as before align with “oil wars”, economic depression and world economic restructuring.

Another very well credentialed reference<sup>3</sup> pulls no punches in explaining where the current and future oil supplies were and are now, and why the supply of oil is fast becoming very scarce.

Moving to the focus Australia (Sydney), the UK figures were normalised to Sydney prices from about 2000 and plotted on the same chart as the estimated pump prices from a more “economically-based” reference<sup>4</sup>.

On top of these two sets of figures, two exponential mathematic estimations, like error bands (both set on only 6.5% pa) were included. Even then, the new reference estimated pump prices are considerably (optimistically) lower than the lower boundary math fit curve by about 30%, but tracks the exponential 6.5% pa math fit growth.

Considering this reference is highly conservative, is relatively short-term; it too quickly comes up with a 6.5% pa future price rise, which is in alignment with the UK and Sydney pump pricings. It is no surprise that these rather conservative calculated prices are also in the order of 2.5% pa below the historical longer-term exponential trend that I have extrapolated into the future.

<sup>3</sup> “Why Your World is About to get a Whole Lot Smaller”; Jeff Rubin; Random House Canada; 2009; ISBN 978-0-307-35751-9

<sup>4</sup> [http://www.atrf.info/papers/2010/2010\\_Gargett.pdf](http://www.atrf.info/papers/2010/2010_Gargett.pdf)

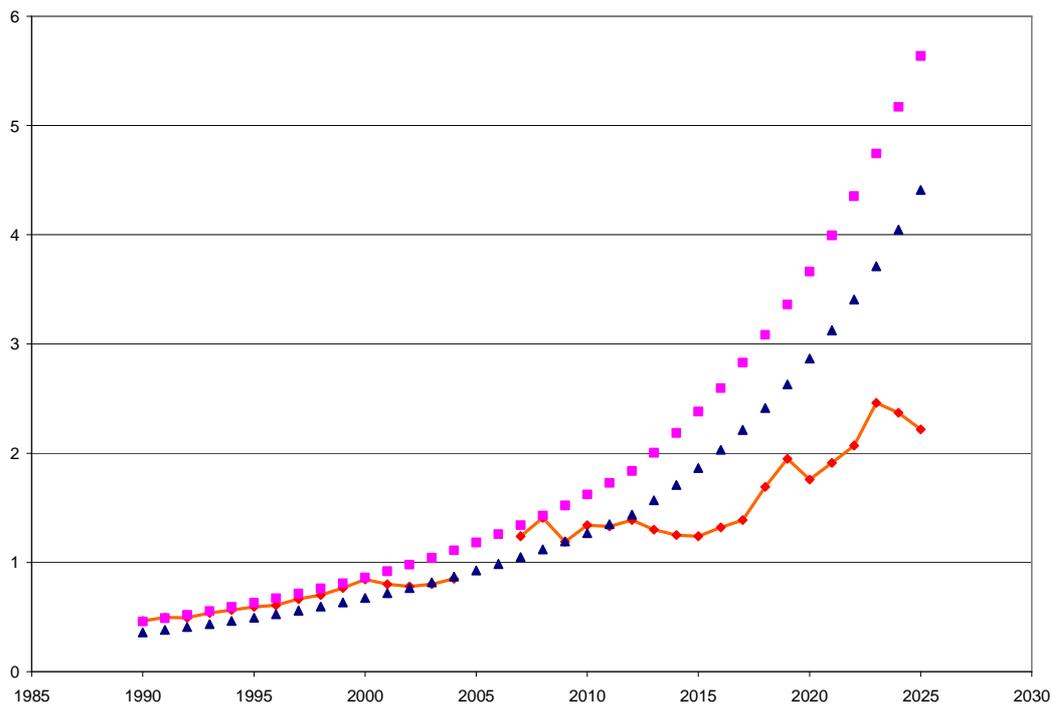


Figure 3: Conservative Estimated Petrol Prices in Sydney 1990 – 2025

So, not only is the oil / petrol price rising at an exponential rate, but the rate factor is also increasing at an exponential rate too! So, in effect, the oil / petrol price is rising at a hyper-exponential rate, and this is a reason for a very major concern.

