



Briefing Paper

Meeting 14/8/2017

with Parramatta Administrator
Amanda Chadwick

Prepared by Matt Mushalik mushalik@tpg.com.au twitter @crudeoilpeak

Contents

Summary.....	3
Peak oil is not a theory.....	5
Historic peak oil events which changed the world.....	7
The 2008 oil shock – causes and consequences.....	14
Response: money printing and unconventional oil.....	16
Shale oil is an extra light oil with condensate.....	19
Unaccounted for oil.....	20
Declining Earnings.....	21
CAPEX reduction followed by next oil crunch.....	22
Peak shale oil.....	23
OPEC paper barrels.....	26
North Korea and Iran.....	27
Updated fuel import graphs.....	28
Venezuela.....	29
Saudi Arabia 2017.....	30
NSW Treasury has no idea about oil.....	30
Latest incremental crude oil graph.....	32
Debt Wall.....	33
Permanent impact of 2008 oil shock.....	34
Population and GDP.....	35
Transurban kicks debt can down the toll-way.....	36
Power consumption and peak demand.....	37
AEMO Scenario.....	39
Conventional Gas Peak on East Coast.....	40
CO2 emissions.....	41

Summary

Current growth plans by governments on all 3 levels are on collision course with the requirements to reduce oil dependency, electricity consumption and CO2 emissions. These plans are driven by an ambitious federal immigration program which generates 88% of population growth. It is thought that this will increase GDP. However, Australian annual GDP growth rates are now down to the same level as population growth rates caused by immigration such that GDP/capita is no longer improving. This is also plausible as Australia's economy is still resource dependent (12% of GDP). Royalties, direct and indirect taxes and other economic benefits from commodity exports are a function of global demand, not local population numbers. A growing population means therefore that these benefits per capita will decline. Given that this high immigration has caused the housing affordability problem, worsened congestion in all areas of infrastructure and increased debt levels there is no benefit in this perpetual growth plan, contrary to propaganda suggesting prosperity will grow.

Moreover, Sydney has reached its limits to growth. Example indicators for this are very clear: modern buildings like the Cambridge Business Park in Epping are being pulled down to make room for residential towers, containers are erected in school yards, road tunnels are built because roads are not wide enough, car parks are filling up and trains are at capacity in peak hours.

All the while the state government – pre-occupied with town planning in Sydney instead of state planning for the whole of NSW - is enjoying to play monopoly with developers instead of preparing the state (including agriculture) for the evolving oil, energy and climate crisis.

Global crude oil production started to peak in 2005 as the global oil supply system and Saudi Arabia in particular could not pump sufficient quantities of oil required by the world economy. Oil prices went up which caused the US recession in 2007. In mid 2008, China went on the oil market with an extra demand for the Olympic Games, an unfortunate timing because in summer Saudi Arabia burns additional quantities of crude oil for power plants. The resulting oil price shock caused the financial crisis. Mortgage re-sets and \$4 a gallon petrol prices in car dependent US cities were the trigger. Insufficient oil flows at any given moment are similar to insufficient blood flows in a human body which result in a heart attack or stroke, leaving permanent damage behind even if the patient survives.

The responses to the peaking of conventional oil were low interest rates, money printing and unconventional oil. The cheap money policy allowed the economy to afford high oil prices which continued despite the additional shale oil. This ultimately reduced oil demand growth, leading to a softening of oil prices in the 3rd quarter of 2014. In December 2013, the US Federal Reserve reduced quantitative easing, thereby strengthening the US\$ which – due to an established inverse relationship – contributed to lower oil prices. By end 2014 it became apparent that US inventories were filling up with unsaleable shale oil as imports of similarly light oil had been eliminated and US refineries were reaching their absorption capacity for this extra light oil and condensate. The US crude oil export ban was lifted end 2015 but recent statistics suggest that shale oil is used as blending component, not as bulk feedstock. The problem of high shale oil inventories continues to the very day, keeping oil prices low and killing the (much larger) conventional oil sector in the process. Low oil prices also lead to failed states as we can witness by looking at what is happening in Venezuela.

Low oil prices have also resulted in a reduction of capital expenditure in the oil and gas industry. This means that once all projects which were started during the high oil price period are commissioned (which takes about 5 years) there will be a supply gap as natural decline takes over. The IEA estimated that this problem will come up around 2020. The oil service company Halliburton (former CEO Dick Cheney – later US Vice President) has also warned about a similar time frame. When that happens there will be no quick fix as projects will take 5 years until the 1st oil flows. US shale oil – which can be restarted within 6 months – will not help as it is an extra light oil which cannot replace the average crude oil.

A 2nd oil price shock will be like a 2nd heart attack or stroke. It is doubtful whether the world economy can survive this as the permanent damage from the 1st shock – job losses, budget deficits and debt – still persist even now. Interest rates are already very low and whether another cash injection will help is hotly debated. NSW Treasury which responded to one of my emails hasn't got a clue about all these interdependencies with oil.

The world is now accumulating more and more unsolvable problems. Australian governments do not seem to monitor – let alone understand - geo-political events otherwise they would strategically prepare for their impact. They are in deep sleep mode. For example I participated as witness in a Senate inquiry hearing on transport fuel resilience in April 2015. One issue discussed was a strategic oil reserve – or lack thereof – which is now far below IEA requirements. No action was taken. 3 refinery closures (in themselves part of the peak oil story because production in IOCs peaked) were not taken seriously. I warned several times on my website that these closures make Australia more vulnerable to fuel supply disruptions. No one knows what is going to happen with North Korea but what we know is that almost 50% of Australia's petrol imports come from South Korea and Japan. One single Scud missile on a huge refinery and tank farm complex in Ulsan will be enough for tankers to stop delivering crude oil – mostly from the Middle East. If that were to happen the impact would be felt immediately. Yet the NSW government continues to build oil dependent infrastructure, completely outside the geopolitical context.

The South China Sea problem is also continuing. In Saudi Arabia fights with Shias have started just 20 kms from the giant refinery and oil port at Ras Tanura.

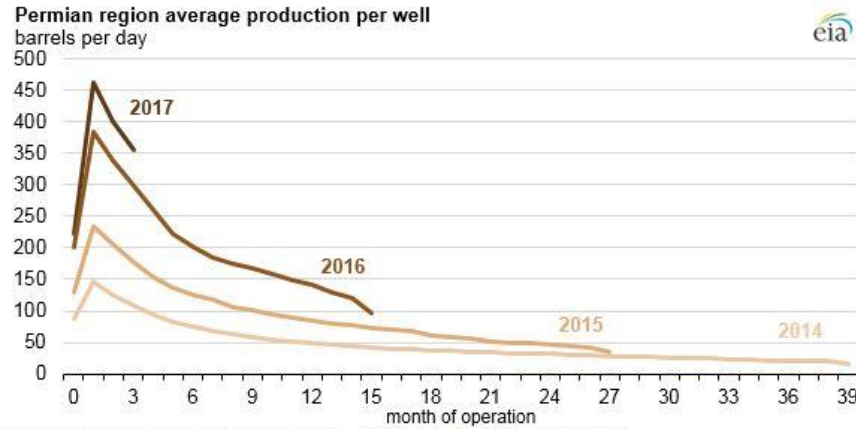
Australia's power supply system is fragile in summer. Ever since the 4th IPCC report came out in 2007, no lasting decisions were made on carbon pricing. This resulted in uncertainties for the power sector faced with aging coal fired power plants. What is not understood is that conventional gas on the east coast has peaked, something John Howard mentioned in his flawed 2004 energy white paper. He should have insisted the gas industry build a west-east gas pipeline. It is an irony of history that the current Prime Minister himself approved the LNG export projects on the west coast. It is a typical example that governments do not comprehend the seriousness of peaking production, whether it be oil or gas.

The latest CO2 emission report showed that Australia fails to reduce CO2 emissions which means that future reductions will have to be much steeper than would otherwise be the case.

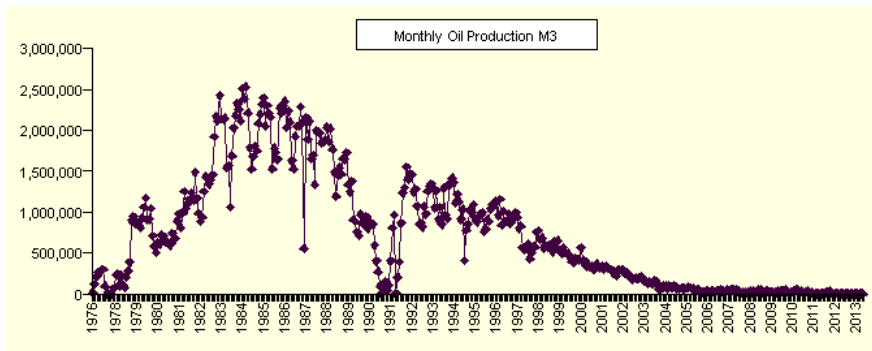
I recommend that government changes direction by 180 degrees. Reduce immigration, make sure agriculture has sufficient fuel supplies in a crisis, replace oil dependent infrastructure with light rail on all major roads, don't increase power demand in and for high rise buildings and transform the energy supply away from coal. Town planning must have the objective to reduce commuting requirements.

Peak oil is not a theory

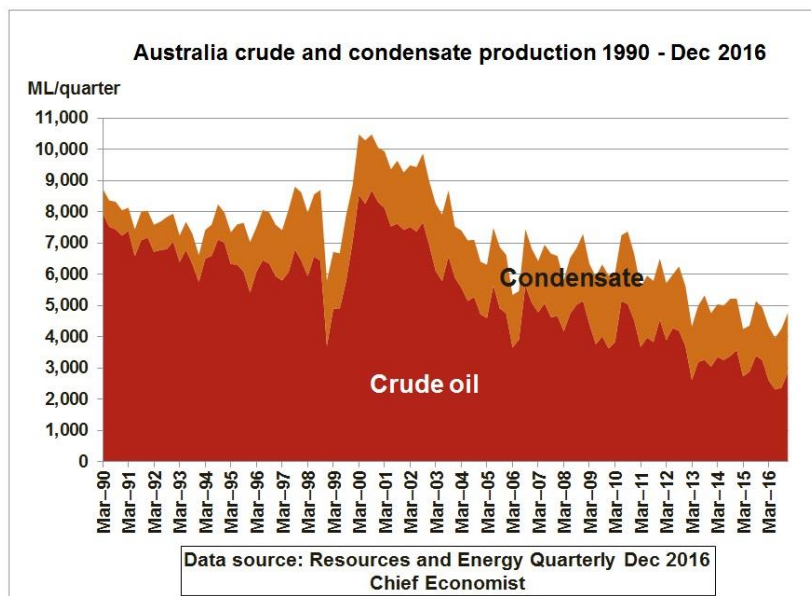
It is reality controlled by fluid mechanics in oil reservoir rocks. Oil flows mainly depend on the porosity and permeability of the rock and the viscosity of the oil (Darcey's law). Peaking happens in wells, fields, basins, countries, regions and finally the world.



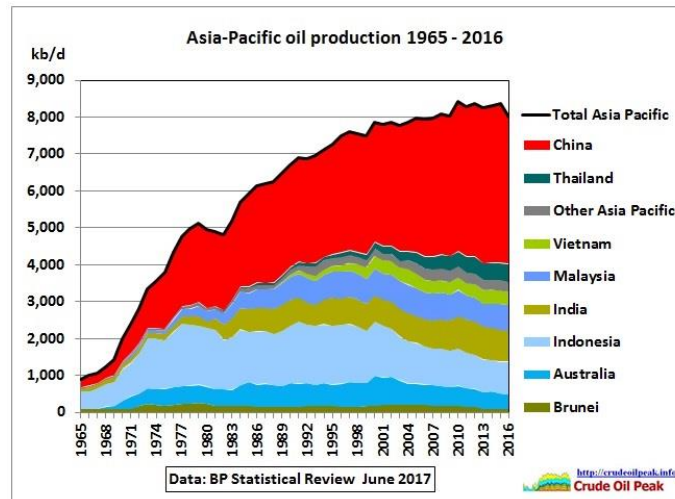
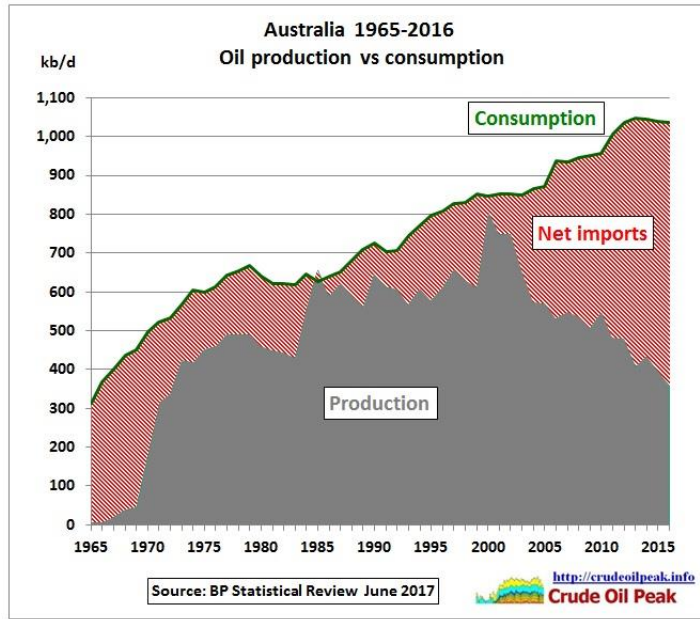
Shale oil wells peak within 2 months after start of production



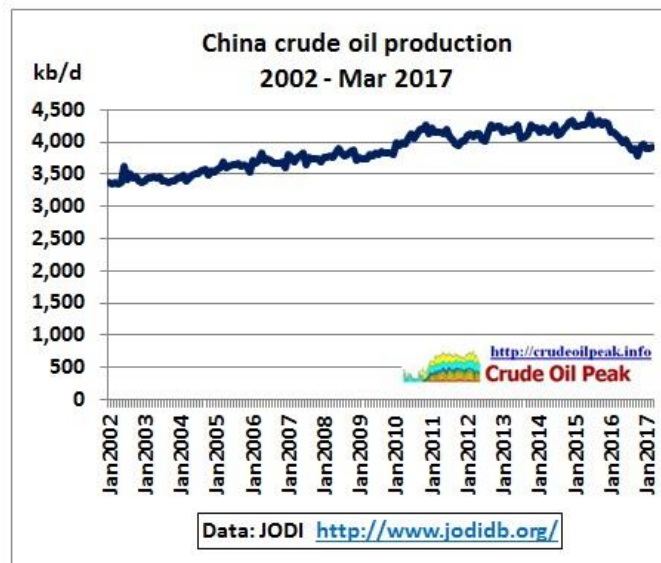
Oil production profile of Brent oil field



Peak oil in Australia



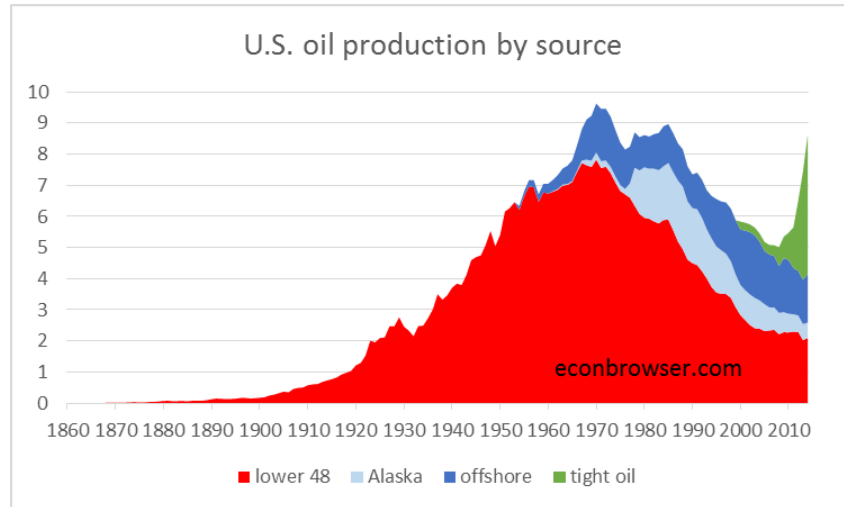
Peak oil in Asia Pacific



China peak oil

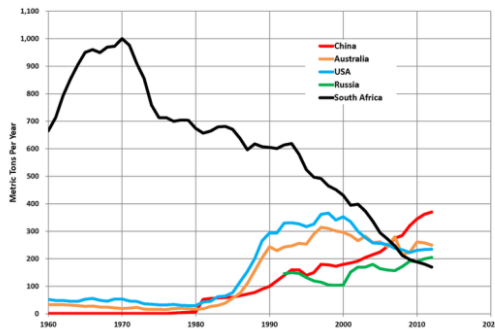
Historic peak oil events which changed the world

US peak oil 1970

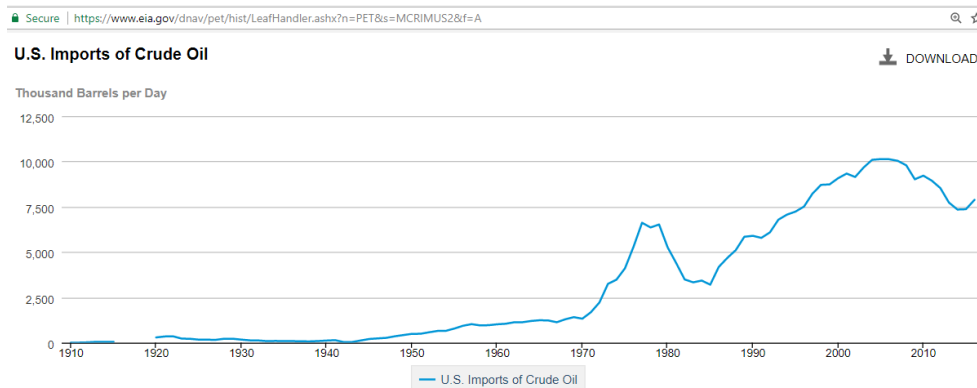


Impacts: Nixon shock 1971 https://en.wikipedia.org/wiki/Nixon_shock

Cancellation of the US\$ convertibility to gold to allow ever growing oil imports after the peak which would otherwise have been limited by gold production which incidentally also had a peak in 1970 (South Africa). It was the 1st step on the way to the petro dollar deal with OPEC in 1975, engineered by Henry Kissinger.



