

Canberra observed



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ANU Energy Update 2016; a timely event for Minister Frydenberg

The ANU Energy Change Institute hosts an annual forum on energy supplies. On 29 November the Minister for the Environment and Energy gave the key note address and was followed by 12 other speakers. I am commenting on three of these presentations. All of them are available at <http://energy.anu.edu.au/news-events/energy-update-2016>, including the Minister's talk.

The venue and the timing was a good opportunity for the Minister to provide information on the Chief Scientist's review of Australia's National Electricity Market (NEM).

Frydenberg's review of the National Electricity Market

Against a background of student activists chanting 'Don't burn dirty coal, keep it in the ground' and 'Keep our gas at home', the Minister gave what I thought was an excellent review of the current situation regarding the NEM.

The NEM is the longest geographically connected power system in the world, extending from Port Douglas in Queensland to Port Lincoln in South Australia. It supplies all the states and territories of eastern and southern Australia and generates around 200 terawatt hours of electricity annually, or about 80% per cent of our electricity consumption. The goal is to have a secure and affordable electricity system for households and industry that is resilient and can handle the

loads and stresses that will be placed on the infrastructure that supports it.

The NEM is changing as manufacturing industry contracts and the service sector expands. New technologies are changing the way energy is generated and delivered to consumers and Australia is committed to reducing its greenhouse emissions. A series of recent events brought these issues into focus. The Bass Strait cable between Tasmania and the mainland was severed and remained out of action for six months, the Heywood interconnector between South Australia and Victoria failed, and a storm in September 2016 caused several electricity pylons to collapse in South Australia. To make matters worse, the Hazelwood Power Station is expected to close in March 2017. The Minister pointed out that although it is an older power station and a high emitter of carbon, it also provided 22 per cent of Victorian operational electricity demand in 2015 and is a significant source of electricity for South Australia.

He also reminded attendees that the NEM was based on 'a system powered by the big spinning machines of coal-fired generators - rotating 50 times a second which provide power at a steady frequency of exactly 50 Hz, and that coal is increasingly being replaced by the intermittent, non-synchronous generation of renewables like wind and solar.'

Furthermore, although 'the costs of solar PV and wind generation have fallen further and faster than any pundits predicted even five years ago, new-build solar and wind cannot compete yet with existing coal fired power or gas on price.' 'However, a 2016 Australian Power Generation Technology report estimates that wind and solar PV are cost-competitive with new build generators of equivalent emissions profiles, such as fossil fuel generators with carbon capture and storage, and that by 2030 wind and solar generation will be cost competitive with new build technologies generally.' He also said that 'Consumers, hungry for renewable energy, battery storage and more energy efficient technologies to manage their household energy bills, are driving change in the electricity market and leading to a more distributed grid. There are now 1.5 million households in Australia with solar PV installed and over 1 million solar hot water systems and, by 2030, it is estimated that 24 per

cent of installed capacity in the National Electricity Market will be rooftop solar. A major problem is that 'in 2015, only 4.9 per cent of Australia's national electricity generation came from wind generation, and 2.4 per cent came from solar.' There is a long way to go.

Because of these challenges, the Minister arranged for the COAG Energy Council to commission Dr Alan Finkel, Australia's Chief Scientist, to examine what energy market reforms are needed, together with a new national approach to energy security and reliability. A preliminary report was released in December 2016: <https://www.environment.gov.au/system/files/resources/97a4f50c-24ac-4fe5-b3e5-5f93066543a4/files/independent-review-national-elec-market-prelim.pdf>.

This report identifies some key questions for the future of our energy system. One of these is:

- What role should the electricity sector play in meeting Australia's emissions reduction targets?

This set the cat among the pigeons and some factions of the government objected stridently to this question because the review may recommend a carbon tax or a carbon trading scheme. As a result, Prime Minister Turnbull abandoned a review of the Direct Action emission reduction scheme. It just shows what a sensitive political issue climate change is for the current government.