### ***The Rise of China***

As China continues its development, it has now (2013) become the largest vehicle manufacturing country in the world, and concurrently is now becoming the largest user of petrol / oil in the world. This massive increase in the demand for oil products has caused the cost of oil-based products to rise significantly higher than ever before, aggravating the situation where the price for petrol is now conservatively rising at about 9 % pa where before it was about 6.5 % pa.

### ***Reconstructing the Petrol Price Rate***

As demonstrated earlier, the petrol / diesel / LPG pump price rate is rising on the longer term at a hyper-exponential rate, where the exponential term itself is “step” rising with time, and it is fully expected to continue to do so in the future – and with many externality consequences that I believe have not really been thought out beyond the immediate short-term of a few years.

Year In	Year Out	Year Range	Annual %	Increase
1896	1932	36	1.8 % pa	
1932	1970	38	4.1 % pa	2.3 % pa
1970	2012	42	6.5 % pa	2.4 % pa
2012	2052	40	9.0 % pa	2.5 % pa

The chart in Figure 4 shows the hard incremental steps that the petrol price has taken in the past from 1896 through until 2013. Each of these steps is about 40 years apart and each of these steps is about 2.5 %.

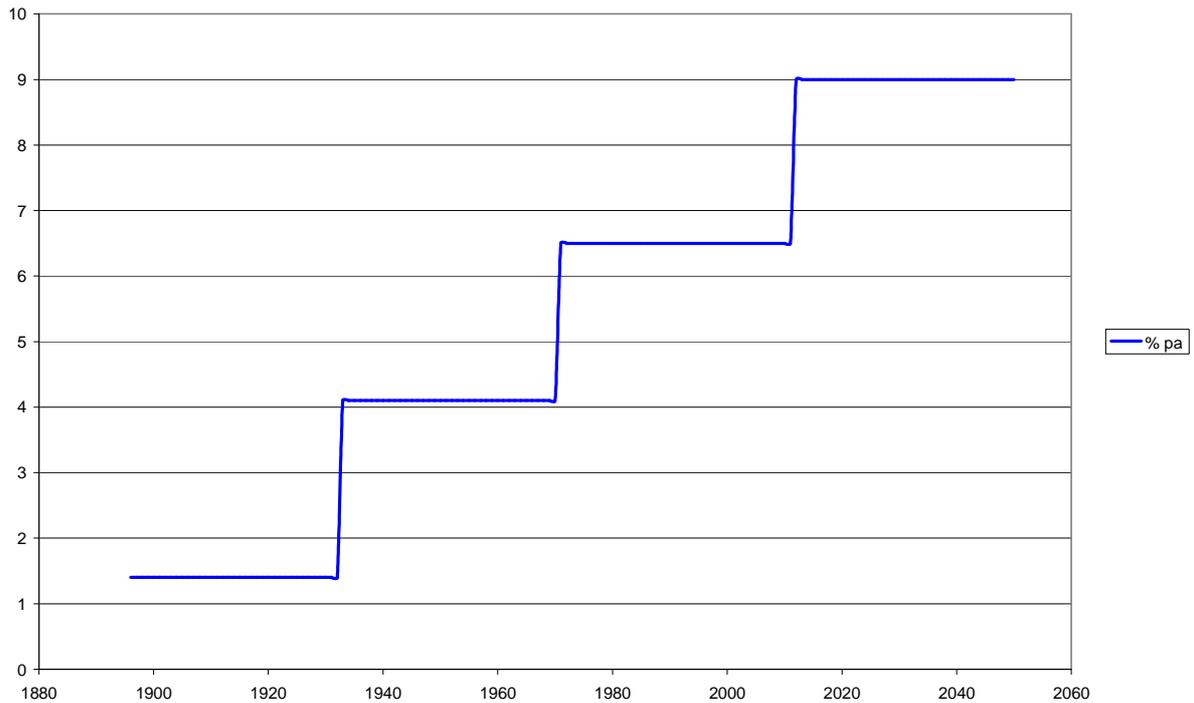


Figure 4: The Historical and Expected step “% pa” for Petrol / Diesel / LPG

After 1970, the annualised UK petrol price rate step-increased from 4.1% pa to about 6.5% pa and that compound exponential rate remained consistent until 2012. Since about 1970 the rate rise in Australia was not in line with the UK because politically and economically, Australia stepped away from the UK / Europe and Australia became more attached to Asia, but this is a global issue.

The underlying problem is that as China and India become major powers in the very near future (2014 – 2038), their oil requirements will clearly outstrip much of the earlier “Western World” and this shall push up the demand for oil such that the next expected increment is starting in 2013 and I believe the new rate will be in the order of 9% pa instead of 6.5% pa, and this explains the next step in Figure 4.

The chart in Figure 5 shows what I believe the Sydney petrol prices will really be in the range from 2000 to 2045.

It does not take a rocket scientist to realise that at some time in the not too distant future that the petrol / fuel costs will be so expensive that the general public will not be able to afford to purchase these fuel products as they have been doing so for more than the past century. Aviation fuel is more expensive than car petrol!

Currently (August 2013) the cost of car petrol is in the order of \$1.50 per litre (more expensive than milk), and a car typically runs about 10,000 to 15,000 km per year. Considering that most cars are run in metropolitan areas, then the average fuel usage is in the order of 10 to 15 litres per 100 km.

