From:	Bruce Mcleod
To:	fracking inquiry
Cc:	[redacted]
Subject:	Report to NT Hydraulic Fracturing Taskforce
Date:	Sunday, 30 April 2017 4:46:55 PM
Attachments:	image001.gif 28 4 2017 NT Fracking Inquiry - final.pdf

To: Hon. Justice Rachel Pepper
Chair for the Hydraulic Fracturing Taskforce

Please find attached from Imperial Oil & Gas a report for the Northern Territory Hydraulic Fracturing Taskforce, which is due today being April 30, 2017.

To ensure receipt of the report a second copy will be forwarded by Mr Geoff Hokin.

We look forward to further comments and participation.

Kind Regards

Bruce McLeod
Executive Chairman & CEO
Empire Energy Group Limited
[redacted]

Presenting the facts, debunking the myths

Imperial's support and vision to the safe development of the Northern Territory onshore shale gas industry

Presentation to the Northern Territory Hydraulic Fracking Taskforce
April 2017

Imperial Oil & Gas is an Australian company working in the McArthur Basin since 2010

Imperial has worked extensively and responsibly with the traditional owners and pastoralists to secure 2 Petroleum Permits. Negotiations are close to completion for a remaining 4 permits.

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Development of Shale Gas – The Conclusion

The benefits of a well responsibly managed shale development program

- ✓ Shale gas can be easy and effectively released from tight rock (shale).
- ✓ Much scientific evidence is proving that shale gas processes are environmentally clean and safe.(1)
- ✓ Unfortunately much of the media has a very strong '*anti-fracking*' bias and so much of the positive scientific evidence supporting the positive aspects of fracking is not provided to the public.
- ✓ This report brings to the forefront examples of anti-fracking '*paid-for–research*' who publish incorrect and misleading 'scientific reports'. Once necessary headlines are received the 'research' is often retracted with no public acknowledgment.
- ✓ Managed responsibly shale development will bring many opportunities to the region:
  - ➢ Economic independence for Traditional Owners.
  - ➢ New industries and jobs as other major NT projects run down.
  - ➢ Improved regional infrastructure, health, education and training.
  - ➢ New employment in region, especially following the closure of the Gove smelter.
- ✓ On a macro-level, the USA has clearly shown on a global basis the positive effects natural gas has in terms of reduction in CO2 emissions and the extensive job creation.

The development of the USA shale industry is an example that responsible shale development in the NT will, for many years, bring **significant social and economic benefits** to the region.

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(1) As an example in Pennsylvania, USA a group of shale industry environmentalists imposed strict standards that both industry and environmentalists can live with. Four organisations (Chevron, Shell, Consolidated Energy & EQT Corp) have applied for and received certification from The Centre for Sustainable Shale Development.

Fracking Benefits Everyone

Recent research declares fracking provides net benefits to local communities

"The discovery of hydraulic fracturing is widely considered the most important change in the energy sector since the commercialization of nuclear energy in the 1950's. To date, almost all of the fracking activity has been confined to North America, yet even so it has upended many features of the global economy, global environment and international relations. There are substantial shale deposits both in North America and other parts of the world that have not been exploited to date so there is potential for further change.... to date local communities that have allowed fracking have benefited on average..."(1)

"This study makes it clear that on net there are benefits to local economies — which we believe is useful information for leaders in the USA and abroad who are deciding whether to allow fracking in their communities," - MIT's Chris Knittel, a co-author of the study...(1)

- for further findings and detail of this research refer to the "Conclusion" of this Report

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(1) University of Chicago co-study– Dec 2016

McArthur Basin – Clean shale gas

Imperial believes it is important to provide insights from other large scale shale development regions comparable to Greater McArthur Basin.

The scientific facts in their entirety from USA show a proven way forward to safely develop onshore shale gas in the Northern Territory:

- ✓ Hydraulic fracturing ("fracking") has existed since the 1940s with over 1 million oil and gas wells have been fracked since then.
- ✓ Globally there has not been a confirmed report of systemic ground water/aquifer contamination from fracking.
- ✓ This report shows the degree to which fracking has been targeted by a small group of USA based anti-resource, anti-fracking lobbyists ("fractivists") using false, deceptive and incomplete information.
- ✓ Science, research and court cases are disproving the myths and exposing the fraud spread by a sensationalist media that focuses on controversial headlines and rarely reports retractions of false information.

There are no proven cases fracking has contaminated aquifers/groundwater.

Is there any other industrial process with that record?

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Fear of fracking is unfounded - Clean shale gas is a greener way

"The fact we are transitioning from coal to natural gas means less greenhouse gases. We've got to live in the real world. I say that not because I don't recognize the urgency of the (climate) problem. It is because we have to straddle between the world as it is and the world as we want it to be."

– Barrack Obama 2016*

"As a lifelong champion of the Green cause, I'm convinced that fracking is not the problem but a central part of the answer... And if activist groups including Greenpeace really want to help the environment, they should stop protesting about projects like this [UK fracking] and let them be built as quickly as possible."

– Stephen Tindal, Greenpeace U.K. Executive Director 2000-2005**

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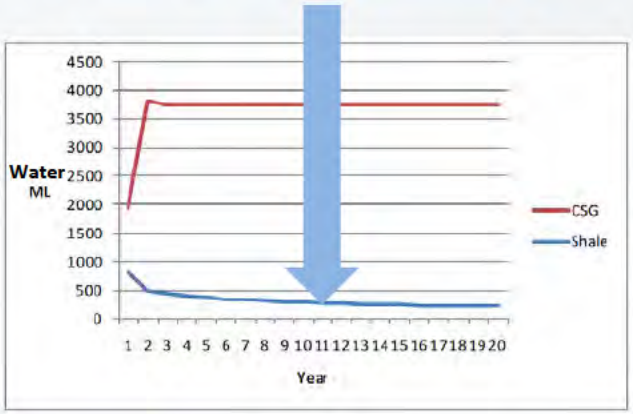
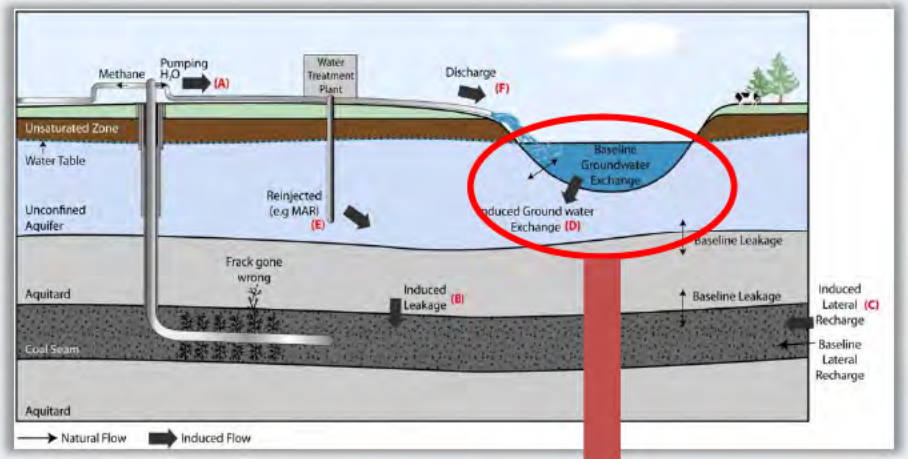
* energytomorrow.org/blog/2016/10/04/progress-the-president-and-natural-gas
**www.washingtontimes.com/news/2016/oct/19/former-greenpeaceleader-defies-environmentalists-l

Clean shale gas is NOT coal seam gas (CSG) – it's much greener

Little or no water produced by Shale Gas*





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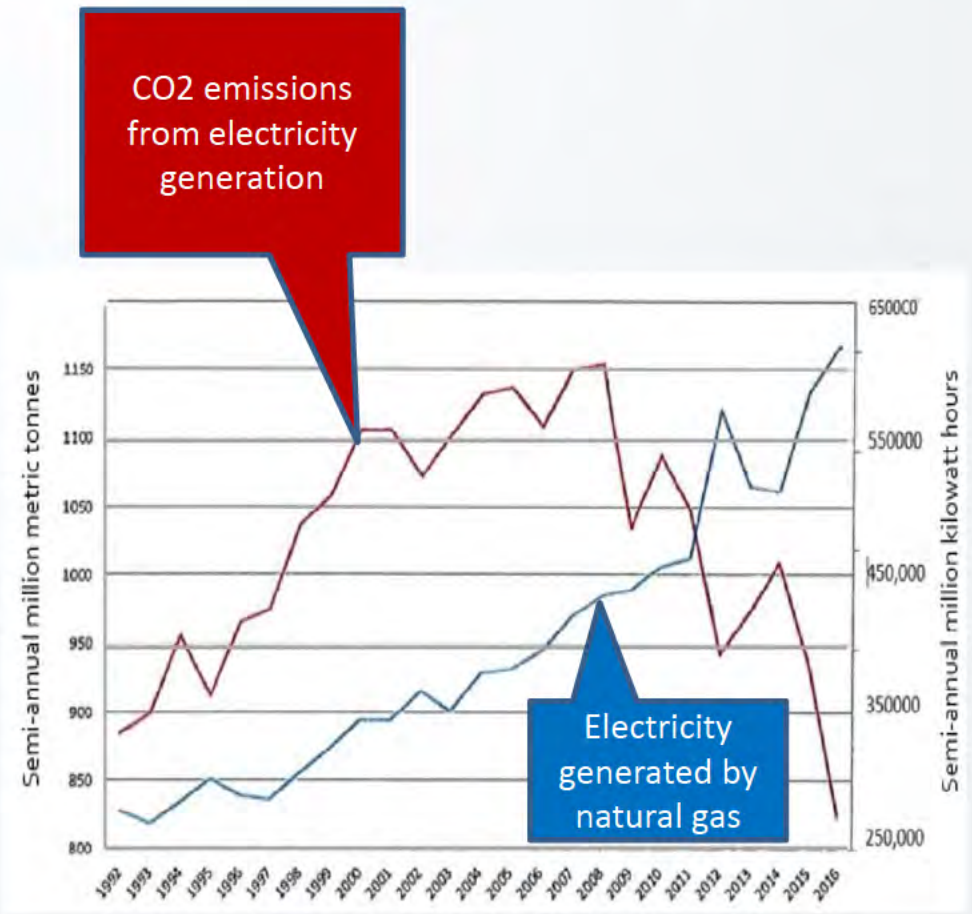
*SKM – Unconventional Gas in Australia – Infrastructure Needs SKM SH43380, 30 Jan 2013

Shale Gas delivers CLEANER electricity



- ✓ As the share of electricity generated from natural gas increased in the USA, CO2 emissions decreased.
- ✓ Fracking has allowed the USA to lead the world in reducing energy-related CO2 emissions.
- ✓ In 2016 USA CO2 emissions declined to their lowest level since 1993.

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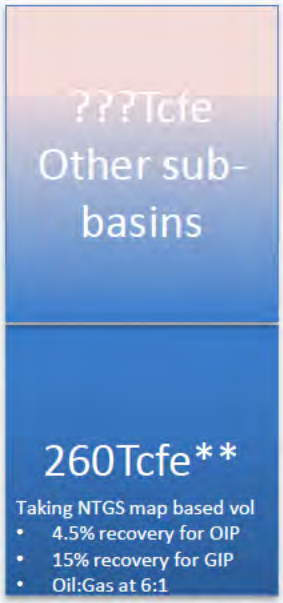
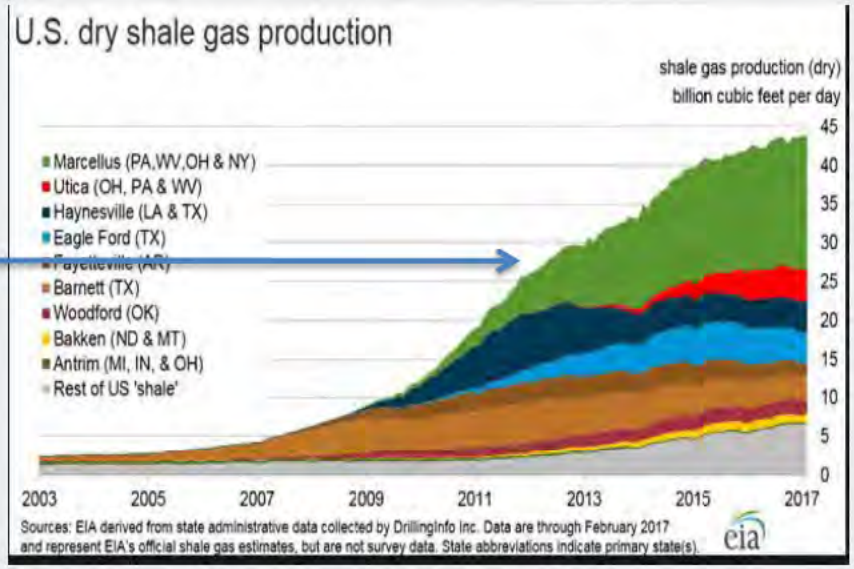
Is the potential in the McArthur Basin larger than the Marcellus in Appalachia?

- ✓ Un-risked prospective resource of the McArthur Basin is 240Tcfe*, comparable to Marcellus.
- ✓ However NTGS has placed a 2C P50 recoverable resource of ~260Tcfe on the Beetaloo sub-basin alone.**
- ✓ The North McArthur sub-basin is expected to be much more productive than the Beetaloo sub-basin.
- ✓ Marcellus shale production in 2016 represents around half of all US dry shale gas production.