https://en.wikipedia.org/wiki/List_of_countries_by_gold_production

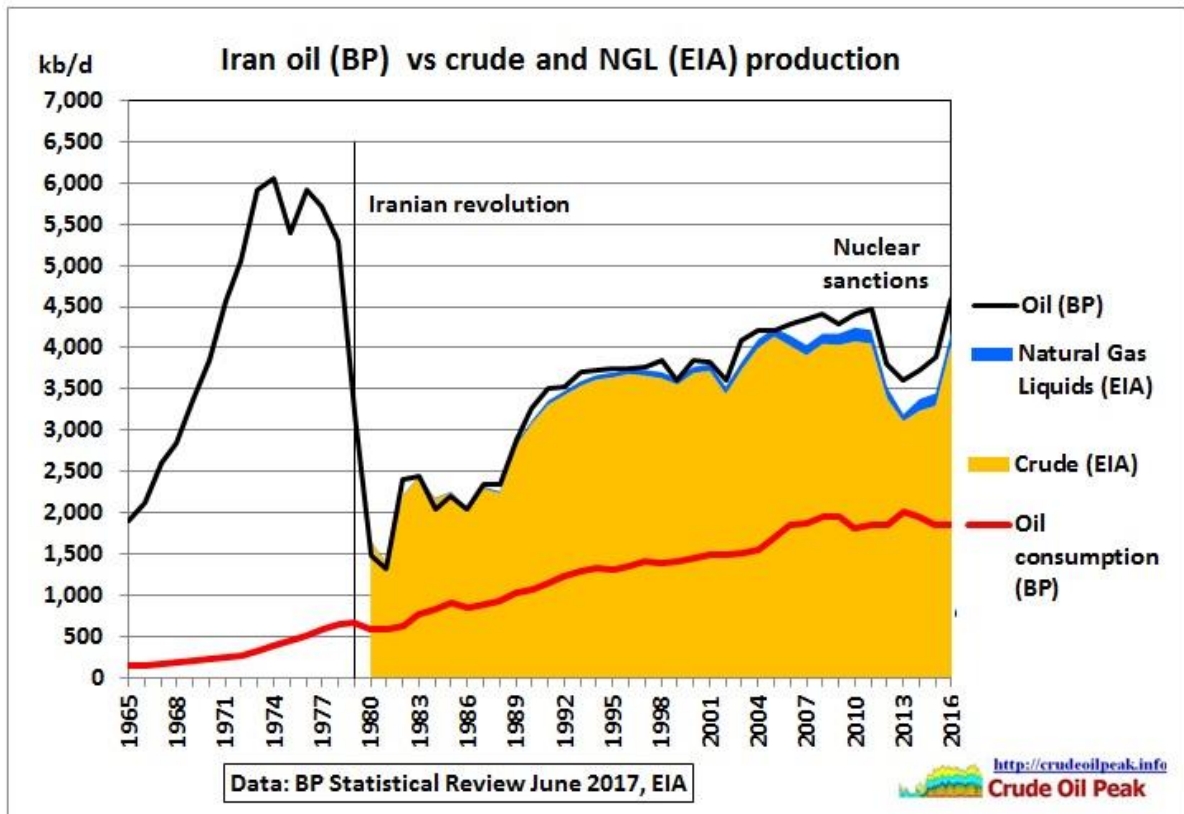


<https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRIMUS2&f=A>



OPEC's oil embargo after the Yom Kippur war in 1973 was a success because the US could not increase oil production which OPEC must have monitored. Therefore, the 1st oil crisis was caused by peak oil in the US.

2nd oil crisis: peak oil in Iran



The Shah, seeing himself in competition with Saudi Arabia, overproduced oil which peaked in the mid 70s. It contributed to his downfall, followed by the Iranian revolution in 1979. It is a typical case of peak oil in a dictatorship with negative feed-back loops.

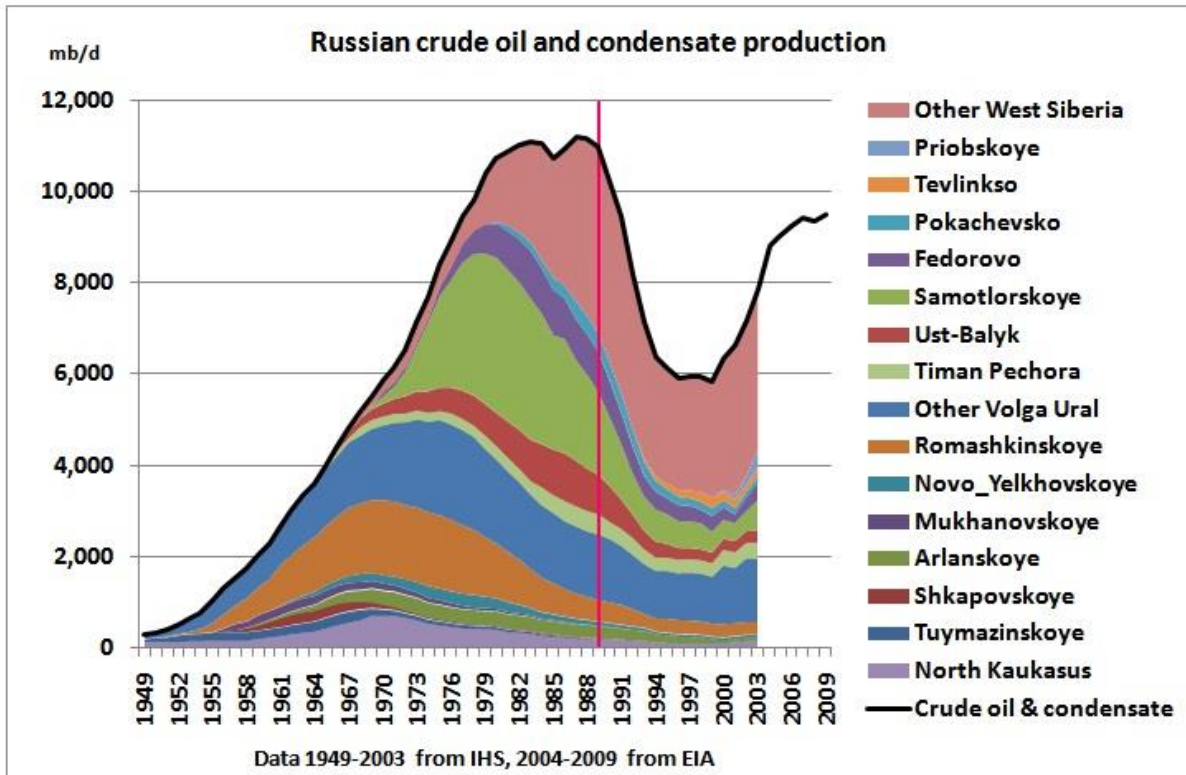
In 1979 I was working as an advisor in the Office of the President and Cabinet in Malawi. I have documented the petrol shortages in that year in this post:



<http://crudeoilpeak.info/my-experience-oil-crisis-1979>

The West Siberian oil peak

The next oil peak happened in Russia's West Siberian oil fields

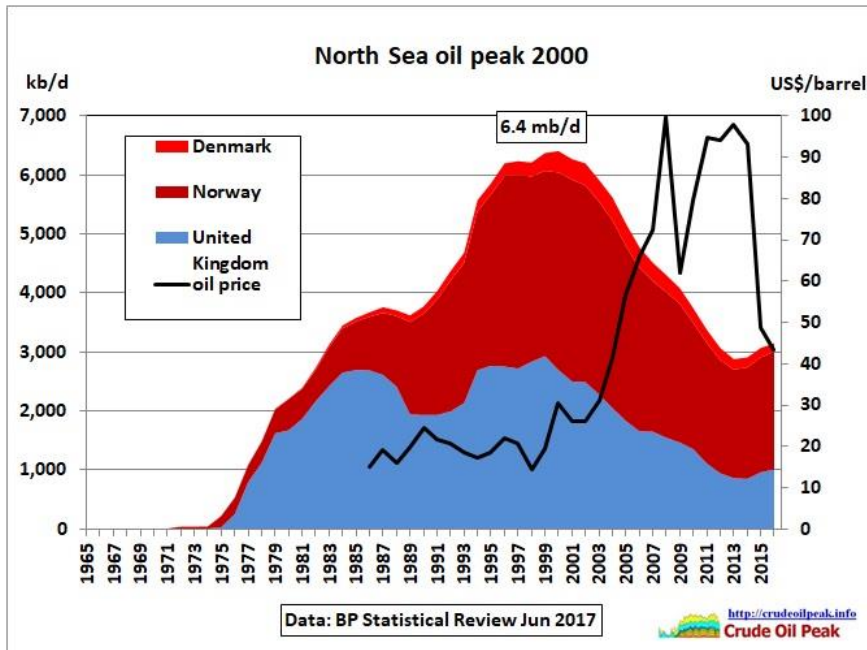


At the technological level available to the Soviet Union at the time oil production in West Siberia peaked in the mid 80s. Gorbachev had visited the oil fields in September 1985 and knew about the problem.

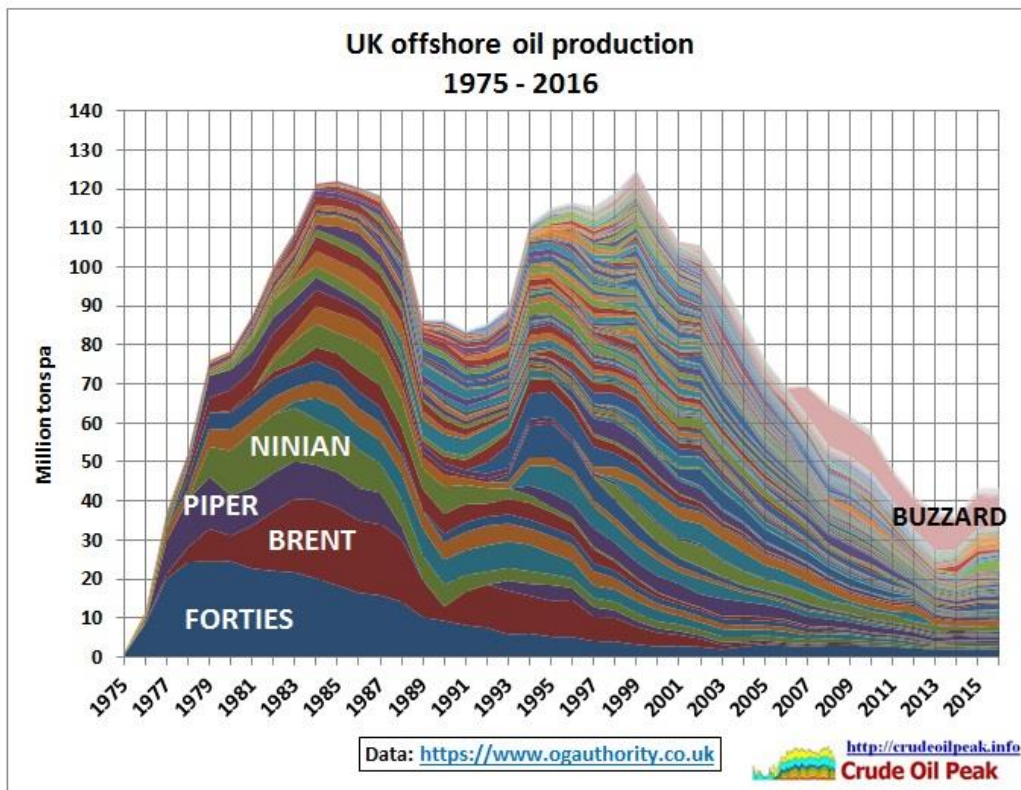
4/10/2010 Russia's oil peak and the German reunification

<http://crudeoilpeak.info/russia%E2%80%99s-oil-peak-and-the-german-reunification>

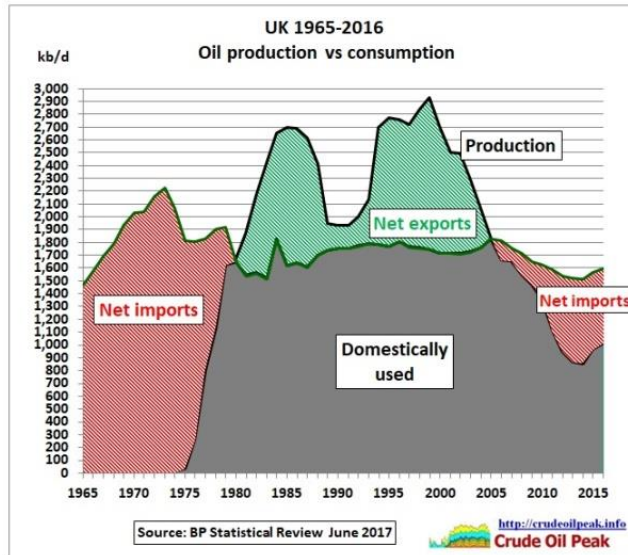
North Sea oil peak 2000



This peak contributed to oil prices going out of their 1990s range



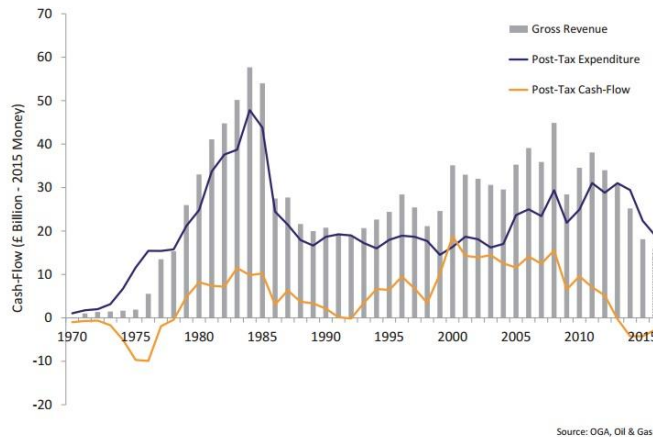
Large oil fields were developed in the beginning, leading to the 1st peak after just 10 years of production. On the backside of that peak there was also the Alpha Piper accident in 1988 requiring the re-design of many platforms.



Since 2006 UK is a net oil importer. Huge decommissioning costs are waiting in challenging waters.

oilandgasuk.co.uk/wp-content/uploads/2016/09/Economic-Report-2016-Oil-Gas-UK.pdf

Figure 9: Revenue, Expenditure and Post-Tax Cash-Flow



Cash flow after tax is negative. UK has more important things to do than Brexit.

<http://crudeoilpeak.info/brent-exit>

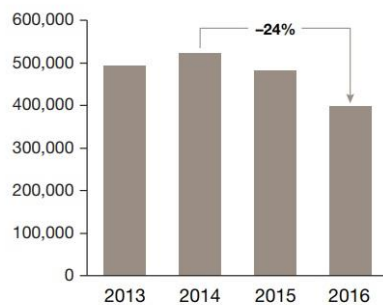
UK job losses

<https://www.strategyand.pwc.com/media/file/2017-Oil-and-Gas-Trends.pdf>

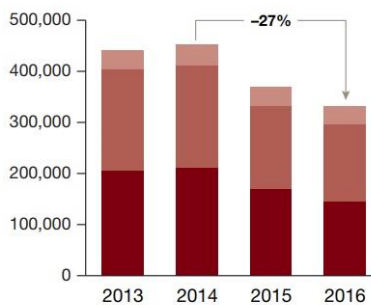
Exhibit 1

Oil price jitters resulted in a loss of critical talent

Number of U.S. employees in upstream oil and gas



Number of U.K. offshore employees in upstream oil and gas



Direct employment
Indirect employment
Induced employment

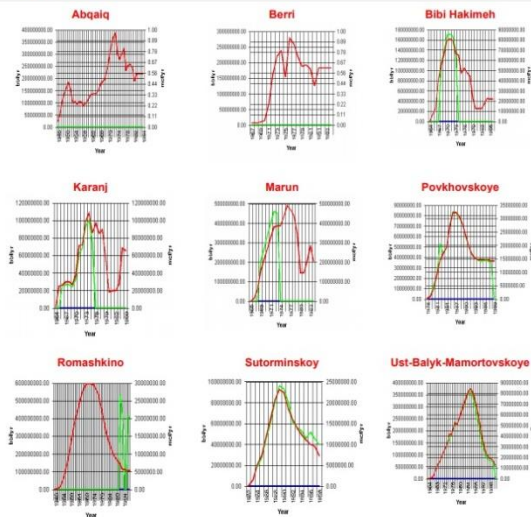
Iraq war was 1st peak oil war

The Iraq war in 2003 was not just an oil war, but the 1st peak oil war. This is because Bush and Cheney were oil men. They knew exactly what peak oil means. From an exchange of letters I had with Howard I can say he never understood it.

Cheney had held a speech in 1999 at the Institute of Petroleum, saying: “Governments and the national oil companies are obviously controlling about ninety per cent of the assets. Oil remains fundamentally a government business. While many regions of the world offer great oil opportunities, **the Middle East with two thirds of the world’s oil and the lowest cost, is still where the prize ultimately lies**, even though companies are anxious for greater access there, progress continues to be slow.”