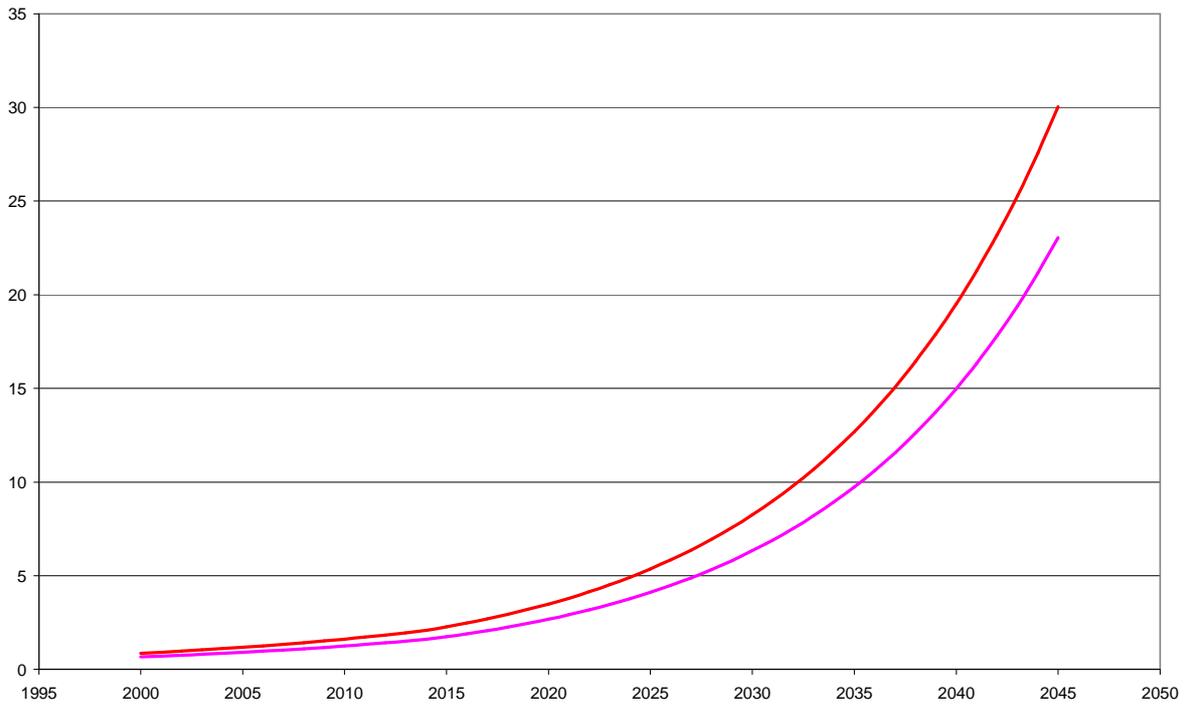


Figure 5: Estimated (upper and lower bounds) Sydney Petrol Prices as \$ / Litre

If a conservative 12 Litres per 100 km were chosen then the average car fuel usage is about 1,200 to 1,800 litres per year, or about \$1,680 to \$2,520 per year/ per car.

Looking at this problem another way, the cost to fill a typical 50 litre car tank since 2000 through to 