Greater McArthur Basin, NT

Marcellus USA



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*Deloitte 2015 Prospective Resource
**NTGS AGES2017 28 March 2017

The McArthur Basin can deliver $billions in economic activity and taxes

Fracking is good for the economy and the environment as proven by the Marcellus.

"given the large amounts of natural gas available in the USA, at moderate cost ... natural gas can indeed play an important role over the next couple of decades (together with demand management) in economically advancing a clean energy system.."

– Former Obama Energy Secretary Moniz, MIT

By 2020, in Pennsylvania alone, shale gas development will have contributed nearly US$14 billion in economic activity and $5.6 billion in taxes.*

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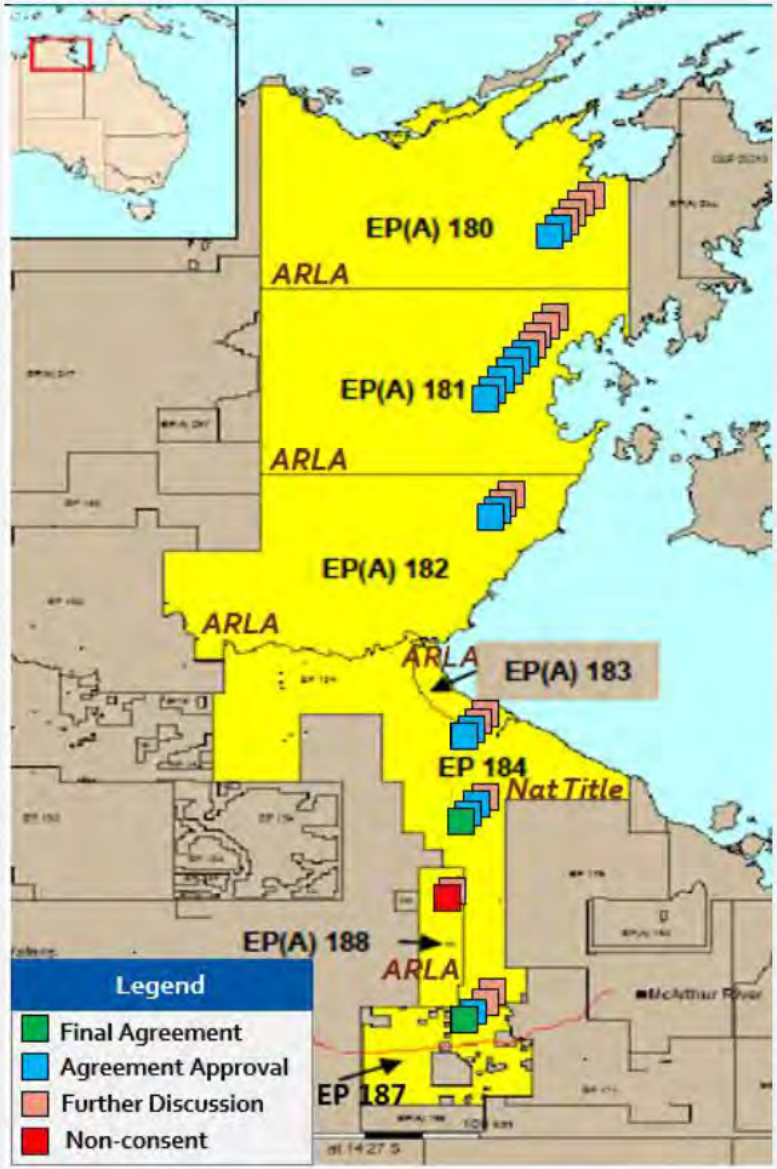
*Energy in Depth, Feb 19 2016

Imperial On-Country Meetings

Lengthy and thorough process of induction and education for the ALRA Land & Native Title Traditional Owners outlining hydrocarbon development relating to company permits

- ✓ 29 On-Country meetings with Traditional Owners 2010-2016
- ✓ 2 Final Agreements
- ✓ 4 approved to negotiated final agreement
- ✓ 1 Non-consented
- ✓ 4 final meetings required, but deferred due to current moratorium



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Beneficiaries to a controlled and responsible shale gas development program

Traditional owners benefit:

- ✓ Royalty on on-ground expenditure ~$200,000/well(1)
- ✓ Royalty on oil & gas sales ~$1million/well/20yr life(2)
- ✓ Further royalties on infrastructure
- ✓ Skills, jobs, contracting opportunities
- ✓ New infrastructure (schools, roads, hospitals..)

Regional population benefit:

- ✓ Bring new jobs and industries to existing towns
- ✓ Replace industries that are in decline or recently closed (e.g. closure of Gove smelter)

Pastoralists benefit:

- ✓ New/improved roads and access.
- ✓ Connection to local natural gas supply to replace diesel generators.
- ✓ Jobs & contracting opportunities across permits.
- ✓ Improved local education and medical facilities.
- ✓ Employment opportunities so family members can stay in region.
- ✓ Water quality monitoring bores handed over for water supply bores.

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(1) Assumption average well cost at ~$9 to $12 million, 60% of cost is subject to royalty
(2) Assumption average resource with ~10,000ft Hz, >10Bcf/well @ net $3.50/Mcfe subject to royalty (80% royalty paid in 1st 5 years)

Imperial's vision is to develop resources while preserving cultural heritage and environment

"Traditional owners are embracing a proactive future where they are involved in resource projects on their land that can have substantial socio-economic benefits without eroding their deep cultural heritage."

– Presentation to COAG ALRA review Dec 2014

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The Northern Territory & Natural Gas

What are we talking about?

The Northern Territory Starting Point

Access to a environmentally clean energy & manufacturing feedstock

"The economic development of northern Australia offers opportunities of national significance. These include, but are not limited to the economic empowerment of Indigenous communities, diversification and growth in pastoral and agricultural industries, growth in the resources sector and the realisation of economic and social potential in secure and equitable water rights."

- James Cook University 2013 "Land Tenure in northern Australia - Opportunities and challenges for investment"

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Natural Gas

An understanding of this potentially significant 'free' resource

In a very few, lucky regions on this planet, people have been provided access to an energy resource that will not only address many environmental issues, such as assisting in the lowering of global CO2 emissions, but it will also have the ability to provide jobs, social and educational enhancement and security to the many people of those 'lucky' regions.

- ✓ Natural gas - a colorless, odourless fossil fuel.
- ✓ A versatile building block of our society, consumed as an energy source and a basic feedstock.
- ✓ Natural gas is a principal component of modern chemistry and plays a central role in our quality of life including modern medicine, fertilizers and energy.
- ✓ An essential material in such products as propane, paints, fertilizer, plastics and medicines.
- ✓ A modest coal-to-gas switching in the Asia Pacific region would lead to a seismic shift in global gas demand and dwarf the current global Liquefied Natural Gas (LNG) market while significantly reducing environmental pollution.
- ✓ Coal to LNG substitution would lead to a significant reduction in CO2 generation slowing global warming.

The Northern Territory has the social and economic opportunity to benefit from a globally significant natural gas resource, with the ability to contribute significantly to a reduction in global CO2 generation as a potential world leader in clean energy production.

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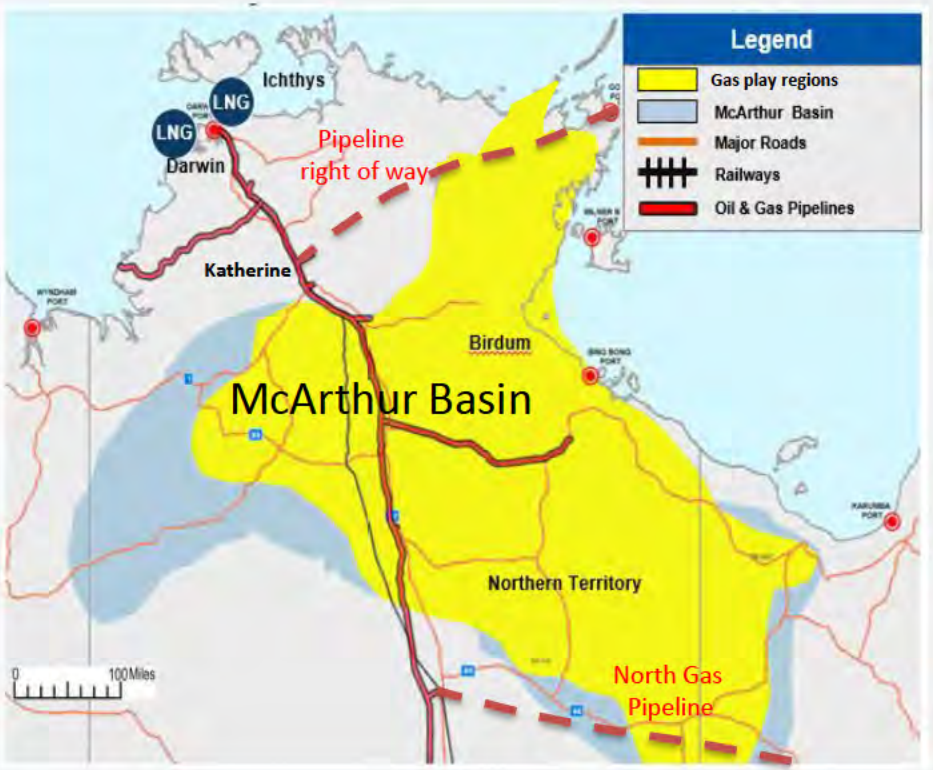
The Importance of the McArthur Basin

The Northern Territory has a globally significant untapped resource

- ✓ The Greater McArthur Basin consists of 5 sub-basins (for a description of the sub-basins refer to the next slide).
- ✓ The McArthur Trough is considered to be the major depositional basin within the Greater McArthur Basin structure (two slides forward).
- ✓ Estimated Resource of the Greater McArthur Basin is estimated at:
  - ➢ 240Tcfe (Deloitte 2015).
  - ➢ Significantly higher with the NTGS placing a 2C P50 resource calculation of 260Tcfe on the Beetaloo sub-basin alone.
- ✓ This infers that the North McArthur Sub-Basin (refer to next slide) is likely to hold significantly greater than a 250Tcfe resource.



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The McArthur Basin structure

Key sub-basins of the McArthur Basin

North McArthur sub-basin

- ✓Prospective development targets include Velkerri, Kyalla, Wollogorang, McDermott and Barney Creek shales.
- ✓Major Operator - **Imperial Oil & Gas**

Beetaloo sub-basin

- ✓Primary organic rich unconventional targets include Velkerri, Barney Creek and Kyalla shales.
- ✓Operator - **Imperial Oil & Gas**

Glyde sub-basin

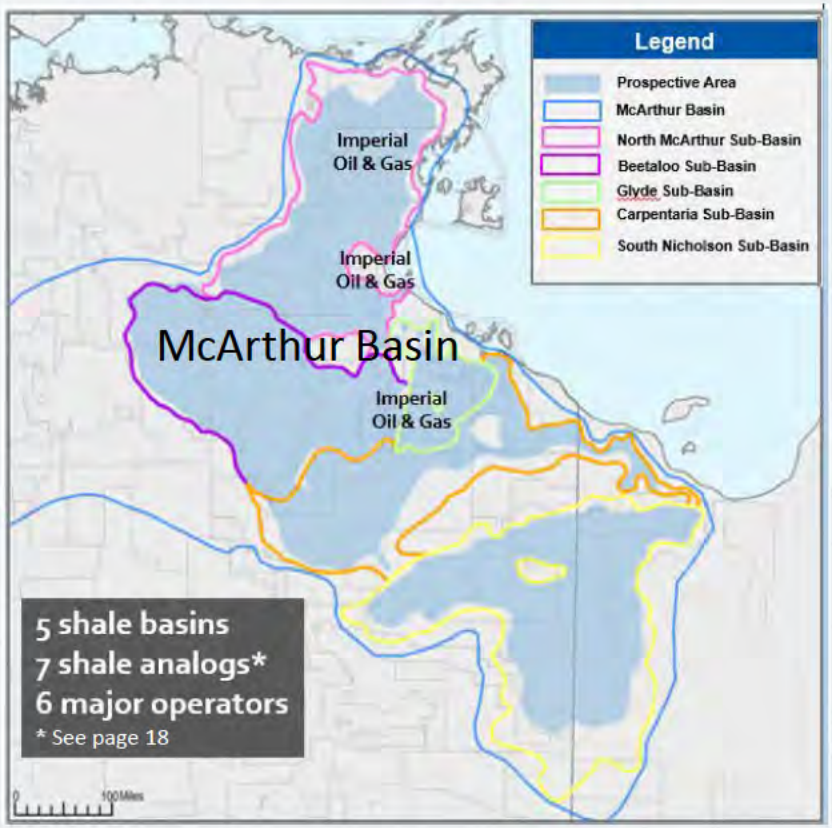
- ✓Primary organic rich unconventional targets include the Wollogorang, McDermott and Barney Creek shales.

Carpentaria sub-basin

- ✓Primary organic rich unconventional targets include the Wollogorang, McDermott and Barney Creek shales.

