

Presenting the facts
Debunking the myths.....

DEVELOPMENT OF THE NT ONSHORE SHALE GAS INDUSTRY



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CLEAN SHALE GAS

totally fracking different to
COAL SEAM GAS ("CSG")

Shale Gas - What are we talking about?

- Shale gas processes are environmentally safe⁽¹⁾
- Shale gas is environmentally clean unlike CSG
- Successful shale development will bring immense economic benefits to the region
- Work together to create and generate.....
 - New Industries and Jobs as other major NT projects run down
 - Improved regional infrastructure, education and training
 - Economic independence for Traditional Owners

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

Fact v Fiction.....

"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

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

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

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

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**

The Simple Science – why anti-fracker's are wrong⁽¹⁾

- How can we be sure fracking will not pollute aquifers?
- Shale gas producers have major interest in avoiding aquifer connection.....
 - It would result in uneconomically excessive amounts of water to be pumped from wells – **therefore provide adequate casing and cement**
- **Upward hydraulic gradients effecting aquifer contamination**
 - Nominal upward hydraulic gradients will typically only be developed for a few hours during fracking process – **so, solute transport limited**
 - Thereafter depressurization of wells to allow gas to flow will result in downward hydraulic gradients maintained for many years - *physics*
- **The anti-fracking proposition is therefore unsupportable**

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

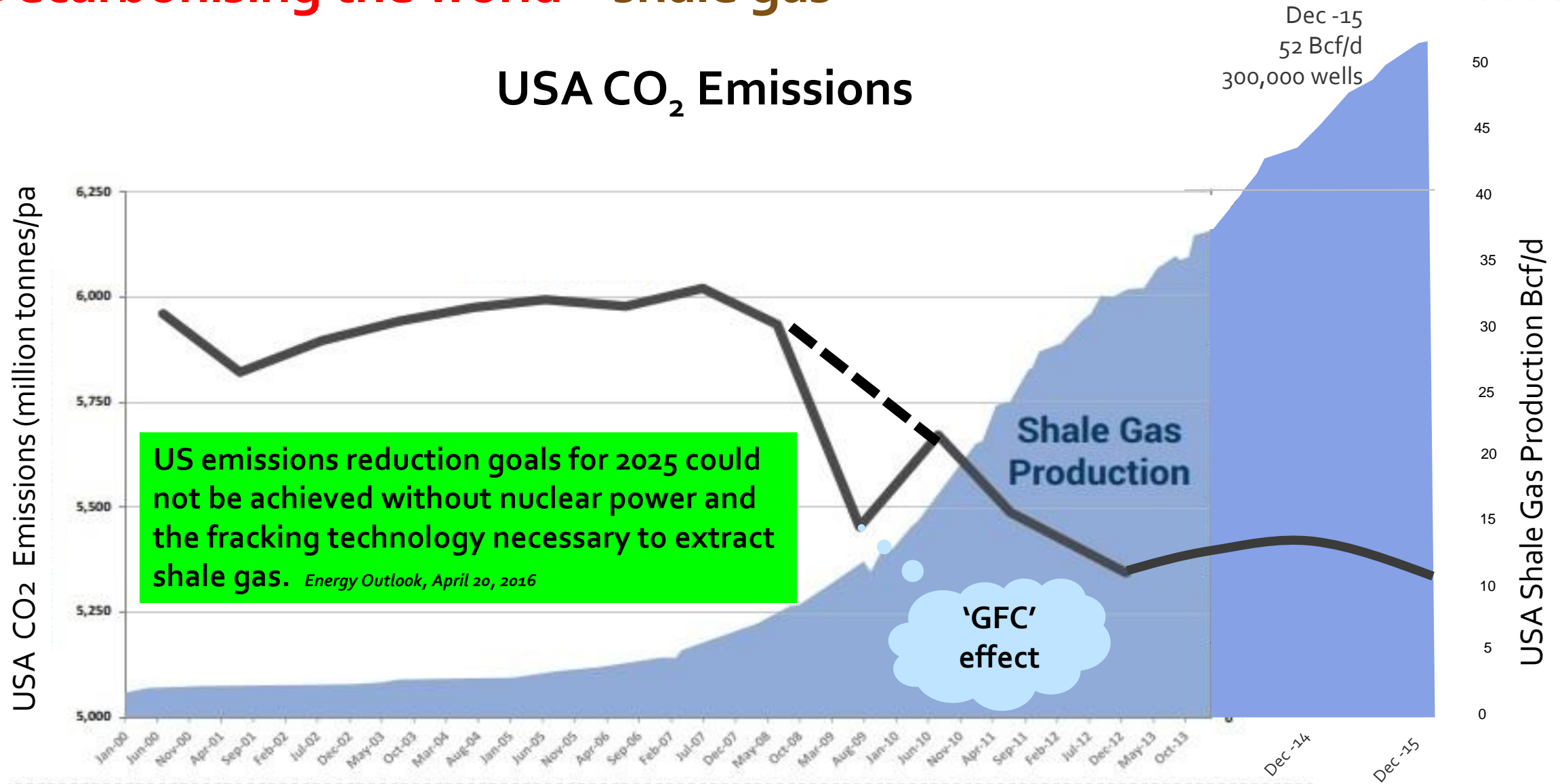
"Keep it in the Ground" Protesters..... "Naïve"

Sally Jewell, President Barack Obama's Interior Secretary had these words for the "keep it in the ground" movement, May 6, 2016

<http://www.desertsun.com/story/news/environment/2016/05/06/sally-jewell-keep-ground-protests-naive/83992074/>

Decarbonising the world – shale gas

USA CO₂ Emissions



Energy in Depth Oct, 27 2015, EIA May 2016, Monthly Energy Review

News (a sample) – Fracking, where are the issues?

- In 2012, the University of Cincinnati started a 3 years study (funded by anti-fracking foundations) testing Ohio wells to see if hydraulic fracturing was causing water contamination⁽¹⁾
 - Anti fracking funders tried to withhold the report and refuse to provide further funding
 - Conclusion in March 2016 - *"The good news is that our study did not document that fracking was directly linked to water contamination."*
- In 2009 the University of Syracuse commenced a study on the sampling and analysis of 19,278 predrilling ground water wells in the Appalachian Basin (mainly Ohio)⁽²⁾.
 - Conclusion in April 2016 - *"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."*
- In 2013 Duke University commenced a three year 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 in May 2016 - *"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..."*
- Findings match other experts: ***Fracking in shale, when done properly, is safe for the environment:***
 - Yale University - no evidence that fracking natural gas wells contaminates ground water.
 - USA Energy Department - neither shale gas nor fracking fluid travelled upward through rock in wells tested in Pennsylvania.
 - USA EPA - concluded that shale fracking has not had "widespread, systemic impacts on drinking water."
- In 2015 the West Australian Report 42⁽⁴⁾ into shale fracking confirmed that – *"land impact, chemical use, water quality and the legacy of fracking can be safely managed."*

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) Report 42 Standing Committee On Environment And Public Affairs Implications For Western Australia Of Hydraulic Fracturing For Unconventional Gas . Nov 2015.

More News – Authors of UK Fracking Study..... Dismayed that Fracking is Safe!

- The study is titled “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 drilling, production, and heavy truck traffic
- Opposition groups generally do not understand fracking nor do they base their claims on science or research
- Heavy vehicles are associated with producing higher 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.

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. These findings, in addition to the environmental benefits of natural gas compared to coal or diesel, should make environmentally conscious people in the United Kingdom eager to consider the environmental benefits of fracking.

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

News Highlight⁽²⁾ — The interim report for the Senate's Bender Inquiry (Glenn Lazarus Chairman) concluded along party lines with Federal **Labour** and **Liberal** senators concluding fracking can be safely managed, but as expected the uninformed Lazarus and Greens found serious issues with gas fracking although their report contains no evidence to support their 'head-line' seeking attacks on the industry! *The anti frackers are NOT interested in FACTS!!*

(2) EnergyNewsBulletin, May 6, 2016

How many more investigations - Hydraulic Fracking in Australia

• AUSTRALIAN GOVERNMENT

- [Senate Committee on Rural and Regional Affairs and Transport Inquiry](#)
 - Title: The impact of mining coal seam gas on the management of the Murray Darling Basin.
 - Status: Report finalised 30 November 2011.
- [NICNAS, CSIRO, Department of Environment and Geoscience Australia](#)
 - Title: National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
 - Status: Initiated July 2012. Current.
- [Select Committee on Unconventional Gas Mining](#)
 - Title: Unconventional gas mining
 - Status: Initiated 12 November 2015. Report to be provided on or before 30 June 2016.

• NEW SOUTH WALES

- [Legislative Council Inquiry – General Purpose Standing Committee No. 5](#)
 - Title: Inquiry into coal seam gas: Report no. 35
 - Status: Report finalised 1 May 2012.
- [Chief Scientist and Engineer](#)
 - Title: Final report of the independent review of coal seam gas activities in NSW. September 2014.
 - Status: Report finalised 30 September 2014.

• NORTHERN TERRITORY

- [Allan Hawke AC. Commissioner](#)
 - Title: Independent inquiry into hydraulic fracturing in the Northern Territory
 - Status: Final report completed 28 November 2014.

• SOUTH AUSTRALIA

- [Parliamentary Committee - Natural Resources Committee](#)
 - Title: Inquiry into unconventional gas (fracking)
 - Status: Initiated November 2014. Interim report released 17 November 2015.

• TASMANIA

- [Department of Primary Industries, Parks, Water and Environment](#)
 - Title: Review of hydraulic fracturing in Tasmania
 - Status: Final report completed 25 February 2015.

• VICTORIA

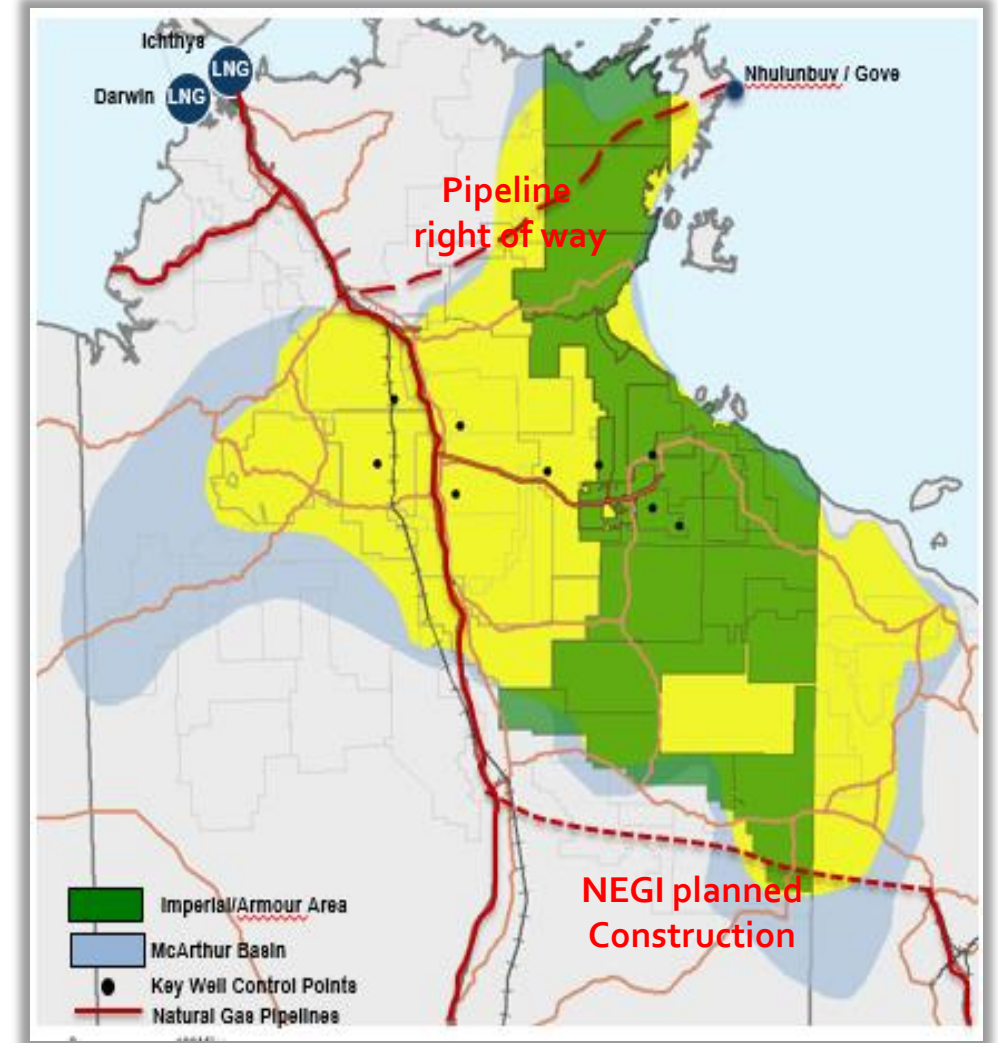
- [Gas Market Taskforce](#)
 - Title: Gas Market Taskforce: Final report and recommendations
 - Status: Report finalised 1 November 2013.
- [Auditor General](#)
 - Title: Unconventional gas: Managing risks and impacts
 - Status: Report tabled August 2015.
- [Legislative Council – Environment and Planning Committee](#)
 - Title: Inquiry into onshore unconventional gas in Victoria
 - Status: Final report tabled 8 December 2015.

• WESTERN AUSTRALIA

- [Legislative Council – Standing Committee on the Environment and Planning](#)
 - Title: Inquiry into the implications for Western Australia of hydraulic fracturing for unconventional gas
 - Status: Final report released on 17 November 2015.

