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Submission to the Inquiry into Australia's future oil supply and alternative transport fuels.

Introduction

With this submission I would like to introduce the idea that the oil supply problem of Australia and alternative transport is not an isolated problem. Too often the problems of climate change, future energy supplies and Peak Oil are thought of as different problems that need different solutions. My submission is that they are coupled and solution of one, Peak Oil and Transport, has far reaching effects to solving Australia's future energy needs without risking climate change.

The Problem

It would seem that people who think Peak Oil is going to be a near term problem are wrong and there is plenty of oil. The only major problem with this is that it is pure fantasy.

So lets start with absolutely known reserves. Here are a couple of links.

The Physics Fact book [1]that compiles quite a few different sources and gives the mean value of all these estimates to be about 950 billion barrels of oil. All these estimates include the figures from the Middle East. Around 1985 when oil quotas were set to be proportional to the countries known reserves then this happened from this article.[2]

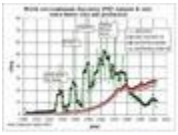
"Previous OPEC estimates, inherited from private companies before governments took them over, had probably been conservative, P90 numbers. So some upward revision was warranted. But no major new discoveries or technological breakthroughs justified the addition of a staggering 287 Giga barrels. That increase is more than all the oil ever discovered in the U.S.—plus 40 percent."

So there is possible 280 billion barrels of this number that are imaginary as the true reserve figures of Saudi Arabia, Kuwait etc are not audited and even closed to Exxon-Mobil.

Now if Exxon-Mobil think that there are 3000 billion barrels of oil left then they must be estimating the yet to be discovered resources as 2000 billion barrels. If the oil reserves of Middle Eastern countries are over estimated, as

Kuwait's were recently was exposed [3] to be, then that figure could be over 2200 billion barrels yet to find.

Now the largest oil field yet discovered is Ghawar in Saudi Arabia. Ghawar had about 120 billion barrels and about 60 or 70 billion barrels remain. The figure that Exxon-Mobil want you to believe is the the ultimate oil reserve represents discovering 16 Ghawar size fields between now and 2030.



This data was compiled from known oil data and you can clearly see that since the last field of 50 billion barrels was discovered in 1970 and none this size have been discovered since. Also it is immediately apparent that the rate of discovery has dropped from the peak in about 1965 and has been dropping ever since. So Exxon-Mobil is asking you to believe that they can turn around this 40 year trend and discover a Ghawar size field a year until 2030.

Peak Oil is not a conspiracy theory. It can be seen with simple mathematics and a bit of logic.

Climate Change, Energy and Society

The problem is partly this. I live in Australia. I have a 4 bedroom brick house in the suburbs and a reasonable income. Food is plentiful and cheap. I can go to the local store and afford to buy enough high quality, safe, hygienic food to keep my family very well fed. My house has hot and cold running water, electricity, phone and Internet. I have an evaporative air-conditioner that keeps my house beautifully cool in the summer and I have a small heater to keep us warm in the winter. If the air-conditioner is not enough I have a swimming pool. If I or a member of my family gets sick I have access to incredible quality health care at very low cost as we have Medicare and if I need medicine I can purchase virtually any medicine that modern technology can provide at nominal cost through the Pharmaceutical Benefits Scheme. For transport I can afford to run a car and drive anywhere whim takes me anytime. If I do not want to run the car I can take efficient cheap public transport.

Here are some statistics.

1.3 billion people live on less than one dollar a day;
3 billion live on under two dollars a day;
1.3 billion have no access to clean water;

3 billion have no access to sanitation;
2 billion have no access to electricity.
Source (James Wolfenson, The Other Crisis, World Bank, October 1998)

Number of children in the world 2.2 billion
Number in poverty 1 billion (every second child)
Source (http://www.unicef.org/sowc05/english/index.html)

20% of the population in the developed nations, consume 86% of the worlds goods.
Source (http://hdr.undp.org/reports/global/1998/en/)

A mere 12 percent of the world's population uses 85 percent of its water, and these 12 percent do not live in the Third World.
Source(http://www.foodfirst.org/pubs/backgrdrs/2001/s01v7n3.html)

Now here in Australia and the US and much of Western Europe my lifestyle is quite normal. Most people in Australia live much as I do. If my hot water stops working then this is a big problem to me. If the electricity goes then I scream blue murder. Most people I know have a dishwasher. Is getting up from your evening meal and spending 10 mins washing dishes so hard that we need to install a machine that uses heaps of hot water, gobs of electricity and dangerous corrosive chemicals???