South Nicholson sub-basin

- ✓The Lawn Hill and Riversleigh shales identified as significant development horizons



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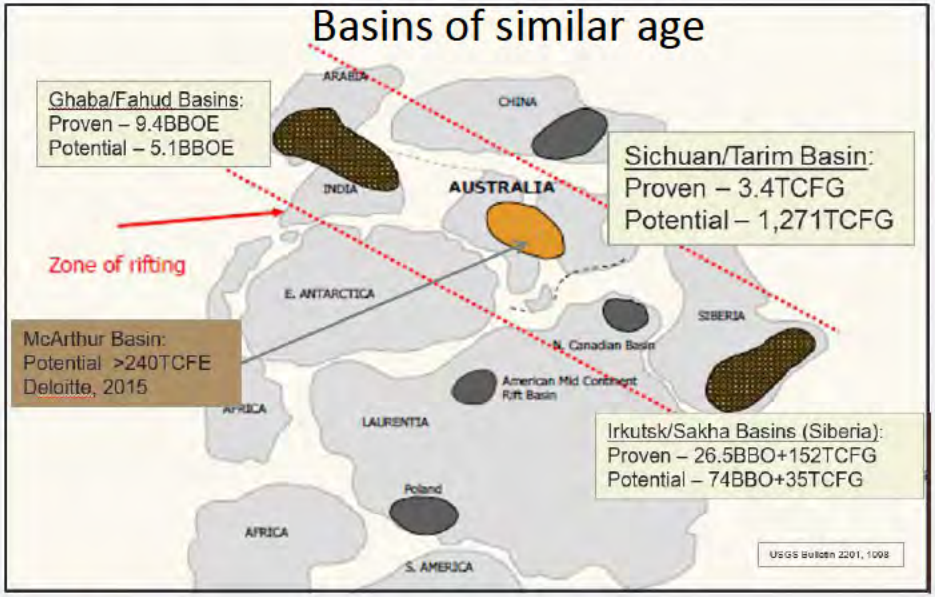
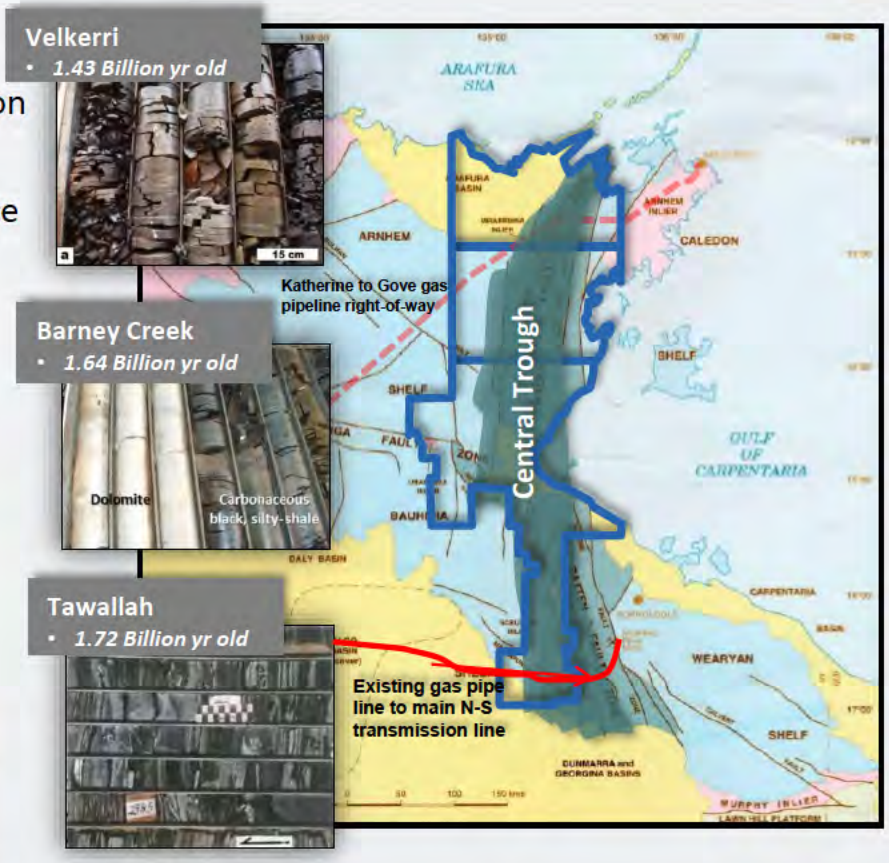
Why the North McArthur sub-basin is so attractive

It consists of a majority of the Depositional Basin (Central Trough)

- ✓ Greatest organic carbon preservation & thickness is predicted in Central Trough.
- ✓ Central Trough – provides up to 6 stacked targets. This leads to less surface disturbance for greater gas production as a single drill pad can access each formation.
- ✓ The Central Trough has remained largely undisturbed since created, ~1.64 Ga years ago.





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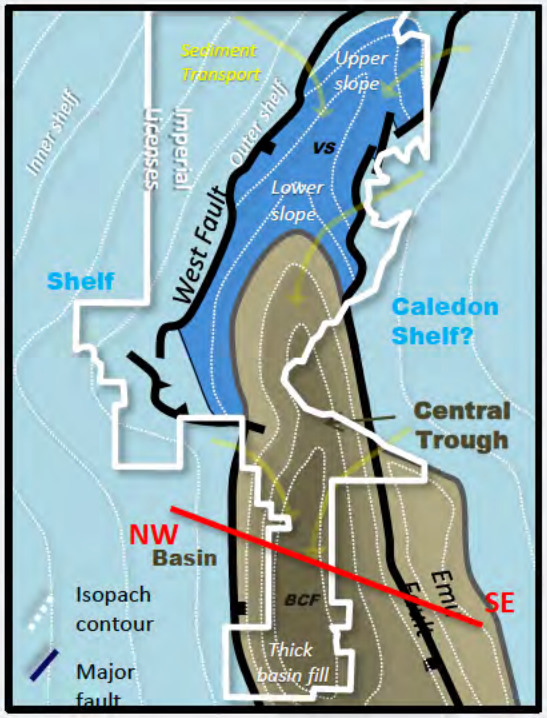
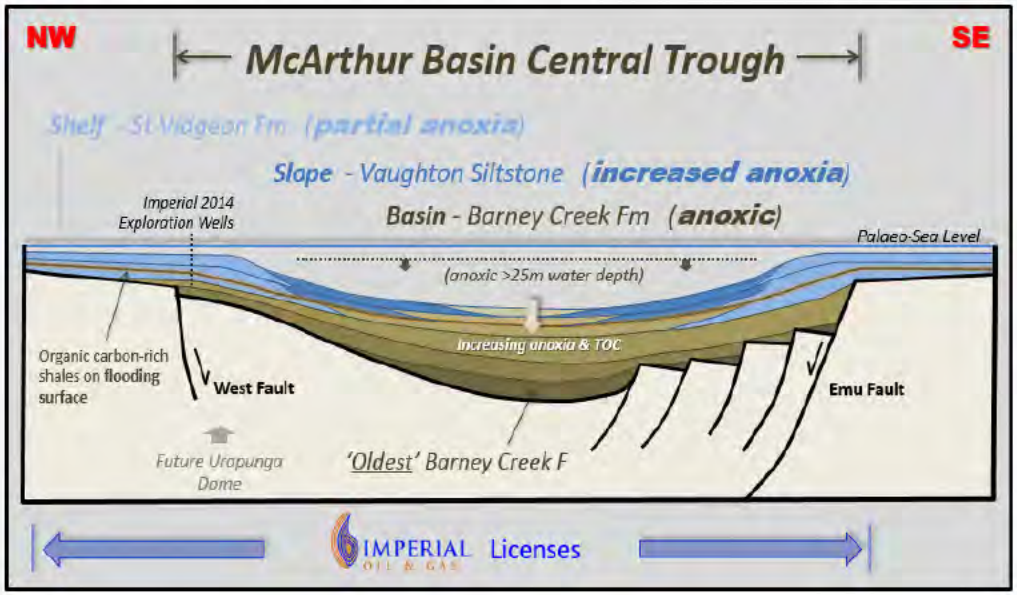
Structure of the North McArthur sub-basin

Formed 1.64 billion years ago

- ✓ Simple basin filled with water and organics during an anoxic environment (low oxygen content in the atmosphere).
- ✓ Imperial acreage has the depo-centre with the greatest predicted total organic content (TOC) preservation & shale thickness.
- ✓ High TOC preservation in the restricted anoxic trough (generating environment for high gas content).





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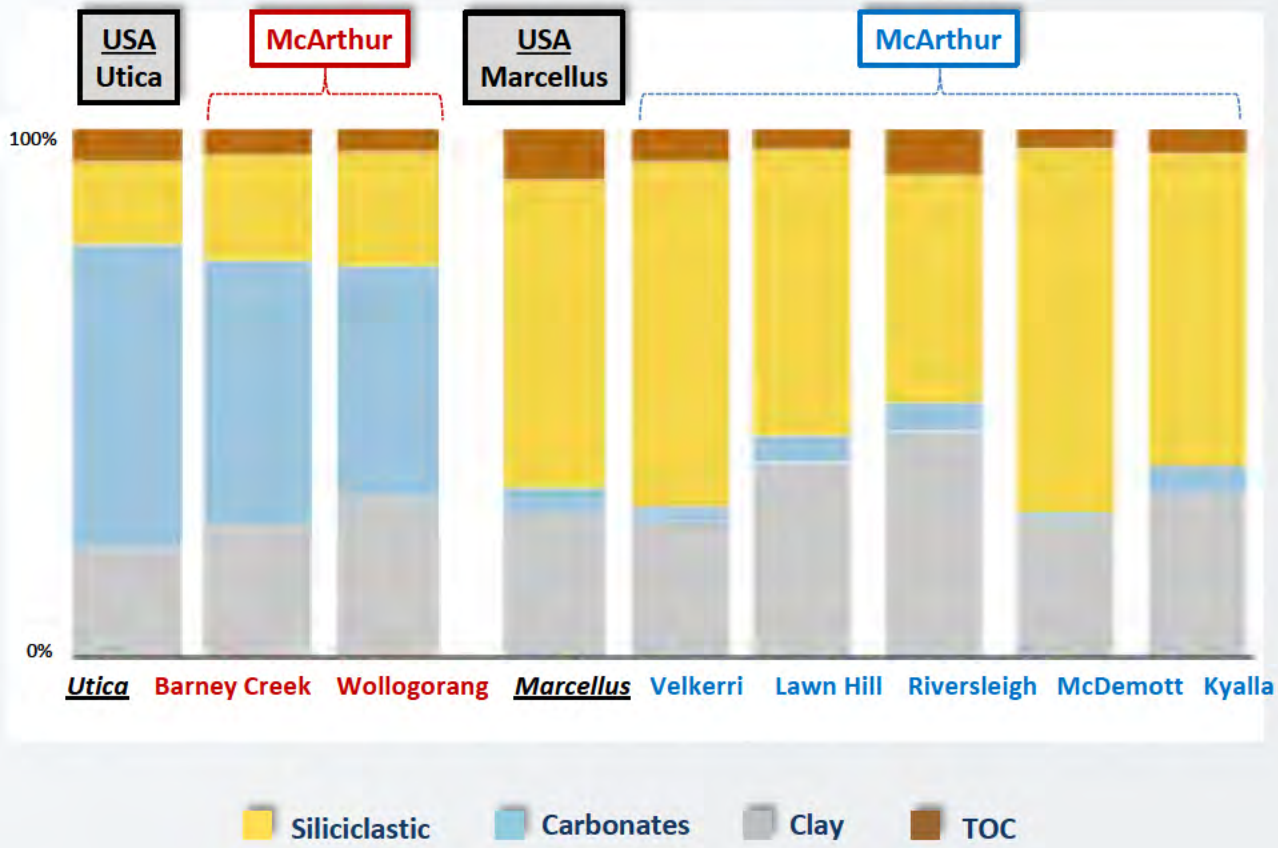
McArthur Basin v major USA shale plays

Research shows similar structure, similar dynamics but more gas/metre!

McArthur Basin compared the Marcellus & Utica Shale Basins, USA



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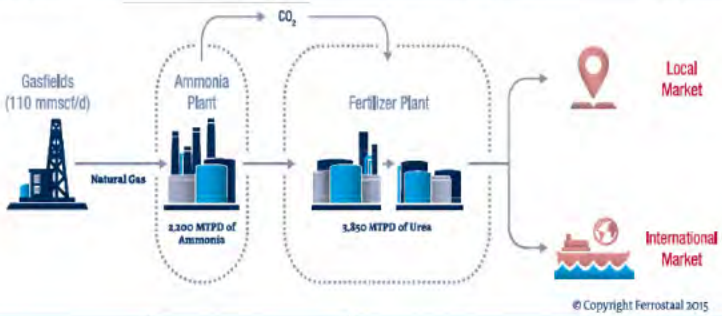
Will the NT Govt take advantage of this asset?