The McArthur Basin

- Largest tenement holders in the Beetaloo / McArthur Basin are Imperial Oil & Gas and Armour Energy
- Combined 44 million acres (shown in green opposite)
- In 2015 Imperial & Armour signed Farmout Agreements with American Energy Partners ("AEP")
 - AEP brings to Australia the 'worlds best' shale technology, expertise and capital
- First stage on-ground combined expenditure of up to ~A\$250 million over 5 years
 - This expenditure equates to jobs creation and infrastructure development
 - Significant royalties to Traditional Owners
 - Success – further large increases in expenditure



“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

The Beneficiaries

- **Regional Traditional Owners**
 - ~3.5% royalty on defined on-ground expenditure (~\$200,000/well)⁽¹⁾
 - ~3.5% royalty on oil & gas sales (~\$1,000,000/well/20 year life time)⁽²⁾
 - ~3.5% royalty on infrastructure/TO jobs across tenements
- **Northern Territory Government**
 - ~7% net royalty (after offsets) oil & gas sales (~\$2mm/well/20 year life time)⁽³⁾
- **Regional Employment Growth.....**
 - New supply & services companies throughout the NT
 - Opportunity for local community SME business development
 - Training and direct employment for 'real jobs' for local indigenous population
 - Provide Nhulunbuy with potential downstream industry as Gove winds down
 - Regional high tech shale gas processing plants (see later sections)

⁽¹⁾ Assume average well cost at ~\$8 million and 65% subject to royalty

⁽²⁾⁽³⁾ Assume average resource of 10,000ft Hz, ~10Bcf/well @ \$3.00/Mcf subject to royalty (80% in first 5 years)

The Pastoralists

- **Communications & Direct Benefits**

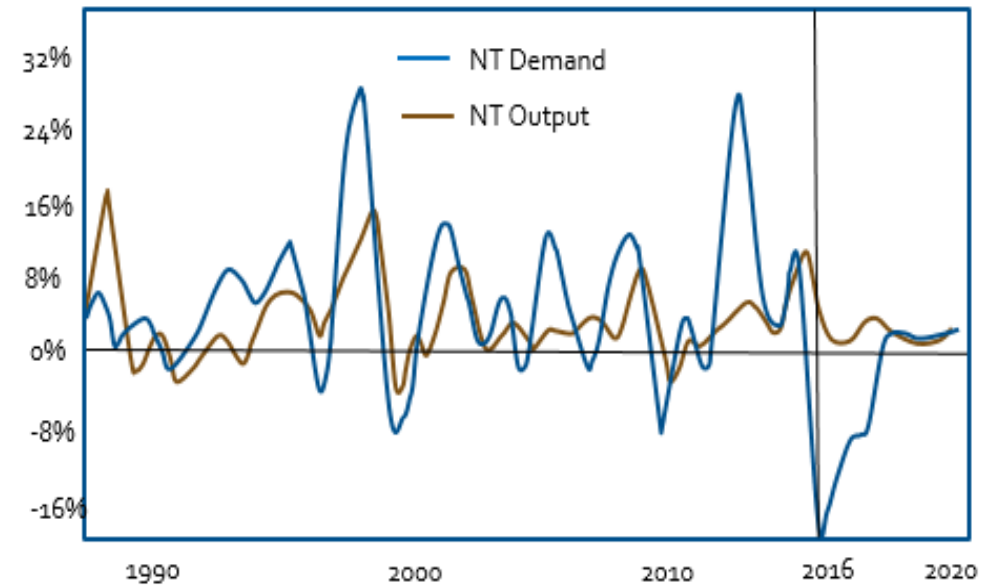
- Long term ongoing relationship building
- Land Access Agreement (Petroleum Activity) discussed individually and agreed
- Discussions with Pastoralists involve:
 - Approval processes for any site clearances
 - Selecting seismic lines and roads to suit ongoing use by Pastoralists/operators
 - Care of gates and fences
 - Ongoing road maintenance
 - Supply of services to drilling/production crews
 - Potable water bores/sources to be shared whenever possible
 - Potential for gas taps/meters for homestead power generation



The Northern Territory - at an Economic Downturn⁽¹⁾

- The NT Economy came late to the resources boom
- One huge gas project only - INPEX Ichthys LNG
- The impact was epic:
 - surge in rents, housing values, wages, room occupancy, population, retail & car sales growth while unemployment dropped
 - Over 2014-15 the NT grew 3 times as fast as WA!
- As Ichthys reaches completion there will be substantial falls in all these value & growth levels
- **This is likely to leave NT's project pipeline very bare for many years, suggesting a decline in all recent growth drivers, including:**
 - Housing – weak outlook ahead
 - Population growth over the last 12 months – weakest in Australia
 - New Engineering Projects – none (other than non-viable NGEI)
 - Commercial Construction – most due to wrap up in 2016
- **Essential - a new long term, sustainable project pipeline**

NT Output & Demand (change on year earlier)

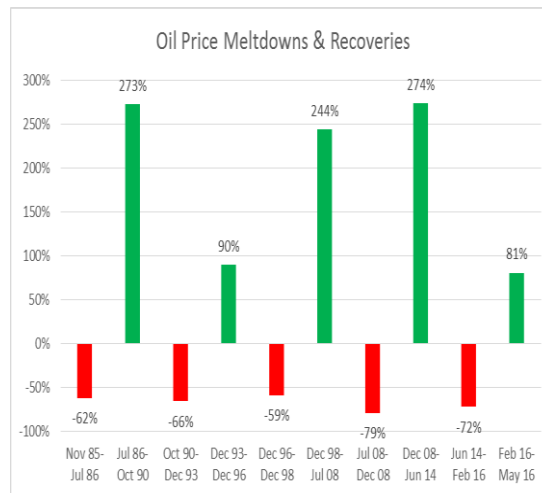
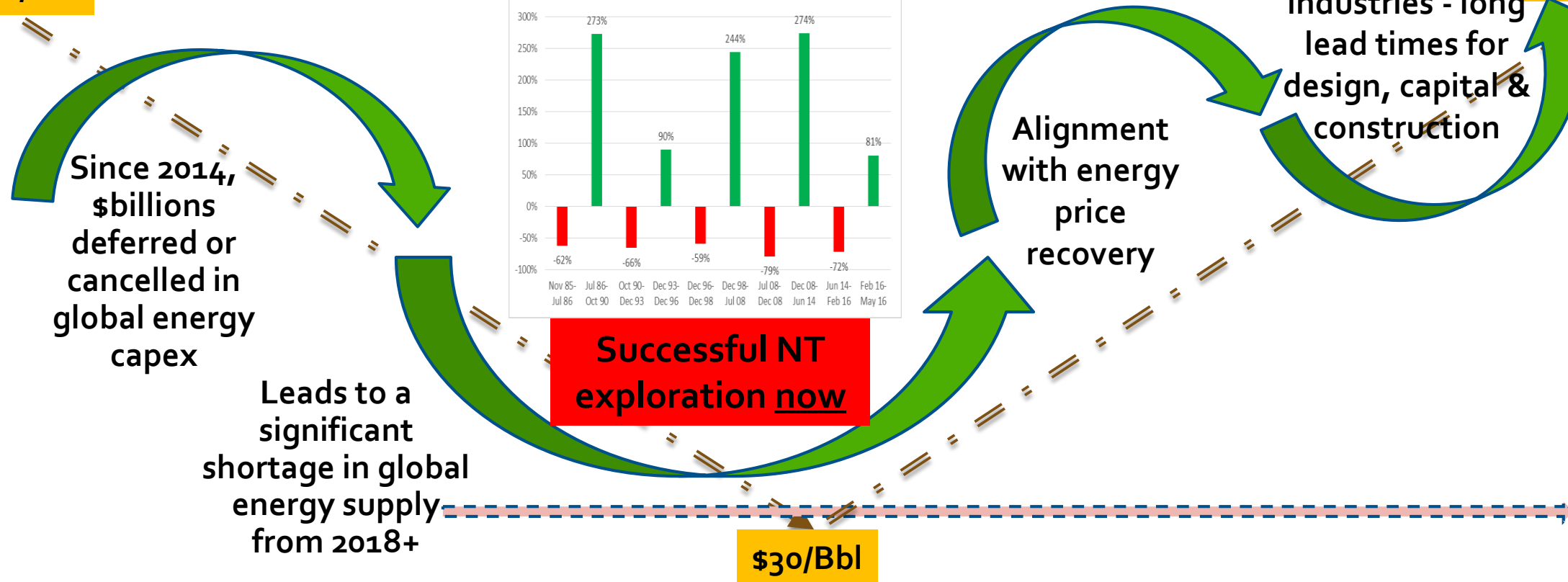


⁽¹⁾ Deloitte Access Economics Business Outlook – April 2016

However – develop clean, safe NT Shale Gas alternative

\$100/Bbl

\$100/Bbl



2014

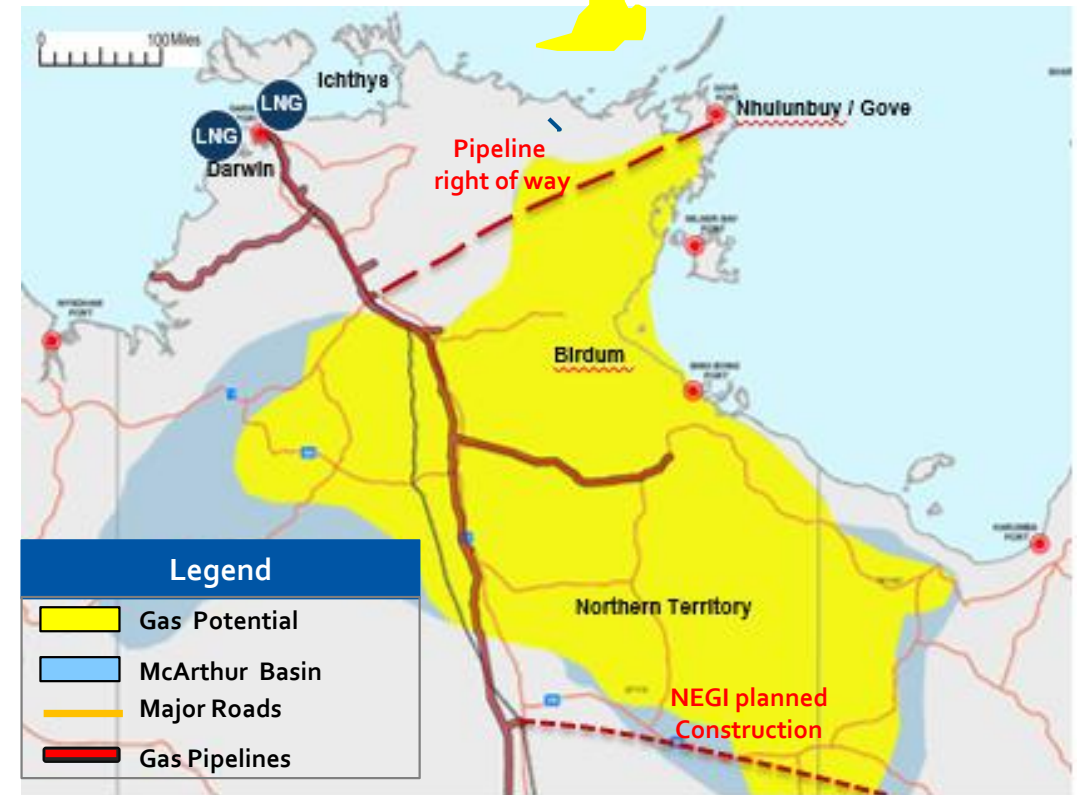
2016

2018+

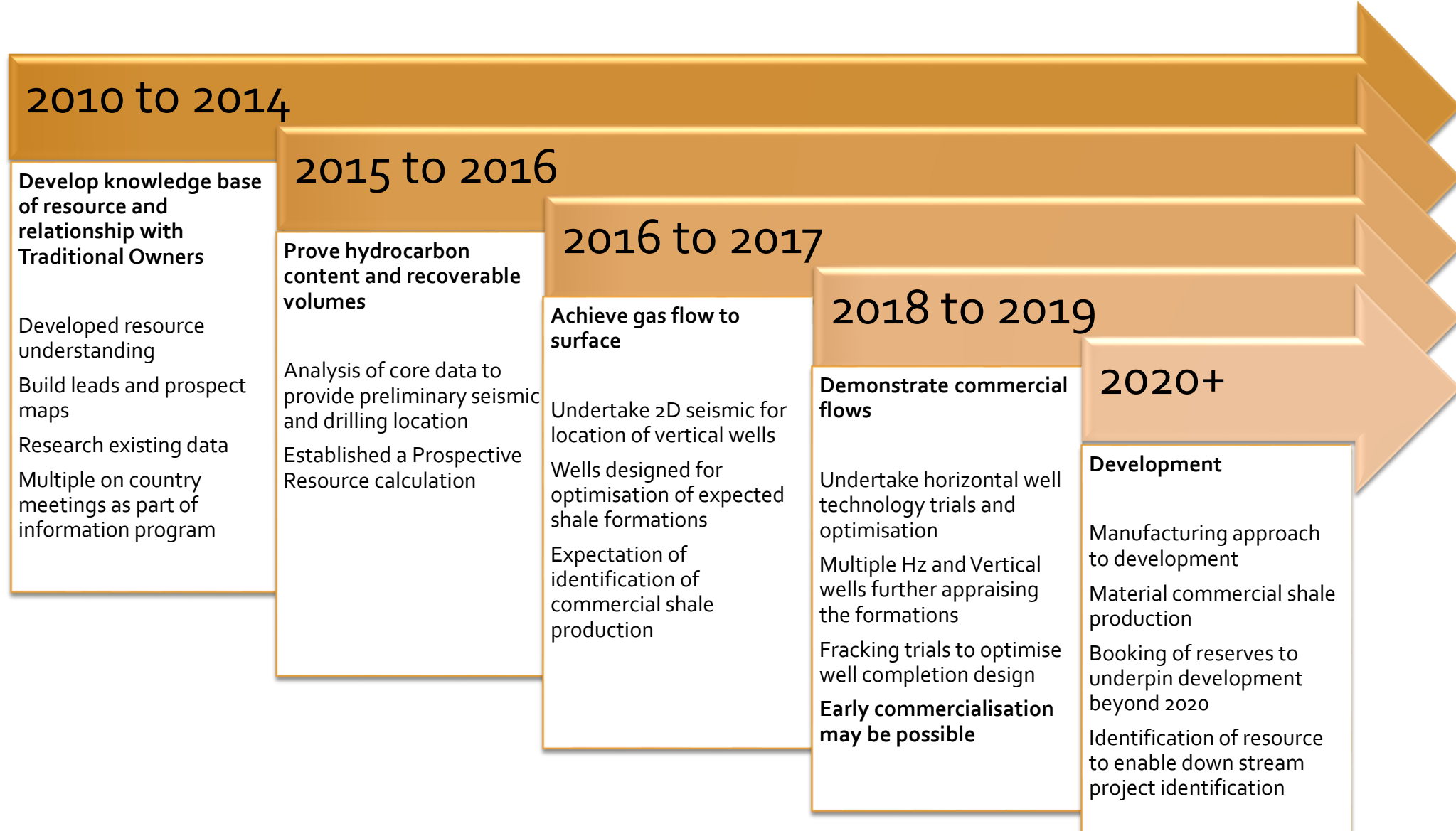
For the NT to take advantage of the current shut-down in global energy capital - exploration must continue now or be forever a lost opportunity – 1 year now lost