<http://www.resilience.org/stories/2004-06-08/full-text-dick-cheney-s-speech-institute-petroleum-autumn-lunch-1999/>

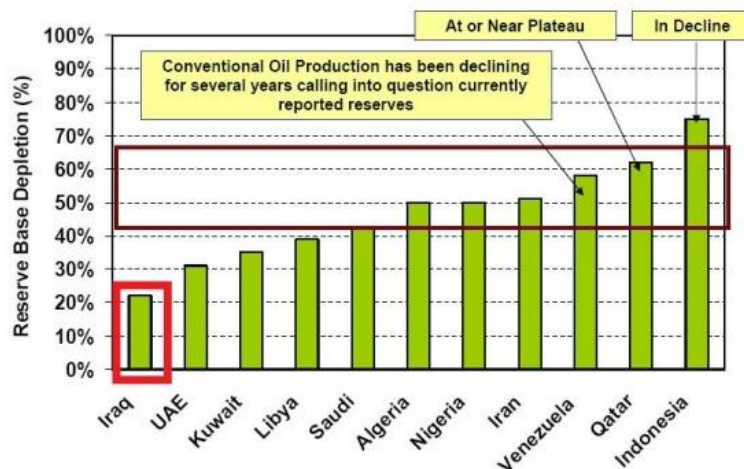
energyskeptical.com/wp-content/uploads/2011/07/Simmons-Giant-Oil-Fields.pdf



In 2001 Matt Simmons (an investment banker from Houston, Texas) did a study of the world’s giant oil fields for Dick Cheney’s energy task force and found the world oil supply was heavily dependent on just 116 giant oil fields half of which were more than 40 years old. Many had already peaked. In particular, the study warned about Saudi Arabia’s Ghawar oil field which had peaked in 1990 at 6.5 mb/d

The smoking gun was produced 1 ½ years after the Iraq war, in October 2004, in a slide show by PFC Energy at the Centre for International and Strategic Studies (Washington). Iraq had under produced oil (Iran-Iraq war, Oil-for-Food Program OIP) resulting in low depletion levels. In order to unlock this geologically easy pre-peak oil, Saddam Hussein had to be removed from power to be able to lift the OIP sanctions imposed by the UN.

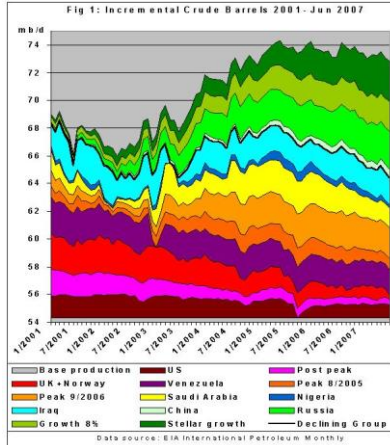
Historical Production and Depletion Levels (OPEC)



OPEC as a whole is depleting but some countries are depleting faster than others

Global crude oil peak started in 2005

In 2005, Matt Simmons published a book “Twilight in the desert, the coming Saudi oil shock and the world economy”. 2 years later, statistics showed a decline in global crude oil production, mainly in the North Sea and Saudi Arabia.



Had it not been for growth in Russia, Azerbaijan and Kazakhstan, the decline would have been more.

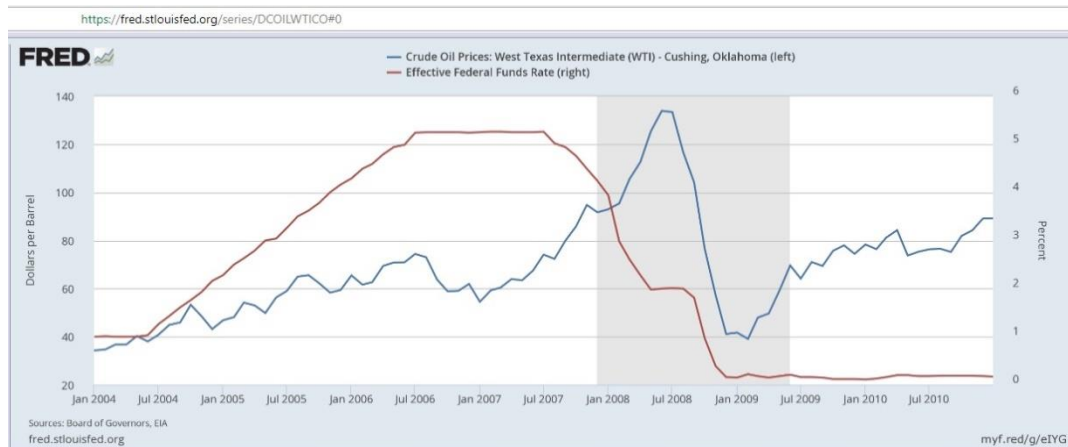
Together with Gail the Actuary from Atlanta, Georgia, I wrote following article on the Oildrum blog

9/10/2007

Did Katrina hide the real peak in world oil production?

<http://www.theoildrum.com/node/3052>

Oil prices went up and caused a recession in the US by end 2007, shown as grey area in following FRED graph:



US Federal Reserve graph <https://fred.stlouisfed.org/series/DCOILWTICO#0> showing oil price vs Funds Rate between 2004 and 2010. Note the Federal Reserve intervened by lowering the Funds Rate only at an oil price of \$70 – too high, too late.

Colin Campbell On Peak Oil - The Credit Crunch Predicted In 2005



“....The banks lent more than on deposit...because they had confidence that the resulting expansion of all this investment, loans and everything was sufficient collateral for today’s debt...but unrecognised was that this expansion was not just money, it was the cheap good old energy which made the wheels turn and build everything. So we now face the situation, I think quite soon ... that the debt is losing its collateral Every company on

the stock market is overvalued, there has to be some radical re-adjustment... I talk to these bankers....they don’t really care too much, bundles of money flowing to them every day and their main concern is to be competitive with each other. And it does not matter to them if the whole thing goes down as long as they are in the crowd.”

<https://www.youtube.com/watch?v=MOMI5Ia9mVA>

The 2008 oil shock

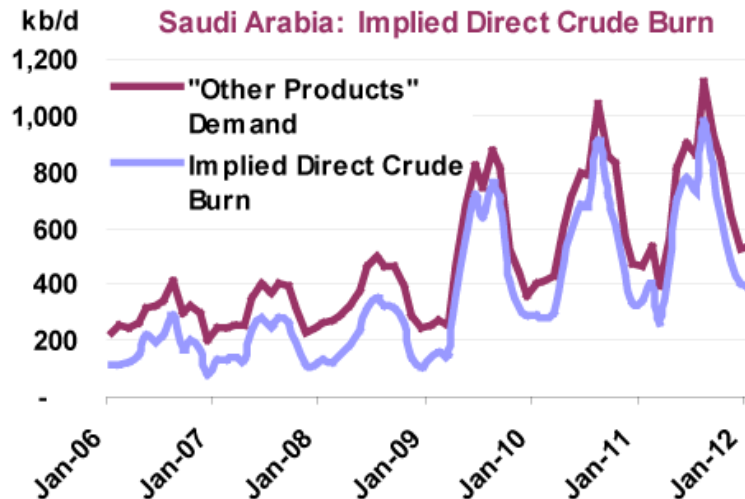
In mid 2008 China went on the oil market with an extra demand of 800 kb/d in order to prepare for the Olympic Games, avoiding previous shortages.



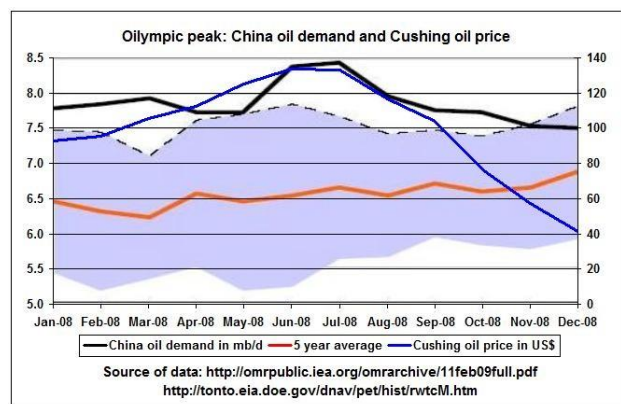
This was a very unfortunate timing because in summer (starting in April-May) Saudi Arabia increases direct crude oil burn in power plants like these in Riyadh

Riyadh-9 Blocks C&D Operation: 2007-2008 <http://www.industcards.com/cc-saudi.htm>

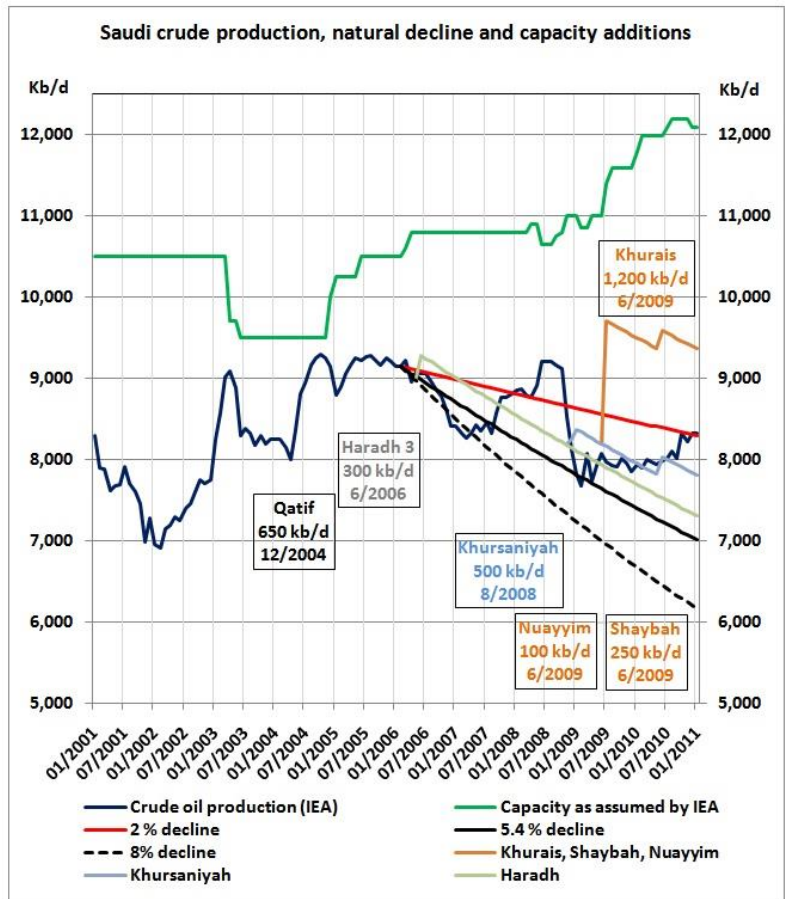
At that time oil supply was so tight, every 100 kb/d demand mattered. In the first half of 2008 US crude production had declined by 400 kb/d compared to 2005



<https://www.iea.org/oilmarketreport/reports/2011/0711/>

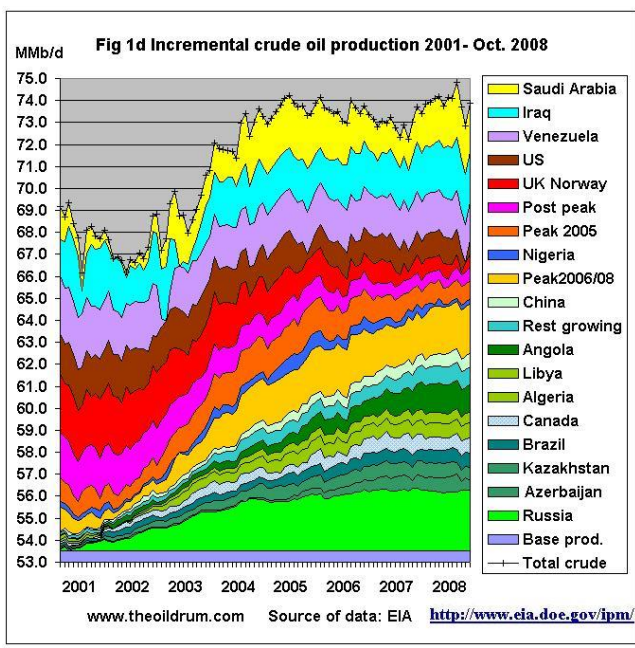


Left: Chinese petrol shortages in 2005, right: Graph from the IEA monthly oil market report 2/2009 (page 15) overlaid with Cushing oil prices. Oil prices went down the moment Chinese demand waned.



This graph shows how Saudi Arabia was struggling to offset natural decline by revamping old oil fields. The 2006-07 decline was geological, not engineered to drive up prices. More in this article:

2/3/2011 WikiLeaks cable from Riyadh implied Saudis could pump only 9.8 mb/d in 2011 <http://crudeoilpeak.info/wikileaks-cable-from-riyadh-implied-saudis-could-pump-only-9-8-mbd-in-2011>



<< The above Saudi rebound can be seen in this October 2008 graph.

But it came too late.

The drop in US oil production in the 2nd half of 2008 was caused by hurricanes Gustav (1/9/2008) and Ike (13/9/2008). But by that time oil prices were already down to \$100

Lehman Brothers collapsed 15/9/2008

Causes and Consequences of the Oil Shock of 2007-08

By James Hamilton

April 2009

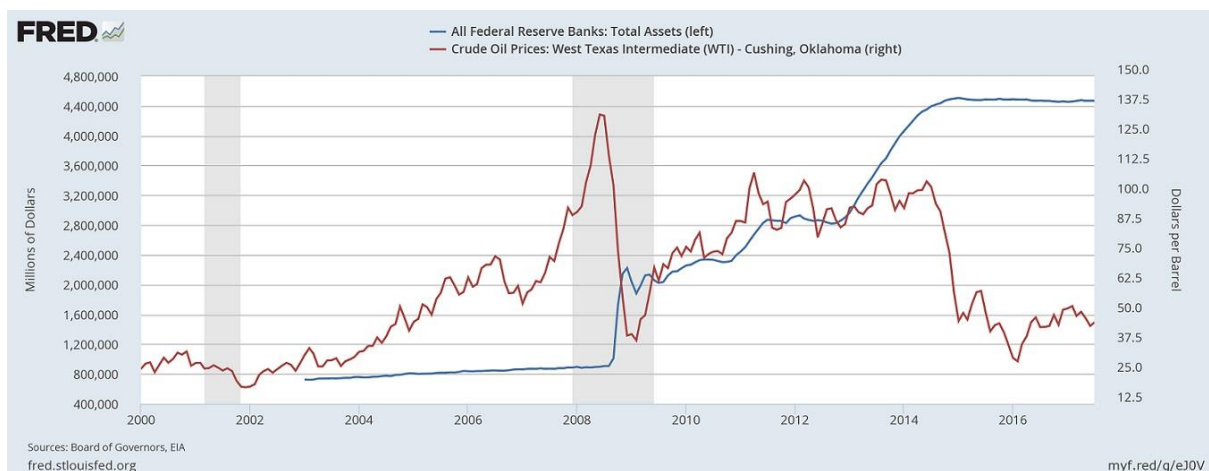
*This paper explores similarities and differences between the run-up of oil prices in 2007-08 and earlier oil price shocks, looking at what caused the price increase and what effects it had on the economy. Whereas historical oil price shocks were primarily caused by physical disruptions of supply, **the price run-up of 2007-08 was caused by strong demand confronting stagnating world production.** Although the causes were different, the consequences for the economy appear to have been very similar to those observed in earlier episodes, with significant effects on overall consumption spending and purchases of domestic automobiles in particular. In the absence of those declines, it is unlikely that we would have characterized the period 2007:Q4 to 2008:Q3 as one of economic recession for the U.S. The experience of 2007-08 should thus be added to the list of recessions to which oil prices appear to have made a material contribution*

Eventually, the declines in income and house prices set mortgage delinquency rates beyond a threshold at which the overall solvency of the financial system itself came to be questioned, and the modest recession of 2007:Q4-2008:Q3 turned into a ferocious downturn in 2008:Q4. Whether we would have avoided those events if the economy had not gone into recession, or instead would have merely postponed them, is a matter of conjecture. Regardless of how we answer that question, the evidence to me is persuasive that, if there had been no oil shock, we would have described the U.S. economy in 2007:Q4-2008:Q3 as growing slowly, but not in a recession.

http://econweb.ucsd.edu/~jhamilto/Hamilton_oil_shock_08.pdf

Response: money printing and unconventional oil

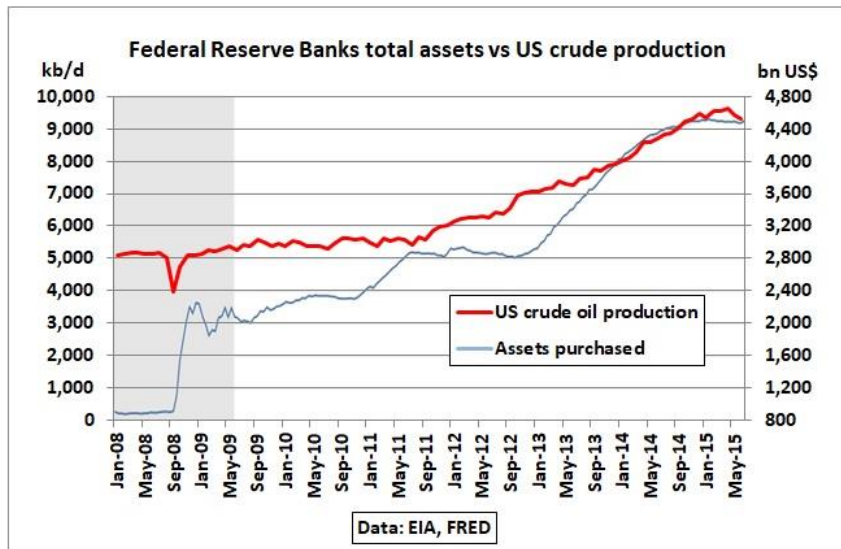
The response to the oil shock was a low interest rate policy (just the opposite of what happened in the 70s) and quantitative easing



<https://fred.stlouisfed.org/series/WALCL#0>

Quantitative easing vs oil price

QE allowed the economy to afford high oil prices which did not go down despite additional shale oil production.