Example – downstream possibilities - Shale Gas Methanol, Ammonia, Urea Plants

	Production Capacity	Required Gas Reserve (estimated for 20 yrs of operation)	Required Gas Flow
Methanol	5,000 tpd	1.0 Tcf	150 mmscfd
Methanol	3,000 tpd	0.7 Tcf	110 mmscfd



	Production Capacity	Required Gas Reserve (estimated for 20 yrs of operation)	Required Gas Flow
Ammonia/Urea	3,850 tpd (of Urea)	0.7 Tcf	110 mmscfd
Ammonia	2,200 tpd	0.5 Tcf	70 mmscfd

- ✓ Process design adapted to local gas composition.
- ✓ Petrochemicals need economically produced natural gas. Onshore gas would achieve this benchmark.
- ✓ Project realisation
  - ➢ Gas allocation to FID: 18-24 mths
  - ➢ EPC to operation: 3 to 4 years
- ✓ Capital Costs:
  - ➢ ~$1bn for 3,000 tpd Methanol plant
  - ➢ ~$1.4bn for 3,850 tpd Urea plant
- ✓ Project funding availability - high
- ✓ Process Plant plot ~760m x 450m (max)
- ✓ Employment created:
  - ➢ Methanol: 60 – 80 direct permanent jobs + ~3x as many indirect jobs
  - ➢ Urea: 120 – 150 direct permanent jobs + ~3x as many indirect jobs
- ✓ Huge development of these type of industries in the USA

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Content is provided by courtesy of Ferrostaal Topsoe Projects GmbH

Shale Gas and its Importance in our World

USA analogues

Successful shale development, USA

Focus on the Appalachian Basin, northeast USA

- ✓ Appalachia, at the forefront of shale development, is a useful example to compare the benefits of this energy evolution. Using Pennsylvania (PA) as a comparison to the NT:
  - It is large area covering around 61 million acres.
  - It covers many cities, towns and villages, estimated population 5.8mm[1].
  - The region consists of hundreds of farms and is heavily forested in many areas.
  - The region contains extensive pristine rivers and streams prided by sportsmen and conservationists.
- ✓ Western PA (heart of shale development) is booming, while upstate New York is dying.
- ✓ Why do fractivists have an issue with the fracking of rock thousands of feet below drinking water aquifers, but throughout the USA they are comfortable with (utilising PA as an example)?...
  - More than a million PA homeowners or around 4 million residents depend on wells for water supply and similar numbers of on-lot sewage systems (generally drawn from/released into ground with 150 feet of the surface).
  - Septic systems can be a significant source of ground water contamination leading to waterborne disease outbreaks and other adverse health effects, causing gastrointestinal illness, cholera, hepatitis A and typhoid.
  - Nitrogen, primarily from urine, faeces, food waste, and cleaning compounds, is present in sanitary wastewater. Consumption of nitrates can cause methemoglobinemia (blue baby syndrome) which can be fatal for affected infants. The compounds are often in significantly heavier concentrations than recommended.
- ✓ ...The reason is simple, *'anti-fracking'* provides a much higher media profile that fixing the massive sewage problem throughout the USA, which no one wishes to tackle.
- ✓ *In the early days of fracking, fractivists did not have to rely on 'science and facts'. Misleading, emotive headlines were enough. This has now changed (as shown by this Report). The new focus for fractivists, (other than in a couple of States) is pipelines, NOT fracking!*

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[1] Pollard K., Jacobsen L.A. - The Appalachian Region in 2011-15: A Data Overview. Appalachian Regional Commission, March 2017)

The Marcellus Gas Industry

An example of significant regional economic growth

Pittsburgh Regional Alliance

An affiliate of the Allegheny Conference

10 County Pittsburgh Region

- ✓ The Pittsburgh, PA region has been blessed by the Marcellus Shale industry.
- ✓ The Pittsburgh Regional Alliance (PRA) recently issued its annual Business Investment Scorecard.
- ✓ Largely because of the Marcellus, 2016 saw the biggest year ever for capital investment in the region, with $10.2 billion of investment committed.
- ✓ The report finds that in 2016 due to the Marcellus industry, $9.11 billion worth of investment commitment was related directly to shale gas, processing plants, gas-fired power plants, pipelines etc.
- ✓ This does not take into account the many other Counties in Pennsylvania where significant investment is being undertaken in midstream and downstream industries.

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Employment Creation

The future with shale gas – more jobs for the Northern Territory

The USA has the ability to make more petrochemicals and make more products from petro-chemicals and export them to the rest of the world. The USA is positioning itself to be a substantial exporter of petro-chemical derivatives.

As at mid 2016 the USA Chemical Industry Investment linked to shale gas tops $164Bn*

- ✓ ACC analysis shows that spending could lead to $105 billion per year in new chemical industry output and support 738,000 permanent new jobs across the U.S. economy by 2023.
- ✓ Includes 169,000 new chemical industry jobs, 357,000 jobs in supplier industries and 312,000 jobs in communities where workers spend their wages.
- ✓ Much of the new investment is geared toward export markets.
- ✓ The replacement of much of the global chemical industry is underway through cheap and abundant supplies of natural gas.
- ✓ This does not take into account the many other significant investments being made in non-manufacturing mid-stream and downstream industries

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*American Chemistry Council, Apr 6, 2016

Example – Real job generation[1]

Success in the "Rust Belt, Ohio"

- ✓ There was little new employment growth up until ~2008.
- ✓ From 2008, ~180,000 direct shale related jobs created.
- ✓ Ancillary shale-related industry added thousands of additional jobs (~30 identified industries).
- ✓ Ohio shale counties - 66% decline in unemployment from 2008.
- ✓ Ohio shale jobs pay ~60% more than the average Ohio salary.
- ✓ Economic stimulus, brings more tax revenue, one County experienced tax revenue increase of +340% in 4 years (USA Counties do not receive royalties).

Ohio is fortunate to have a natural resource that can provide good jobs for families and reinvigorate many of our communities, especially those in the eastern part of the state. As you'll see in the pages that follow, core shale-related employment, which includes such things as oil and gas pipeline construction and well drilling, increased 64.4 percent from the first quarter of 2011 to the first quarter of 2016. Ancillary employment – for example, freight trucking and environmental consulting – also increased. We expect non-shale industries, such as food and retail businesses near drilling sites and the surrounding communities, to benefit from shale activity, as well.[2]

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(1) *Ohio Shale – October 2016*
(2) **Cynthia C. Dungey, Director, Ohio Department of Jobs & Family Services*

The future for our farmers

In Pennsylvania, the shale revolution is "boosting agriculture"

SAVE THE FARM

- ✓ How? By providing new sources of capital (cash) to buy new equipment, more livestock, fix buildings, etc.
- ✓ Shale is also lowering the cost of fuel and fertilizer for farmers.
- ✓ Shale provides jobs for members of farming families, bringing in an important new income stream.
- ✓ **It is not an overstatement to say that shale is literally saving the family farm in PA…"**

This was predicted at the start of the shale revolution:

A University of Michigan report from 2014 suggested this may happen, stating that:

- ✓ the farming industry stood "to benefit dramatically from the shale gas boom."
- ✓ It noted that "just three years ago, more than half of U.S. nitrogen fertilizer was imported."
- ✓ "…..a recently announced spate of new projects [after] no new ammonia plants had been constructed on U.S. soil in the past 30 years" was changing things.
- ✓ Farmers will have access to plentiful supplies of urea at competitive pricing, lower than any other global market.

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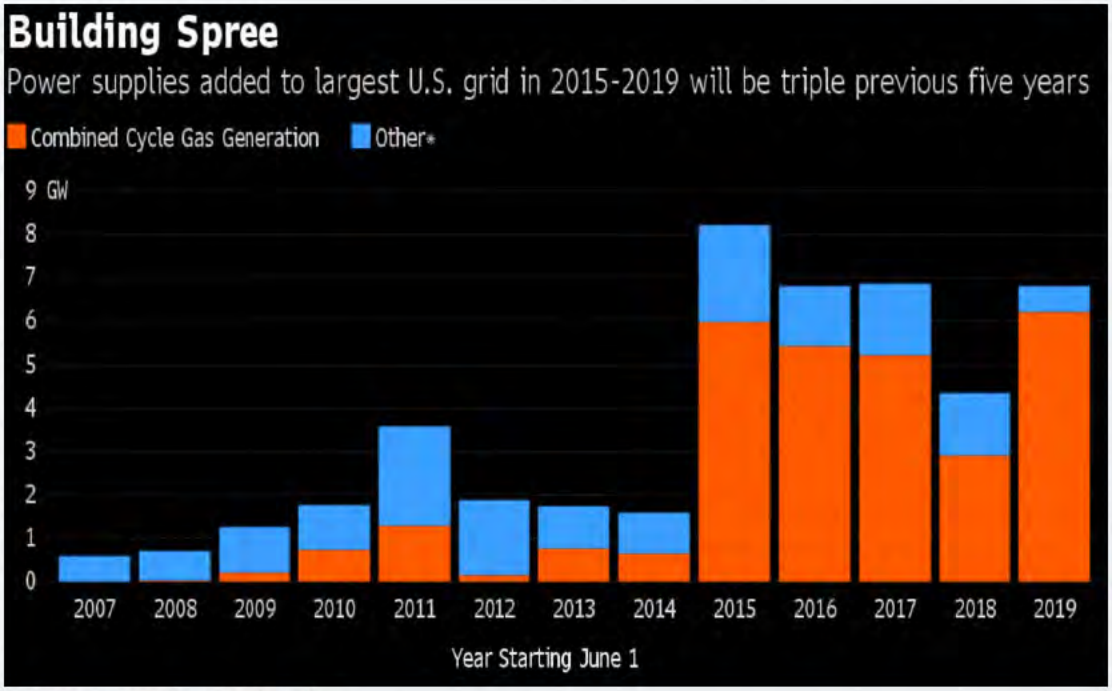
Lebanon (PA) Daily News – Feb 27, 2017

Electricity Generation

The future is clear – new USA electricity generation powered by shale gas

- ✓ Electric power generation is one of the biggest incremental drivers of new demand for Marcellus shale gas.
- ✓ A close second behind power generation are industrial sources, namely, utilising natural gas as feedstock for manufacturing processes."
- ✓ Reducing CO2 emissions

None of which Australia appears to wish to develop.



PJM Interconnection LLC, Bloomberg
**Coal, nuclear, oil, renewables, other.*

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Electricity Generation in Perspective

The importance of natural gas

Wind Vs shale gas powered electricity:

The wind farm gets its unreliable energy source (wind) for free.

The gas that powers **Panda Liberty** is not free.

However there aren't enough hills to cover with big ugly turbines to take the place of clean-burning natural gas.

Natural gas is a clear winner.

- We hear a lot about wind these days, not so much about solar, as an alternative to 'nasty' fossil fuels like natural gas.
- Associated Press ran a story about "*the USA's first offshore wind farm*" opening off the coast of Rhode Island.
- **Deepwater Wind** built five turbines producing 30 MW of electricity (enough electricity to power 17,000 homes) 3 miles off Block Island, at a cost of $300 million!
- That's about $10 million/MW to construct the facility.
- A gas-fired electric plant costs about $1 million/MW (10x less).
- In 2017 the very first built-from-scratch natural gas plant to use Marcellus Shale gas, called **Panda Liberty**, went live.
- Panda Liberty is an 829-megawatt Marcellus gas-fired electric generating plant in Asylum Township, Bradford County, PA.
- Panda Liberty's 829 MW plant at a cost of ~$830 million supplies enough electricity to power 1 million homes!

In Australia the average solar farm covers a minimum land area of 250Ha (7.3 km sq.); the average completed gas well covers approx. 63 square meters of land. (0.000063 km sq.)

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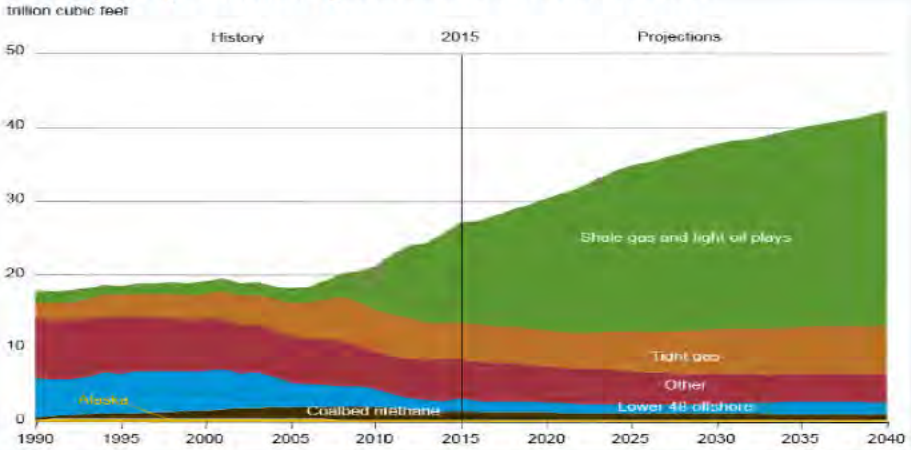
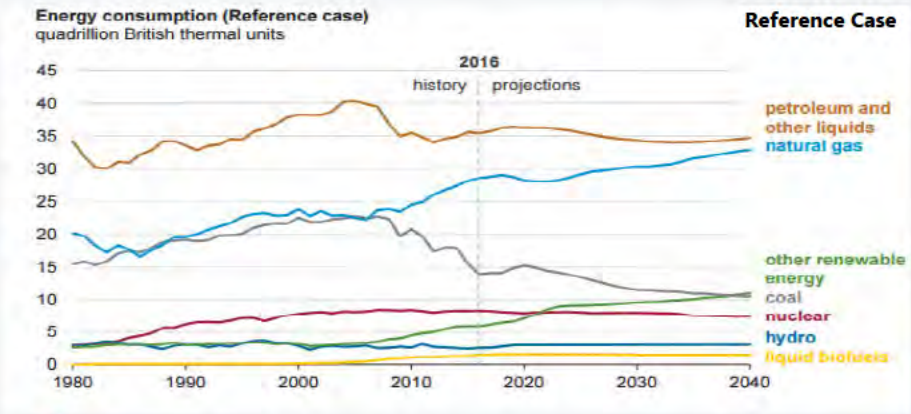
AP/Pittsburgh (PA) Post-Gazette, Dec 14, 2017

How transformational will USA shale gas be?