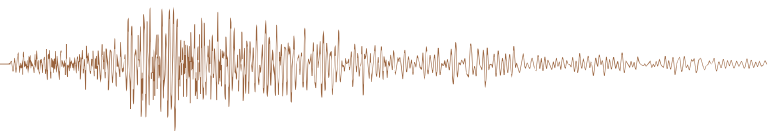
Anyway, if anyone wants to provide input to the review the details can be found on: <http://www.environment.gov.au/energy/national-electricity-market-review>. Submissions are invited until 21 February and the report is due to be presented to COAG in mid-2017.

Mark Howden: Climate change: an overview of the science, public attitudes and the politics

Mark Howden from the ANU Climate Institute reviewed the current observations of climate change, particularly those that affect Australia and the public attitude towards climate change here.

According to Howden:

- 46% of Australians consider that climate change is happening and



human-influenced, 38% that it is happening but natural, and 8% say it is not happening (what happened to the other 8% is not known)

- Most of the 'not happening' category related to media 'balance'
- There was an optimism bias (going to affect others more than me) across all groups
- And psychological distancing (problem far away or in the future) across all groups
- BUT climate adaptation was supported across the political divide (74% want more action): linked to relevance, ethics/moral position and trust in the science/scientists.

How big the sample was and what can be done with these results to improve practical policy development is not clear.

What I did find interesting was the climate spirals produced by Ed Hawkins of the Climate Lab in the UK and shown by Howden for temperature and CO₂ levels. The increases in temperature and CO₂ levels globally are well known, but the presentation is usually restricted to simple graphs of temperature or CO₂ concentrations versus time. What Hawkins and his team have done is

made a dynamic presentation that provides another way at looking at these parameters.

If you visit the url: <https://www.climate-lab-book.ac.uk/spirals/>, you can also see other variables, such as Arctic Sea ice. The figure below is taken from this website and it's certainly worth a look as you can watch the changes month by month.

Andrew Blakers: 100% renewable energy

The critics of wind and solar energy sources argue that you will always need a background supply of coal, nuclear or gas to provide the base load. Andrew Blakers from the ANU Energy Change Institute tackled this argument head-on and proposed that off-river pumped hydro energy storage (PHES) could, and should, be developed to cope with the no wind/no sun situations.

The concept is simple. An array of solar panels is built near two off-river storage dams with a significant elevation difference of greater than 300 m. The surface areas should be at least 20

hectares and the water should be at least 25 m deep. During the day, the solar cells generate power for the grid and drive pumps to fill the upper reservoir. When the sun is not shining the water from the upper dam falls to the lower dam and generates electricity. In theory, there are hundreds of sites in southern Australia where these criteria can be met and that could be developed.

In practice the costs to construct the infrastructure at each site and connect it to the NEM might be prohibitive, but a prototype is being developed at the abandoned gold mine at Kidston, near Georgetown in Queensland. The Kidston Solar Project involves a huge solar panel array on the main tailings store and three reservoirs based on the old mining pits.

It is not clear how an elevation difference of 300 m is achieved at the site, or whether the evaporation losses will be prohibitive, but it is a worthwhile practical test of the technique. For more information go to: <http://www.genexpower.com.au/the-kidston-solar-project.html> or have a look at Andrew Blakers' presentation.

Sinodinos replaces Hunt as Minister for Industry, Innovation and Science

Prime Minister Turnbull has moved Greg Hunt from Industry, Innovation and Science (IIS) to Health. Senator Arthur Sinodinos is the new Minister for (IIS).

Sinodinos has a Bachelor of Commerce from Newcastle University, has worked in the Departments of Finance and the Treasury, and was a Director of Goldman Sachs JBWere investment bank before being elected to the Senate in 2011.

Government Ministers have to be agile and innovative. Greg Hunt took on the IIS Ministry in July 2016 and was moved to Health in January 2017.