2020 will be like the figure below, and remember, the recent history matches reality, so the future is quite reliable!

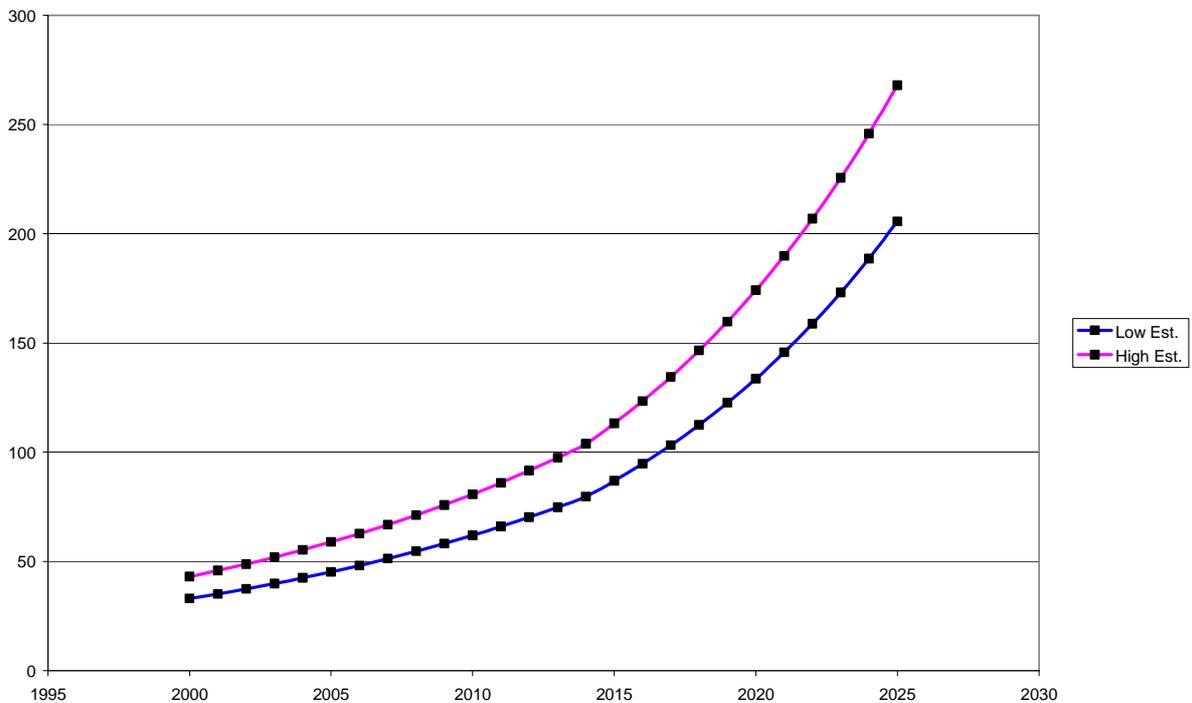


Figure 6: Cost to fill a 50 Litre Car Tank with Petrol

Assuming the average wage is currently \$60k pa, and is increasing by about 3% pa compound, then a conservative \$2,100 in petrol is currently about 3.5% or the before income tax.