What do the USA see in terms of developing shale gas, that Australia doesn't

USA dry gas production by source in the Reference case





There is a major disconnect between what is happening in the USA and Australia…

- ✓ From 2008 natural gas prices in the USA have dropped from around ~US$8/mcf to ~US$3.00/mcf. In Australia natural gas prices are escalating and the Federal Government is seeking to break commercial contracts to ensure domestic gas supply, increasing sovereign risk costs.
- ✓ Shale now provides ~67%% of USA natural gas (<10% in 2000). Zero in Australia.
- ✓ Shale gas is rapidly replacing coal for electricity generation. Zero in Australia.
- ✓ Massive growth in USA manufacturing of natural gas derived products. Declining in Australia due to high gas feedstock prices.
- ✓ Meeting its CO2 reduction targets well ahead of time. Australia failing and now dealing with power blackouts and rapidly rising electricity costs.

Australia's problem ultimately…a big fall in standard of living.

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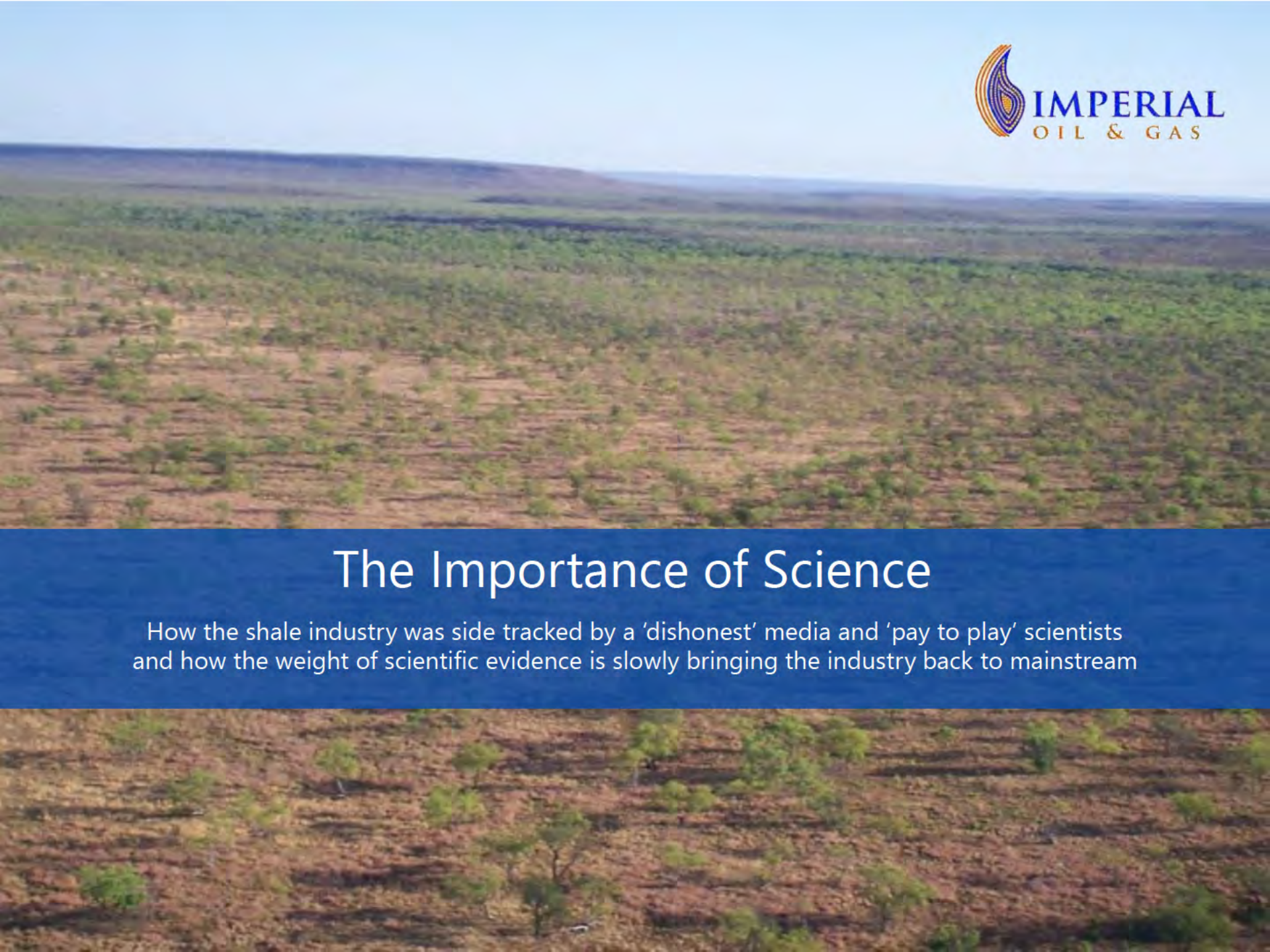
EIA – Annual Energy Outlook 2017



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The Importance of Science

How the shale industry was side tracked by a 'dishonest' media and 'pay to play' scientists and how the weight of scientific evidence is slowly bringing the industry back to mainstream

Junk research discredited

An objective of this report is to highlight the misleading nature of fractivist funded research

- ✓ Teams of 'Researchers' and some University research departments, generously funded by fractivists, publish research reports which garner headlines from the media.
- ✓ Often, within days, these reports are withdrawn or shown to be incorrect.
- ✓ By the time a retraction is made the media has (conveniently) focused on other items. So there is generally no response from the same media that lauded the original published headlines as the "science" or the "facts".
- ✓ In some cases Courts or State Government Departments finalise matters relating to shale development. Generally the media only reports fractivist misinformation. Court Judgements or findings adverse to fractivists, are seldom reported by the media (The Dimock, PA, case being a prime example. Refer to this Report).
- ✓ The reoccurring process means much of this irresponsible fractivist research and reporting continues to be debunked and ultimately shown to be false.
- ✓ After initial headlines, the corrections and retractions are seldom seen in the public domain.

The following section provides an insight into the generally misleading behaviour of the media and fractivist community.

Fact or Fiction? - Fears debunked

Over time fractivist claims have been shown to be false

"Based on experience and science, I recognized that fracking was one of our very best and safest extraction techniques. Fracking is good for the country's energy supply, our national security, our economy, and our environment."

"Opposite of Woe: My Life in Beer and Politics", (pg. 277), Colorado Governor J Hickenlooper (D)

In early May 2016 the Pennsylvania DEP quietly dropped a $8.9mm fine against Range Resources "for contaminating the groundwater-fed wells of private water supplies, and a nearby stream." Range and the landowner where the well is drilled say methane was in groundwater supplies long before Range drilled the well. Range provided the DEP a complete isotopic analysis that proves what is in the well water did not come from the gas well.

Patriot-News, May 21, 2016

New Dimock Study Does Not Link Water Issues to Fracking

ATSDR, May 2016

CABOT WIN APPEAL IN DIMOCK WATER TRIAL.

March, 2017

New Yorkers pay an average of 50% more for electricity than residents in other states Gov. Cuomo has turned upstate NY into one, big economic sacrifice zone– sentencing residents to a life of poverty and enslavement. Why? To appease the people who vote him into office every four years (mostly located in New York City)

K Moreau, API, May 10, 2016

25 year Colorado research program - In looking at levels of dissolved methane in groundwater both before and after fracking began, the researchers found, "The rate [of ground water methane] did not change after the introduction of horizontal drilling combined with high-volume hydraulic fracturing in 2010."

Proceedings of the National Academy of Sciences – June 7, 2016

The United States has become the world's leading producer of oil and natural gas. Natural gas is now the leading source for power generation thanks to new reserves that were once considered unreachable. By 2040, an estimated 80% of all U.S. energy consumption will be met by carbon-based energy.

Killing America's Pipe Dreams, R Bradley, IER, 2016

CABOT LODGE APPEAL AGAINST DIMOCK WATER VERDICT. Ask Judge to Overturn Jury Verdict

April 8, 2016

As frack activists lose the drilling science argument..... "The political class, including regulators, profess to care about the plight of the working and middle class. Yet they continually block pipeline projects that would create thousands of jobs, enhance the national grid, and reduce energy costs for consumers".

Killing America's Pipe Dreams, R Bradley, IER, 2016

Why Dimock Really Loves Fracking - *Shepstone Mgt Co., July 17, 2016*

Activist groups have been working overtime in Colorado to mislead lawmakers, the media and everyday citizens into adopting their view that energy development in the state should be banned. Governor Hickenlooper is not buying into their talking points and has joined a growing chorus of business leaders, editorial boards and elected officials who are recognizing just how extreme the groups behind the initiatives have become. ***Energy in Depth, April 2016***

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The Simple Science of gas extraction

Why fractivists are wrong[1]

Shale gas producers will avoid water aquifer connection at all cost.....

Construction of a well.....

- ✓ Shale formations being targeted will be 000's of metres below aquifers.
- ✓ Shale formations themselves generally produce little water, so any water from an aquifer connection will decrease returns from the well.
- ✓ Fracking can NOT take place if well integrity is not there. Proper cementing techniques, volumes and post cement procedures will eliminate possible formation break out[2].
- ✓ Capital expenditures to fix any wellbore problems prior to completion is expensive and time consuming.
- ✓ Operators forced to take actions by correcting cement blends and cementing procedures after the completion of a well would experience a potential loss of reserves and revenue over the life of the well leading to longer pay out.

(continued over page)

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(1) Paul L. Younger Rankine Chair of Engineering, School of Engineering, University of Glasgow, Glasgow G12 8QQ, Scotland, UK, Jan 21, 2016
(2) In Canada cement bond logs, pressure testes and cement samples are required prior to regulatory approval to complete the well. Similar legislation exists in Australia

The Simple Since of gas extraction (continued)

Why fractivists are wrong[1]

Operation of well.....

- ✓ Only positive (high) hydraulic pressures (forcing gas and water into the aquifer) can generate aquifer contamination.
- ✓ Positive (high) hydraulic pressure will typically only be developed during the fracking process. It is only during this phase that solute can be forced into aquifers (but there is triple cement and steel casing over the aquifer to prevent this happening).
- ✓ As such, to ensure excessive amounts of water are not pumped from wells during production, operators will ensure adequate casing and cement over aquifers.
- ✓ Production wells are depressurized to allow gas to flow over the life of the well. This means it is impossible for gas or any other matter to gain access to the aquifer.
- ✓ If somehow the triple cement and steel casing is defective, aquifer water will flow into the well. This will not affect the aquifer and the operator will prevent this leak at all costs due to the expense of processing surplus water.

The science shows the fractivist proposition that fracking contaminates aquifers is totally unsupportable.

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[1] *Paul L. Younger Rankine Chair of Engineering, School of Engineering, University of Glasgow, Glasgow G12 8QQ, Scotland, UK, Jan 21, 2016*

The Inconvenience of a Court Judgement

"Gasland", fractivists most high profile case against fracking, found fraudulent

In 2009, with the backing of 'Gasland' fractivists, 14 families in Dimock Township, PA reportedly experienced turbidity in their water from methane migration, supposedly from nearby shale drilling operations.

Following a State Court trial, the Jury ordered damages of $4.24 million against the driller.

In late March 2017, an Appeal Judge ordered a new trial confirming that the evidence on which the jury awarded damages was flawed.

The judgement called evidence against the driller as *"sparse, sometimes contradictory, frequently rebutted by other scientific expert testimony, and relied in some measure upon tenuous inferences."*

- The State Dept. of Environmental Protection (DEP) investigated in 2010 and declared the driller responsible and imposed stiff and requirements, including a requirement to provide compensation to a number of families that complained fracking had interfered with their water aquifers.
- **Research later showed that the driller was not responsible. All families settled in 2012 after tests showed the wells contained elevated levels of methane but none of the chemicals associated with gas drilling or fracking.** In conjunction with fractivist supporters, two holdout families continued to *'ride the horse of hope'* that they could sue for big money and retire millionaires.
- In March 2016, the trial took place in Scranton, PA. The lawyer for the two families engaged in borderline unethical practices in the courtroom in her attempt to influence the jury. "Expert" fractivist witnesses Tony Ingraffea and Paul Rubin were shown to be inept in their testimony.
- One of the two families admitted, under oath, that their water had too much methane in it BEFORE drilling nearby had even begun. The same family, later built a 22-room house on the property after they admitted there was *'trouble'* with the water.
- The jury found the driller at fault for creating a nuisance (dust, noise etc), NOT for water well contamination and awarded $4.24 million.
- On appeal by the driller, a Federal Court confirmed a total miscarriage of justice against the driller and tossed out the $4.24 million verdict, calling the evidence against the driller as *"sparse, sometimes contradictory, frequently rebutted by other scientific expert testimony, and relied in some measure upon tenuous inferences"*
- The Appeal Judge went further *"The jury's award of more than $4 million in damages for private nuisance bore no discernible relationship to the evidence, which was at best limited; and even were the court to find that the jury's verdict of liability should stand,* ***the court can perceive no way in which the jury's damages award could withstand even passing scrutiny*** *regardless of the applicable standard of review".* (Judgment made public).