As the Prime Minister said: 'The industry, innovation and science portfolio is critical to generating the jobs of the future and Senator Sinodinos' extensive public policy experience over many, many years gives him a strong understanding of the key drivers of new sources of economic growth and how government can ensure that its policies deliver the innovation, the investment, the technology that will secure the future for our children and grandchildren.'

With endorsements like this we expect great outcomes from the new Minister.

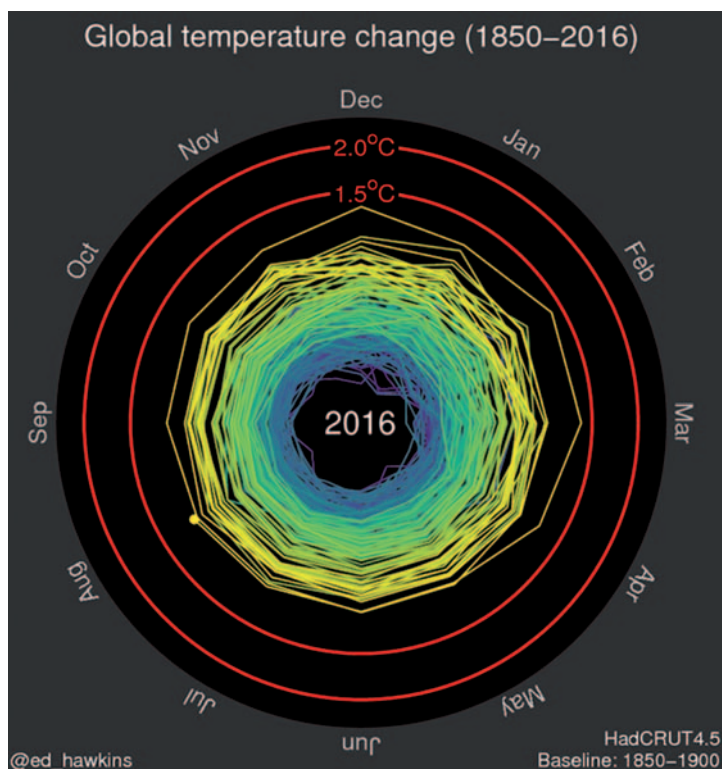


Figure 1. The final image of the temperature spiral taken from http://blogs.reading.ac.uk/climate-lab-book/files/2016/05/spiral_optimized.gif and presented by Mark Howden. If you visit: <http://blogs.reading.ac.uk/climate-lab-book/files/2016/09/co2.gif> you can look at a similar presentation for atmospheric CO₂ levels from 1958. Well worth a look, but the variation in CO₂ levels is much smoother than the temperature curves, as you would expect.

Proposed areas for the 2017 Offshore Petroleum Exploration Acreage Release¹

The 2017 Offshore Petroleum Exploration Acreage Release area nomination and shortlisting processes are now complete. There were 97 area nominations from 21 companies received, which is similar to previous years. Twenty-two areas have been proposed for inclusion in the 2017 acreage release. Information about the proposed areas is available online at <http://www.petroleum-acreage.gov.au/2016/2017-nominations> and is summarised in Figure 1 and Table 1.

Bidding on the first work programme round of the 2016 Offshore Petroleum Exploration Acreage Release closed on 8 December 2016. In addition, 12 areas will be re-released and bidding will close on

Table 1. List of proposed areas for the 2017 Offshore Petroleum Exploration Acreage Release

Proposed areas	
Bonaparte Basin	NT17-1, 2; W17-1 & 2
Bonaparte & Browse Basins	AC17-1,2,3,4 & 5; W17-3; WA 56-R
Roebuck Basin	W 17-4
North Carnarvon Basin	W17-5, 6 & 7
Exmouth Plateau	W 17-8
North Perth Basin	W 17-9 & 10
Otway Basin	V 17 2 & 3
Bass Basin	T 17-1
Gippsland Basin	V 17-1

23 March 2017, in line with the second round of work programme bidding for this release. The areas are:

- AC16-1 to 2.
- W16-1, W16-3, W16-10 to 11, W16-13, W16-15- to 16, W16-19 to 21.