As can be seen from the statistics I quoted most of the worlds population does not live like this. Most do not have access to water let alone running water. A significant proportion do not have power, access to health care or access to cheap safe food. People in Australia consider themselves poor if the cannot afford the latest plasma TV. The basic functions of water,food, health care and power are taken totally for granted. Even the poorest person in Australia is still well off compared to people in poorer countries. A comedian on the Glass House summed it up. He said "I have a 20 GB iPod that stores 20 000 songs yet when the new one comes out that can have 40 000 songs on it I feel like crap"

When it comes to mentioning that we need to reduce our energy demand I run into this brick wall. We are so comfortable in our consuming lifestyles that we will not change. No-one will take our dishwashers, air-conditioners and plasma TVs. We do not see the people living in poverty in other countries. We only see similar people in Australia who have a plasma TV so we are of course poor because we do not have one. Any attempt to talk about energy use reduction is howled down because this would reduce our living standards. The fact that our living standards are unsustainable and costing use the Earth is immaterial - we do not or will not see this.

This is the response to a attempt to increase the fuel mileage requirement for American cars.[4]

> “But committee Democrats from Michigan, where the auto industry is based, said Congress can't mandate what type of automobiles Detroit should make.
>
> "People are driving around in big cars, because they like them, because they feel safe," said Democrat John Dingell of Michigan.
>
> Opponents to the amendment said higher mileage requirements would force automakers to produce dangerous, small cars to meet the stronger fuel standard.
>
> "You'll never get your soccer moms and soccer kids in there," said Democrat Bart Stupak of Michigan, referring to the feared subcompact vehicles. "It's not what Americans want."”

Now we face some problems for the future.

Burning fossil fuels is raising the CO2 in the air causing Global Warming with consequences that we cannot predict. Most of the world’s population does not share in this energy bonanza. However because of possible climate change and sea level rises this poor 80% will probably bear most of the burden of any change in the climate. We cannot predict any of the potential problems however we are going to do it anyway.

We are facing a Peak in our easy energy supply - oil. We are using 80 million barrels a day of this non-renewable and finite resource and this rate of consumption is increasing every day. The result of this is that the oil that we base our mobile society on will become firstly expensive as demand exceeds supply then scarce as the main oil fields are depleted and damaged due to over exploitation and finally non-existent as all recoverable oil is used up. We are using up this easy energy so no-one else will have it and we are going to continue to do this anyway.

One solution to this problem according to some people is to build thousands of nuclear reactors to power our society. This is despite that fact that we cannot conceive of the time scales that nuclear waste remains harmful for, we cannot secure the facilities from a determined attacker or guarantee that there will never be an accident. What will happen is that we will leave millions of tons of harmful waste for later generations to dispose of. We are going to do this anyway.

Another solution is to continue burning coal but sequester the CO2 underground. This is despite not being able to predict the long term future of the CO2 storage structures. This could result in the billions of tons of CO2 that we would have to store escaping in to the atmosphere at some later time to hazard the climate of future generations. We are going to do this anyway.

These schemes that pose such a dire threat to people living and not yet born, are going to happen so that 20% of the worlds population don't have to give up one thing in their lifestyles. Don't kid yourself that the remaining 80% will get any of if. No Nuclear reactors will be built in their counties as they are not 'reliable', democratic nations like the USA. They will remain in poverty because we do not have the 3.6 planets required for them to enjoy the same standard of living as ourselves.

In the light of this does it seem reasonable that we will not give up some of our luxuries? It does not have to be much: more efficient fridges and air-conditioners or take the bike to work. If we do this we can reduce our energy use into the 'capture' range of renewable power. Reducing oil dependency means that we can reduce our spending on oil and more on cancelling third world debt. Using renewable power means that we can limit Global Warming to 2 degrees and avoid the poor countries from being flooded or their climate changed so that they cannot grow food. Mind you climate change will affect us just the same but because of our vastly greater share of world resources we have much greater capacity to cope with it.

Everybody in the developed world needs to take a long hard look at themselves and think about what they want from the future. There are 2 alternatives. One is to continue on with 'no regrets' as is the current policy and build hundreds or thousands of nuclear power stations and sequester CO2 to preserve our lifestyles. This could result in future generations having to clean up our mess. Or we can realize that our lifestyles are unsustainable, reduce our energy use and use renewable power. This sustainable model can then be exported to poorer countries so that they can raise their standard of living without needing extra planets.