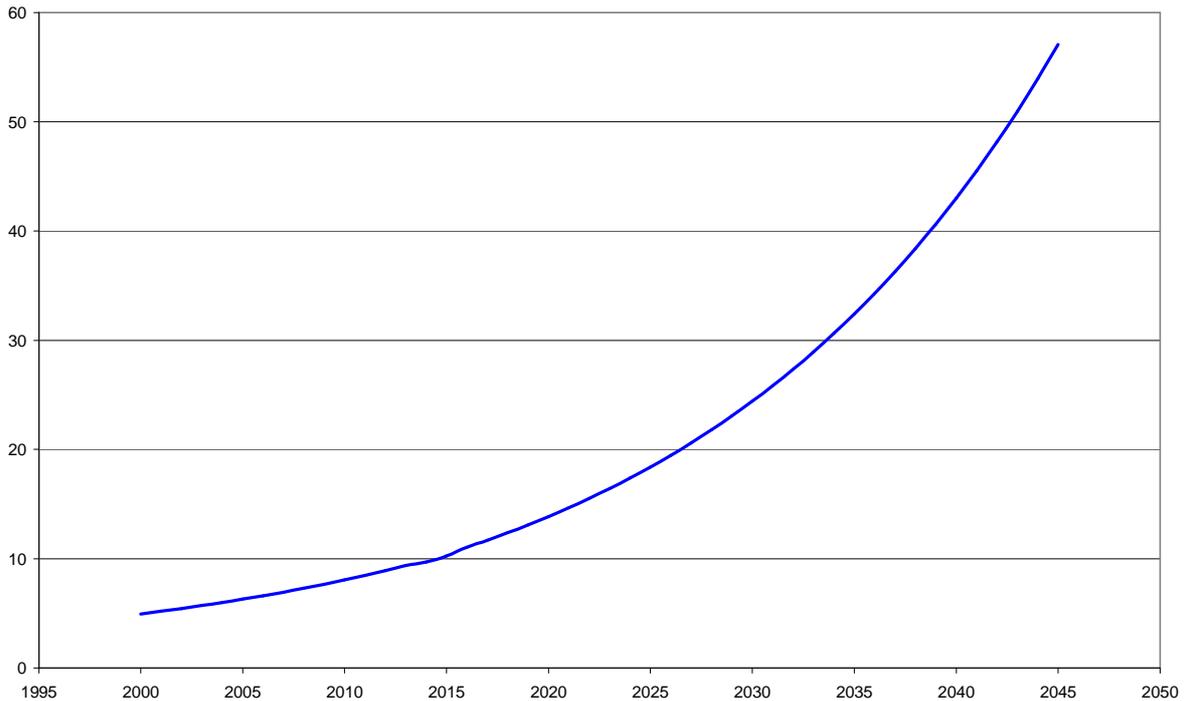


Figure 7: Estimated Percentage of after Tax Income spent on Petrol / Diesel

This chart is very telling, based on fact from earlier historical charts; showing that currently, the average cost of petrol per “working” person using a car in Sydney on an average wage, after tax – shown as a percentage of their available income.

### **Conclusions**

As petrol continues to rise in price at a rate far faster than inflation (and far faster than the average wage increases) in Australia, as we approach 2025 the average wage earner will no longer be able afford to use their car as they did before, especially if they are petrol or diesel fuel powered.

Structurally, vehicles will have to change to (liquid) LPG, which is less expensive, and this will give a breathing space in time until about 2020, and then LPG will also be too expensive to pay for and still have money to pay for food and rent / mortgage, education, and clothes.