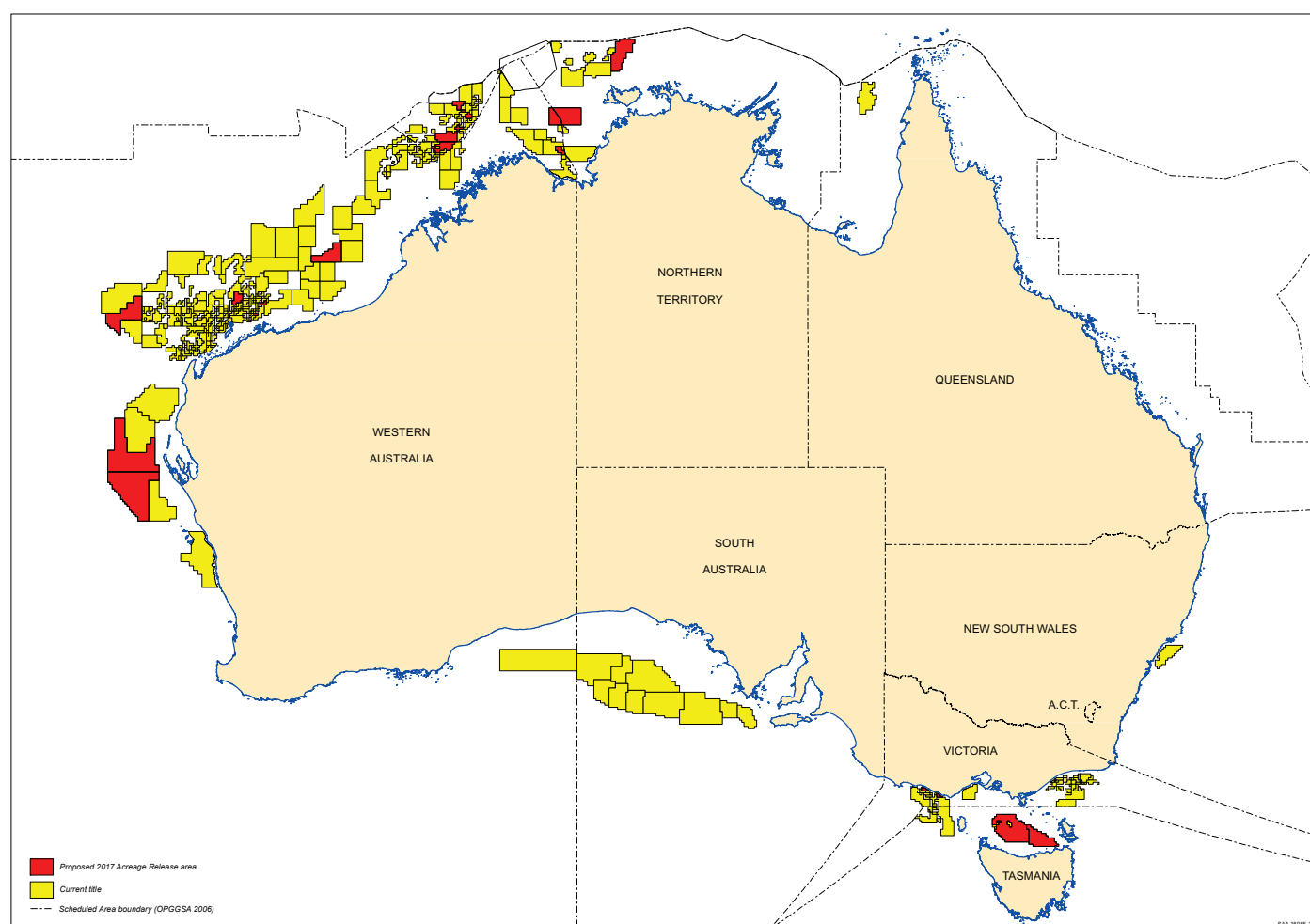
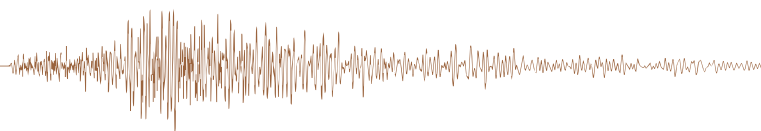


Figure 1. Location of proposed area for the 2017 Offshore Petroleum Exploration Acreage Release.