Darwin LNG Gas Shortfall – Onshore Beneficiaries

- Tremendous accumulations of onshore shale gas. >240Tcf of recoverable gas in McArthur Basin (ref: Deloitte)
- The Bayu-Undan field supplying ConocoPhillips (“COP”) Darwin LNG plant is expected to start running short of gas in 2017, exhausted 2022
- Onshore development **must** commence now for COP supply
- COP plant has option to expand from 0.5Bcf/d to 1.4Bcf/d
- INPEX Ichthys plant has option to expand from 1.2Bcf/d to 3.6Bcf/d
- Significant job opportunities
 - Large capital expenditure would continue in Darwin
 - Significant long term jobs and business development in regional fields
 - Assist in the decarbonisation of Asian neighbours

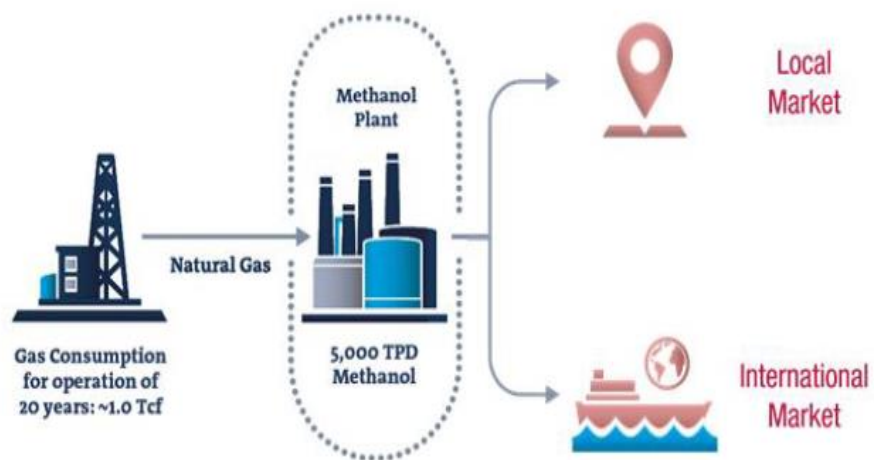


But - Long Lead Times to Shale Gas Production



Leads to - Shale Gas Methanol Plant/s (Darwin/Nhulunbuy)?

FERROSTAAL TOPSOE⁽¹⁾ PROJECTS



© Copyright Ferrostaal 2015

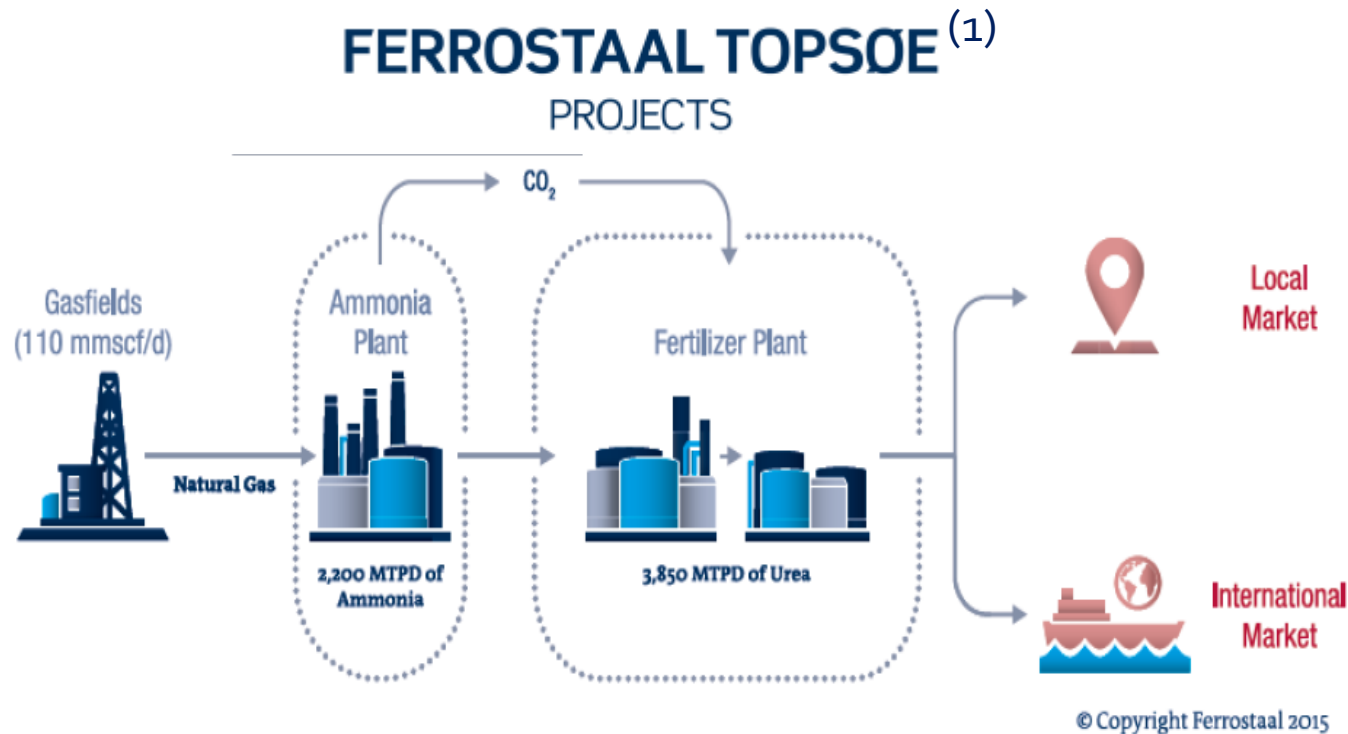
| | Production Capacity | Required Gas Reserve (estimated for 20 yrs of operation) | Required Gas Flow |
|----------|---------------------|--|-------------------|
| Methanol | 5,000 tpd | 1.0 Tcf | 150 mmscfd |
| Methanol | 3,000 tpd | 0.7 Tcf | 110 mmscfd |

Imperial prospective resource EP 187 >1.7 Tcf

- Process design adapted to local natural gas composition
- Petrochemicals need very economically produced natural gas. Onshore gas should achieve this benchmark
- Project realisation
 - Gas allocation to FID: 18-24 mths
 - EPC to operation: 3 to 4 years
- Capital Cost ~\$1bn for 3,000 tpd
- Project funding should be available
- Process Plant plot ~400m x 250m
- 3,000 tpd plant creates 200 – 300 direct permanent jobs + ~3 times as many indirect jobs

⁽¹⁾ Content is provided by courtesy of Ferrostaal Topsoe Projects GmbH, refer page 35 for detail

And - Shale Gas Ammonia/Urea Plant/s (Darwin/Nhulunbuy/Katherine)?



| | 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 |

Imperial prospective resource EP 187 >1.7 Tcf

- Process design adapted to local natural gas composition
- Petrochemicals need economically produced natural gas. Onshore gas should achieve this benchmark
- **Fertilizer for NT agricultural growth**
- Project realisation
 - Gas allocation to FID: 18-24 mths
 - EPC to operation: 3 to 4 years
- Capital Cost ~\$1.4bn for 3,850 tpd
- Project funding should be available
- Process Plant plot ~760m x 450m
- 3,850 tpd Urea plant would create 350 – 400 direct permanent jobs + ~3 times as many indirect jobs.

⁽¹⁾ Content is provided by courtesy of Ferrostaal Topsoe Projects GmbH, refer page 35 for detail

Generates Huge Potential – when a gas resource is defined

- **Project Development** – from gas allocation to FID - 18 to 24 months
- **Realisation** – from start EPC contract to commercialisation +3 years
- **Investment Cost** – project dependent, 3,000tpd methanol plant US\$800-\$1,200 million
- **Funding** - If Ferrostaal lead developer, subject to project feasibility, they would arrange funding/project finance
- **Markets** – South East/North East Asia
- **Plant Location** -
 - Brown field more attractive than green field
 - Close to deep water port
 - Infrastructure needed
 - Special economic zone conditions
 - Government support, title, approvals, incentives etc
 - Availability of labour and supplies
- **Example to left** - Trinidad project reference is provided by Ferrostaal GmbH



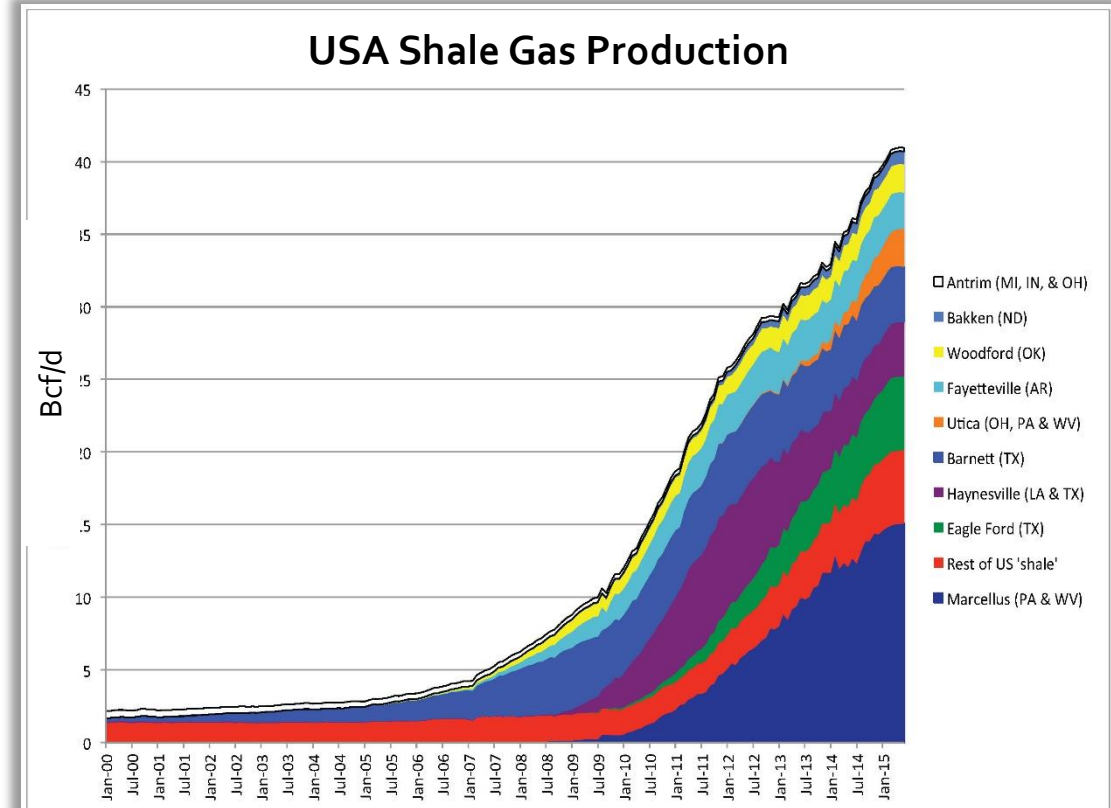
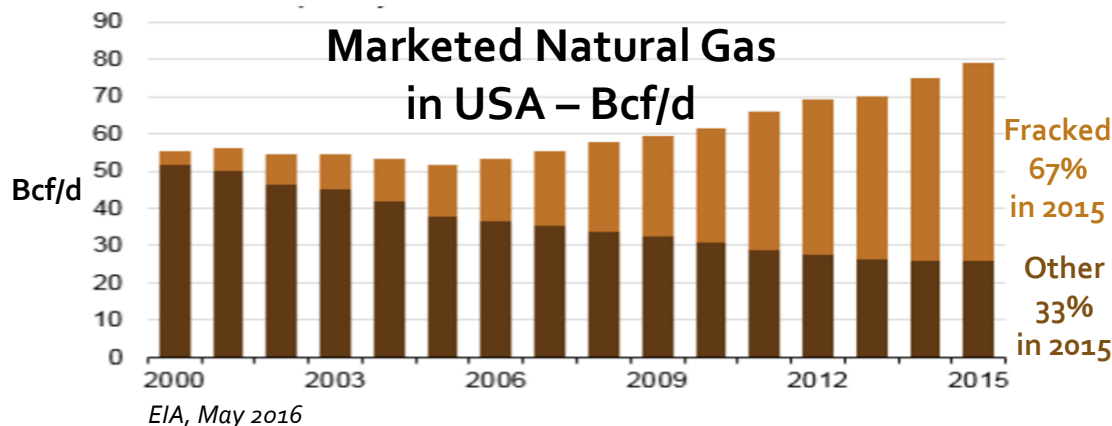
Australia for all Australians – not the vocal minority?