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Philadelphia (PA) Inquirer (Mar 31, 2017) –Judge throws out $4M tainted-water award to Dimock shale-gas families

Groundwater not affected by fracking

Fingerprinting of shale gas & chemicals leaves fractivists in the 'lurch'

- The Duke team collaborated with researchers from the Universities and the French Geological Survey to sample water from 112 drinking wells in NW West Virginia over a three-year period.
- 20 of the water wells were sampled before drilling or fracking began in the region to provide a baseline for later comparisons
- Samples were tested for an extensive list of contaminants, including salts, trace metals and hydrocarbons (methane, propane and ethane).
- The tests showed that methane and saline groundwater were present in both the pre-drilling and post-drilling well water samples, but they had a chemistry that was subtly but distinctly different from the isotopic fingerprints of methane and salts contained in fracking fluids and shale gas.

"Fracking has not contaminated groundwater in northwestern West Virginia."

Researchers from Duke University, Penn State, Ohio State and Stanford University published a study:

- ✓ But, accidental spills of fracking wastewater, if any, may pose a threat to surface water in the region.
- ✓ *"The integrated suite of tracers we used, which were developed at Duke in recent years, provides us with tools sensitive enough to accurately distinguish these subtle differences, which might be missed if you only used a handful of simple measurement techniques" – Jennifer Harkness, Duke U.*
- ✓ *"To our knowledge, we are the first to report a broadly integrated use of these various geochemical techniques in studying groundwater contamination before and after the installation and fracking of shale gas wells" – Avner Vengosh, Duke U.*

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Source: Duke University – Nicholas School of the Environment (Apr 24, 2017) –West Virginia Groundwater Not Affected by Fracking, but Surface Water Is

Another Court Judgement a blow for fractivists

4 years and 3 appeals

PA Appeal Court Says Range Resources Impoundment Did NOT Contaminate Water Well

A junkyard plaintiff from South West PA who was 'used' by the fractivist community as a poster child for their cause, had his case thrown out of Court after 4 years and 3 appeals.

Mainstream scientists state that upward migration of fracking fluids through thousands of feet of impenetrable rock into water tables is basically physically impossible.

- ✓ *"I have been working in hydraulic fracturing for 40 plus years and there is absolutely no evidence hydraulic fractures can grow from miles below the surface to the fresh water aquifers." — Dr. Stephen Holditch, Texas A&M University*
- ✓ *"Fracturing fluids have not contaminated any water supply and with that much distance to an aquifer, it is very unlikely they could." — Stanford geophysicist Mark Zoback*
- ✓ *"Data gathered from hydraulically stimulated wells in other states does not show evidence of hydraulically-induced fractures extending into overlying fresh water aquifers." — University of Michigan*

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Fracking wastewater - mostly brines, not frack fluids

Science continues to fill the knowledge gaps

- The Duke researchers used three statistical techniques to quantify the volume of wastewater generated from unconventional oil and gas wells in six basins nationwide: the Bakken formation in North Dakota; the Marcellus formation in Pennsylvania; the Barnett and Eagle Ford formations in Texas; the Haynesville formation in Arkansas, Louisiana and East Texas; and the Niobrara field in Colorado and Wyoming.
- Using multiple statistical techniques "helped us more accurately account for changes in each well's wastewater volume and salinity over time, and provide a more complete overview of the differences from region to region," - Andrew J. Kondash, Duke U
- "This makes our findings much more useful, not just for scientists, but for industry and regulatory agencies as well," - Andrew J. Kondash, Duke U

Naturally occurring brines, not man-made fracking fluids, account for most of the wastewater coming from hydraulically fractured unconventional oil and gas wells, a new Duke University study (1) finds:

- ✓ *"Much of the public fear about fracking has centered on the chemical-laden fracking fluids, which are injected into wells at the start of production, and the potential harm they could cause if they spill or are disposed of improperly into the environment" – Avner Vengosh, Duke U*
- ✓ *"Our new analysis, however, shows that these fluids only account for between 4 and 8 percent of wastewater being generated over the productive lifetime of fracked wells in the major U.S. unconventional oil and gas basins. Most of the fracking fluids injected into these wells do not return to the surface; they are retained in the shale deep underground". – Avner Vengosh, Duke U*
- ✓ *"To our knowledge, we are the first to report a broadly integrated use of these various geochemical techniques in studying groundwater contamination before and after the installation and fracking of shale gas wells." – Avner Vengosh, Duke U*

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Source: Duke University – Nicholas School of the Environment (Oct 17, 2016) – Fracking wastewater is mostly brines, not man made racking fluids
1) Published its findings Oct. 14, 2016 in the peer-reviewed journal 'Science of the Total Environment'.

Alarmist anti-fracking research debunked

Anti-fracking report found to be wrong by 27,500%

In May 2015, a newly released "study" from "scientists" at Oregon State University and the University of Cincinnati reportedly *"found people living near fracking sites in Ohio were being exposed to 'deadly' air pollution"*.

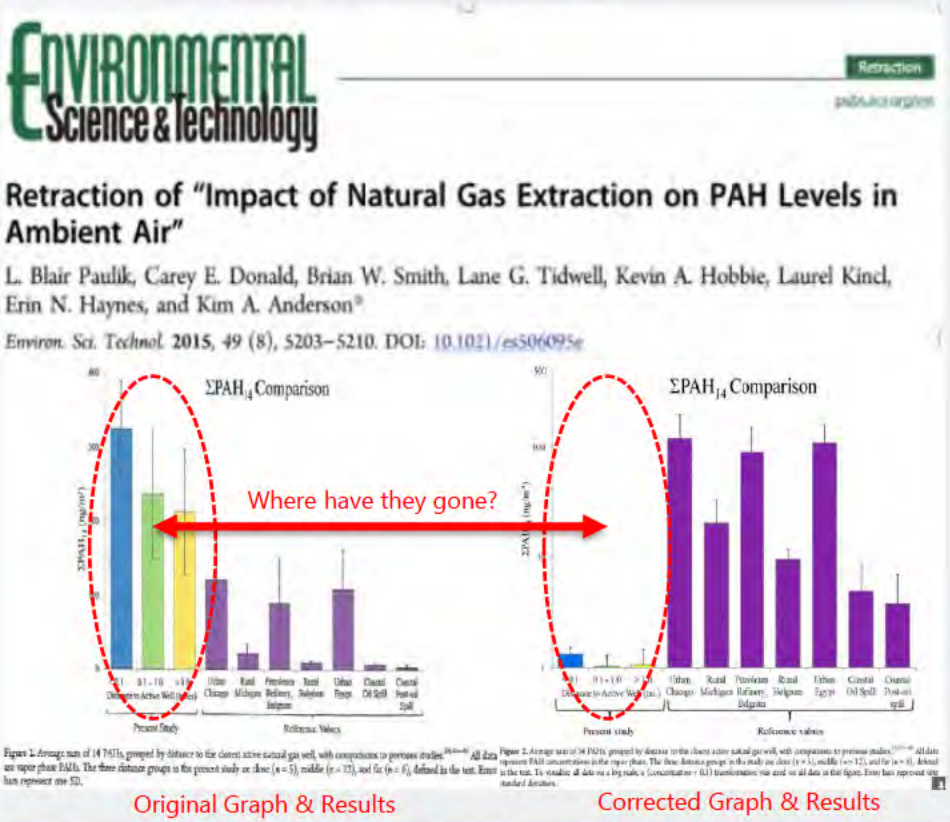
- The published paper was titled *"Impact of Natural Gas Extraction on PAH Levels in Ambient Air"* and published in the 'peer reviewed' journal Environmental Science & Technology.
- One of the authors of the study implied elevated toxins in the air near fracking sites may lead to cancer.
- Industry pointed out the significant problems with this so-called scientific research: a very small number of air samples, taken from "non-random" (i.e. cherry-picked) locations, with untrained homeowner "volunteers" collecting the samples and shipping them to Oregon for study.

After significant scrutiny by industry and real researchers within a few weeks the authors of the study retracted it because.....

(a) they used a wrong value for a gas constant; and
(b) the Excel spreadsheet link/formula was wrong!

That meant the whole conclusion was disparately wrong.

When the data was corrected, air quality risks near those fracking sites were "well below EPA levels"



Original Graph & Results

Corrected Graph & Results

Combined with the many flaws of the study, the fact that the study participants were recruited by a fractivist group, and the sheer degree to which the research team botched the original data borders on shocking, especially considering scientists would seemingly be capable of catching such egregious mathematical errors.

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Further False Research

Govt Health Report destroys fractivist funded 'Fracking & Asthma' Study

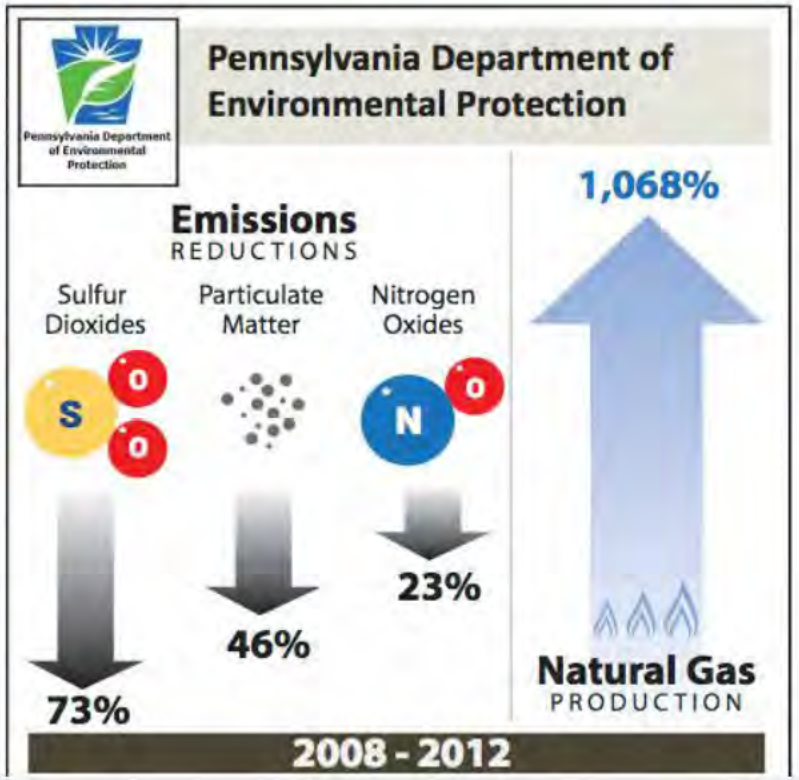
Johns Hopkins University released further "science junk" in July 2016, concluding fracking causes asthma attacks.....

- The report didn't include Pennsylvania county-by-county comparisons or between areas with and without shale development

Within days, the Pennsylvania Department of Health ("PDH") produced data showing that heavily shale drilled counties within the study area have far lower age-adjusted rates of asthma hospitalizations!

- The icing on the cake is that in 2009 to 2013, the PDH data *actually shows a significant 24% reduction in inpatient asthma hospitalizations throughout the entire state*, which just so happens to be the time the shale boom really took off
- **The fractivist researchers' conclusion that proximity to shale gas wells leads to asthma attacks was total destroyed by PDH data.**

Not coincidentally, sulphur dioxide, nitrogen oxide and fine particulate matter all started decreasing rapidly in Pennsylvania once fracking commenced



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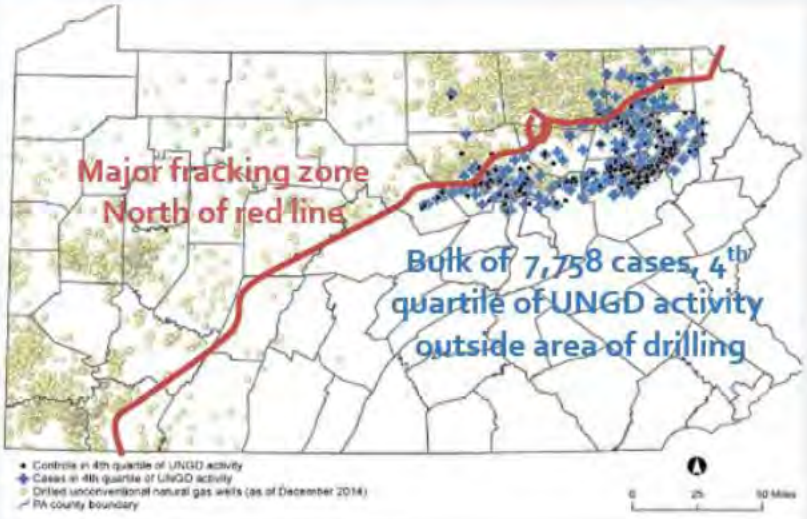
Fractivist paid-for research dishonest

Claims fracking leads to headaches, fatigue and sinus problems found illegitimate on inspection

Pennsylvanian counties sampled (blue crosses), but few were major drilling areas (yellow dots) with some counties having no drilling at all!



The easy fatal flaws for this 'research'..... "*no consideration of baselines for smoking, poor nutrition, drug use, coal mining activities, coal power plant exposure, highway traffic (records closely follow a major interstate highway), pollen seasons and urban development*"

Johns Hopkins University's "science junk" claims fracking leads to headaches, fatigue and sinus problems[1].....