This is for illustrative purposes only

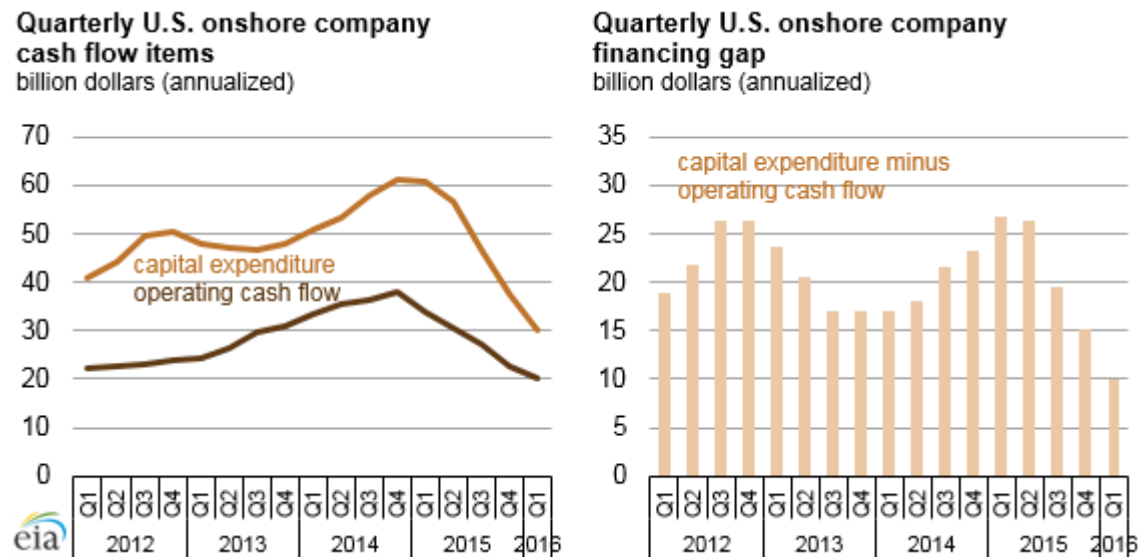
Quantitative Easing and the Texas Oil Boom

April 2016

So QE helped push investors to move money into the Texas oil companies, and encouraged market action that propped up high oil prices that in turn made Texas oil companies increasingly profitable and attractive to investors. The result was self-validating growth based more on artificial influence than real market forces—in short, a bubble, just like the housing bubble to which QE was a response.

<https://pboilandgasmagazine.com/qe-and-the-texas-oil-boom/>

The EIA calculated the financing requirements for 39 US onshore oil companies:

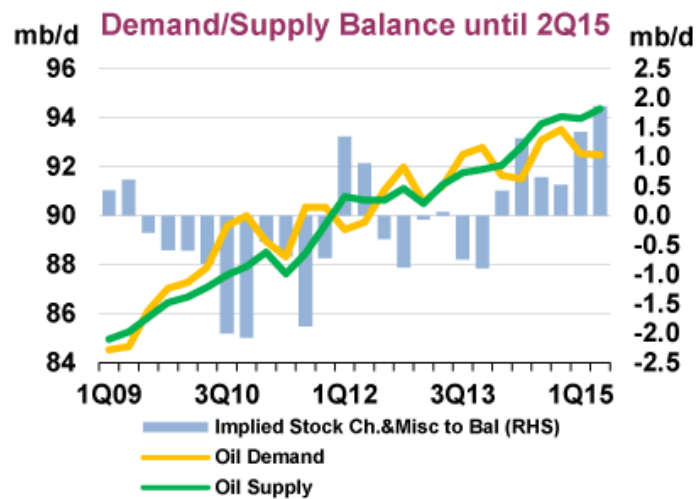


<https://www.eia.gov/todayinenergy/detail.php?id=27112>

This does not look good. The operating cash flow to capital expenditure ratio is <1.

This means without cheap money and quantitative easing there would have been no shale oil boom starting in 2010/11.

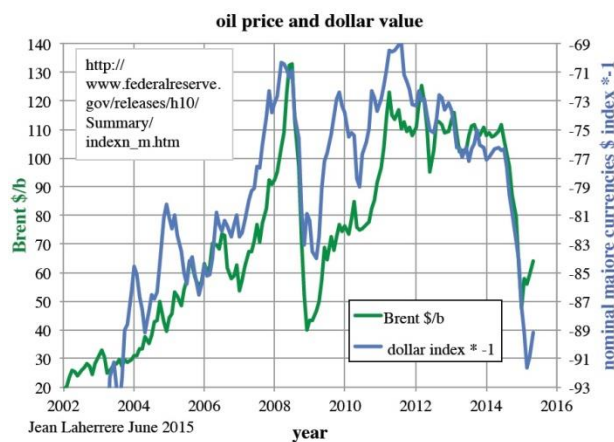
In August 2014, oil prices dropped below \$100 due to a changing demand/supply balance as shown in this IEA graph:



Bernanke announced a tapering of quantitative easing in December 2013, shown as a flattening of the cumulative asset purchase curve in this graph.



That pushed the value of the US\$ up. There is an inverse relationship between US\$ and oil price (which means the real currency is oil)

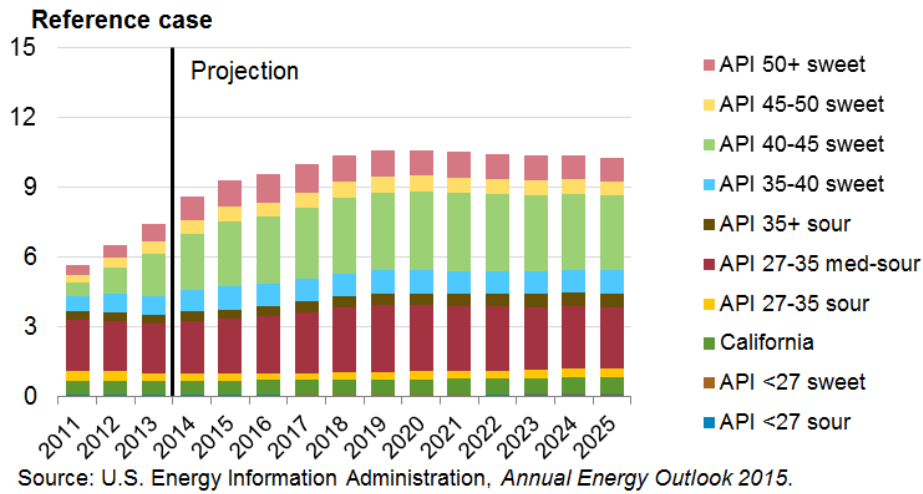


That contributed to lower the oil price

Shale oil is an extra light oil with condensate

Figure 1. U.S. crude oil production by crude type, Reference case

million barrels per day

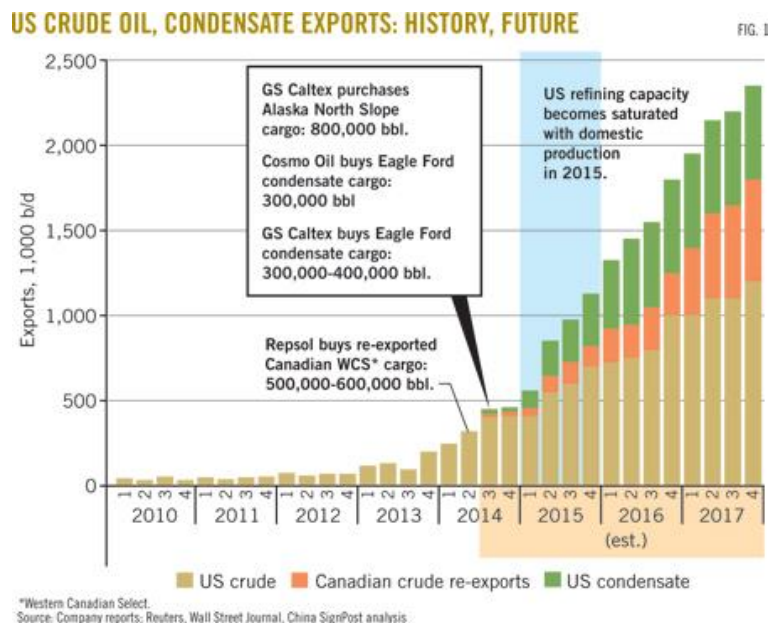


The benchmark West Texas Intermediate (WTI) has a gravity of API 40. The above (optimistic) outlook of the EIA shows that practically half of future US production is lighter than WTI.

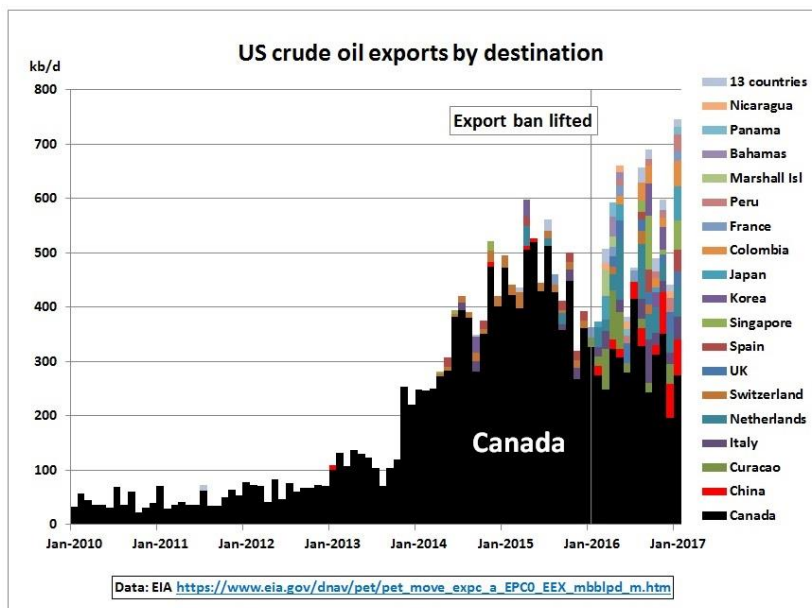
In the first phase of the shale oil boom, similarly light crude imports (e.g from Nigeria) were substituted. Nigerian oil replaced Libyan oil lost during the Arab Spring. That's why oil prices did not skyrocket at that time.

In the second phase, US refineries tried to use more light oil, but there are limits because many refineries are designed for heavy (and cheaper) crudes from Venezuela, Mexico and Saudi Arabia.

By end 2014 it became clear that the absorption capacity of US refineries for extra light shale oil was coming to an end.



The oil industry therefore pushed for lifting the crude oil export ban, which happened end 2015. Statistics show that exports have increased, to many countries in small quantities suggesting it is used as blending component, not as bulk feedstock



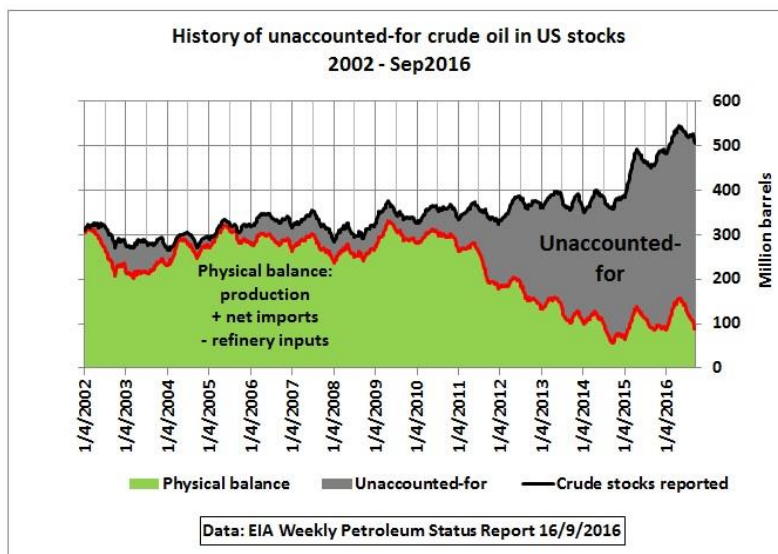
Unaccounted for oil

Last year I worked together with an oil geologist from Houston, Texas, Art Berman, on this post:

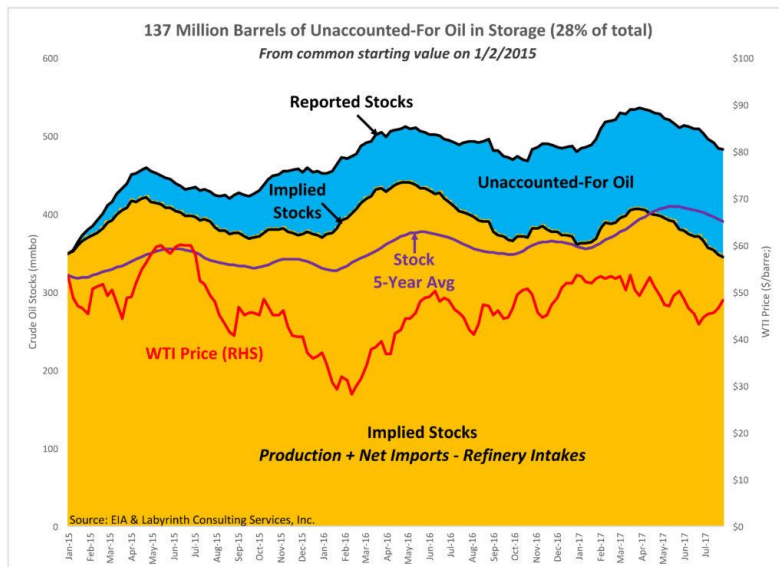
8/10/2016 U.S. Storage Filling Up with Unaccounted-For Oil

<http://crudeoilpeak.info/u-s-storage-filling-up-with-unaccounted-for-oil>

We could not match US crude production, imports, exports, refinery use and inventory changes.



After publishing our research, we were contacted by the Deputy of EIA (meaning we had hit a raw nerve) and an exchange of emails ensued. The discrepancies could not be resolved and continue to the very day. Just recently, Art did an update:



<http://www.artberman.com/u-s-inventory-reductions-probably-not-sustainable/>

One interpretation is that this unaccounted-for oil is shale oil which somehow bypasses statistics and can't be sold otherwise. The following article describes the problems of keeping track of thousands of short lived shale oil wells.

Reducing Unaccounted Oil and Gas Production Uncertainty

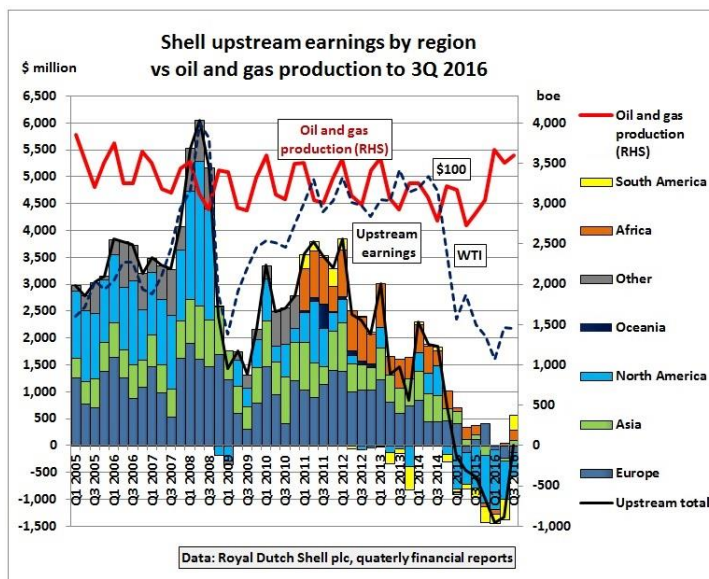
Michael Machuca

7 Sep 2016

<https://www.emersonprocessxperts.com/2016/09/reducing-unaccounted-oil-gas-production-uncertainty/>

Declining Earnings

Oil markets focus on inventories as an indicator for the demand supply balance. When inventories are full, the oil price is kept low. That puts pressure on companies producing conventional oil. So if inventories are filled with unsaleable shale oil, then money printing has created a system which destroys the much larger conventional oil supply.



Last year, I did this analysis

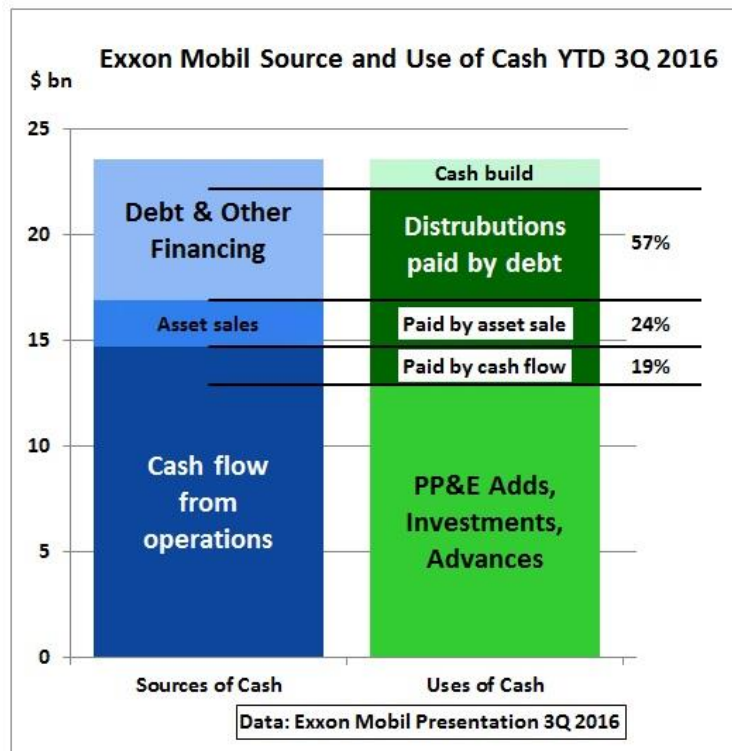
16/10/2016

Royal Dutch Shell's upstream earnings peaked 2008, now in the red

<http://crudeoilpeak.info/royal-dutch-shells-upstream-earnings-peaked-2008-now-in-the-red>

It shows the problem of declining earnings started long before the oil price drop. Peak oil at work.

Needs regular update.