"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"

Shale Gas – Australian development can parallel the transformation of the USA economy

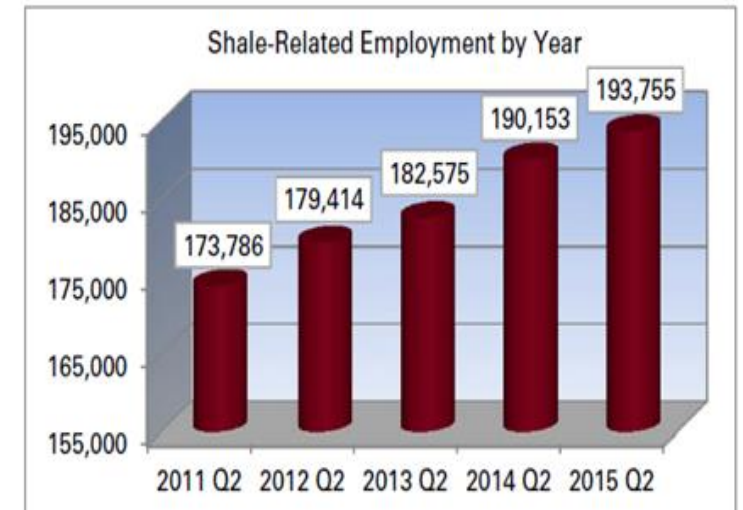
- Australian infrastructure is lacking
- USA technology available to take advantage
- Australian shale gas will not be as cheap as in USA
- Leading practices and a transparent regulatory systems will minimise impact
- High quality baseline surveys and monitoring
- Effort by all stakeholders to ensure shale gas resources can be effectively managed



- From 2010 to 2016 natural gas prices in the USA have dropped from \$10/mcf to ~\$2.00/mcf
- Shale now provides +67% of USA gas
- Shale gas is rapidly replacing coal for electricity generation

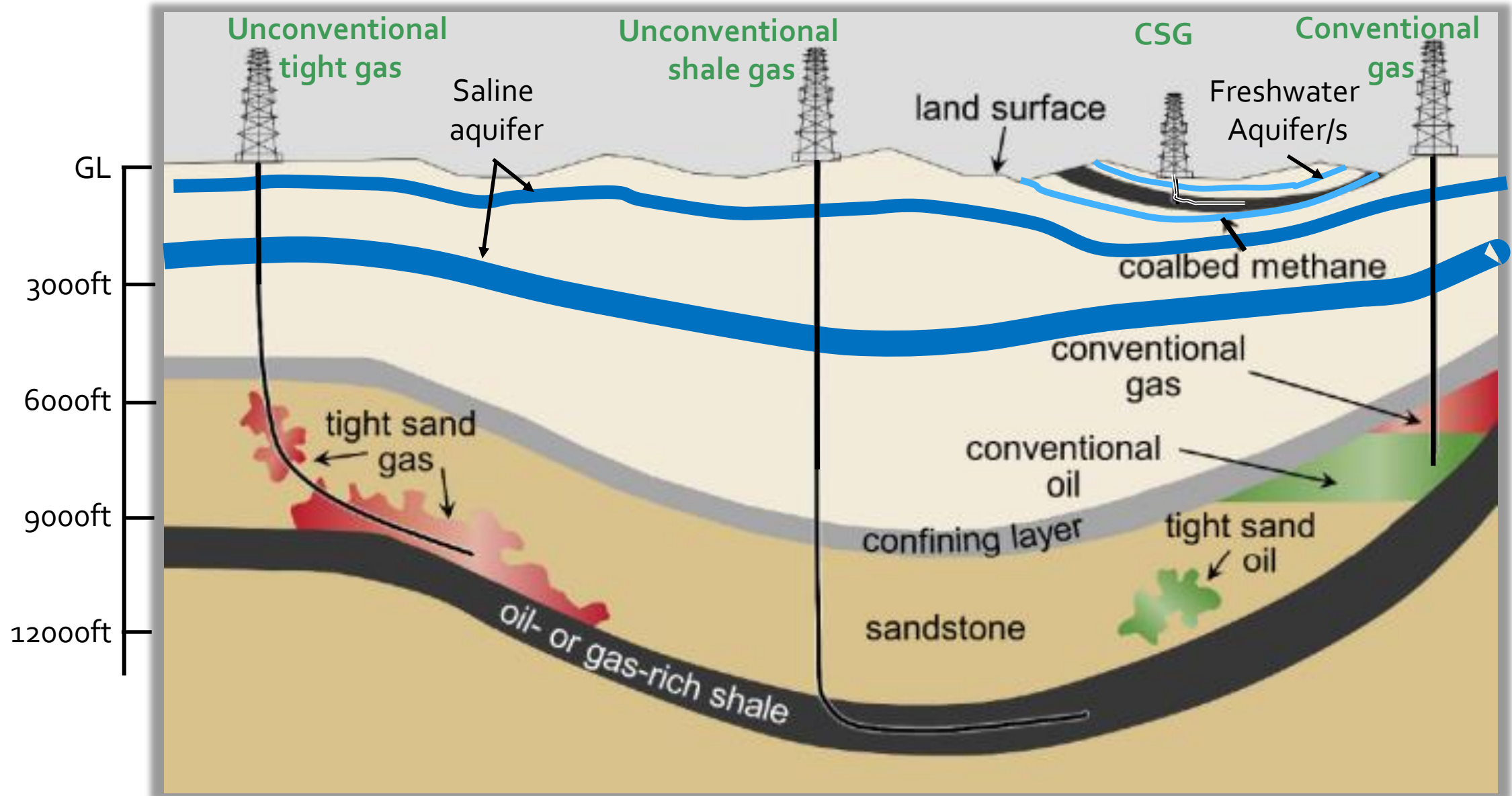
Example of Job Creation – Ohio, USA⁽¹⁾

- A 'rust belt' USA State with little new employment until ~2010
- From 2011, shale created an average of 183,000 jobs per annum
- Boosted ancillary shale-related industry adding thousands of additional jobs (~30 identified industries)
- Shale Counties saw a 66% decline in unemployment from 2010
- Shale jobs pay on average 38% more than other jobs
- Economic stimulus, brings more tax revenue, one County experienced tax revenue increase of +340% in 4 years (USA Counties do not receive royalties)

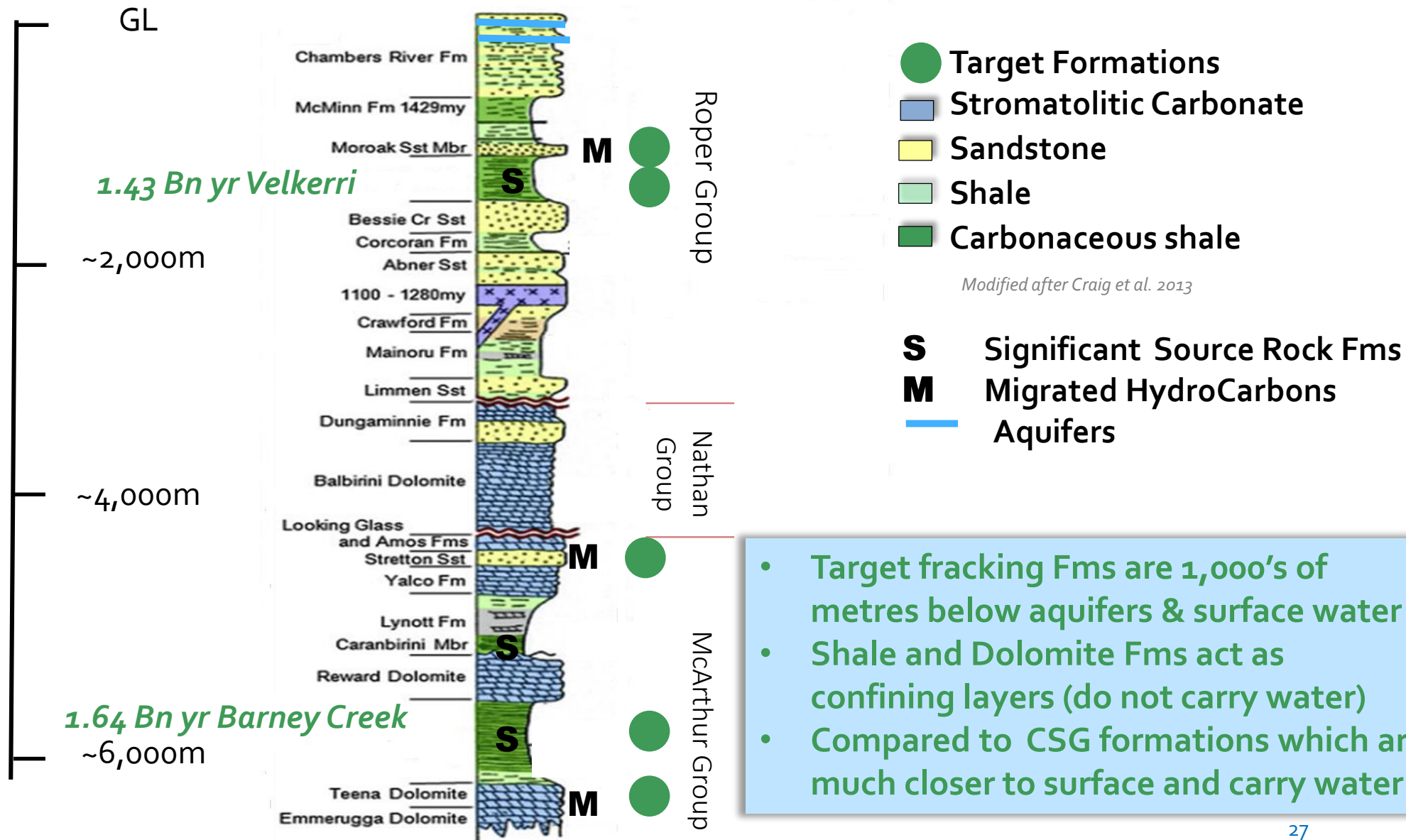


(1) Ohio Sees 96 Percent Increase in Oil and Gas Jobs - Energy In Depth, Ohio, Feb 23, 2016

Conventional VS Unconventional Gas

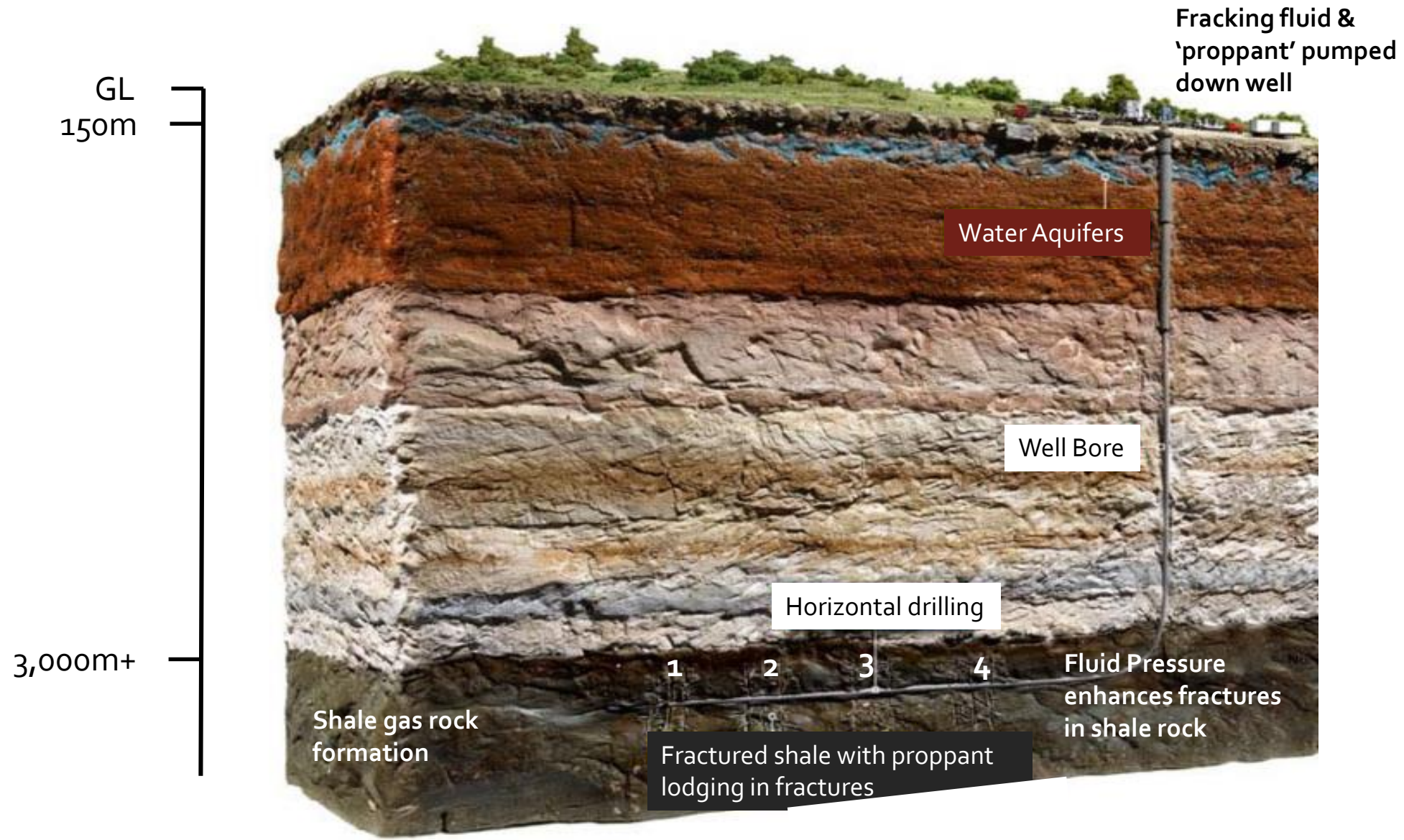


McArthur Basin Formations – why shale fracking is safe

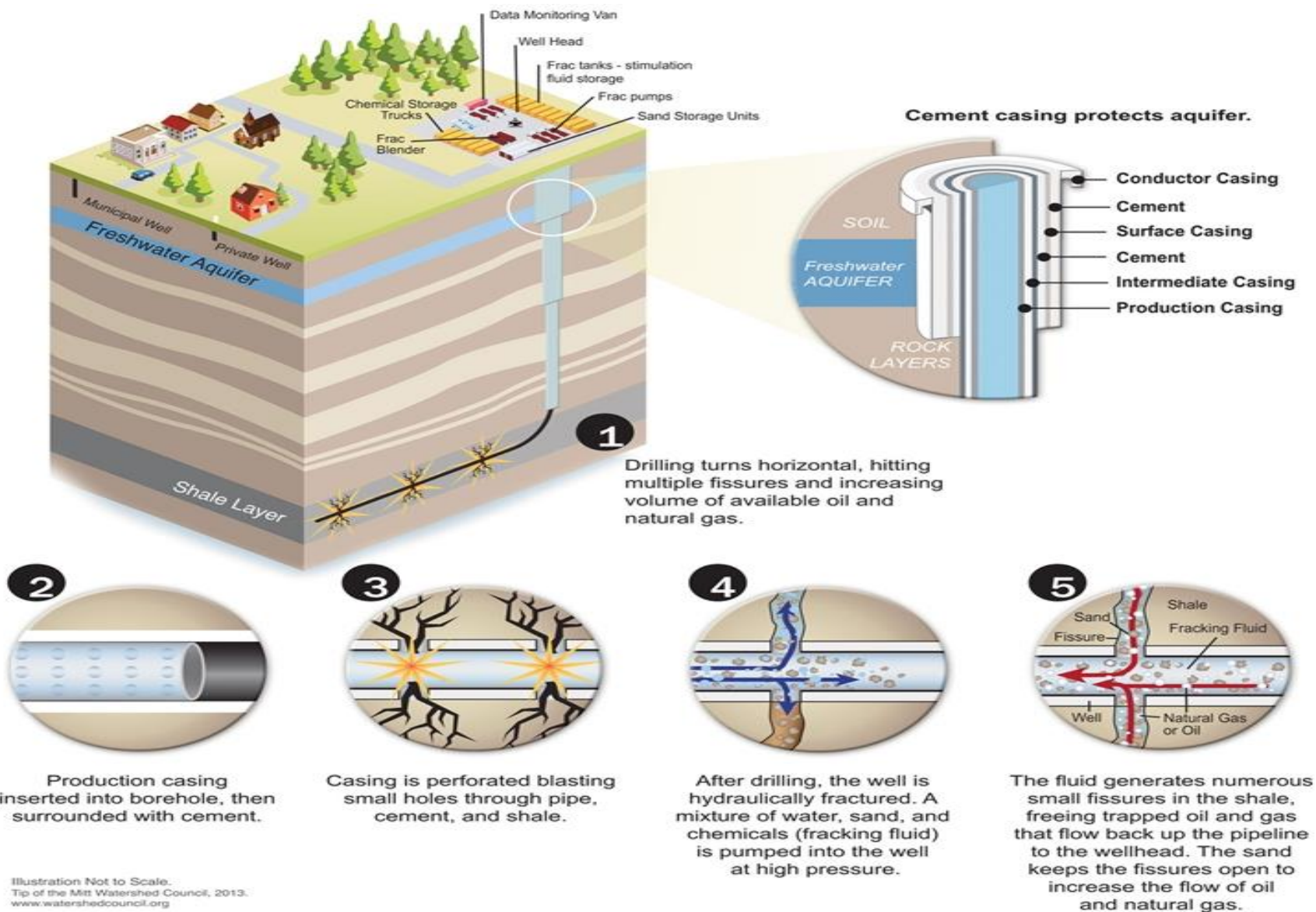


- Target fracking Fms are 1,000's of metres below aquifers & surface water
- Shale and Dolomite Fms act as confining layers (do not carry water)
- Compared to CSG formations which are much closer to surface and carry water