- But a researcher did say "*our data can rarely prove that an exposure caused a health outcome.*"
- What the report stated amongst its many disclaimers "*our activity metric did not allow identification of specific exposures or exposure pathways.*"
- But then the peer review claimed "*These are the kind of studies that should have been done five, six, seven years ago.*"

Then media, in typical lazy fashion, reported "*FINDINGS OF THE STUDY*" to fit their prejudices. The researchers' conclusions were widely reported by the media as the 'truth'.

A little scrutiny would have revealed the study deserved no legitimacy: almost all the subjects whose doctor records were used LIVE OUTSIDE of drilling areas. Media does not retract dishonesty and so the headline remains!

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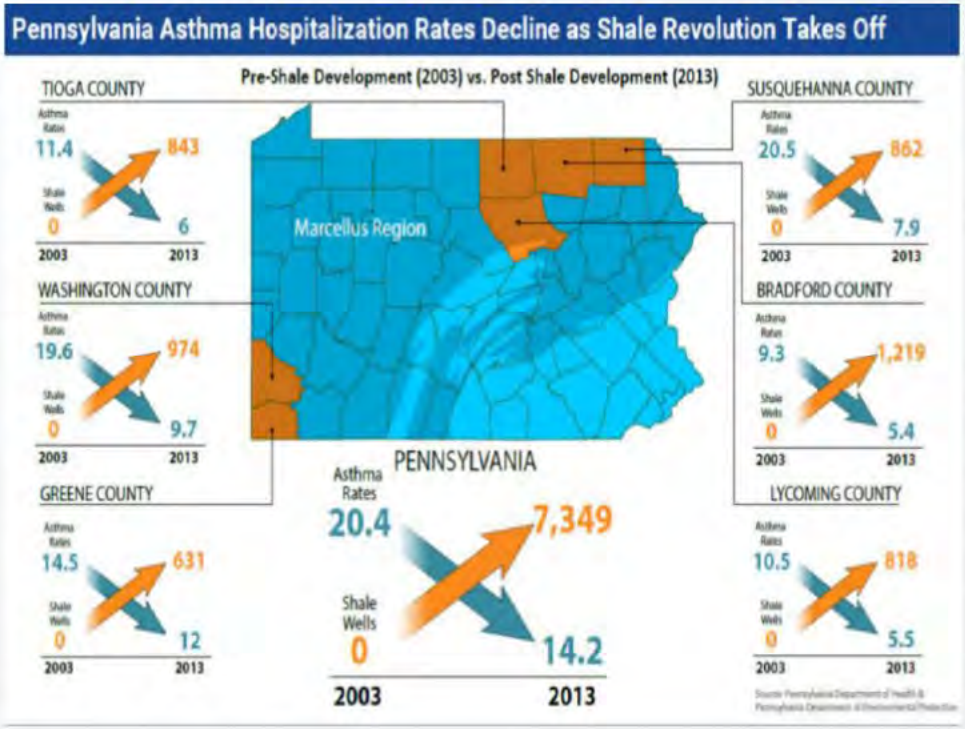
(1) Johns Hopkins University Fracking and Health – Aug 25, 2016

Real Research – revealing the truth

The facts on hospitalisation proves shale gas drilling does not cause asthma



Why did researchers at Johns Hopkins University not include county-by-county comparisons?

- ✓ Did they know their conclusions weren't sound?
- ✓ Asthma hospitalization rates in PA have fallen across the state as shale development took off.
- ✓ On closer view of this data the top producing natural gas counties (see map, in brown) asthma hospitalizations rates have fallen.

Is Marcellus development driving down those rates? – this is unknown, but what is known is that it is not negatively impacting asthma hospitalization rates.

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False Research is not just about health

Penn State University eats crow over cause of earthquakes

Penn State 'Pre-Research' announcement:

In May 2016 Penn State University setup a seismic monitoring system throughout Pennsylvania to track earthquakes.

- Without <u>any</u> research they theorized fracking may be the cause for some of the earthquakes and said: *"We have not done enough analysis of the data to make any conclusions yet, but there is a correlation spatially and temporally between the fracking and the earthquakes." – Andrew Nyblake*

In other words, they had not actually done the research, but announced there's a connection between fracking and earthquakes.

When the concept was reported, as usual the media ran with this pre-research "anti-frack" announcement. The actual conclusions do not seem to have been made public through the media.

When the Penn State researchers actually did some research, they changed their tune.

- What they now say in a recently issued report is this:

  "The report found no correlation between the seismic events during that period and Marcellus Shale fracking or gas injection wells."

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Penn State News - May 18, 2016

The USA EPA fails in its last anti-fracking case

John Fenton, who spread his false anti-fracking message throughout the NT, loses the final EPA anti-fracking case.

In Nov 2016, the last, solitary anti-fracking case being run by the USA EPA, at the instigation of John Fenton's 'Pavillion Area Concerned Citizens' failed to prove a connection between fracking and water contamination in Pavillion, Wyoming.

Pavillion – another debunked claim of so-called fracking-caused water contamination.

- An EPA investigation started in 2010, at the request of citizens living outside Pavillion who reported taste and odour in their well water.
- The geology where the drilling occurred around Pavillion is porous sandstone, not tightly-packed shale.
- Drilling in Pavillion was around 1,200 feet in depth, with the water table in that area at 800 feet. In shale gas drilling (in Appalachia), fracking occurs at least 5,000 feet down, and the average depth of the water table is at 150 feet from the surface.
- A December 2011 EPA draft report hinted at a link between drilling and water contamination turned Pavillion into a focus for the fractivist debate, despite then EPA Administrator Lisa Jackson stating after the report's release, *"in no case has the EPA made a definitive determination that the fracking process has caused chemicals to enter groundwater"*.
- EPA officials expressed concern internally over the "*inflammatory and irresponsible*" media coverage of the report.
- EPA's data came from just two water monitoring wells in Pavillion, wells the EPA drilled. The quality of the drilling for the two wells was substandard. Ultimately the EPA handed them to the Wyoming's Department of Environmental Quality (DEQ) to complete the review.
- The DEQ(1) report concluded 'drilling activity did NOT contaminate well water. Contaminants found in wells *"were likely to be naturally occurring"*.
- Further, the monitoring wells the EPA drilled were done incorrectly, and the EPA itself accidentally introduced the very contaminants that it later detected and reported on.
- *"Evidence does not indicate that fracking fluids have risen to shallow depths utilized by water-supply wells,"* states the DEQ report's fact sheet.
- Further the DEQ(1) noted *"Also, based on an evaluation of fracking history, and methods used in the Pavillion Gas Field, it is unlikely that fracking caused any impacts to the water-supply wells"*.

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American Thinker, Jeff Folks – Is the EPA Just Sloppy, or Cooking the Books – Apr 10, 2012
NGI Shale Daily – EPA formally ends inquiry into Pavillion Water contamination – Sep 12, 2013
(1) DEQ – Pavillion Groundwater Report Fact Sheet- Nov 7, 2016
Fracking did not contaminant water in Pavillion – GSI Environmental – Environmental Science & Technology – Nov 2016

Fractivists now proving fears unfounded

After nearly 5,000 observations logged by fractivists, no harm from fracking found to local streams.

Considering the number of wells drilled, shale gas drilling does not harm local streams...

ALLARM stands for Alliance for Aquatic Resource Monitoring. With the rapid growth of the Marcellus industry shale drilling in Pennsylvania and neighbouring states, "concerned citizens" wanted ways to collect data on water quality impacts from shale gas activities.

As a response to requests from communities, ALLARM developed a volunteer-friendly protocol in 2010 to assess small streams for the early detection and reporting of surface water contamination by shale gas extraction activities.

- ✓ Volunteers (i.e. fractivists) monitor water quality throughout the year, including:
  - conductivity, barium, strontium, and total dissolved solids; and
  - physical parameters, including stream stage and visual observations prior to, during, and after shale gas well development.
- ✓ Monitors also participate in a quality assurance, quality control program which includes in-person trainings, routine meter calibration, and sample testing via split-sample analysis two times a year.
- ✓ Since they began monitoring local streams, nearly 5,000 observations have been logged. **And no problems with shale drilling.**

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Debunking more fracking myths

Science keeps showing, despite fractivist fear mongering, there is no risk to public health

University of Texas - Arlington's Collaborative Laboratories for Environmental Analysis and Remediation[1] conducted a study on ambient emissions at hydraulic fracturing sites in the Eagle Ford Shale. This covered....

- ✓ Measured volatile organic compounds that can be carcinogenic and affect the central nervous system, at frack sites in 13 different counties.
- ✓ It found toluene and xylene levels were 40x and 100x below Occupational Health & Safety (OHS) limits, respectively.
- ✓ Xylene isomer concentrations did not exceed NIOSH air quality standards.
- ✓ Importantly, emissions were not the result of the fracking process itself, but emanate from onsite activities. This would be similar to standing by a freeway or construction site etc.

These results suggest that air contamination events from fracking can be monitored and controlled.

In Colorado, the state's top medical officer Dr Larry Wolk[2] debunked claims about risks of fracking to public health.....

- ✓ Wolk, a practicing physician said he believes there is no causal relationship between oil & gas development and chronic diseases.
- ✓ In Greeley and Weld County's where a majority of Colorado's fracking is taking place, there is no registering of higher levels of negative health conditions.

"Despite public fears that oil and gas development is causing asthma, birth defects and cancer, statistics from the health department show oil and gas has not affected the general health of Weld County, which produces 90% of the state's oil." - Dr Larry Wolk

"We've had at least 10,000 wells or more in Weld County for about 30 years or more and with that number of wells... if it was going to be a problem, it should have shown up long ago, but it hasn't." - Dr Larry Wolk

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(1) Science of the Total Environment – August 2016
(2) The Greely Tribune – Sept 2016

UK study in-step with positive science

Authors of UK Fracking Study – *"Traffic impact of fracking is negligible"*

Although the authors of the study don't seem thrilled about the results, people in Britain should be, because it shows:

- ✓ Over a longer baseline (the entire operational lifetime of a pad) fracking would result in negligible relative increases compared to baseline traffic impacts.
- ✓ In addition, there are the environmental benefits of natural gas compared to coal or diesel for the generation of electricity.

All this should make environmentally conscious people in the United Kingdom eager to positively consider the environmental benefits of fracking.

"Investigating the traffic-related environmental impacts of hydraulic-fracturing (fracking) operations"(1)

- ✓ Fracking could boost natural gas production in the United Kingdom. But fracking has been met with staunch opposition from environmental groups who oppose the potential impacts of drilling, production, and heavy truck traffic.
- ✓ Oppositions groups generally do not understand fracking nor do they base their claims on science or research.
- ✓ Heavy vehicles are associated with producing high levels of noise, road damage, and air pollution in the form of small particulates, which form as a result of fuel combustion in all vehicles.
- ✓ The authors of the paper developed a traffic impact model to produce an environmental assessment of both the short-term and long-term impacts of fracking at individual sites, as well as regional impact analysis.

The results at left were shown to be net positive.

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(1) *Environment International/Science Apr-May 2016.*

Debunking the methane-in-water myth

Scientists have again proven that fracking does not contaminate ground water supplies

A study funded entirely by the National Science Foundation[1] (no Big Green money or oil and gas money involved) has found that fracking operations in Colorado have not led to an increase in methane migration into groundwater supplies. The study, titled "Groundwater methane in relation to oil and gas development and shallow coal seams in the Denver-Julesburg Basin of Colorado" *was published in the Proceedings of the National Academy of Sciences (PNAS) and is significant. The research examined methane levels going back 25 years, long before any horizontal fracking took place in the state.*

The study, that examined 25 years of public data maintained by the Colorado Oil and Gas Conservation Commission, were used to determine sources and occurrence rates of methane and other gases in groundwater supplies.

It was found that microbially generated methane, rather than high-volume hydraulic fracturing, is the primary source of dissolved methane in that region's groundwater supply.

- ✓ The study is important, because it is where there has been a huge increase in oil and natural gas drilling, which uses fracking.
- ✓ Because that drilling activity is happening in one of the state's most populous areas, it has became controversial, leading to efforts to ban the process, including through three proposed statewide ballot measures, which failed.
- ✓ The report shows that fracking has little to nothing to do with methane in groundwater supplies.

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(1) Proceedings of the National Academy of Sciences (Jul 11, 2016) – Groundwater methane in relation to oil and gas development and shallow coal seams in the Denver-Julesburg Basin of Colorado

More positive research not making News

Why is science is not considered?