Exxon had to finance dividend payouts by taking on new debt. That is not a viable business model

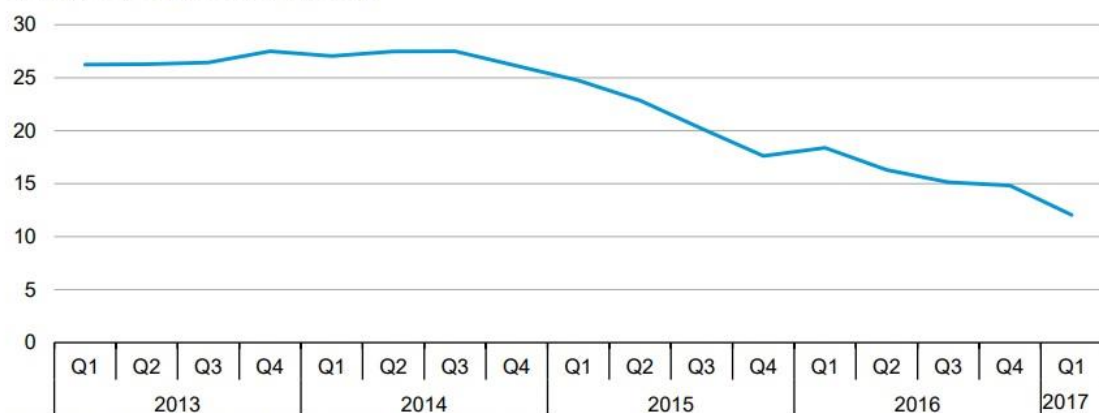
CAPEX reduction followed by next oil crunch

The poor financial performance of oil companies leads to a reduction in capital expenditure which is vital to reduce natural decline rates in legacy oil fields and also in green field developments to offset that decline:

https://www.eia.gov/finance/review/pdf/financial_q12017.pdf

Upstream capital expenditure on a per-barrel basis continued to decline

upstream capital expenditure per barrel of oil produced
2017 \$/boe four-quarter moving average



Source: U.S. Energy Information Administration, Evaluate Energy
Note: boe=barrel of oil equivalent



During the high oil price period, many expensive projects were started under the assumption that oil prices would remain high. When oil prices fell, these projects could not be stopped and are being commissioned now. Once this portfolio of projects has been completed, there will be fewer projects which were started after 2014. That is why the IEA warned in March this year:



Global oil supply to lag demand after 2020 unless new investments are approved soon

6 March 2017



<https://www.iea.org/newsroom/news/2017/march/global-oil-supply-to-lag-demand-after-2020-unless-new-investments-are-approved-so.html>

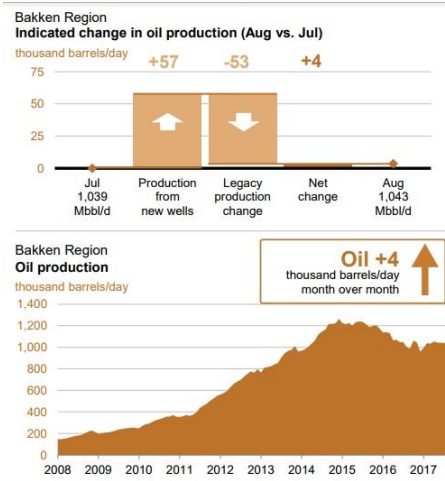
Halliburton sees 2020 oil spike after industry cuts \$2 trillion

<http://www.worldoil.com/news/2017/7/12/halliburton-sees-2020-oil-spike-after-industry-cuts-2-trillion>

Peak shale oil

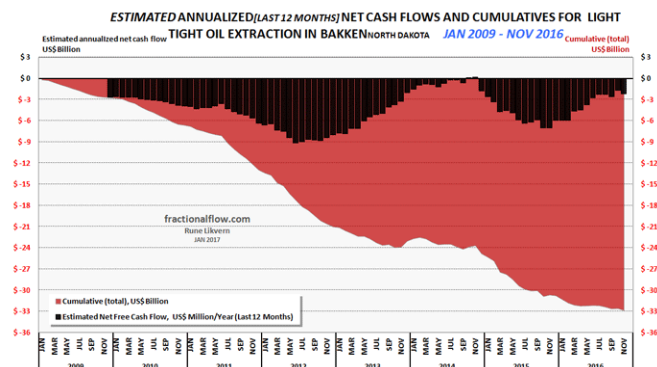
In the meantime, 2 shale oil provinces have peaked, Bakken and Eagle Ford

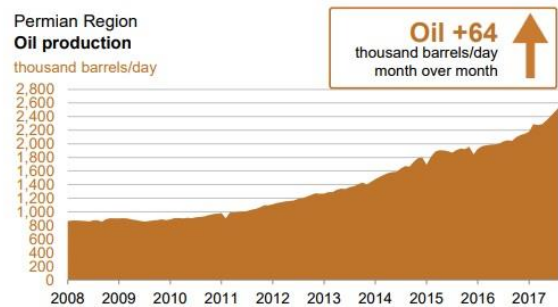
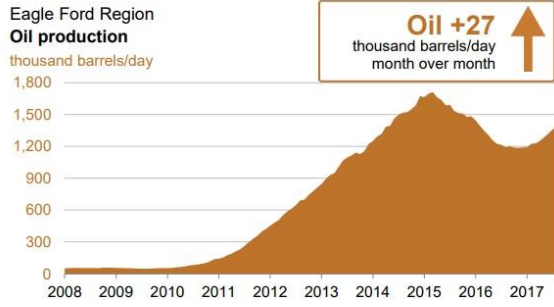
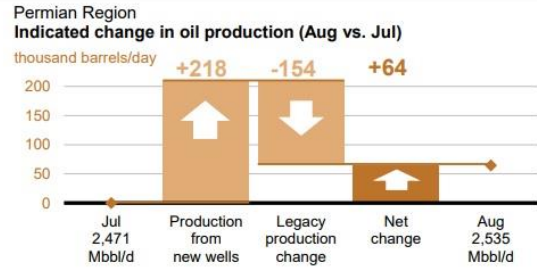
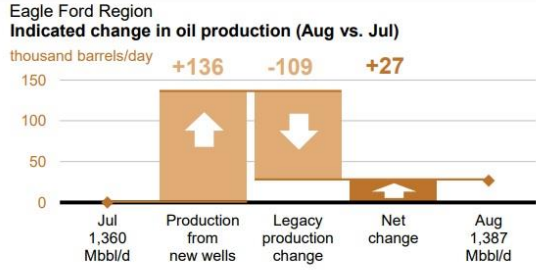
<https://www.eia.gov/petroleum/drilling/pdf/bakken.pdf>



U. S. Energy Information Administration | Drilling Productivity Report

Bakken cash flow in minus





<https://www.eia.gov/petroleum/drilling/pdf/bakken.pdf>

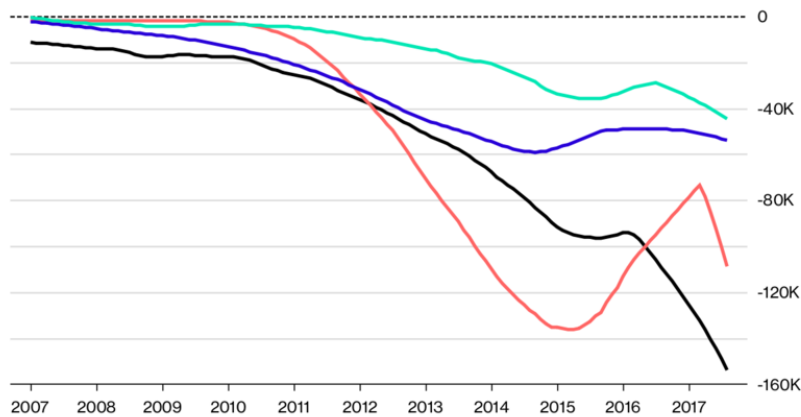
The Permian is different as it contains conventional oil

3/8/2017

Ailing Wells

U.S. big four shale plays show steep decline rates

■ Permian ■ Eagle Ford ■ Bakken ■ Niobrara



Note: Values are in barrels a day for monthly declines in legacy oil production.
Source: U.S. Energy Information Administration

Bloomberg

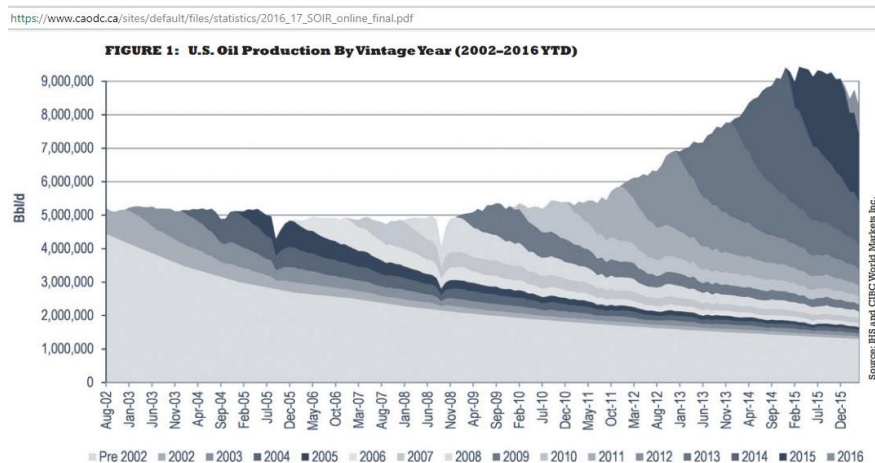
Another risk from the boom is that shale producers have been spending more than they make for a decade, aided by a flow of money from investors. But that has encouraged companies to focus on ramping up production at the expense of profitability, according to a report released last week by Wood Mackenzie Ltd.

That could worsen a global supply glut and push down oil prices, leading to an outflow of finance that may jeopardize the entire industry.

"At some point debt investors start to worry they will not get their capital back and cut lending to the industry," Clark said. "Even a small reduction in capital would likely lead to a steep fall in U.S. production."

<https://www.bloomberg.com/news/articles/2017-08-03/how-the-wild-shale-race-may-be-harming-the-permian-s-oil-trove>

Shale oil is fundamentally different from conventional oil not just because of its chemical composition of light hydrocarbons but also because of its astronomical decline rates as shown in this graph



The bottom part of the above graph shows the slow decline in conventional fields and the upper part the steep declines in shale oil fields. The more wells are added, the steeper the cumulative decline and the more wells must be added in future just to keep production flat. This question tells you everything:

When will tight oil make money?

28/7/2017

Tight oil profitability has been the focus of much debate since the oil price collapse of 2014. Its ability to scale down (and up) quickly and break even at low price points has made the Permian the star of the show for investors — but there are still plenty of sceptics when it comes to [tight oil profitability](#).

We believe tight oil producers will begin generating significant free cash flow in 2020. Tight oil specialists failed to generate positive cash flow in 28 of the 29 quarters since 2010. We've found that tight oil requires as much upfront investment as conventional projects, and like most early-life operations, comes with its own learning curve and infrastructure development – as well as being highly sensitive to the downturn in price. It will take a while to generate returns.

<https://www.woodmac.com/analysis/when-will-tight-oil-make-money>

How much shale oil is there?

Table 2. Crude oil production and proved reserves from selected U.S. tight plays, 2014-15

Basin	Play	State(s)	2014		2015	
			Production	Reserves	Production	Reserves
Williston	Bakken	ND, MT, SD	387	5,972	421	5,030
Western Gulf	Eagle Ford	TX	497	5,172	565	4,295
Permian	Bone Spring, Wolfcamp	NM, TX	53	722	66	782
Denver	Niobrara*	CO, KS, NE, WY	42	512	58	460
Appalachian	Marcellus*	PA, WV	13	232	16	143
Fort Worth	Barnett	TX	9	47	5	33
Sub-total			1,001	12,657	1,131	10,743
Other tight			56	708	83	859
U.S. tight oil			1,057	13,365	1,214	11,602

Note: Includes lease condensate. Bakken/Three Forks tight oil includes proved reserves from shale or low-permeability formations reported on Form EIA-23L.

Other tight includes proved reserves from shale formations reported on Form EIA-23L not assigned by EIA to the Bakken/Three Forks, Barnett, Bone Spring, Eagle Ford, Marcellus, Niobrara, or Wolfcamp tight plays.

* The Niobrara estimate may contain some reserves from the Codell sandstone. The Marcellus play in this table refers only to portions within Pennsylvania and West Virginia.

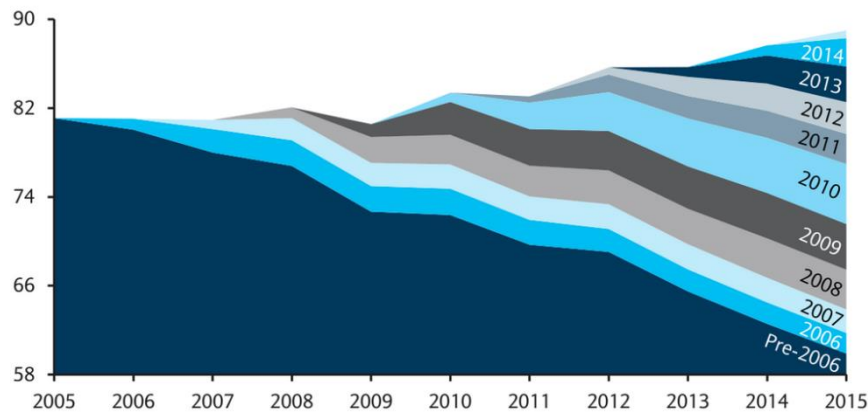
Source: U.S. Energy Information Administration, Form EIA-23L, Annual Report of Domestic Oil and Gas Reserves, 2014 and 2015

<https://www.eia.gov/naturalgas/crudeoilreserves/>

11,62 Gb is about 1/3 of global annual consumption!

Compare above shale oil decline rates to global decline rates for all types of oil:

Crude oil and NGL production by project start date (mb/d)



<https://www.businessinsider.com.au/barclays-researchers-forecast-a-major-oil-price-rebound-in-2016-2015-10?r=UK&IR=T>

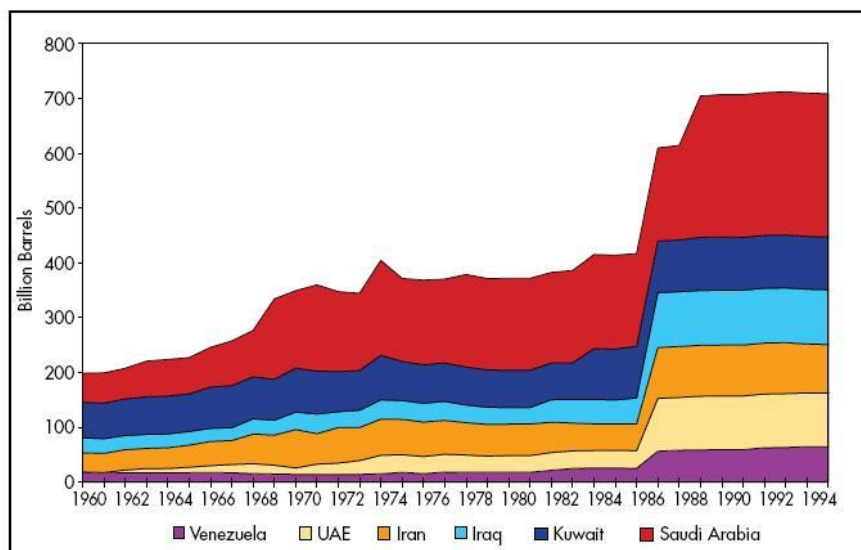
OPEC paper barrels

OPECs remaining reserves are interpreted as discoveries								
1	2	3	4	5	6	7	8	9
OPEC	Cum Prod End 2003	% Depleted	Indicated Total	Remaining reserves Gb				BP Estimates Interpreted
				PFC	ASPO	Salameh	BP	
Iraq	28	22%	127	99	62	62	115	Total Discovered
UAE	19	31%	61	42	49	37	98	Total Discovered
Kuwait	32	35%	91	59	60	71	97	Total Discovered
Libya	23	39%	59	36	29	26	36	
Saudi	97	42%	231	134	144	182	263	Total Discovered
Algeria	13	50%	26	13	14	11	11	
Nigeria	23	50%	46	23	25	20	34	? High Estimate
Iran	56	51%	110	54	60	64	131	Total Discovered
Venezuela	47	58%	81	34	35	31	78	Total Discovered
Qatar	6.8	62%	11	4.2	4.1	4.6	15	Total Discovered
Indonesia	20	75%	27	6.7	9.4	12	4.4	
TOTAL	365		870	506	492	520	882	

http://aspoireland.files.wordpress.com/2009/12/newsletter46_200410.pdf

weo1998.pdf - Adobe Reader

Figure 7.4: OPEC Official (proved) Oil Reserves



Source: BP Statistical Review of World Energy, 1997.

“Reserves” are inflated with >300 B bbls of “resources”

	Depleted	Statistical reliability	Production Outlook	Technical basis
1.1 Trillion				
Actual Reserves : 0.9 Trillion	Proven > 90%	Proven oil in Place – high confidence Developed – clear recovery factor Undeveloped – good. recov. est.	Growth thru actual reservoir mgmt. & performance	Improved Oil recovery thru existing technology
	Probable > 50%	Probable oil in place – confident Developed - prelim. recovery factor Undeveloped – est. fair recovery	Growth thru delineation, testing & development	Clear opportunity with existing technology
Contingent Resources: 1.1 Trillion	Potential > 5%	Potential oil in place – low confiden. Drilled – v. low recovery factor Undrilled – recovery likely poor	Growth thru pricing, delineation or IOR/EOR technology	Indicative data & potential opportunity
	Resource: Uneconomic volume & commerciality	Likely presence but undelineated Oil or GIP	Profitability or Technology currently inadequate	Available access but lacks good reservoir and fluids data
Prospective & Speculative Resources: 2.0 Trillion	Oil, Gas, Shales, EHC & to be discovered resources	Technically present but physically inaccessible hydrocarbons	Future resolution thru exploration & relevant technology	General geological, seismic and/or physical indications
	(speculative outlook)	Conceptually Possible Hydrocarbons, incl. EHCs		

<http://www.energyintel.com/om/speakersNew.asp?Year=2007&filename=SadadIbrahimAlHusseini.pdf>

I personally handed this information over to Kevin Rudd at the Community Cabinet Meeting in Epping Boys High in April 2010 saying it needs his immediate attention. His mind was elsewhere. My paper ended up on a heap of files, never acted upon.

North Korea and Iran

Americans and others have long observed cooperation between these two rogue regimes. You don't need to be a trained missile expert to notice the design similarities between North Korea's home-built Rodong and its Iranian clone, the Shahab 3. Or the Rodong B and Shahab 4.