¹All the information for this article was taken from the December 2016 issue of *Australian Petroleum News*, published by the Australian Government (<http://us11.campaign-archive2.com/?u=8ed6f6a545e71ff832ce3e1af&id=d7455f9b32>).



The 2015 Offshore Petroleum Exploration Acreage Release finalised¹

Nine offshore petroleum exploration permits have been awarded with a minimum investment of A\$475 million over the next six-years. These are summarised below.

Round one – awarded March-June 2016

WA-521-P (released as W15-5) located approximately 250 km from the northeast coast of Western Australia, was awarded to Carnarvon Petroleum Ltd. It proposed a A\$1.32 million guaranteed work programme comprising of 4 000 km of 2D multi-client reprocessed data, 150 km of 2D seismic acoustic impedance inversion and geological and geophysical studies. The secondary work programme comprises acquisition, processing and interpretation of 300 km² of new 3D seismic data and geological and geophysical studies, totalling A\$3.57 million. There were no other bids for this area.

WA-522-P (re-released as W14-1) located approximately 400 km from Darwin, was awarded to Woodside Energy Ltd. It proposed a A\$13.39 million guaranteed work programme comprising of geotechnical studies, 2D seismic interpretation and acquisition and PreStack Time Migration (PreSTM) processing of 1586 km² of new 3D broadband seismic. The secondary work programme comprises 1500 km² of 3D Full Waveform Inversion studies and one exploration well, totalling A\$18.92 million. There were no other bids for this area.

WA-523-P (released as W15-2) is located approximately 470 km from the northwest coast of Western Australia, was awarded to Carnarvon Petroleum Ltd. It proposed a A\$2.83 million guaranteed work programme comprising of 3D data

reprocessing PreSTM reprocessing of 3 000 km of 2D data and studies. The secondary work programme comprises 210 km² of new 3D broadband seismic data, mapping and one exploration well, totalling A\$43.5 million. There were two other bids for this area.

AC/P60 (released as AC14-1) located in the Timor Sea approximately 300 km offshore and 650 km west of Darwin, was awarded to Total E&P Holdings (Australia) Pty Ltd. It proposed an A\$8.70 million guaranteed work programme comprising geological and geophysical studies, acquisition or licensing of 700 km² of new 3D broadband seismic data. The secondary work programme comprises geological and geophysical studies and one exploration well, totalling A\$26.50 million. There was one other bid for this area.

AC/P61 (released as AC15-1) located approximately 600 km Darwin, has been awarded to Finder No. 1 Pty Limited. It proposed a A\$500 000 guaranteed work programme comprising of 330 km² 3D PreSDM seismic data reprocessing and geological and geophysical studies. The secondary work programme comprises 200 km² of reservoir characterisation studies, geological and geophysical studies and one exploration well, totalling A\$15.25 million. There were no other bids for this area.

VIC/P71 (released as V15-2) located about 200 km east of Melbourne, has been awarded to Llanberis Energy Pty Ltd. It proposed a A\$9.3 million guaranteed work programme comprising of geological and geophysical studies, acquisition, processing and interpretation of 550 km² of new 3D seismic data. The secondary work programme comprises acquisition, processing and interpretation of 1200 km²

of new 3D seismic data, two exploration wells and geological and geophysical studies, totalling A\$61.8 million. There were no other bids for this area.