Researchers	Started	Released	Comments
Uni of Cincinnati	2012	Mar 2016	• Funded by anti-fracking foundations. • Testing water wells in Ohio to see if fracking was causing water contamination.(1) • Conclusion - *"The good news is that our study did not document that fracking was directly linked to water contamination."* • Fractivist funders tried to withhold the report and refuse to provide further funding.
Uni of Syracuse	2009	Apr 2016	• Sampling and analysis of 19,278 predrilling ground water wells in the Appalachian Basin (mainly Ohio).(2) • Conclusion - *"Based on the carbon and hydrogen stable isotope data along with the relatively consistent measurements within individual wells over the study period, we have found no evidence for natural gas contamination from shale oil and gas mining in any of the sampled groundwater wells of our study."*
Duke Uni	2013	May 2016	• study covering 16 USA states and interviewing over 200 local government officials along with gathering data and facts to identify the benefits to local governments from shale drilling(3). • Conclusion - *"The recent surge in shale oil and natural gas development has been beneficial for most local governments in the United States.....on balance shale oil and gas drilling benefits local communities..."*
USA EPA	2010	June 2015	• the potential impacts of hydraulic fracturing activities on drinking water resources in the United States. (5 year, 950 sources and a US$40 million research program)(4). • Conclusion - *"Hydraulic fracturing activities in the U.S. are carried out in a way that have not led to widespread, systemic impacts on drinking water resources."*
USA Energy Dept		July 2013	• Neither shale gas nor fracking fluid travelled upward through 8,000 feet of rock in wells tested in PA.
West Australian Report(5)		Nov 2015	• Conclusion - *"land impact, chemical use, water quality and the legacy of fracking can be safely managed."*

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1) Hydraulic Fracturing Opponent Funds Study Finding It Doesn't Contaminate Water. – Energy in Depth, Ohio, Feb 15, 2016
2) Dissolved methane in Shallow groundwater of the Appalachian Basin: Results from the Chesapeake Energy predrilling geochemical database.
3) Most Local Government Budgets Gain from Oil, Gas Development. – Duke University May 18, 2016
4) USA EPA – Assessment of the Potential Impacts of Hydraulic Fracturing for oil and gas on drinking water resources. – Draft Report June 2015
5) Report 42 Standing Committee On Environment And Public Affairs Implications For Western Australia Of Hydraulic Fracturing For Unconventional Gas . Nov 2015.

Shale Development (Drilling & Production)

"Fracking has been good for the USA economy and environment" – former President Obama*

**Energy in Depth, August 16, 2016*

Development of shale gas technology

Application to the Northern Territory

Since early 2000's enhanced drilling techniques have allowed the application of 100 year old fracking technology to be applied to tight rock formations (shales, limestone, sandstone).

- ✓ Shale gas can be easy and effectively released from tight rock (shale).
- ✓ Shale gas processes are environmentally clean and safe.(1)
- ✓ The NT terrain is many regions is conducive to safe and effective shale development.
- ✓ Shale development will bring many opportunities to the region:
  - ➢ New employment in region, especially following the closure of the Gove smelter.
  - ➢ New industries and jobs supporting the downstream and midstream operations of the shale development companies.
  - ➢ Improved regional infrastructure, health, education and training in the shale development regions.
  - ➢ Regional jobs as the industry develops and grows.

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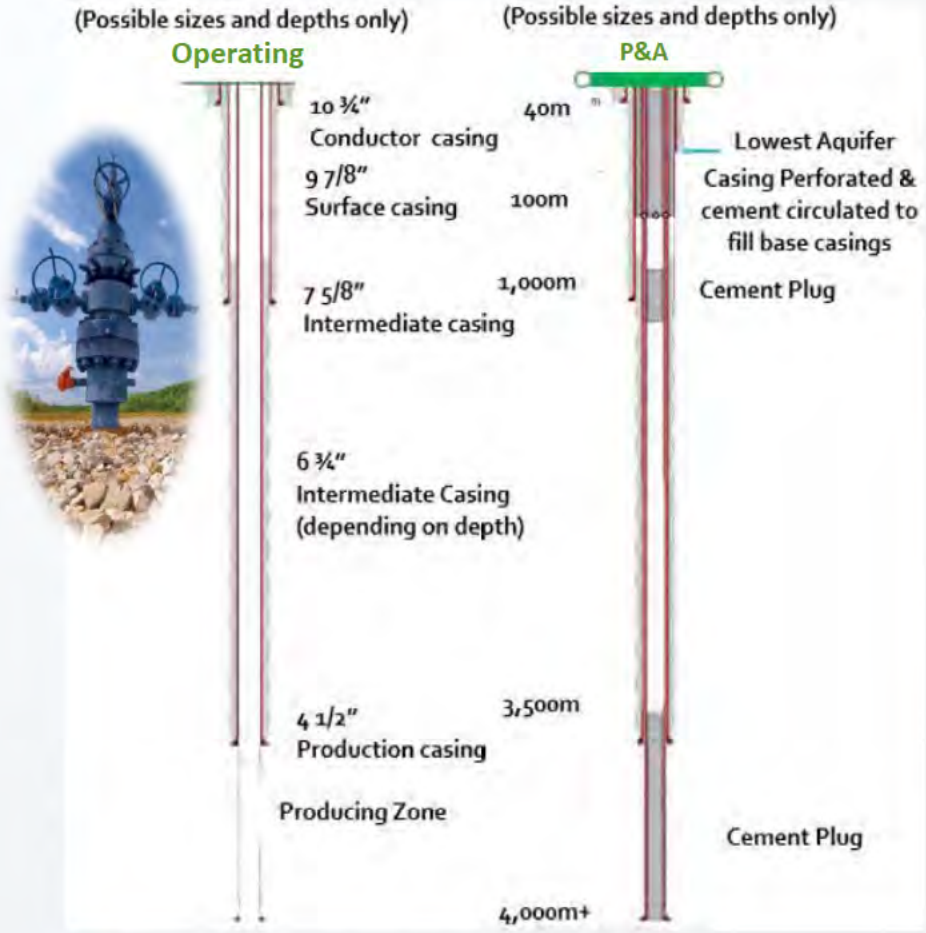
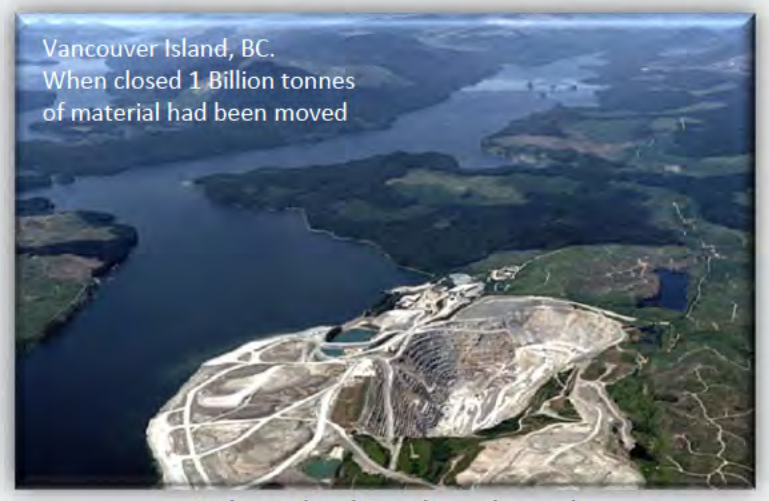
(1) As an example in Pennsylvania, USA a group of shale industry environmentalists imposed strict standards that both industry and environmentalists can live with. Four organisations (Chevron, Shell, Consolidated Energy & EQT Corp) have applied for and received certification from The Centre for Sustainable Shale Development.

Well Construction and Decommissioning

Proper practices ensure a minimal impact on landscape and environment



Gas well plugged & abandoned (P&A)



Mineral mine abandoned

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Development Operations

Substantial direct benefits to all stakeholders

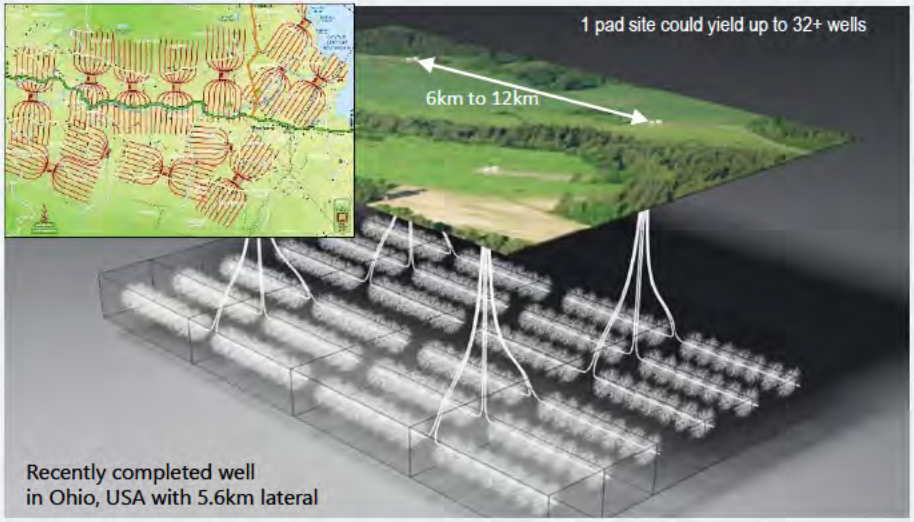
Greater McArthur Basin:

- ✓ sparsely populated.
- ✓ ideal for controlled development.
- ✓ ongoing co-existence programs.
- ✓ development of infrastructure for regional community & pastoralists.

All equipment other than well head moved when drilling is completed

Many Traditional Owners and regional inhabitants see development as:

- ✓ Increased regional employment opportunities.
- ✓ the provision of long term economic security to communities.
- ✓ New technology and horizontal drilling ensures minimal surface disturbance due to multiple wells from single platforms.



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Conclusion

"Fracking Benefits Everyone"

Fracking Benefits Everyone

A study by the Universities of Chicago, Princeton & MIT finds everyone benefits

A new study by researchers at the University of Chicago, Princeton University, and the Massachusetts Institute of Technology (MIT) finds the benefits of fracking outweigh the costs.

- ✓ These are the same organisations that historically published *'anti-fracking'* research.
- ✓ So what has changed – In the end the weight of science overwhelmed emotion and falsehoods.

Titled "The Local Economic and Welfare Consequences of Hydraulic Fracturing[1]" - concludes communities affected by 'fracking' on average, benefit from the industry. The study, published in late December 2016, is the first USA nationwide study of its kind... Significant findings include:

- ✓ The study looked at nine different shale basins, *"the most comprehensive assessment to date,"* according to the authors, and determined their conclusion using a *"willingness-to-pay"* metric.
- ✓ *"This study makes it clear that on net there are benefits to local economies — which we believe is useful information for leaders in the USA and abroad who are deciding whether to allow fracking in their communities," - MIT's Chris Knittel, a co-author of the study.*
- ✓ *"Our estimates are based on the knowledge that communities currently have," - lead researcher Michael Greenstone, University of Chicago. "But based on what is currently known, the average community that has allowed fracking has enjoyed substantial net benefits."*
- ✓ The benefits from fracking are also significant at the macro level. *"The application of fracking to develop oil and natural gas found in shale deposits has led to a sharp increase in U.S. energy production and generated enormous benefits, including abruptly lower energy prices, a reduced trade deficit, stronger energy security and even lower carbon dioxide emissions in the power sector... Higher levels of domestic energy production have ... cut the trade deficit and increased energy security by reducing the amount of fuel purchased abroad"*
- ✓ *"Communities that have banned fracking would perhaps have seen less benefit" -Janet Currie, Princeton University, a co-author*

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(1) University of Chicago – Dec 22, 2016

Conclusion: a safe way forward for NT gas

After many inquiries and studies, the evidence is hydraulic fracturing of shale gas is safe

There is no credible published research that finds hydraulic fracturing is not safe.

In fact, significant numbers of studies, court cases and government reports have consistently found:

- ✓ Fracking does NOT cause systemic contamination of groundwater supplies.
- ✓ Fracking does NOT increase methane in streams or water wells.
- ✓ Fracking does NOT produce deadly air pollution.
- ✓ Fracking does NOT increase asthma rates in local populations.
- ✓ Fracking does NOT have significant long term traffic impacts.
- ✓ Fracking does NOT produce large quantities of waste water brines.
- ✓ Fracking does NOT cause earthquakes.

More money, more jobs, less CO2

Fracking WILL reduce CO2 emissions by replacing coal as a energy source

The lifting of the temporary ban on fracking in the Northern Territory will transform the economy with little, if any long term, environmental impact.

Indeed, lateral hydraulic fracturing of shale gas in the McArthur Basin has the potential to deliver (not in order of importance):

- ✓ Access to a globally significant source of natural gas, potentially greater than the North West Shelf, closer to the East Coast domestic market.
- ✓ Replacement of lapsed industries e.g. Gove smelter, with $billion methanol and fertiliser plants.
- ✓ Through export provide the ability to significantly reduce global greenhouse gases.
- ✓ Development of infrastructure for regional communities & pastoralists.
- ✓ Substantial employment and opportunities for Territorians.
- ✓ Billions of dollars in ongoing royalties to the government.
- ✓ Job creation on a large scale for decades to come.
- ✓ Significant benefits to the Traditional Owners.

Imperial Oil & Gas

An Australian owned and operated company active in the NT and USA

Imperial Oil & Gas is a subsidiary of Empire Energy, listed on the Australian Stock Exchange in 1984. Initial entry into US oil and gas in 2006. A conventional oil and natural gas producer with operations in Appalachia (New York and Pennsylvania) and the Mid-Con (Kansas and Oklahoma).

In 2010 the Company secured approximately 14.6 million acres in the McArthur Basin, Northern Territory, which is considered highly prospective for large shale oil and gas conventional and unconventional resources. Work undertaken by the Company over the past 7 years demonstrates that the Central Trough of the McArthur Basin, of which the Company holds around 80%, is a major Proterozoic depo-centre that forms one segment of a series of extensive prolific hydrocarbon basins extending through Oman, Siberia and southern China, and which contain resources of many billions of barrels of oil equivalent.

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