The Solution - Fix Transport First

My idea of the future of Australian transport is a model mainly based on electric transport in the form of Battery Electric cars and Plug in Hybrids. Electricity is a far more efficient energy carrier than hydrogen and has the enormous advantage of being presently reticulated to every home and business in Australia that is connected to the grid. This is not true of hydrogen without spending billions of dollars in infrastructure. Some of the liquid fuel issues can be helped with ethanol or coal to liquids. Also battery electric cars and plug in hybrids are ready and on the road now. Practical hydrogen fuel cells cars are at least 10 years and 2 or 3 technological breakthroughs away

My model is this:

1. Use battery electric cars
2. Use plug-in hybrids running on ethanol or other alternatives.
3. Limit alternative fuelled IC cars to less than 10% of the fleet.

1. Battery Electric Cars - Battery Electric Vehicles (BEVs) have come a long way recently. Lithium batteries, that are currently used extensively in portable devices because of their high energy density, can be made large enough to power an electric car. Also with advances in Alternating Current electric motors and controllers electric cars can be made that can go 100km on just 10KWHrs. A 18 KWHr Lithium Ion battery pack with production Lithium batteries from Thunder Sky would weigh just 120Kg and power such a car for nearly 200Km. A small car with Lithium batteries drove non-stop from Los Angles to Las Vegas, a distance of 300 miles, at normal highway speeds.

Now the problem with electric cars is range and the power that needs to be generated to power them. I mean it is no good having electric cars if power is generated from coal. And everyone has to have a long range - or so they think. Firstly in Australia in 1995 55% of all car trips were less than 5km. I submit that at least 80% were less than 50km all of which would easily be accommodated by a small electric car. The other point about generating capacity is a valid one. We have to reduce demand to allow renewables to power our society however electric cars can actually facilitate renewable power by providing a spinning reserve for the renewable grid and therefore provide a service rather than being a drain.

An AC electric motor needs a electronic controller to change the DC in the batteries to AC to power the electric motor. This controller also varies the speed and torque of the motor. Typically an AC controller for an electric car is 25 or 30 kW. This controller with slight modifications can easily provide 240V AC power for feeding into the grid when it is plugged in. A test of this has been carried out and can be and it does work in practice. What this means is that if there were millions of electric cars with 18kwHr batteries then this represents an electricity storage that can supply power to regulate the grid and make renewable power more reliable.

In 2004 there were 10,629,401 passenger cars in Australia. Lets replace 30% of them with electric cars 10 629 401 cars X .30 = 3 188 820 battery electric cars with 25KwHr battery packs. This represents, if say 40% of them were plugged in at any one time (statistics can predict quite accurately how many should be plugged in at any one time and we use about half of the charge), 3 188 820 cars X .4 * 12 kWh = 15 GWh at any one time that the grid can draw on. This is a massive amount of power that can smooth out transitions due to wind turbines dropping in and out. The problem is to charge all these cars. We currently use about 225 000 GWh a year of electricity. Having about 3 million electric cars would add 3 000 000 cars X 12 kWh = 36 000 000 kWh - as they would not always need a full charge. If you assume 1 charge per day then 36 000 000 kWh * 365 = 13 140 GWh

So in a year they would add about 13 000 GWh to the electricty bill which is about 5%.

2. Pluggable Hybrid Electric Vehicles - Pluggable Hybrid Electric Vehicles is a mouthful that I will heretofore refer to as PHEVs. A PHEV is a hybrid electric car like the Toyota Prius or Honda Civic Hybrid that can be plugged into the electricity grid for recharging. Currently the only way a present hybrid car can recharge its batteries is with the IC engine. A group has modified a standard Toyota Prius with a bigger battery and a charger so you can plug it into a wall socket and charge the batteries. The upshot of this is that if you are commuting or travelling less than, say 50km, then this can be done totally on the electric motor and the engine need never start and you will not use any petrol. When you get home the car will recharge from your home power supply ready for the next trip. If you only do short trips you may not have to buy petrol for months. However the instant you need to drive for longer the IC engine is there so the range of the car is unlimited - almost the perfect car. Soon these will be coming onto the market.

Now the IC engine of the PHEV does not have to run on petrol, it can be made to run on Ethanol. The big advantage is that because the effective fuel consumption is greatly reduced by being a hybrid, less ethanol would have to be produced to meet demand. If you read the update in my last post you can see it would need 4 times the grain growing area available in Australia to grow enough grains to produce enough ethanol to replace petrol. This is clearly out of the question so the PHEV solution coupled with pure battery electric cars could make the difference.