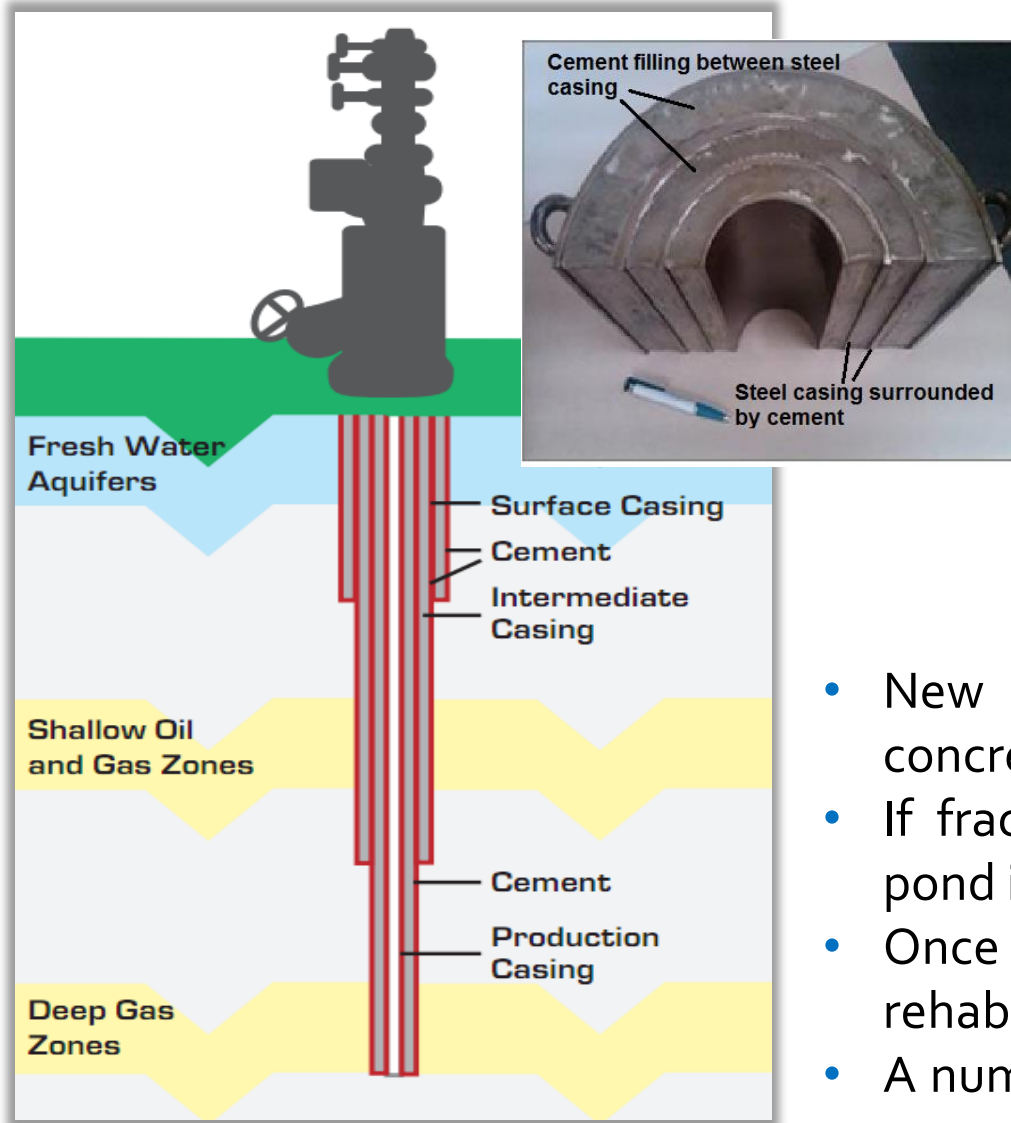
Fracking a Horizontal Shale Well



Detail of Shale Well Fracking.....

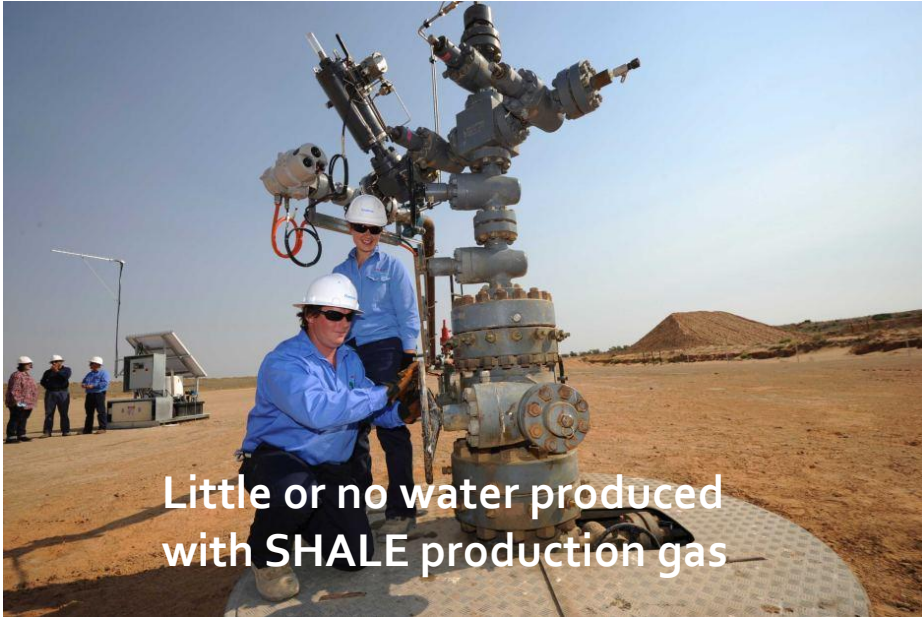


Aquifer & Water Control, Management & Containment



- New well casing consists of several layers of steel and concrete through fresh water aquifer formations (see left)
- If fracking tanks are not available, a temporary fully lined pond is constructed for use during the drilling/fracking stage
- Once the shale well is in production the pond will be rehabilitated
- A number of wells would be drilled from one pad utilising the same pond

Shale Production



Little or no water produced with SHALE production gas

Santos shale gas well head at the Moomba field, SA

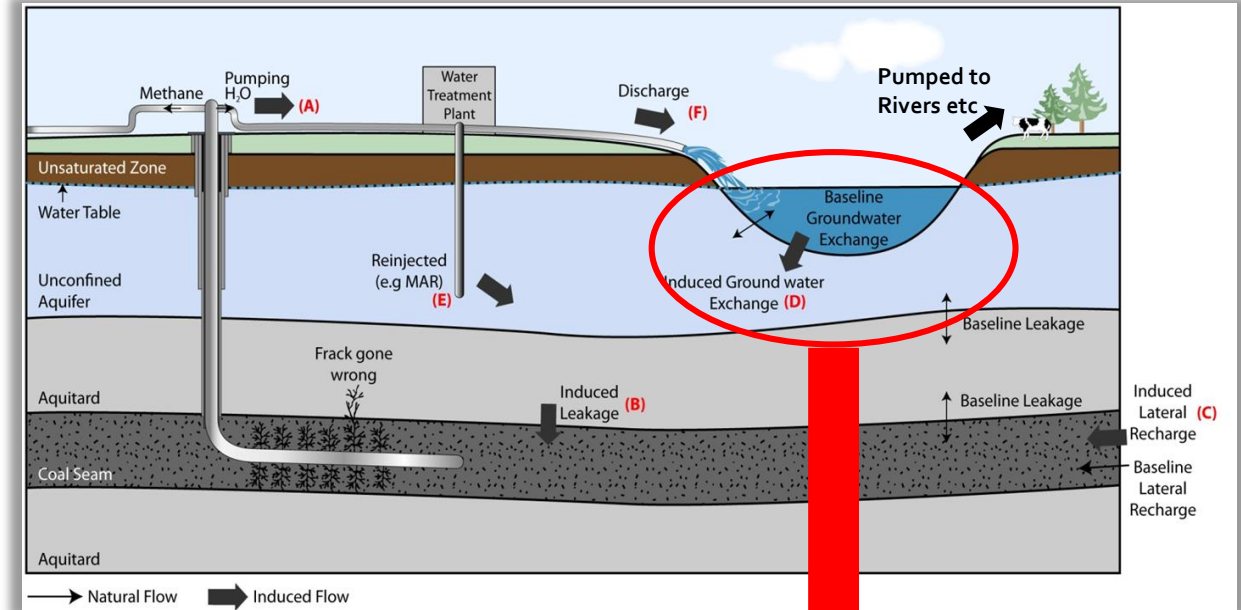
- In summary, shale gas producers:.....
- do not want water coming into wells due to cost of extracting and disposing, so quality casing & cement jobs
- know upward hydraulic gradients will only typically take place during fracking (too brief to achieve solute transport over vertical intervals of a km), thereafter depressurization of wells to allow gas to flow will result in downward hydraulic gradients being maintained for many years.

The anti-fracking propositions are unsupportable

Refer to: Paul L Younger, Uni of Glasgow, Jan 21, 2016 "How can we be sure fracking will not pollute aquifers

VS

CSG Production



Large quantities of water produced with CSG production gas

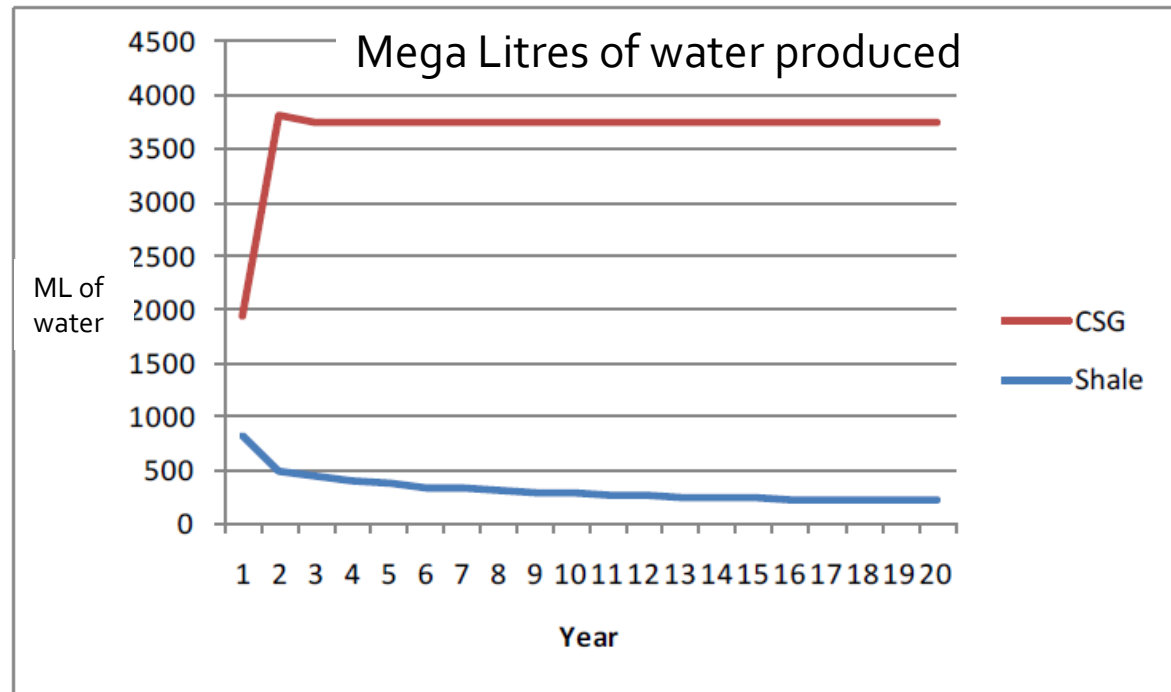
Shale Gas ("Shale")

VS

Coal Seam Gas ("CSG")



- Fracking used in tight rock formations (dolomites, shales etc) to release the hydrocarbons
- NIL or MINIMAL water production in extracting gas from shale (see below)



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

- Found in coal seams
- Methane is bonded to the coal and trapped by water pressure
- CSG wells need to be dewatered to allow gas to flow
- High potential of ecological issues when dewatering CSG wells due to water storage and disposal, etc
- Fracking does not need to be used in all CSG wells, as dependent on water pressure
- **LARGE QUANTITIES** of water production in extracting gas from CSG (see left)
- **ECOLOGICAL ISSUES** of what to do with the water - can it be diverted to rivers, cleaned or utilised in other ways?
- **BY PRODUCTS** of salt/sulphur residue may occur in significant quantities