*Note that in 2012/3 Orbital Engineering in Perth were contracted by Ford Australia to optimise their vehicle engine to use liquid LPG. This technology proved very successful and now Ford Australia is to close down. Considering the Green Car Initiative Fund (CGIF) is/was sponsored by the Australian Federal Government, all new and imported cars should be legislated as from a feasible date by the Australian Federal Government to run on only LPG.*

Car assembly factories in Australia will cease to be assembling petrol / diesel / LPG cars, and they will move to electric/LPG hybrid plug-ins. Even then, these 4-stroke hybrid plug-ins are too expensive, and the engines are too large/heavy, and the car assemblers will have to opt for a highly efficient 2-stroke engine, for example the

CITS<sup>5</sup> engine (an Australian invention); running on LPG to keep the weight down, the power up and the carbon emissions really low. *Where is the Green Car Initiative Fund (CGIF) support to fund this initiative?*

The synergy with electric-powered vehicles is inexpensive and clean electricity. Since about 1990, the Australian Governments have mindlessly sold off our electricity infrastructure to the private sector. The privatisation mindset has dropped all long-term planning, dropped all preventative maintenance, kept minimum repair crews; and these greed policies are now showing disastrous consequences.

Apart from more frequent “unexpected” substations fires caused by nil preventative maintenance, bushfires caused by faulty aged insulators, exceedingly high costs for incidental poles and wires that should have been long-term budgeted etc; this infrastructure is now fast running down to such a low level of reliability that the cost of restoring this infrastructure for the long term to power electrical vehicles (including Cars, Trams and Trains) will again have to be picked up by the Australian Federal Government to again cover the costs that investors should be paying for.

The privatisation mindset is totally focussed on maximising the Return on Investment (ROI) for its shareholders and as such will continue using coal-fired power stations irrespective of the pollution caused to produce “base load” (24/7) electricity.

Australia has an immense amount of Natural gas, which is intrinsically far cleaner than coal and gas-fired 24/7 power stations would be ideal in Western Australia and the Northern Territory – utilising the off-shore natural gas resources.

The obvious alternative clean power generation fuel is to use Uranium / Thorium instead of Coal or Natural Gas, and Australia is also blessed with massive supplies of these minerals. Several decades ago, Australian technology developed a very safe way to chemically and physically stabilise used Uranium, and Australia has plenty of geographically stable open cut mines where these materials could be very safely returned (on a world basis) at a commercial price. Unfortunately, Thorium energy conversion technology is deliberately stifled worldwide by the larger military powers, because the by-products do not create nuclear warhead materials.

Because of Australia’s large size, about six or seven 20 GW nuclear-electric plants could be very economically and safely established about 400 – 600 km inland and have very low loss 1 MV DC feeds towards the coast where DC to AC conversion work then very economically distribute stable electricity to the Grid.

As and when petrol / diesel prices start to really cripple Australia’s economy, the Federal Government will have to step in (over the privatised infrastructure) and take over management of Australia’s electricity generation and distribution infrastructure.

This change in policy will happen such that by 2035 electricity will be far more available and far less expensive than petrol in Australia. If the price of petrol well exceeds the established expectations in this paper, then the Australian Federal Government will have to nationalise the electricity generation plant and grid by about 2020, if not before.

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<sup>5</sup> <http://citsengine.com.au/>

The other alternative is that car usage will significantly drop and public transport using trams, busses and trains will significantly increase – but again the Australian Federal Government is thinking in very short term (three-year re-election timeframes) so this alternative infrastructure is not being considered as it is not short-term re-election material (just yet).

By about 2025, long-distance (i.e. greater than 50 km) heavy transport by highway road freight using diesel will literally become a memory of the past as it will be far too expensive to fuel, so inter-city / inter-state Road Freight will be very uneconomical.

Main highways will very quickly become the immense white elephants of the future because road freight between major capital cities will simply become highly uneconomical.

Already the main roads / highways are breaking up due to the weight and speed of the current B-Double vehicles inflicting on these highways. If these road transport businesses had been charged an equitable fee for the damage caused by their vehicles, then this transport would have moved to rail more than a decade ago. There is therefore systematic Government corruption to ensure that these equitable road maintenance fees are not raised and/or charged on the trucking businesses.