Iranian nuclear scientists were present at Pyongyang's first nuclear test. Iran-allied Syria modeled its nuclear plant (later eliminated by Israel) on a similar North Korean one. Rather than violating the Obama deal by experimenting at home, Iran can advance its nuclear program by observing North Korea's and contributing to its progress.

The mullahs have what Kim Jong-un needs most: cash. Pyongyang's only foreign-currency-worthy export is weapons and knowing how to build and use them, which Iran craves. It's a match made in hell.

Iran's missile program was, bizarrely, left out of Obama's nuclear deal. Revealing the Tehran-Pyongyang nexus might convince allies wobbly about Tehran's violations that the mullahs' threat is global. It could also start the process of plugging a major cash source for the Kim regime.

<http://nypost.com/2017/08/01/its-time-to-take-on-the-iran-north-korea-nuke-alliance/>

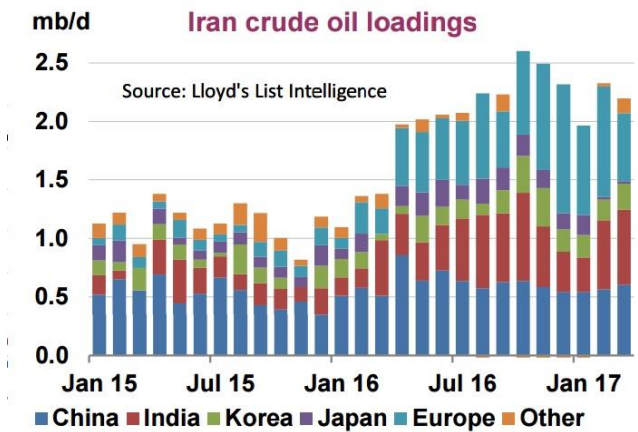
A Closer Look at Iran and North Korea's Missile Cooperation

May 13, 2017

<http://thediplomat.com/2017/05/a-closer-look-at-iran-and-north-koreas-missile-cooperation/>

Asian oil imports from Iran may help finance North Korea's nuclear and missile program:

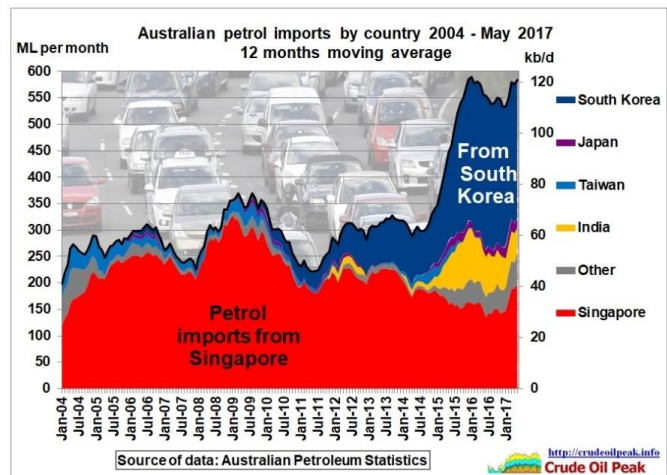
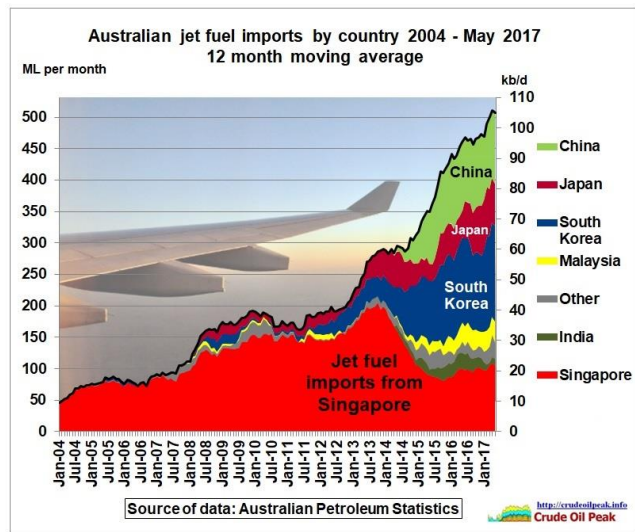
<https://www.iea.org/media/omrreports/fullissues/2017-04-13.pdf>

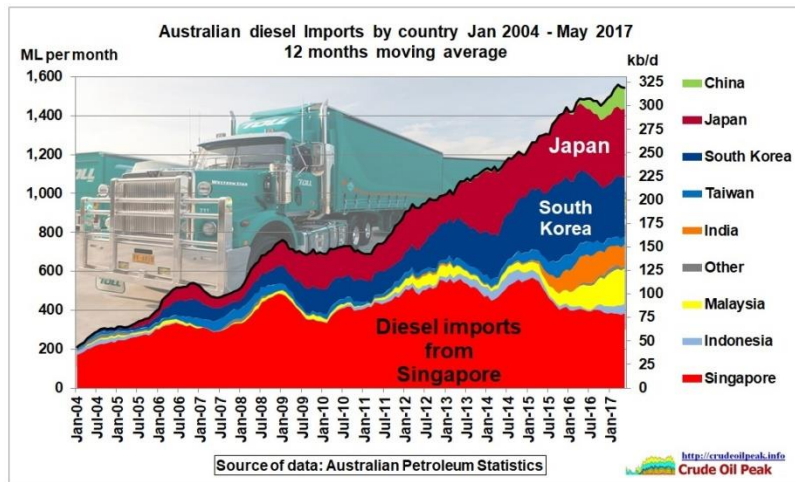


Updated fuel import graphs

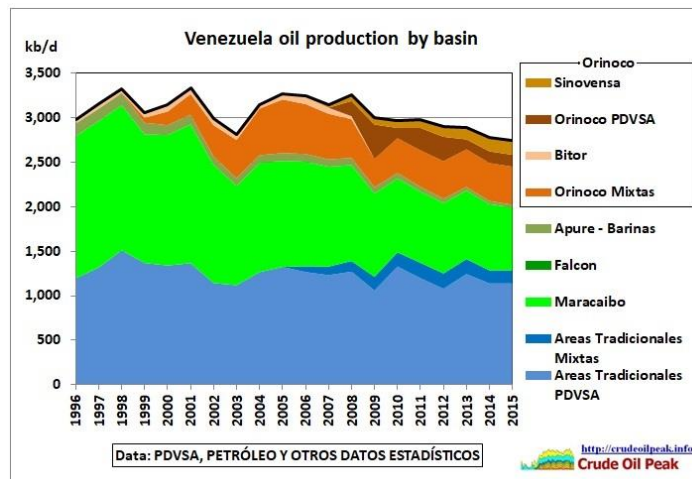
After 3 refinery closures, fuel imports surged

<http://crudeoilpeak.info/almost-half-of-australias-petrol-diesel-and-jet-fuel-imports-come-from-south-korea-and-japan>

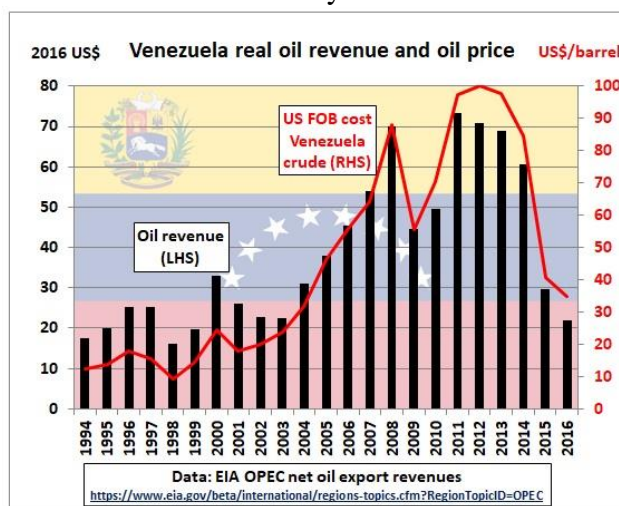




Venezuela



Conventional oil production has peaked. Unconventional extra heavy oil partially offsets this decline but brings less revenue. Due to these problems and the oil price drop total revenue has dramatically declined. This double whammy has led to a failed state.

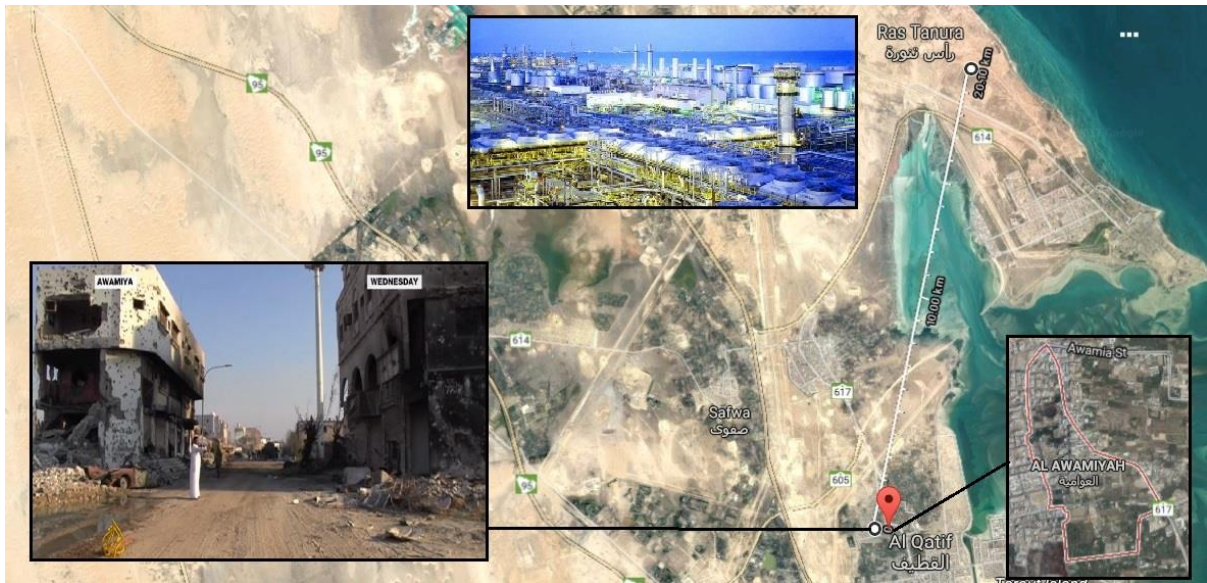


11/8/2017 Special Report: Vladimir's Venezuela - Leveraging loans to Caracas, Moscow snaps up oil assets

<http://www.reuters.com/article/us-venezuela-russia-oil-specialreport-idUSKBN1AR14U>

Saudi Arabia 2017

The Shia town of Awamiya in Qatif was flattened between May and Aug 2017, only 20 kms from the giant refinery and oil port of Ras Tanura



Glimpse into the future when Sunni-Shia conflict intensifies (in which Iran may intervene):



10/8/2017 A security campaign against Shia Muslim fighters in eastern Saudi Arabia has reduced dozens of buildings in the town of Awamiya to ruins and forced thousands of residents to flee.

<http://www.aljazeera.com/news/2017/08/saudi-security-forces-flatten-quarter-awamiya-170809213631682.html>

NSW Treasury has no idea about oil

-----Original Message-----

From: mushalik [mailto:mushalik@tpg.com.au]

Sent: Thursday, 22 June 2017 1:40 PM

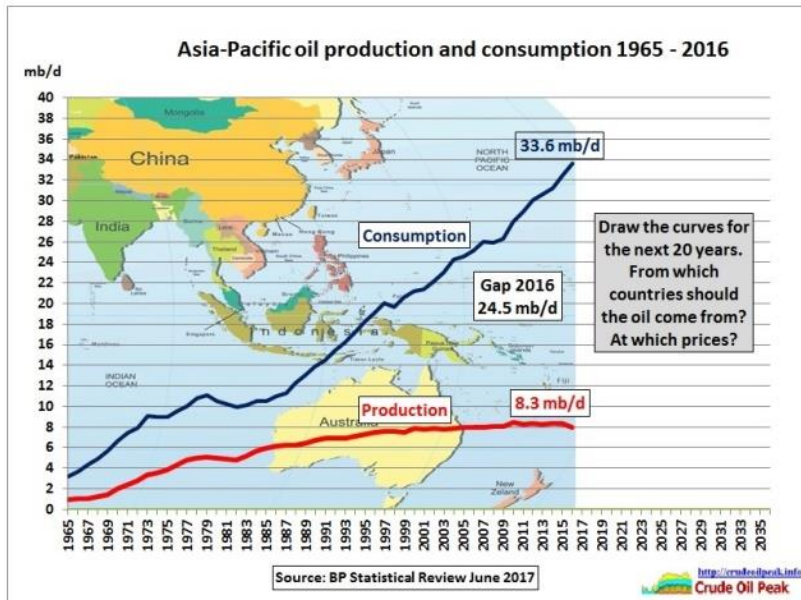
Subject: Peak oil in China and Asia

To
NSW Treasury
Madam, Sir

Re: The NSW budget does not allow for stormy economic weather

<http://www.smh.com.au/business/the-economy/nsw-budget-does-not-allow-for-storm-clouds-ahead-20170620-gwv6mh.html>

As the world is accumulating more and more geopolitical problems which will ultimately impact on oil supplies government needs to take up defensive positions to prepare for the next oil crisis



Last week BP's new Statistical Review was published. It shows that China's and therefore Asia's oil production has peaked. While demand still goes up and up

19/6/2017

Asia Pacific oil supply gap widening as China's oil production drops
<http://crudeoilpeak.info/asia-pacific-oil-supply-gap-widening-as-china-production-drops>

I recommend government draw 2 curves in the attached 2nd graph and then calculate the traffic for various toll-way and freeway projects.

The higher the population growth (88% immigration), the more competition at the pump and the longer the petrol lines at filling stations.

Expenditure for oil dependent infrastructure must be reduced

Regards

Dipl. Ing. Matt Mushalik

ASPO Sydney

<http://crudeoilpeak.info>

Twitter @crudeoilpeak

Treasury Response

Dear Mr Mushalik,

Thank you for drawing our attention to trends in international oil reserves. Treasury keeps track of global oil prices as these are a key indicator of energy prices which impact on inflation and the state's terms of trade.

Oil prices have come down in recent years and are now just above US\$40 a barrel. While global oil reserves are not infinite it is not a foregone conclusion that our current road infrastructure will be stranded. New technologies for extracting oil in unconventional ways

have expanded the pool of known reserves, although oil prices would need to be above their current levels to support significant further investment.

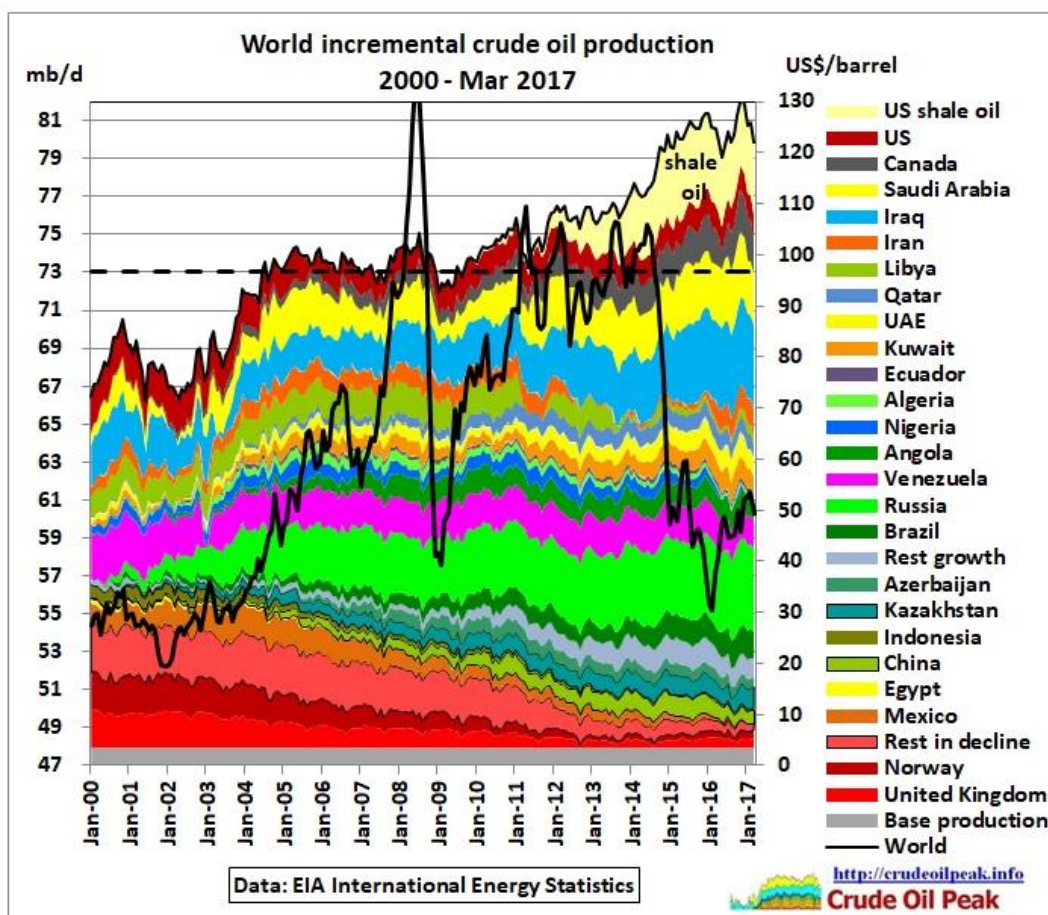
If oil supplies were to become more scarce, then this is like to occur over an extended period of time, during which the price will steadily increase as demand exceeds supply. Price increases will make extraction technologies that are currently unviable more economic and therefore increase supply somewhat. Moreover transport technologies such as electric vehicles will also become more viable over time. This is already happening with the successful commercialisation of hybrid vehicles, which are more energy efficient. Finally a large share of the transport infrastructure investment in New South Wales is in heavy and light rail, which is not dependent on oil consuming vehicles.

Yours faithfully,

NSW Treasury

My 27 page debunking paper is here: http://crudeoilpeak.info/wp-content/uploads/Response_NSW_Treasury_5Jul2017.pdf

Latest incremental crude oil graph



The undulating conventional production plateau since 2005 is clearly visible. The dashed line is for orientation. Russia saved the world from a deep oil crisis. It took Iraq 10 years to recover from the war. Wait for the shale oil peak.