Planning of Drilling Program

- Preliminary Planning
 - Site selection for drilling pad
 - Where possible, sites to be close to existing roadways, or, where pastoralists want new roads
 - Cultural Clearance from land owners
 - Clearance from pastoralists
 - Dimensions of drilling pad and camp to be kept to a minimum
 - Continuing services supply to site over 45 days
 - Continuous communication with land owners and affected parties

Mobilisation of Rig

- Mobilisation of Plant & Equipment
 - Co-ordinated in accordance with move plan to ensure
 - Safe operating procedures
 - Specific routes
 - Executed in accordance with land access agreements
 - Induction process to ensure all persons on site follow land access requirements
 - ~30 loads for rig setup and accommodation

Drill Site

- Small – typically less than 4 acres
- Largest piece of equipment - drill rig, generally 20-30m in height
- Ancillary equipment includes:
 - Fluid pumps and tanks, fuel storage, Drill rods, sample core, Accommodation

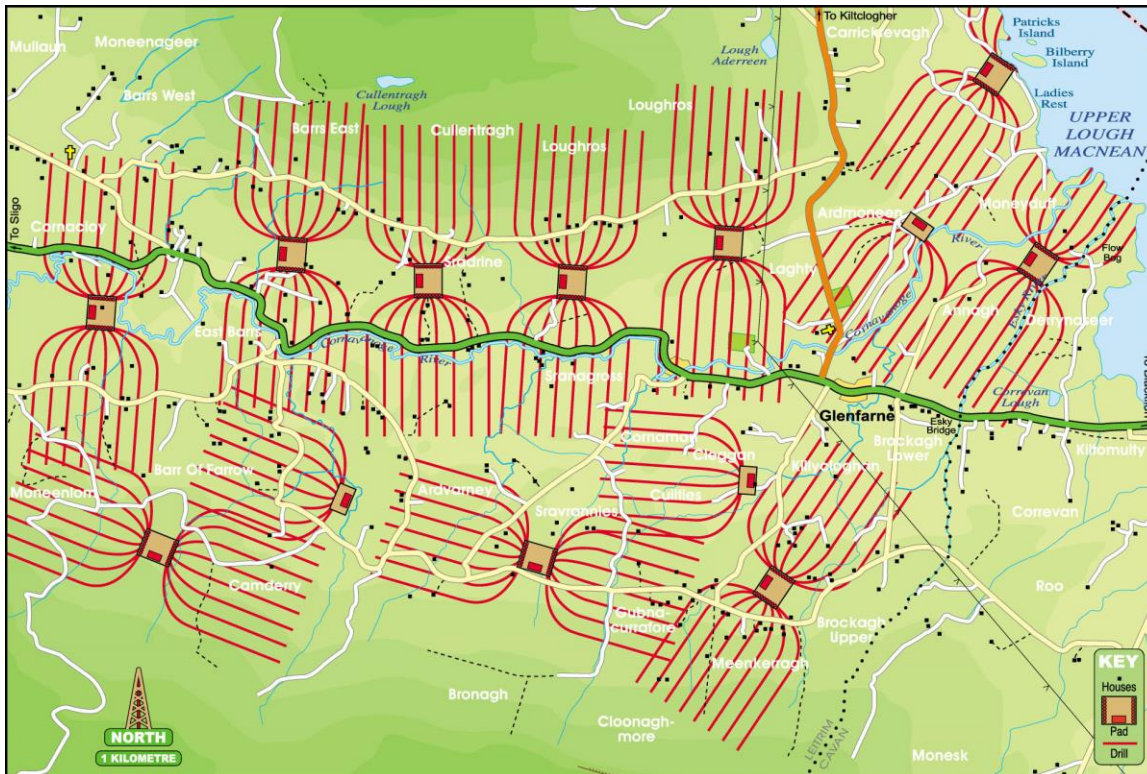


All equipment is removed when drilling is completed

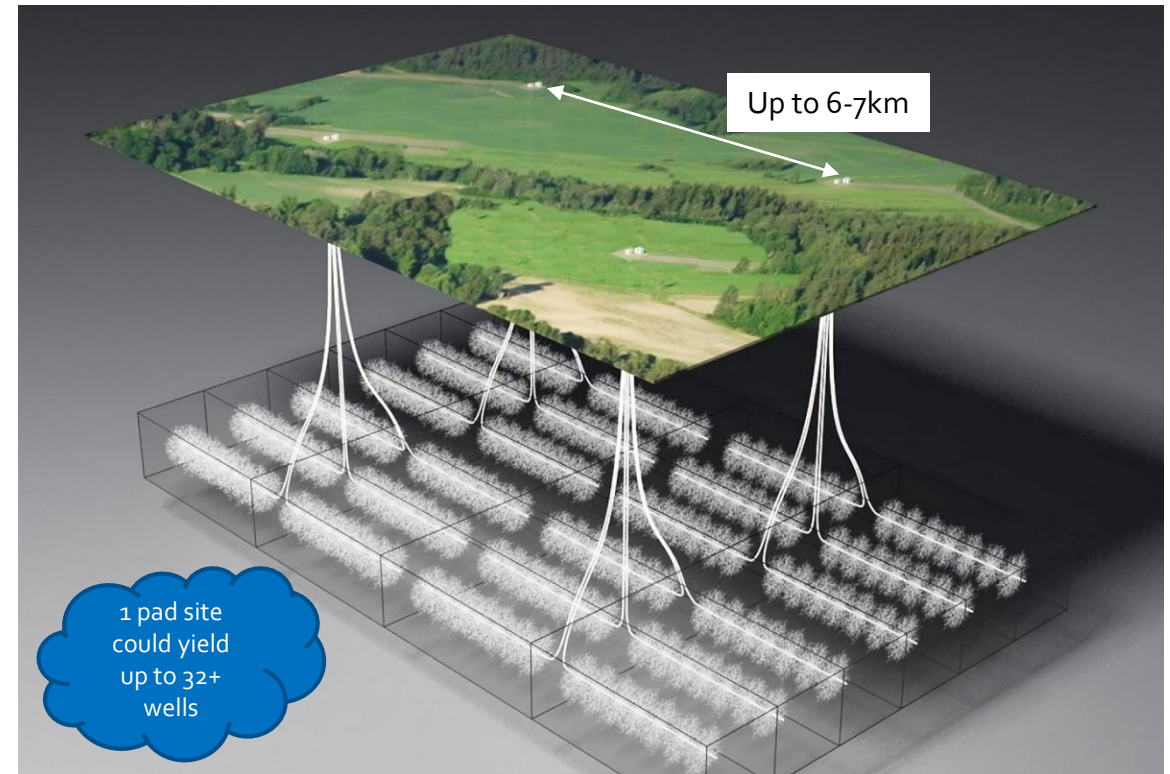
Drilling – multi shale wells from one platform

New technology and horizontal drilling ensures
minimal surface disturbance
Recently completed well in Ohio 5.6km in hz

In Plan



In 3D



Typical Horizontal Shale Well Frack



Source: Chesapeake Energy Corporation, 2008.

Notes: The yellow frac tanks in the foreground and along the tree line hold water, the red tanker holds proppant; hydraulic pumps are in the center.

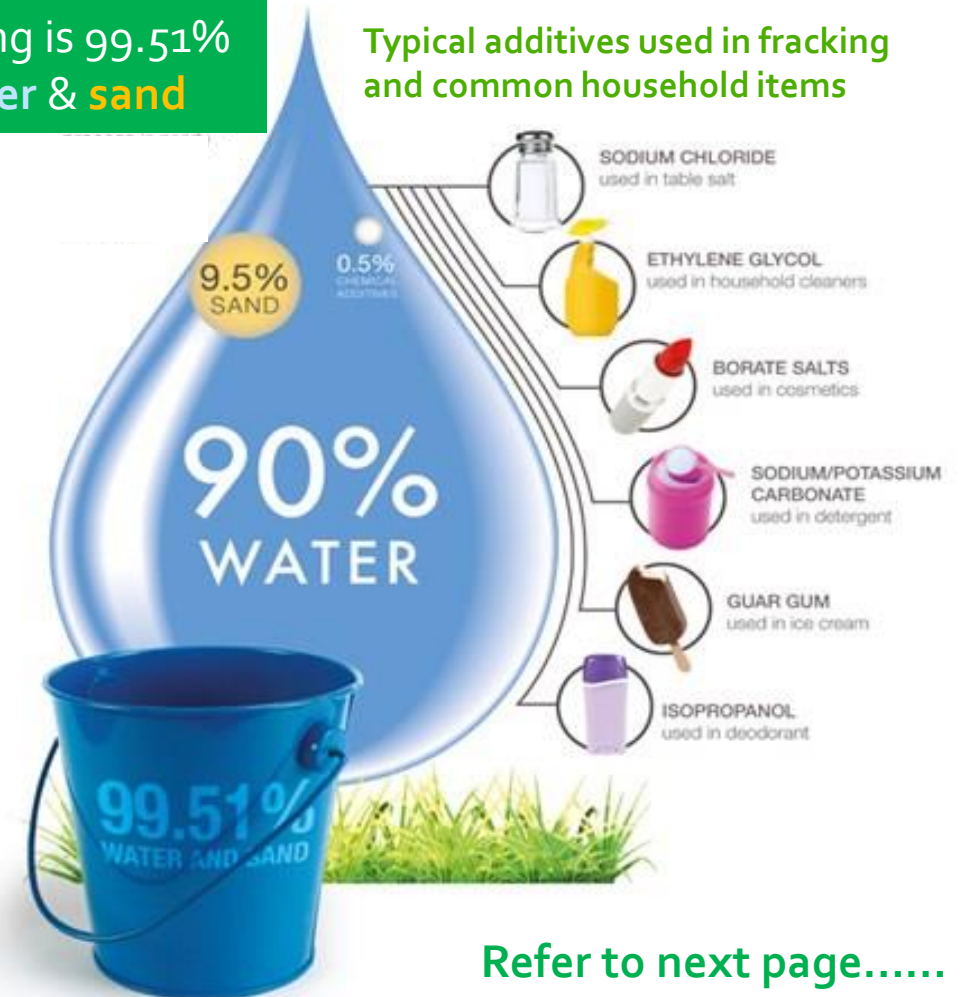
Shale Fracking

- Developed over +60 years
- Applied to ~2.5 million wells (+1,500 wells in Australia, 700 wells on Barrow Island – a “A” class nature reserve)
- **Global reviews - risks associated with fracking can be managed with a robust regulatory regime**
- The fracking process (used in petroleum, geothermal, water production) is essentially the same
- The controlled injection of frack fluid at high pressure into the rock to create or enhance small fractures which are then held open by the sand
- Up to 80% of the frack fluid (90% water) is extracted from the well and can be reused
- Water required for 1 well – approx. 8 swimming pools
- Multi-staged fracks undertaken to ensure adequate pressure is maintained over length of horizontal

Understanding Fracking Fluid

The fluid used in fracking is 99.51% water & sand

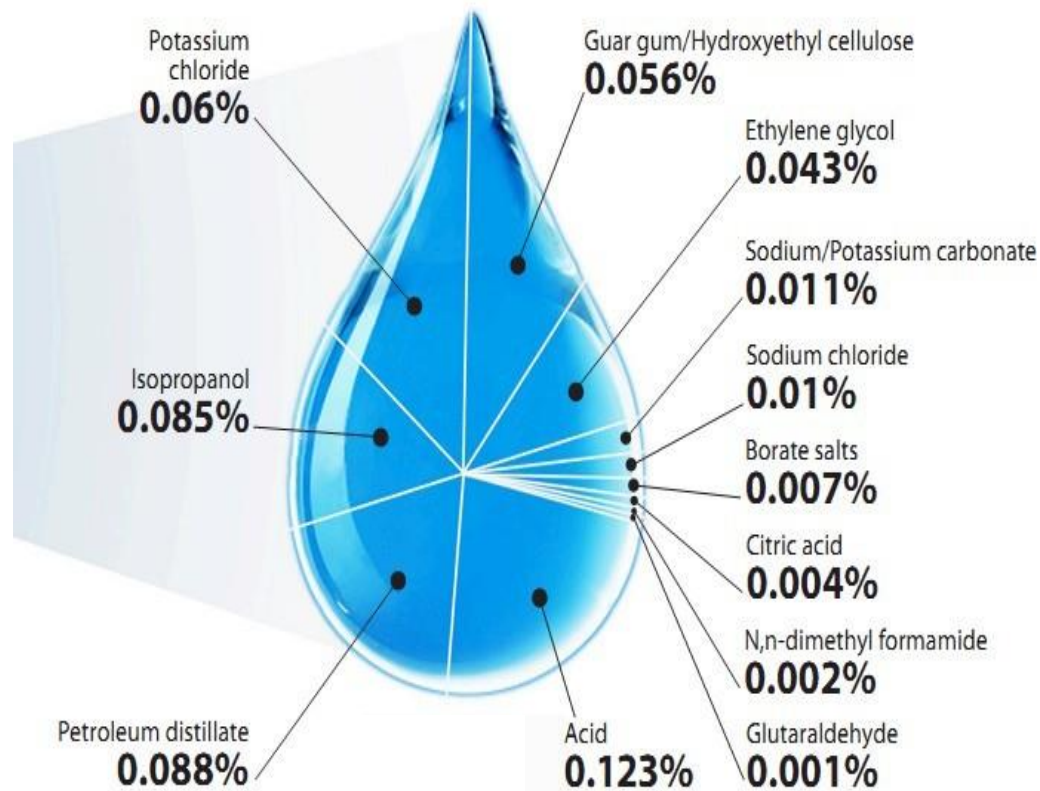
Typical additives used in fracking and common household items



Refer to next page.....

Shale Fracking Fluid in detail.....

Additives are disclosed....