Australian cars travelled 201,497 million kilometers in 2003. Assuming that we can replace 50% of the remaining IC cars with PHEVS then they will travel 201 497 000 000 km X .5 = 100 748 500 000 km. In doing so they would consume 100 748 500 000 km /100 * 11 = 11 082 335 000 liters of fuel. (assuming the national average fuel consumption is 11litres/100km)

We have already substituted 30% of IC cars with electric cars so the total fuel use of 26 400 000 000 liters would be reduced by 30% to 18 479 999 999.7 million liters. Now if the hybrid cars had an effective economy of 1.0 liters/100km then these cars would only use 100 748 500 000 km /100 X 1.0 = 1 000 748 500 liters of fuel saving 10 081 586 500 liters of fuel. The total fuel requirement would be reduced to 18 479 999 999.7 liters - 10 081 586 500 liters = 8 398 413 499.7 liters.

700 liters of ethanol can be produced in Australia from a hectare of grains then:

Fuel required	8398413500	liters
Energy in 1 l petrol	9.5	kWh/liter
Energy in 1 l Ethanol	6.5	kWh /liter
ethanol required	12274604346	liters
Mix of Ethanol	0.8	
Amount required	9819683477	

Yield of Wheat per Hectare 2 tons/hectare
Yield of Ethanol from Wheat 336 liters/ton
Amount of energy required 39892.46
Amount of Ethanol per Hectare 672 liters
Amount of Land required 14.61262422 Million Hectares

This is still more that all the land area currently devoted to wheat just on fuel. Even using this amount of hybrid and electric cars we would have virtually no land to grow wheat. This could be supplemented with coal to liquids. Currently unproductive land that we cannot grow crops on could be used with other plants that still yield ethanol. If these plants could be salt tolerant then this could re-rehabilitate land that has become saline so a double benefit could be gained. Also there are an estimated 456 million hectares of land in Australia under agricultural activity so the area required for Ethanol production is about 3%. These PHEVS would have smaller batteries and would be charged less. Estimating that they would have 10KwHr batteries they would use 5 000 000 X 6 kWhs = 30 000 000 kWh. One charge every second day would be 166 days * 30 000 000 kWh = 4 980 GWhs - again a small percentage of the total.

All these cars would also be plugged into the grid at some time so they could contribute to the spinning reserve. Another benefit is that when the PHEV or BEV is plugged in at home, and the grid electricity fails, it can power your house. So you need never have a blackout. Also businesses could use the electricity stored in the cars in its parking lots to power the business when the grid fails. This would result in far less downtime. Imagine if the grid was down for an extended time and all the food in your deep freeze thaws. For a business this could be thousands of dollars worth of food. The PHEVs and BEVS in the car park could keep the freezers going and save the business money. Also because the PHEVs and BEVs are chargeable from external sources, local renewable power can charge then directly. If you have solar panels on your roof then these can charge the batteries so you need never buy power if you have enough panels. Roofed parking lots could have solar panels or wind generators fitted and charge cars while they are parked generating more revenue for the parking lot and saving loading the grid.

The enormous storage potential of electric cars plugged into the grid and able to contribute to it will be the enabler that renewable energy needs. Right now when the wind is not blowing and the sun is not shining fossil fuel generators are needed to fill the gap. With the storage provided by electric cars renewable energy no longer needs this as it can use the stored electricity in a smart grid comprising millions of cars to get over the lulls and uncertainties of renewable power. The car owners would be paid peaking rates for this power and the cars would communicate their state of charge and other parameters via communications over the mains power.

3. **Limit ethanol fuelled IC cars to less than 10% of the fleet**. - this is the one that really needs enforcing. There is nothing that a PHEV hybrid cannot do that needs a fully ethanol fuelled car or truck. Trucks will greatly benefit from hybrid technology. Right now they use diesels because diesel fuel has a higher energy content than petrol so less is used. With that though diesel engines are heavier and emit more particulates that are difficult to screen out. We can make bio-diesel but why should we? If we are going to go to all the trouble of replacing most of our fuel with ethanol then why make two fuels when one will really do.

Trucks and heavy vehicles, as far as I know, use diesels because of their reliability, low fuel use, and their low down power. Reliability comes from the fact that a diesel must be really heavily built so usually it becomes more reliable just by virtue of being built better. With an electric hybrid system the torque and power characteristics can be programmed into the controller so a truck can have all the torque it requires for heavy loads. Trains are diesel electric and they pull massive loads. If the engine was a heavy duty, turbocharged, alcohol fuelled spark ignition engine then this could run at a constant speed to supply power for the batteries and drive the wheels at above 40 or 50 Km/hr so it would not need low down torque. The truck could be lighter conferring fuel economy savings and consume fewer resources to build. It would remove the need for distillate to fuel the transport fleet. Similarly tractors, farm machinery etc could all be hybrid electric. Most large mining machines are already hybrids so not much to do there. This would leave very few instances where a car or truck needs to have solely an ethanol fuelled IC engine.