Road transfer of Freight by Containers / Bulk goods and materials will be very expensive and Rail will become the main goods and materials transfer medium. Again the Federal Governments are not thinking forward past the next three-year election cycle – so Fast Freight Trains with reasonably straight line trajectories have not even been considered, let alone having the planned corridors isolated.

With Airline transport of passengers and goods, the problem of rapidly rising Aviation fuel is a major sticking point. In the recent past, the passenger airlines have deliberately raised their passenger fees based on the increase of Aviation fuel.

The Airline industry is going through a worldwide number of mergers and alliances to minimise overhead costs. As the cost of Aviation fuel continues to rise at a rate far exceeding the average Australian wage (or the Australian inflation rate – take your pick), the percentage of people / businesses that can afford to fly in future years will be sharply curtailed.

By about 2025, the price of flight will literally double, (200% of what it is now) and by 2037 the cost of flight will literally double again (400% what it is now) meaning that about 85% of the current people that fly will simply not be able to afford to fly.

The Melbourne – Canberra – Sydney route has a massive use by Air, Road and Rail, but within a decade, the Air and Road routes will become too expensive for most people / businesses so Rail and videoconferencing will dramatically increase, so multi-room teleconferencing will become standard practice.

It is exceedingly obvious that a fast Rail (electrical) service is urgently required initially between Sydney and Canberra. This infrastructure (service) will no doubt be almost immediately be extended to connect Melbourne / Geelong / Ballarat.

With Rail Freight travelling at nominally 200 km/h, this is twice the speed and half the time of existing Road Freight vehicles. Comparative diesel Rail Freight consumes

about 25% that used by B-Doubles, electric Rail Freight uses no diesel. As the diesel price rises Road Freight will become local delivery at Inter-modal Terminals.

With Rail Passengers travelling at nominally 200 - 300 km/h with fast electric trains, this is twice to three times the speed of road vehicles (or half to a third the time to drive) and using no diesel; the use of the Hume Highway will dramatically decrease.

Rail Passenger loading / unloading times will be dramatically faster than at Air terminals, saving in the order of 30 to 90 minutes each end; so even though the Passenger Rail electric trains may be twice as slow as an Air Passenger flight the overall trip door-to-door will be about the same time, but not use petrol at all.

In other words, the need for a second Sydney International Airport is now totally unfounded as that would be another immense white elephant by about 2030 or even before then as the world supply of oil continues to dry up in the next decade.

In a similar vein, putting in a road extension off the M7/M2 under the trajectory of Pennant Hills Road to join the M3 (Northern Freeway) is again very short-term thinking, because by about 2025 the cost of diesel fuel will be so high that inter-state Road Freight will be totally uneconomic, and this an extension off the M7/M2 under Pennant Hills tunnel will be yet another White Elephant.

Alternatively, the Sydney Basin Rail Bypass<sup>6</sup> would Fast Rail link Campbelltown to Hornsby (44 km). At an average speed of say 150 km/h this takes less than 18 minutes. Currently the Road Freight trip from Campbelltown to Hornsby is about 74 km via the M7/M2/Pennant Hills Road and on a low traffic Sunday takes about 57 minutes to traverse. Typically this road time is well over 90 minutes in peak hours.

The Sydney Basin Rail Bypass would clear Pennant Hills Road, M7, M2, Hume Highway, and Pacific Highway of Road Freight vehicles, remove most of Australia's east coast dependence on diesel fuel, and provide the starting corridor to build a fast Rail connection north of Sydney towards Brisbane and Darwin, and south of Sydney towards Canberra / Melbourne.

Innovative Synergies

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<sup>6</sup> <http://www.moore.org.au/senh/2012/20120809%20Sydney%20Basin%20Freight%20Rail%20Link.pdf>