= 0.49% of fracking fluid

| Compound | % | Purpose | Common Application | Used in Convent Wells ⁽¹⁾ |
|-------------------------------|--------|---|--|--------------------------------------|
| Acids | 0.123% | Helps dissolve minerals and initiate fissure in rock (pre-fracture) | Swimming pool cleaner | ✓ |
| Glutaraldehyde | 0.001% | Eliminates bacteria in the water | Disinfectant, sterilizer for medical equipment | ✓ |
| Sodium Chloride | 0.01% | Allows a delayed breakdown of gel polymer chains | Table salt | ✓ |
| N,n-dimethyl formamide | 0.002% | Prevents the corrosion of the pipe | Pharmaceuticals, acrylic fibers, plastics | ✓ |
| Borate Salts | 0.007% | Maintains fluid viscosity as temperature increases | Laundry detergents, hand soaps and cosmetics | ✓ |
| Polyacrylamide | | Minimizes friction between fluid and pipe | Water treatment, soil conditioner | ✓ |
| Petroleum distillates | 0.088% | "Slicks" the water to minimize friction | Make-up remover and candy | ✓ |
| Guar gum | 0.056% | Thickens the water to suspend the sand | Cosmetics, baked goods, ice cream, toothpaste, sauces | ✓ |
| Citric Acid | 0.004% | Prevents precipitation of metal oxides | Food additives, beverages, lemon juice | ✓ |
| Potassium chloride | 0.06% | Creates a carrier fluid | Table salt substitute | ✓ |
| Ammonium bisulfite | 0.005% | Removes oxygen from the water to protect the pipe from corrosion | Cosmetics, food and beverage processing, water treatment | ✓ |
| Sodium or potassium carbonate | 0.011% | Maintains the effectiveness of other components | Washing soda, detergents, soap, water softener, glass | ✓ |
| Proppant/Sand | | Allows the fissures to remain open so gas can escape | Drinking water filtration, play sand | ✓ |
| Ethylene glycol | 0.043% | Prevents scale deposits in the pipe | Automotive antifreeze, household cleaners | ✓ |
| Isopropanol | 0.085% | Increases the viscosity of fracture fluid | Glass cleaner, antiperspirant and hair color | ✓ |

⁽¹⁾ Same compounds are used in conventional wells

Well Construction/Decommissioning

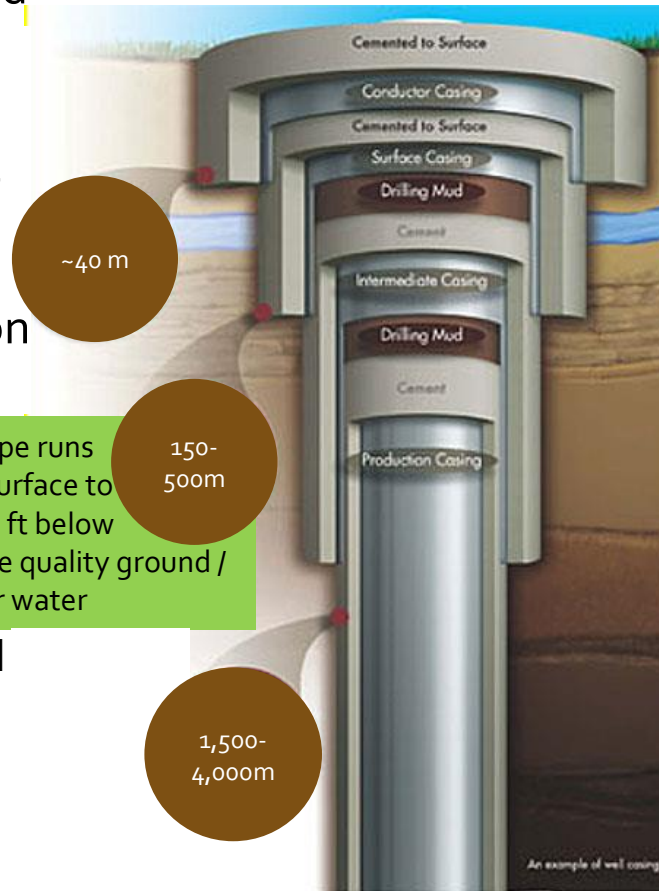
• New Wells

- Designed to acquire data, then be safely commissioned
- Casing and cement isolate borehole from aquifers
- Pressure control equipment to manage any gas influx
- Anticipated duration from start of drilling to completion of a production well is 45 days

• Decommissioning

- Lower section and aquifer section fully cemented with cement plugs
- Casing cut off below surface, cemented and buried
- Site remediated
- No remaining visibility of a decommissioned well

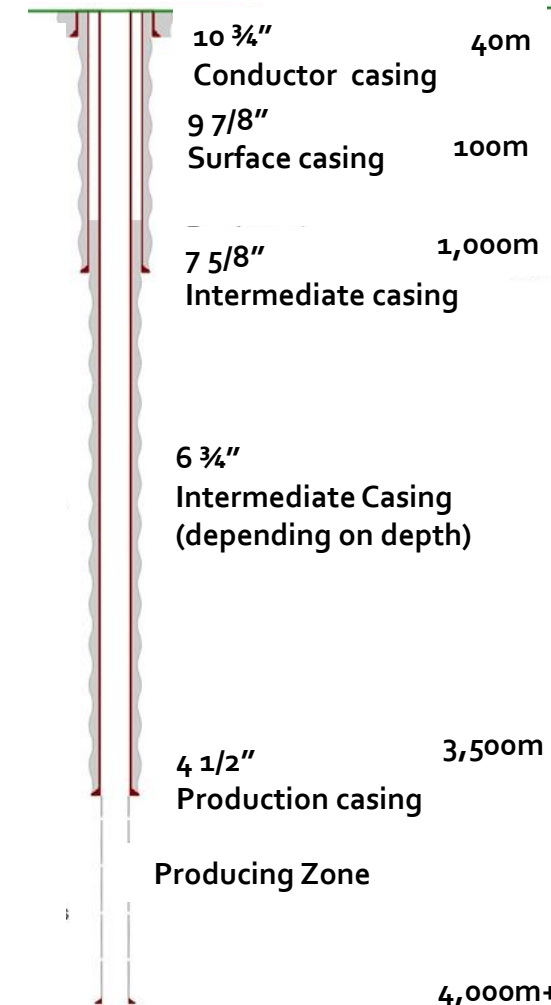
Typical well casing



phic Courtesy of Texas Oil and Gas Association

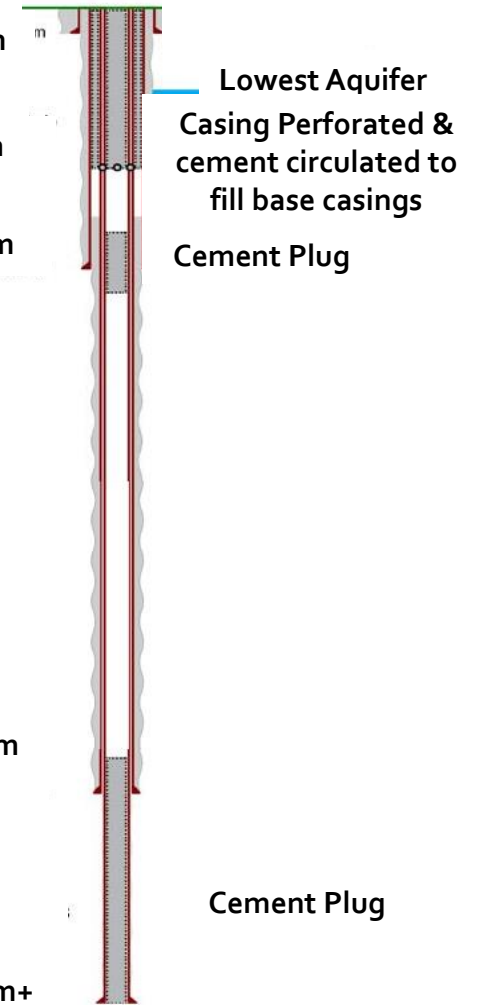
Well Construction

(Possible sizes and depths only)



Decommissioned Well

(Possible sizes and depths only)



Shale Gas Well Production



Well Plugged & Abandoned



Commencement of Development Program

• Employment - Exploration Phase

- Expertise.....
 - Geologists, engineers, environmental scientists, health & safety professionals
 - Drilling Contractor – drill rig crew
- Local opportunities
 - Location and road building
 - Ongoing road maintenance
 - Services to drilling and production crews
 - Water and equipment transportation

• Investment - Long term Development

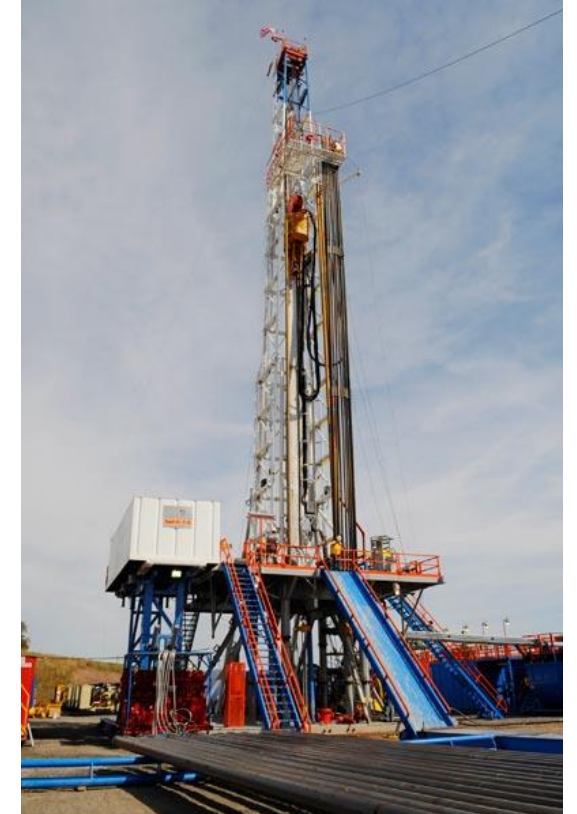
- Opportunities to develop local/national skills and expertise
- Industry and company initiatives
 - Long term sustainable
 - Downstream projects (see later sections)

• Community - Trust & Respect

- Gaining & retaining the social licence to operate
- Transparent approach to data collection
- Dialogue beyond economics or profit to how shale gas development might address other societal priorities eg improvement of infrastructure, educational and other community infrastructure
- In Native Title and Aboriginal Lands ensure scale and impact of development is understood
- Employment creation and development of local economic infrastructure
- Ongoing health and safety assessment plans

Development Operations

- **Scope** - McArthur/Beetaloo Basins:
 - sparsely populated
 - ideal for controlled development
 - ongoing co-existence programs
 - development of infrastructure for regional community & pastoralists
- **Opportunity** - many Traditional Owners see this as:
 - Increased regional employment opportunities
 - the provision of long term economic security to communities
- **Safe** – shale fracking thoroughly researched in Aust. & USA (refer p 43)
- **Reliance** - the many shale fracking reports show that.....



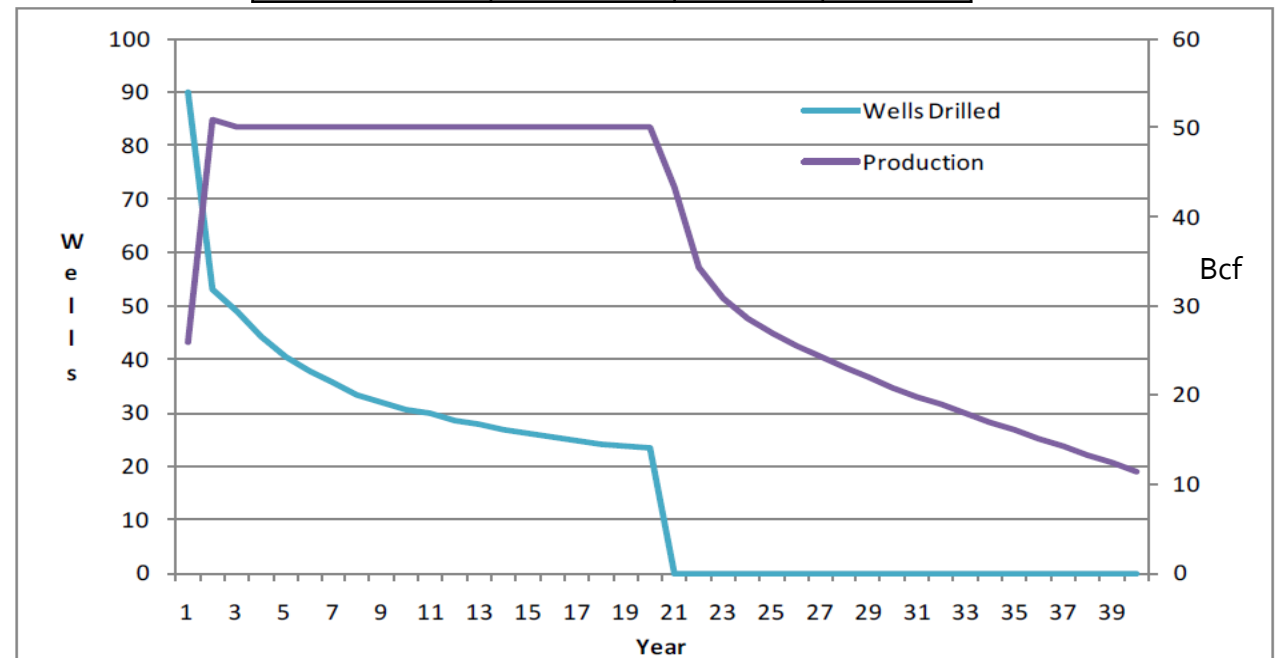
**Exploration and fracking managed correctly,
accrues substantial direct benefits to all stakeholders**

The NT Development Program

- Once commercial objectives established and assume 50 bcf pa over +20 years then a development will require:
 - 90 new wells in year 1 then decreases as shown
 - 15 new drill pads
 - 220km of 'new' roads
 - Gathering pipelines
 - 1,000 ML of frack water (3mm gallons/well)
 - Water holding ponds (construction & decommissioning)
- It will also need:
 - 50 Bcf of processing capacity
 - 10 to 15 MW of compression capacity
 - Drilling & Completion personal
 - Operational staff
 - Servicing staff
 - Maintenance staff (wells sites/ road ways)
 - Mid-Stream & Down-stream staff