Matt Simmons put my type of incremental graphs into his slide show for the Pentagon

Debt Wall

For Oil Companies \$110 Billion Debt Wall Looms Over Next 5 Years
 Aug 2016

The worst may be yet to come for some strained oil services companies as \$110 billion in debt, most of it junk rated, creeps closer to maturity.

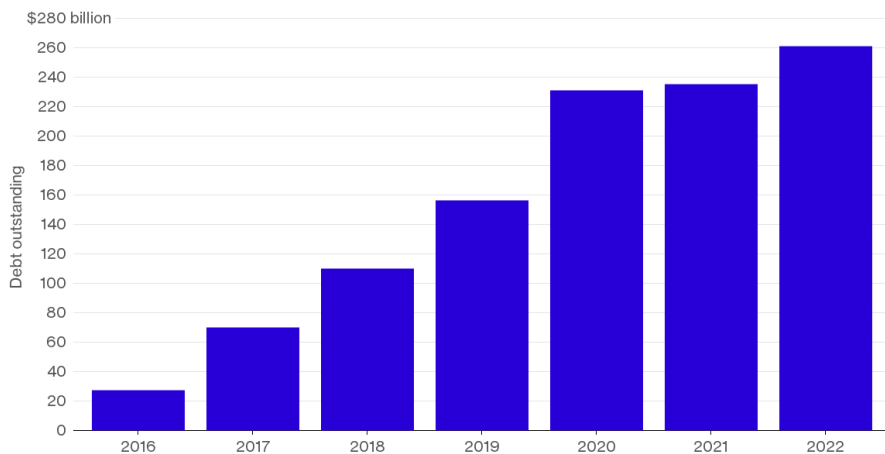
More than \$21 billion of debt from oilfield services and drilling companies is estimated to be maturing in 2018, almost three times the total burden in 2017, according to a report from Moody's Investors Service on Aug. 9. More than 70 percent of those high-yield bonds and term loans are rated Caa1 or lower, and more than 90 percent are rated below B1.

The pressure on oilfield services companies will only increase through 2021, when nearly \$29 billion of bonds and loans are expected to come due. Much of the maturing debt was issued between 2011 and 2015, when U.S. drilling was at a record high fueled by strong energy prices and new technologies. Moody's expects that more than one-third of the analyzed companies will be carrying debt loads that are more than 10 times higher than earnings this year.

<https://www.bloomberg.com/news/articles/2016-08-09/for-oil-companies-110-billion-debt-wall-looms-over-next-5-years>

Debt Wall

The amount of bonds U.S. energy companies below investment grade need to pay back each year



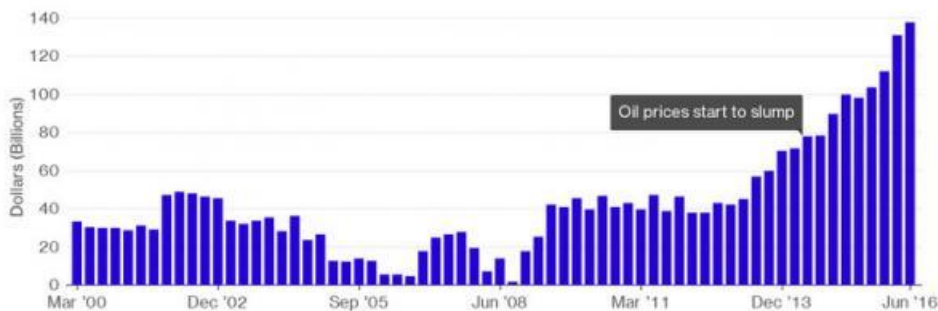
Bloomberg data

Bloomberg

Debt Mountain

The biggest oil companies have piled on debt to pay dividends during the price slump

■ Major oil companies' net debt



Source: Bloomberg

Bloomberg

Permanent impact of 2008 oil shock

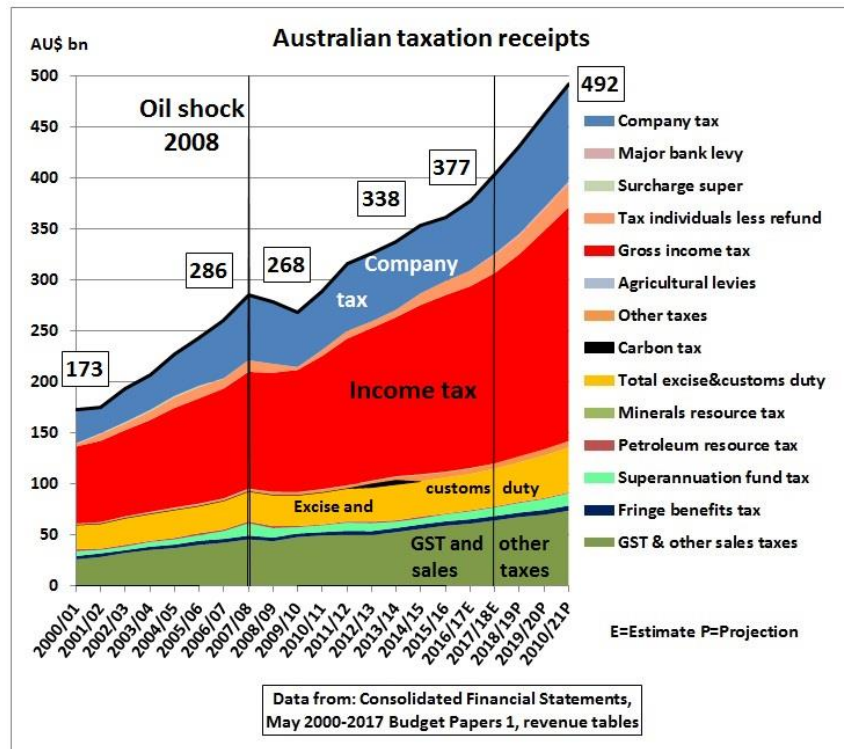


<https://fred.stlouisfed.org/series/GDPC1> A kink in the US GDP timeline.

What recovery?

<http://rooseveltinstitute.org/wp-content/uploads/2017/07/Monetary-Policy-Report-070617-2.pdf>

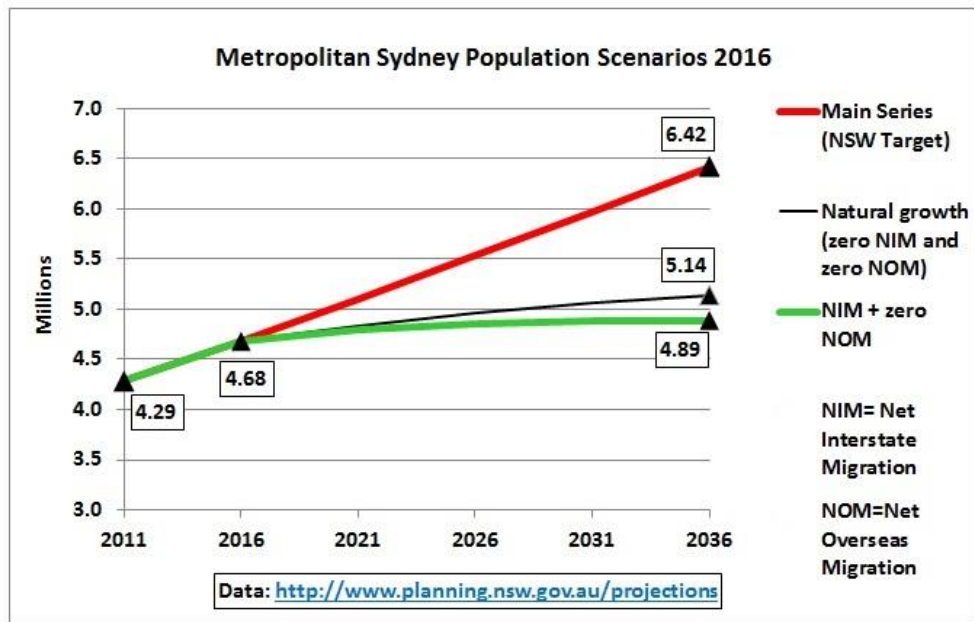
80% of Federal budget deficit is caused by lower company tax revenue after the GFC



25/5/2017 Australian budget 2017-18 ignores IEA oil price warning

<http://crudeoilpeak.info/australian-budget-2017-18-ignores-iea-oil-price-warning>

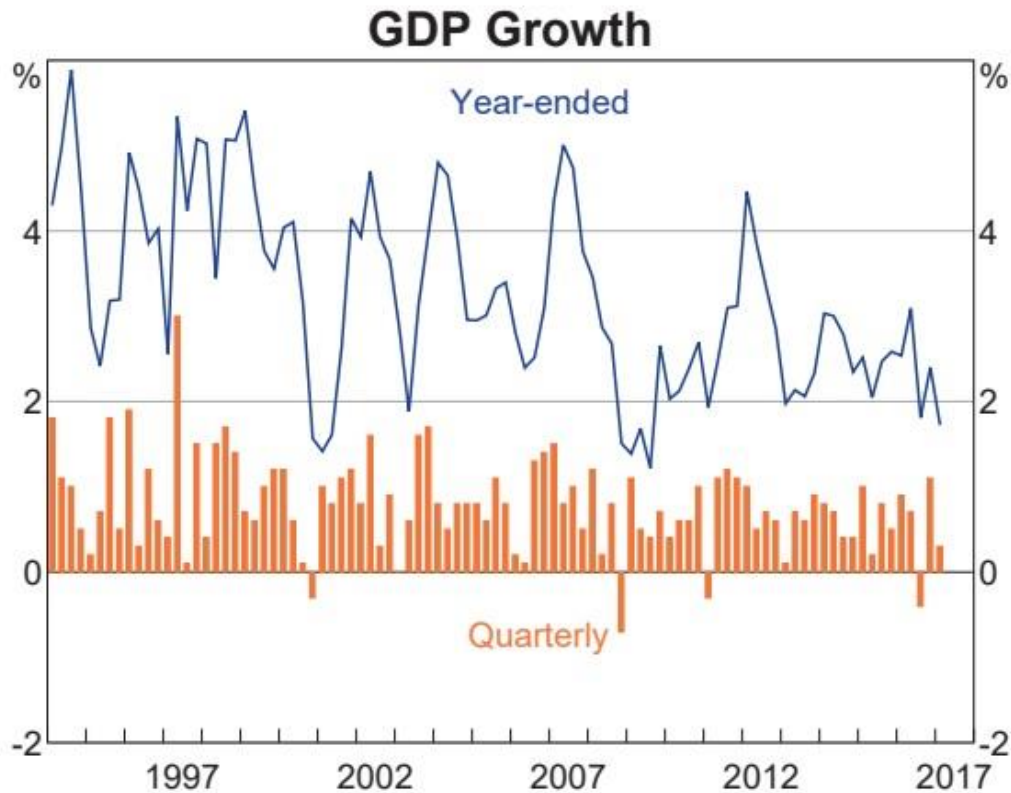
Population and GDP



The underlying population growth is 1.9% pa. Let's look at GDP growth from the latest RBA chart set (July 2017):

Reserve Bank of Australia [AU] | <https://www.rba.gov.au/chart-pack/pdf/chart-pack.pdf>

Australian GDP Growth and Inflation



Source: ABS

<https://www.rba.gov.au/chart-pack/pdf/chart-pack.pdf>

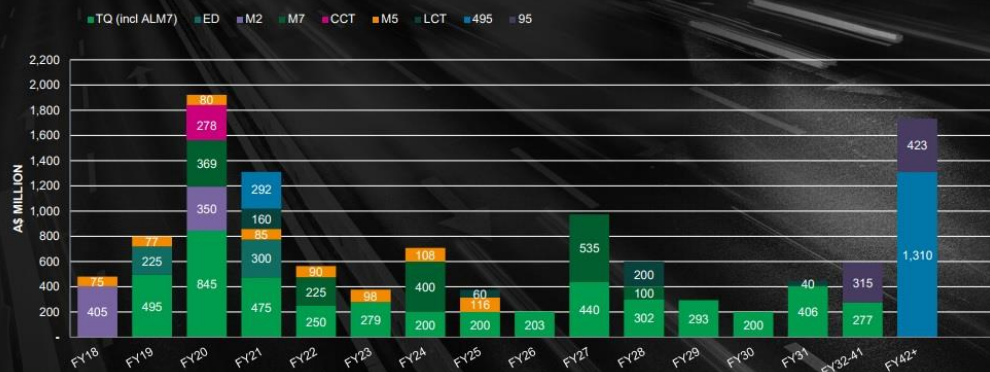
Transurban kicks debt can down the toll-way

Transurban Limited [AU] | <https://www.transurban.com/content/dam/investor-centre/03/FY17-ResultsPresentation.pdf>

GROUP DEBT ¹	JUN 16	JUN 17
Group debt ³	A\$12,484M	A\$13,639M
Weighted average maturity ⁴	8.7 years	9.0 years
Weighted average cost of AUD debt ⁵	5.2%	4.9%
Weighted average cost of USD debt ⁵	4.3%	4.3%
Gearing ⁶	33.3%	35.3%
FFO/Debt ⁷	8.0%	8.6%

Transurban Limited [AU] | <https://www.transurban.com/content/dam/investor-centre/03/FY17-ResultsPresentation.pdf>

Non-recourse debt maturities at 30 June 2017



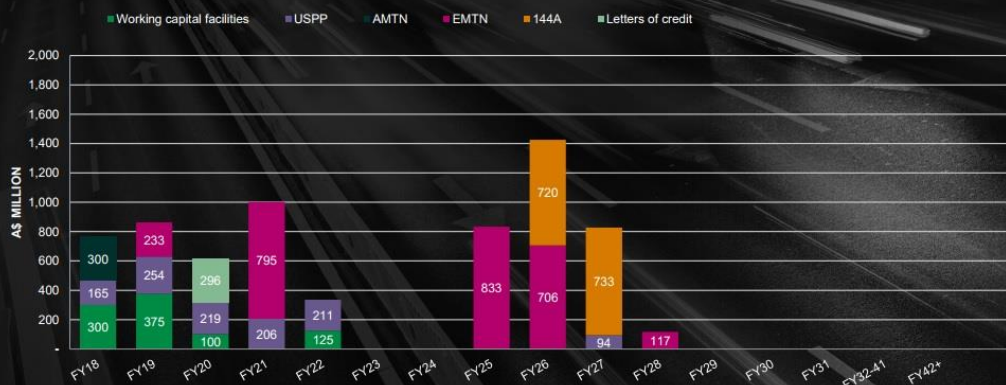
- The full value of debt facilities is shown as this is the value of debt for refinancing purposes. This overstates Transurban's ownership share of the debt.
- Debt is shown in the financial year in which it matures.
- Debt values are in AUD as at 30 June 2017. CHF and USD debt converted at the hedged rate where cross currency swaps are in place. USD debt is converted at the spot exchange rate (\$0.7692 at 30 June 2017) where no cross currency swaps are in place.
- The A\$292 million maturing in FY21 are part of the 495 Express Lanes senior bonds maturing in FY48. This tranche will be refinanced as per the financing structure agreed with the sole holder, J.P. Morgan.
- 95 Express Lanes and 495 Express Lanes maturities show final maturity dates.

TRANSURBAN FY17 RESULTS | 8 AUGUST 2017

61

Transurban Limited [AU] | <https://www.transurban.com/content/dam/investor-centre/03/FY17-ResultsPresentation.pdf>

Corporate debt maturities at 30 June 2017



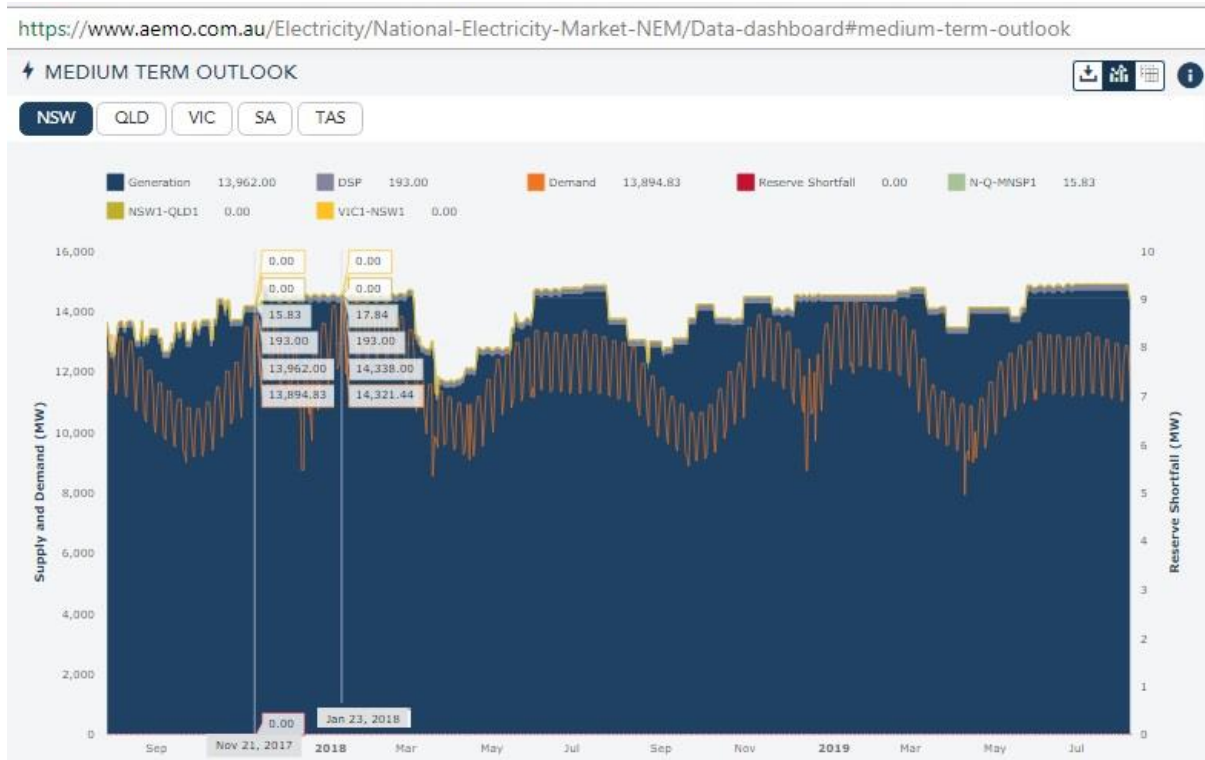
- Debt is shown in the financial year in which it matures.
- Debt values are in AUD as at 30 June 2017. CAD, EUR, NOK and USD debt converted at the hedged rate where cross currency swaps are in place. USD debt is converted at the spot exchange rate (\$0.7692 at 30 June 2017) where no cross currency swaps are in place.
- Corporate working capital shown at final maturity dates. All working capital facilities were refinanced in July 2017.