Round two – awarded September–November 2016

WA-524-P (released as W15-8) located in the Northern Carnarvon basin has been awarded to Carnarvon Petroleum Limited. It proposed a A\$3.4 million guaranteed work programme including 250 km² Broadband PreSDM reprocessing of 3D data. The secondary work programme comprises of well planning and long lead studies and one exploration well, totalling A\$26.3 million. There were no other bids for this area.

EPP46 (released as S15-1) located in the Bight basin has been awarded to Karoon Gas Browse Basin Pty Ltd. It proposed a A\$25.85 million guaranteed work programme including acquisition or licensing of 5 000 km of new 2D seismic, 2D gravity, magnetic and bathymetric survey data; reprocessing existing 2D data; and acquisition or licensing (and processing) of 2500 km² of new 3D seismic data. The secondary work programme comprises geotechnical studies and one exploration well, totalling A\$117.5 million. There were no other bids for this area.

WA-525-P (released as W15-14) located in the Northern Carnarvon Basin has been awarded to BP. It proposed a A\$10 million guaranteed work programme including licensing, reprocessing and interpretation of 2300 km² of the Zeus 3D survey plus other 3D surveys over the permit area. The secondary work programme includes one exploration well and data analysis, totalling A\$93 million. There were no other bids for this area.

¹All the information for this article was taken from the December 2016 issue of *Australian Petroleum News*, published by the Australian Government (<http://us11.campaign-archive2.com/?u=8ed6f6a545e71ff832ce3e1af&id=d7455f9b32>).

Oil price and drilling activity recover in 2016

For the first time in eight years OPEC agreed, in September 2016, to limit oil production to a range of 32.5 to 33 million barrels a day. This is down from an estimated 38 mbl/day produced in 2015.

Given that global consumption has increased consistently by about 1.2% per year from 2005 through 2015 (Table 1), and is expected to have reached 96 million barrels in 2016, it is not surprising that it didn't take long for the oil price to increase after the OPEC decision.

And of course, when the price goes up, exploration investment increases, particularly drilling activity. Baker Hughes has compiled the rotary rig counts as a service to the petroleum industry since 1944, when the Hughes Tool Company began weekly counts of US and Canadian drilling activity. In 1975 Hughes initiated the monthly international rig count. These counts are an important indicator, not only for the drilling industry and its suppliers, but for the whole petroleum exploration industry.

The most recent results plotted in Figure 1 cover the period 2000 through November 2016. As you would expect, there is a strong correlation between the oil price and the number of operating rigs. It turns out there is a lag time now of about four months between a significant price change and the number of rigs operating. In the early 2000s the lag was sometimes as much as two years. If nothing else the drilling industry is now able to respond very quickly to changes in demand.

Canada and the US continue to dominate the rig numbers, probably due to the demand for hydrofracturing, even though the total number of rigs is declining. In 2000 there were approximately 1500 rigs operating each month in North America, while in 2016 the number had dropped about 620. Not only has the number of rigs dropped, but the ratio of North American Rigs to the world total has also declined (Figure 2). This ratio remained between 0.6 and 0.7 from 2000–2014, but by 2016 the share had dropped to 0.4. The Australian count in 2016 averaged only five rigs per month; a huge fall from 1980s when an average of over 30 rigs were operating each month.

There won't be much more oil discovered here unless more drills are working.

Table 1. Global consumption and production of oil

Global consumption and production of oil in millions of barrels/day 2005–2016*											
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Consumption	84.7	85.7	87.1	86.6	85.7	88.8	89.8	90.7	92.0	93.1	95.0
Production	81.9	82.5	82.3	82.8	81.2	83.3	84.1	86.2	86.6	88.8	91.7

*From BP Statistical Review of World Energy, 2016; note that 100 million bl/day is ~4.6 billion t/year. <https://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf>.