Notice also that NO breakthroughs are needed to achieve this. ALL the technology that is required can be ordered from production tomorrow. The Lithium batteries are on now sale as are the controllers and electric motors. In the Hydrogen Economy there are Major breakthroughs are needed in many areas. You cannot buy a roadworthy PEM fuel cell stack or the 10 000psi tanks required to hold the hydrogen.

It may possible to replace liquid fuels in Australia with grown ethanol. The benefits would be greenhouse neutral transport fuels. We would have to modify our transport models as there would be no more V8 Commodores or Monaro's except in museums.

Conclusion

Solving Australia's Transport problems and cutting emissions can be done with a combination of:

1. Fixing Transport First
2. Aggressive demand management to cut down electricity use.
3. Fossil fuel base load (20% or 30%)

4. Renewable peak generation (70% or 80%)

1. By fixing the storage problem of renewable power with the daily commonplace transport of Australia you fix 2 problems. One is what to do when the world's oil production peaks and the other is reducing emissions. With this sort of plan we are entirely carefree about what happens in the Middle East and have convenient personal transport that we have grown used to AND be nearly 70% or 80% down on greenhouse gas emissions.

2. There exists a lot of waste and inefficiencies that can be reversed with taxes and subsidies. The problem is that we are subsidising the wrong things like the diesel fuel rebate.

3. Fossil fuels can continue to generate a base load. If we cut CO2 emissions by 70% then this is possibly a level that can be sustained. With a large increase in carbon sinks like re-forestation etc this could well be a sustainable level without getting us into the dangerous warming territory.

4. Renewable power makes great peaking generators. Solar power, both solar thermal and solar PV, is naturally at its peak at the peak demand time of the day. Geographically dispersed but connected solar thermal plants are ideal peaking plants that are idle during the night just like 50% or 60% of the large fossil fuel plants due to the fact that the peak demand can be 65% more than the base load. Even wind power has been found to naturally follow peak demand.

Most solutions to Peak Oil and transport do not recognise the fact that these problems are energy problems not just transport problems. Most, if not all, are talking about trying to band-aid up 19th century power technologies and topologies with more and more add-ons that will cost billions then take the CO2 and bury it for someone else to worry about. They do not seem to have the vision or courage to abandon these ancient and creaky ideas for really advanced technologies that paradoxically are ready TODAY to be implemented given the political will.

Sources

[1] http://hypertextbook.com/facts/2000/EvanAbel.shtml

[2] http://dieoff.org/page140.htm

[3] http://today.reuters.com/business/newsarticle.aspx?type=tnBusinessNews&storyID=nL20548125&imageid=&cap

[4] http://www.planetark.com/dailynewsstory.cfm/newsid/30362/newsDate/14-Apr-2005/story.htm

http://www.det.csiro.au/factsheets/demandside.htm

http://www.abc.dotars.gov.au/Publications_Resources/benefits_of_cycling.aspx

http://www.abs.gov.au/Ausstats/abs@.nsf/b06660592430724fca2568b5007b8619/00b05a9cee83a73dca2568a90013941c!OpenDocument
Motor vehicles in Australia travelled an estimated 201,497 million kilometres in the 12 months ended 31 October 2003. This is an increase of 16.4% (28,444 million kilometres) since the 12 months ended 31 July 1999 and represents an average annual increase of 3.9%.

http://www.aaa.asn.au/issinfo/fossil_fuels.htm
Cars in Australia consume on average 11.3 liters per 100km (1999). This is around 25mpg.

http://www.abs.gov.au/ausstats/abs@.nsf/e8ae5488b598839cca25682000131612/a89f51dcb5e2e31bca2568a900139429!OpenDocument
An estimated 456 million hectares or 59% of Australia's land mass was used for agricultural activity in 1999-2000. Queensland had the largest estimated land area in agricultural use, with 145 million hectares, or 32% of the national total, followed by Western Australia with 106 million hectares, or 23% of the national total.

The estimated area planted to crops increased by 2% to 23.8 million hectares in 1999-2000. The area devoted to sown pastures and grasses also increased, up by 6% to 23.8 million hectares.