Shale Production - Jobs

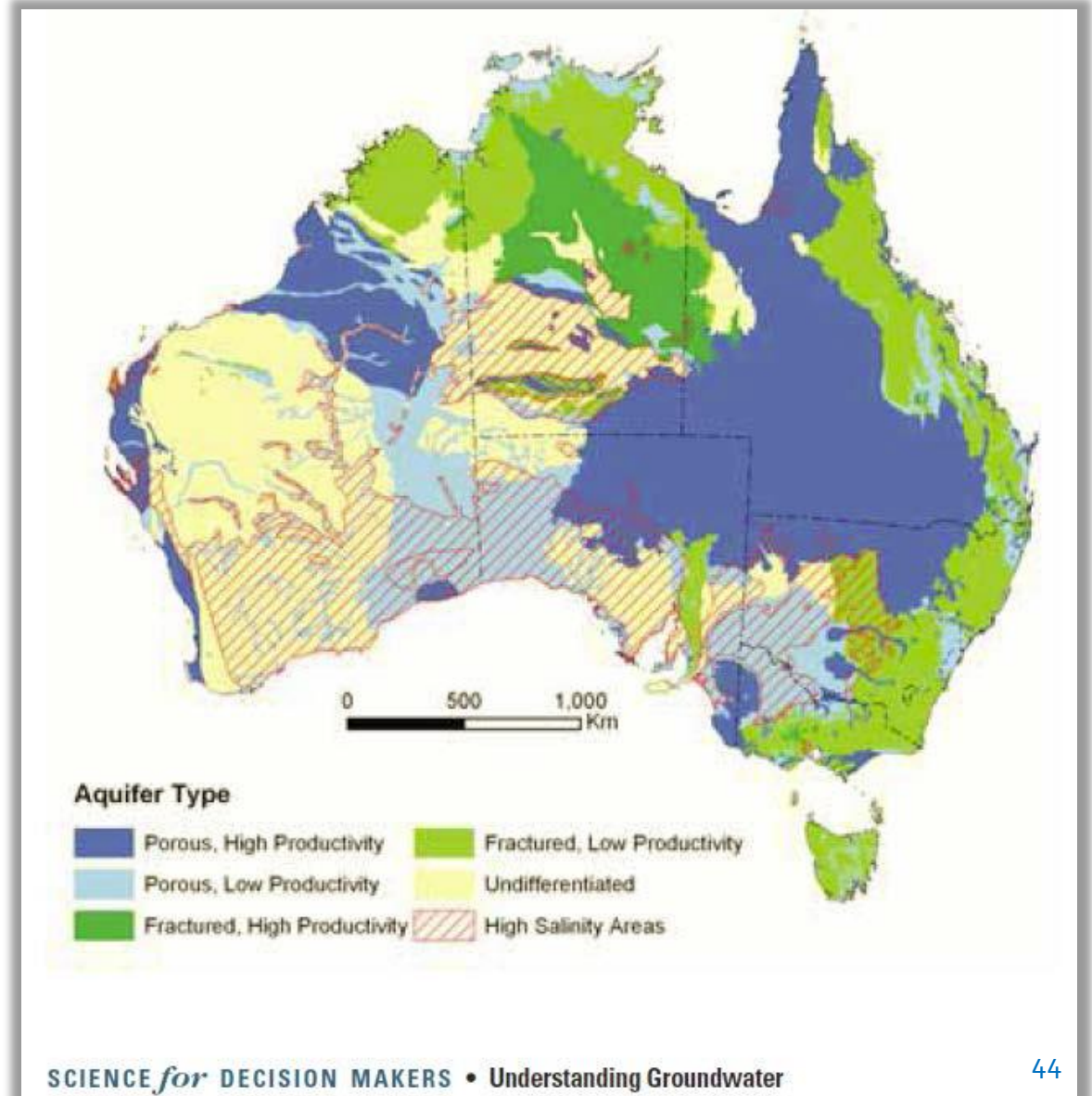
| Element | Per Rig | # of Rigs | Total Jobs |
|--------------------------|---------|-----------|------------|
| Drilling | 28 | 5 | 140 |
| Completion | 14 | 1 | 14 |
| Fracking | 59 | 2 | 118 |
| Other drilling | 10 | 1 | 10 |
| Processing | | | 168 |
| Mgt, Admin, TO, Geo, HSE | | | 50 |
| Total Jobs | | | 500 |



Water Management

- Water Supply & Storage ~50 bcf pa
 - Requires approx. 1,000 ML in year 1
 - Declines to 500 ML by year 4
 - 350 ML by year 10
- Water can be supplied from:
 - Surface & rivers
 - Groundwater
 - Aquifers
 - Recycling
- Fracking techniques can be adopted to utilise available water supply
- Water in NT is widely available by water harvesting from the wet season
- Water for 1 well approx. 8 swimming pools
- 70% to 80% of the frack fluid can be reused (the remainder slowly recovered from the well)
- Water monitoring bores drilled can be transferred to an used by pastoralists for water

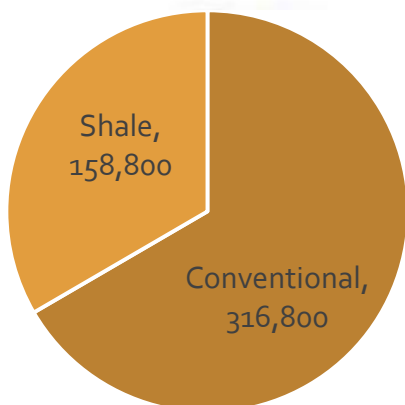
Artesian Basins



Australia's Vast Gas Resources

~1,150Tcf from conventional and unconventional resources

Western Australia
Est. Resource Potential ^{1,2}



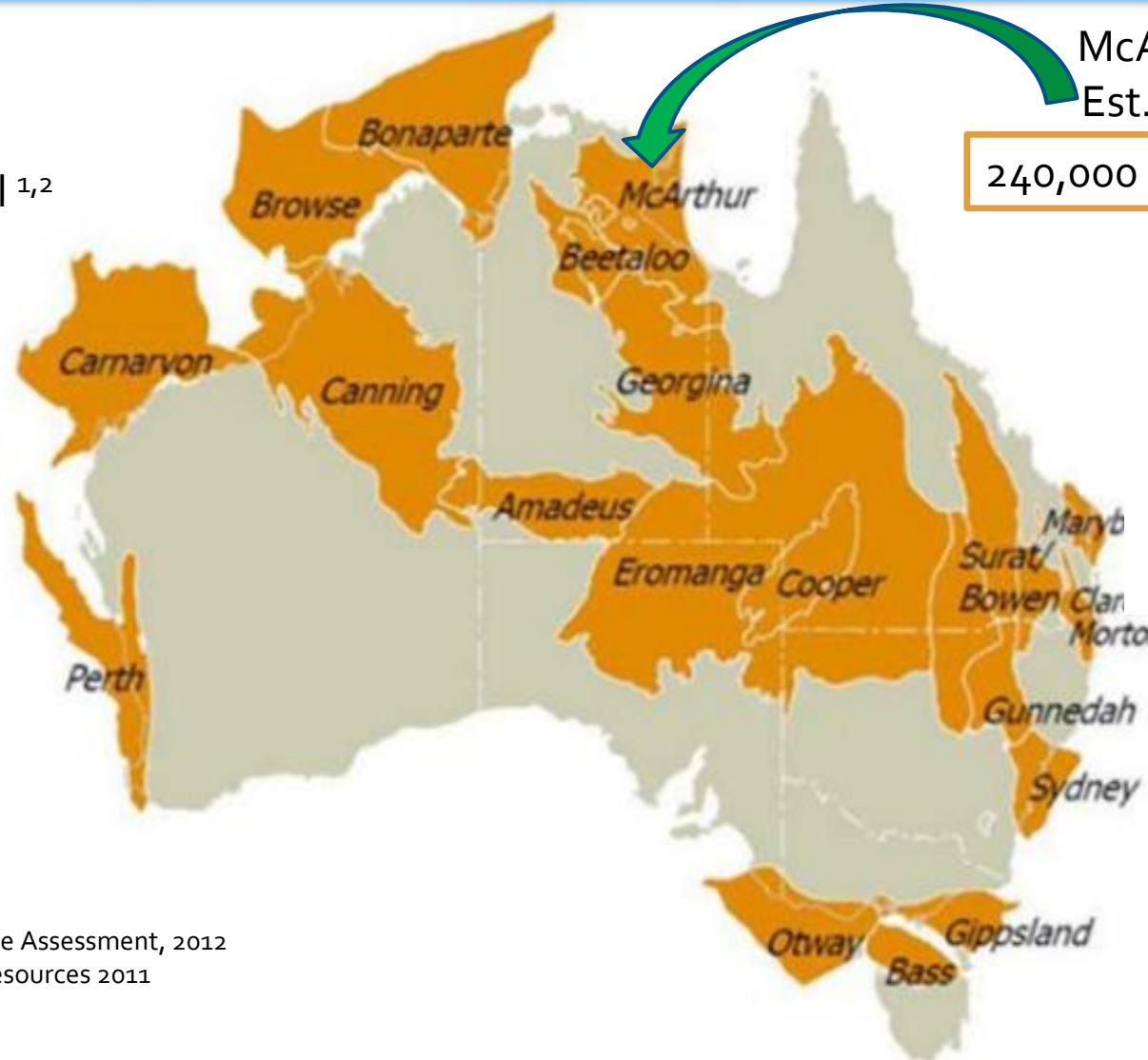
475,600 Bcf

¹, Source: BREE 2012 Gas Resource Assessment, 2012

², Source: EIA World Shale Gas Resources 2011

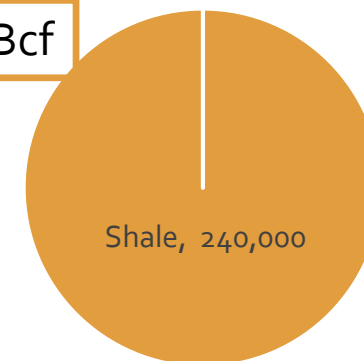
³, Source: AEMO 2012 GSOO

⁴, Deloitte 2014

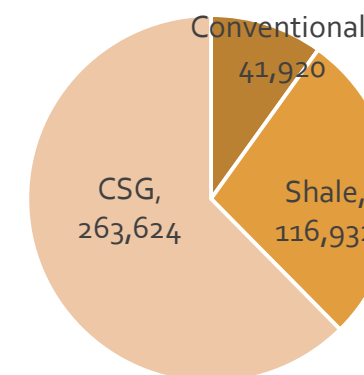


McArthur/Beetaloo only
Est. Resource Potential⁴

240,000 Bcf



Eastern Australia
Est Resource Potential ³



422,476 Bcf

The Importance of the Natural Gas

"The onshore gas industry's direct contribution to Queensland economy in 2014-15 was \$10.6 billion or 3% of Queensland's Gross State product"

"For key upstream gas economies, the industry's direct spending totalled \$1.5 billion with over 10,000 local businesses benefitting"

**Queensland Premier –
Annastacia Palaszczuk**

"To establish an export industry of this scale in such a short time frame is a credit to and importantly local business, communities and landholders"

".....LNG forms part of a burgeoning, long term export industry with associated flow-on benefits from on-going employment and opportunities at regional, state and national levels"

The future – on board or not?

BP: America's shale revolution to spread to world

BP predicts that America's shale revolution will pick up global troops each year to account for roughly a quarter of worldwide shale-gas output by 2035. As the rest of the world adopts the US' innovative gas-extraction technology to reap productivity gains, BP predicts a 5.6% uptick in global shale-gas output each year. The US alone will represent 20% of global output as BP expects shale gas production to continue to grow 4% each year.



BP's annual Energy Outlook anticipates that Asian

Shale-gas to account for a quarter of global output by 2035.

Pacific countries will become major contributors with output of 13 Bcf by 2035. In 2014, global shale-gas output represented 11% while over the last decade North American output has accounted for about two-thirds of the growth, according to the report. The desire for cleaner-burning fuel will be a large driver of increased gas output.

American gas will continue to enjoy a rapid ascent and remain an important global gas source, he said. BP group chief economist Spencer Dale noted that US gas output would grow at a faster clip than domestic tight oil, which BP expects to plateau at 8 MMbo/d in the 2030s. "The resources look far bigger based on current estimates, and so we see

US will continue growth, make up 20% of world supply.

rapid growth of US shale gas over the next 20 years, pretty much throughout that period of time."

PLS – PetroScout April 5, 2016.

The Northern Territory can be the financial engine for the Australian economy for decades into the future.

U.S. Chemical Industry Investment Linked To Shale Gas Tops \$164Bn

- The American Chemistry Council (ACC) today announced that U.S. chemical industry investment linked to plentiful and affordable natural gas and natural gas liquids (NGLs) from shale formations has reached \$164 billion. Forty percent of the investment for the 264 projects – new facilities, expansions and factory re-starts – is completed or underway, while 55 percent is in the planning phase.
- ACC analysis shows that \$164 billion in capital 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, including 69,000 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, which can help improve the U.S. trade balance.
- It's also important to ensure a timely, transparent and efficient regulatory permitting process for shale-related manufacturing projects such as new factories and expansions. Companies and state agencies need clarity and certainty about the process and timing for obtaining permits. Legislation introduced in the House last month would help fix longstanding problems with the implementation process for new air quality standards.

American Chemistry Council, Apr 6, 2016

What to learn from 'American Energy Partners, LP'

- *Background:*
 - A USA oil and natural gas operating and asset management company
 - Founded in 2013 by the late Aubrey K. McClendon, who created the USA's 2nd largest gas producer
 - Seeks to deliver industry-leading capabilities in developing and managing oil and natural gas assets
 - More than 150 employees and has raised over \$US\$14 billion in debt and equity commitments for unconventional resource development projects
- World leading unconventional resource development expertise
- Targeting cost effective horizontal drilling and post-frack production
- Optimised drilling & completion techniques
 - At forefront of latest USA technology
 - Proven perforating, fracturing, production and facility design strategies
 - Drilling techniques perfected in USA's largest fields - Fayetteville, Utica & Marcellus
- Value engineering
 - Experienced subsurface, operations team and executive management
 - Track record of success having '*cracked the code*' on multiple USA plays, now focused on NT



What to learn from 'Ferrostaal Topsoe Projects GmbH'

- *Background:*
 - 50/50 JV between Ferrostaal GmbH (German based industrial project developer) and Haldor Topsoe A/S (Danish based world leader in catalysis)
 - JV is serving petrochemical, refining & environment technology sectors
 - Focus and expertise in project development and facilitating investment
- Ferrostaal GmbH:
 - 85 years experience as industrial service provider
 - 2,700 employees in 40 countries
 - More than 1,000 successfully completed projects
- Haldor Topsoe A/S:
 - Private company operating for over 75 years
 - Market leader in heterogeneous catalysis
 - 2,800 employees in 11 countries
- Realisation of Major Projects – from JV for all project sector requirements
- Facilitating Investment – from project development to financial close



Contacts

Imperial Oil & Gas

7/151 Macquarie St

Sydney, NSW 2000, Australia

Phone: +61 2 9251 1846

Attention: Bruce McLeod

bm@empiregp.net

www.empireenergygroup.net