TRANSURBAN FY17 RESULTS | 8 AUGUST 2017

60

<https://www.transurban.com/content/dam/investor-centre/03/FY17-ResultsPresentation.pdf>

Power consumption and peak demand



Captured 2/8/2017 <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data-dashboard#medium-term-outlook>

Demand is always close to generation capacity in summer

Multiple problems found in AEMO report on load shedding in NSW 10th Feb 2017

[https://www.aemo.com.au/-/media/Files/Electricity/NEM/Market Notices and Events/Power System Incident Reports/2017/Incident-report-NSW-10-February-2017.pdf](https://www.aemo.com.au/-/media/Files/Electricity/NEM/Market%20Notices%20and%20Events/Power%20System%20Incident%20Reports/2017/Incident-report-NSW-10-February-2017.pdf)

Liddell coal power plant 2x500 MW under repair

Eraring coal power plant
11:05 Unit 3 output only 549 MW (capacity 720 MW) due to minor boiler tube leak

Vales Point coal power plant
16:09 Within one degree of reaching their absolute outlet temperature limit

Tallawarra gas plant 16:22 trips from 408 MW due to a fault in gas turbine

Colongra gas plant
16:50 All 4 units failed to start. Low gas pressure in fuel supply line as gas was used earlier in the day. 2 unit hrs gas in the pipe. Start with fuel oil also failed. 6-8 hrs of fuel oil available
18:37 Units 3 & 4 finally transitioned to fuel oil but ran out of gas to start units 1 & 2

Interconnectors thermal limits

Victoria-NSW	297 MW over limit
Queensland-NSW QNI	276 MW over limit

14 Feb 2017

NSW's privatized giveaway coal plant causes load shedding in extreme weather

<http://crudeoilpeak.info/nsws-privatized-giveaway-coal-plant-causes-load-shedding-in-extreme-weather>

IMPLICATIONS OF PARRAMATTA CBD GROWTH

PEAK DAY ELECTRICITY DEMAND (MW)

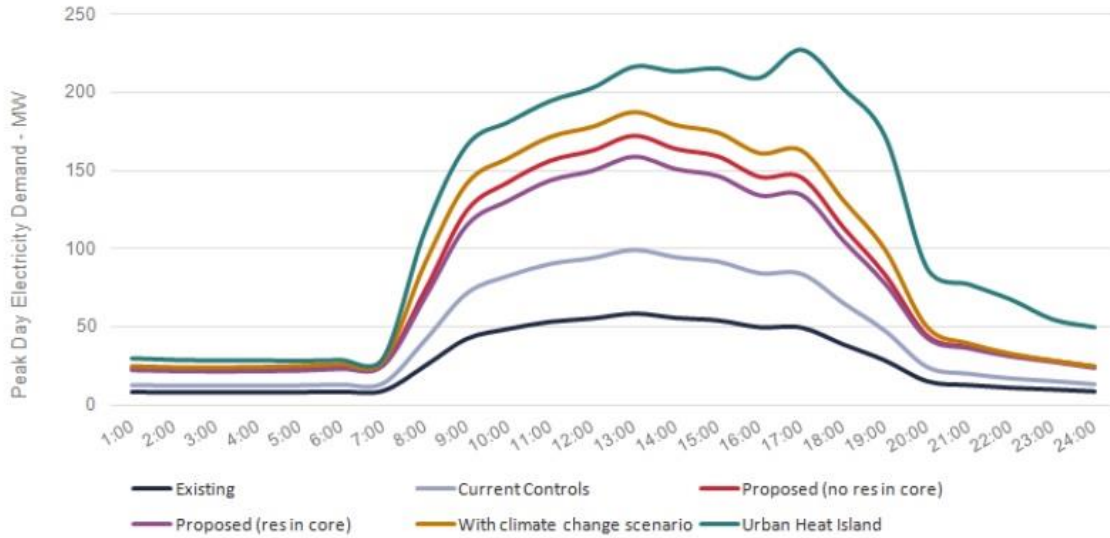


Figure 20: Expected peak day electricity demand profile under each planning scenario as well as under various climate change scenarios.

Where will CO2 free power come from to operate all these planned skyscrapers?



The SA battery pack with 100 MW lasts for only 1.3 hrs at full discharge rate!

<https://www.gizmodo.com.au/2017/07/all-the-details-on-teslas-giant-australian-battery/>



So where is the battery pack for Parramatta? Epping? North West Metro? Badgerys Creek? Barangaroo? Bankstown? 1.5 m immigrants?

Will we wait for Snowy2 pumped hydro storage?

What will happen when Liddell power plant closes? The clock is ticking.

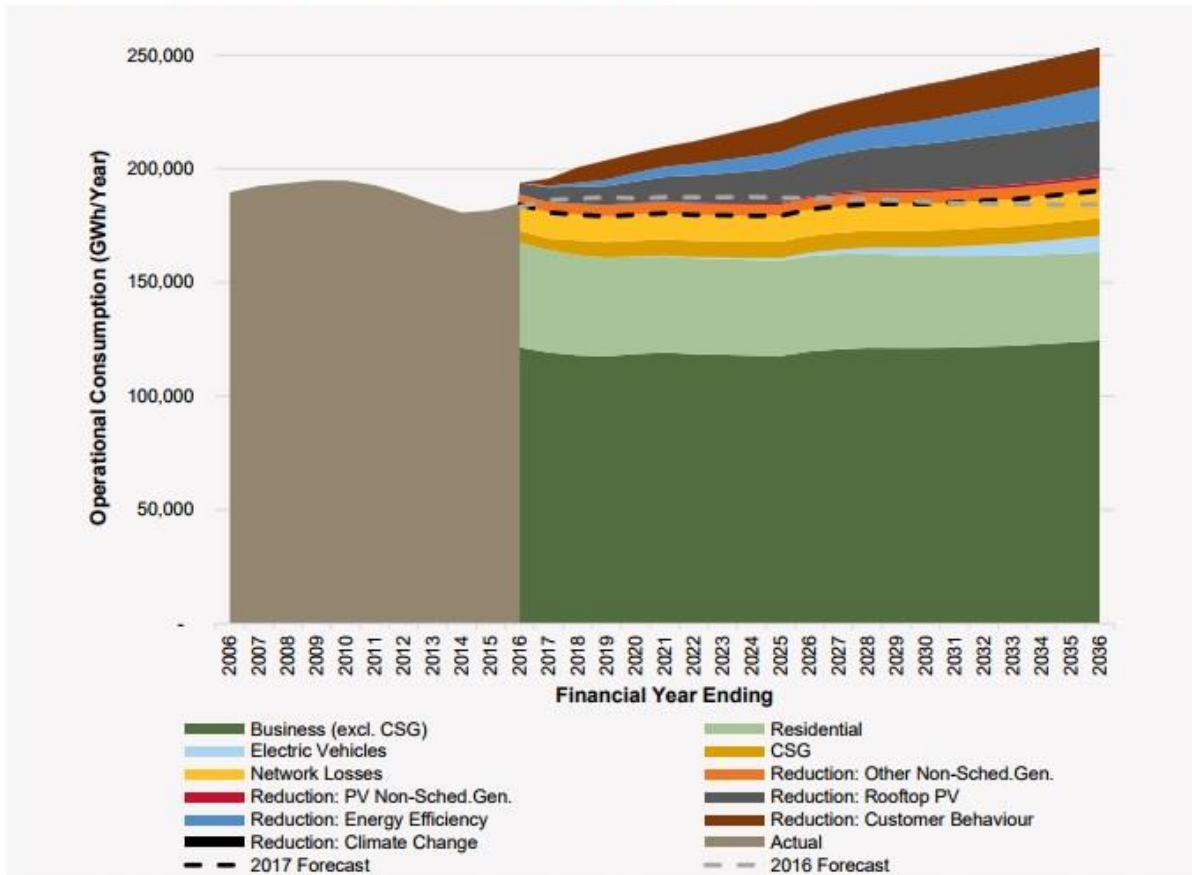
AEMO Scenario

Save, baby, save

www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/EFI/2017-Electricity-Forecasting

Figure 1 Neutral scenario annual operational consumption forecast for the NEM

-Insights.pdf



Note: the liquefied natural gas (LNG) demand sector in the 2016 NEFR is now referred to as coal seam gas (CSG) and is covering electricity consumption associated with extraction and processing of CSG for both export and domestic markets.

ANNUAL CONSUMPTION Neutral scenario shows a flat 20-year outlook for the grid, as increased usage by business and household consumers is offset by self-generation and energy efficiency. Over the forecast horizon, overall annual electricity consumption in the NEM is forecast to remain relatively flat, with reductions due to increased energy efficiency and rooftop PV offsetting recent consumption increases from Queensland's coal seam gas (CSG) sector, which has been the key driver behind NEM consumption growth in the last two years.

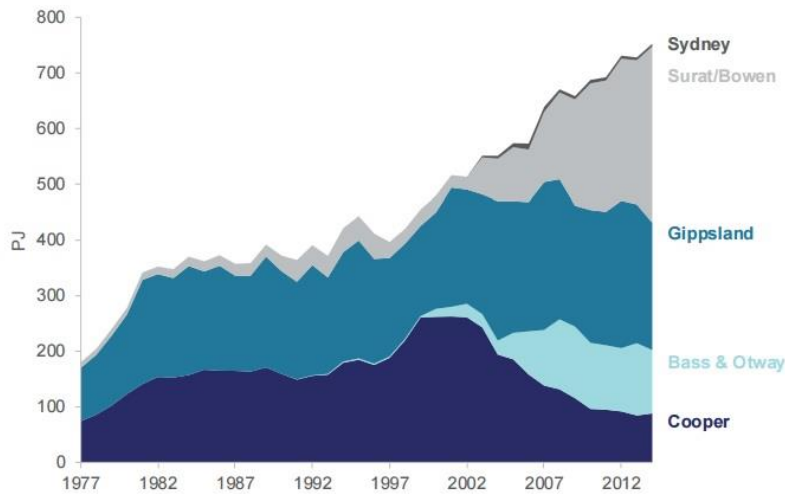
https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/EFI/2017-Electricity-Forecasting-Insights.pdf

PV driving CSG pumps for LNG exports (more fugitive CH₄ emissions, more CO₂ when burning gas at destination) while there is not enough domestic gas for peaking power plants or to complement intermittent renewables: **this system is aimless.**

Conventional Gas Peak on East Coast

industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/gas-market/Gas-Market-Report-2015.pdf

Figure 2.7: Eastern Australia sources of gas supply



Source: SKM (2013) Gas Market Modelling; EnergyQuest (2015) EnergyQuarterly

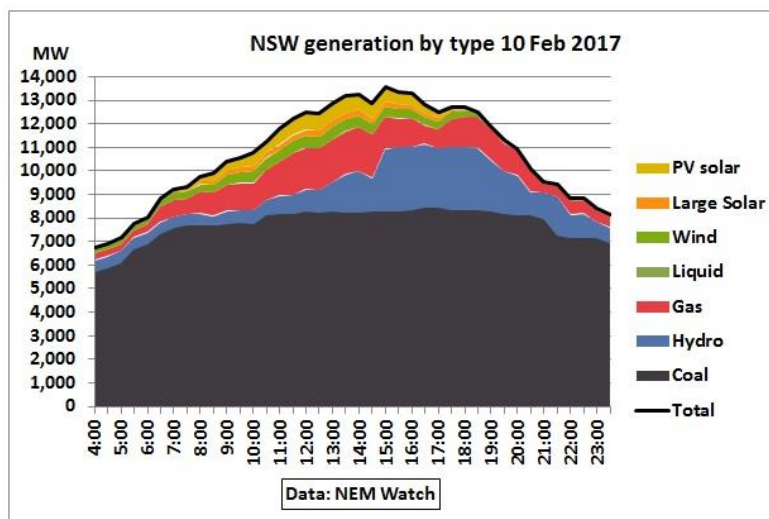
The blue areas are conventional gas fields. Howard mentioned in his totally flawed energy white paper in June 2004 that Cooper was peaking. His Environment Minister Turnbull approved massive LNG export projects on the west coast without the condition that the gas industry builds a west-east gas pipeline to offset decline on the east coast.

27/3/2017

Howard's energy super power stuck in domestic gas shortages

<http://crudeoilpeak.info/howards-energy-superpower-stuck-in-domestic-gas-shortages>

Now Howard's and Turnbull's wrong decisions come back like a boomerang. Lucky for them that the media hasn't understood why this is happening. Howard could have already built Snowy 2 but he thought that market forces will decide on energy projects. Instead, the industry waited for a carbon policy and let their coal assets run down.

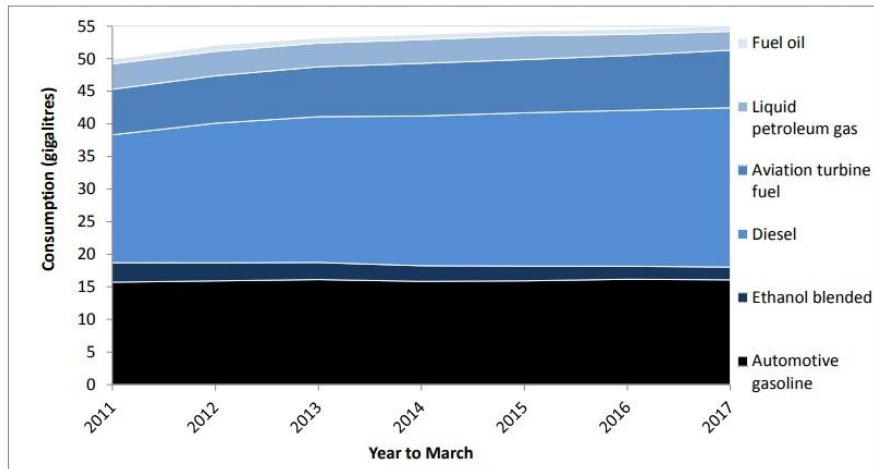


Lack of gas pressure resulted in load shedding of the Tomago smelter, a no-no. They should have turned off lights and aircons in those office blocks where energy illiterate bureaucrats and their political masters fail to make the right decisions.

CO2 emissions

① www.environment.gov.au/system/files/resources/6cc33ded-14aa-4ddc-b298-b6ffe42f94a1/files/nggi-quarterly-update-march-2017.pdf

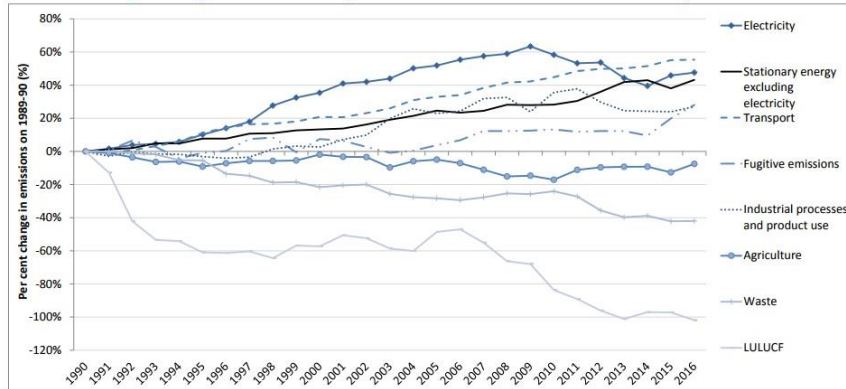
Figure 13: Consumption of major liquid fuels, year to March 2011 to 2017



Source: Department of the Environment and Energy (2017), *Australian Petroleum Statistics*

① www.environment.gov.au/system/files/resources/6cc33ded-14aa-4ddc-b298-b6ffe42f94a1/files/nggi-quarterly-update-march-2017.pdf

Figure 7: Percentage change in emissions by sector since 1990, Australia, financial years, 1990 to 2016

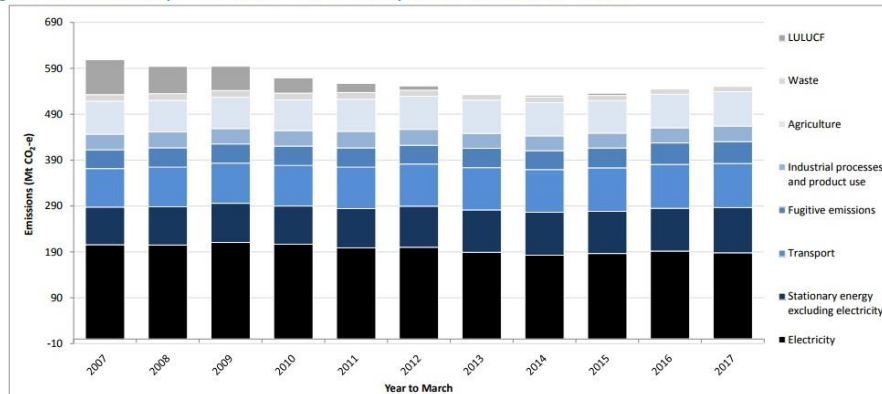


Source: Department of the Environment and Energy

Transport emissions are steadily increasing due to new toll-ways and town planning not reducing long-distance commuting.

① www.environment.gov.au/system/files/resources/6cc33ded-14aa-4ddc-b298-b6ffe42f94a1/files/nggi-quarterly-update-march-2017.pdf

Figure 4: Emissions by sector, Australia, annual, year to March 2007 to 2017



Source: Department of the Environment and Energy

Prepared by Matt Mushalik 14/8/2017 mushalik@tpg.com.au twitter @crudeoilpeak