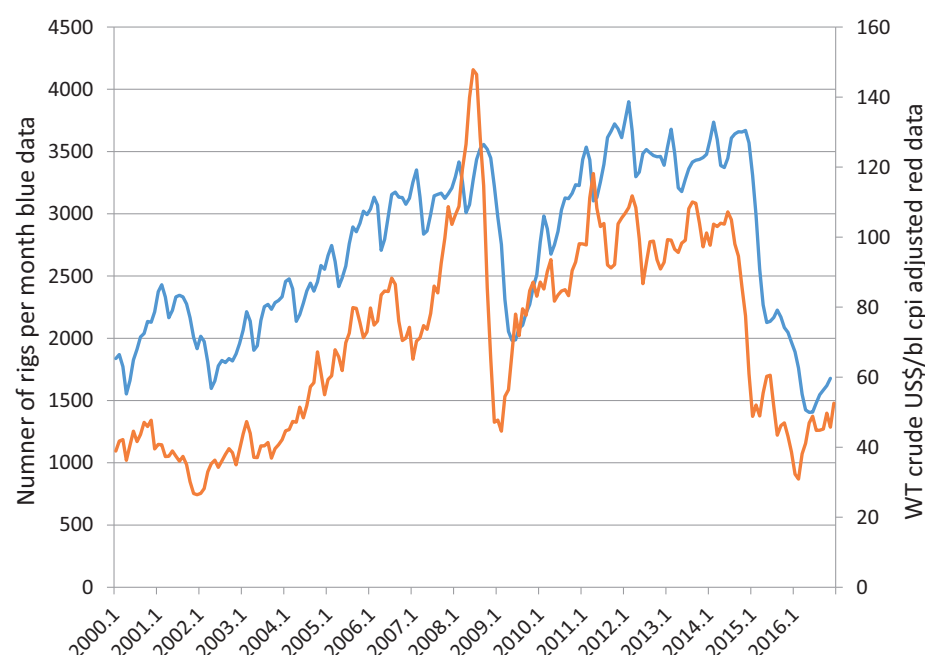


Figure 1. Monthly global operating rig numbers from January 2001–November 2016, taken from the Baker Hughes rig count (see: <http://phx.corporate-ir.net/phoenix.zhtml?c=79687&p=irol-rigcountsoverview>). The oil price is the monthly spot price for West Texas crude (<http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWTC&f=M>) and the price has been adjusted to December 2016 US dollars to correct for changes in the US consumer price index (<http://www.bls.gov/cpi/cpid1503.pdf>).

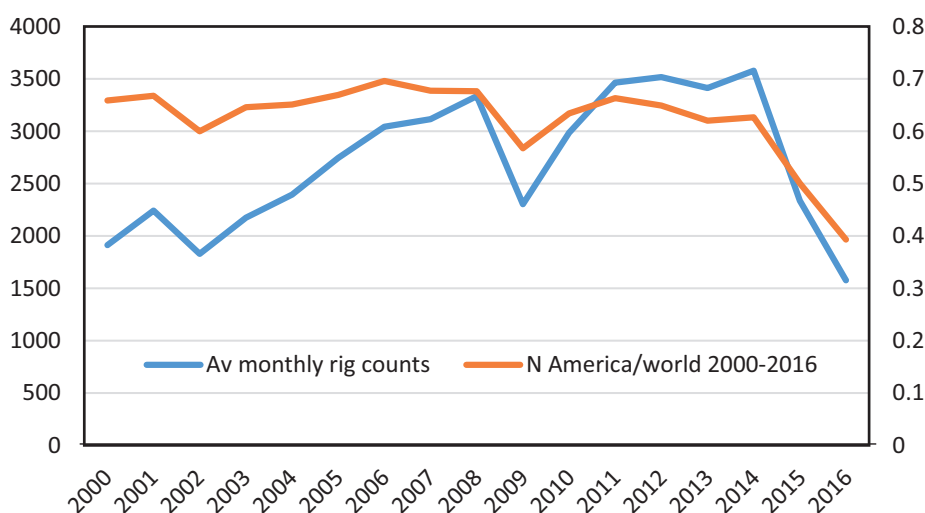


Figure 2. Average monthly number of rigs operating globally (blue curve), for the period 2000–2016 and the ratio of North American rigs to global count (red curve).