



# Shale Gas Exploration McArthur Basin Onshore Australia

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Director & Chief Executive Officer

16<sup>th</sup> Asia Oil Week Upstream Conference  
Singapore  
30<sup>th</sup> September 2011



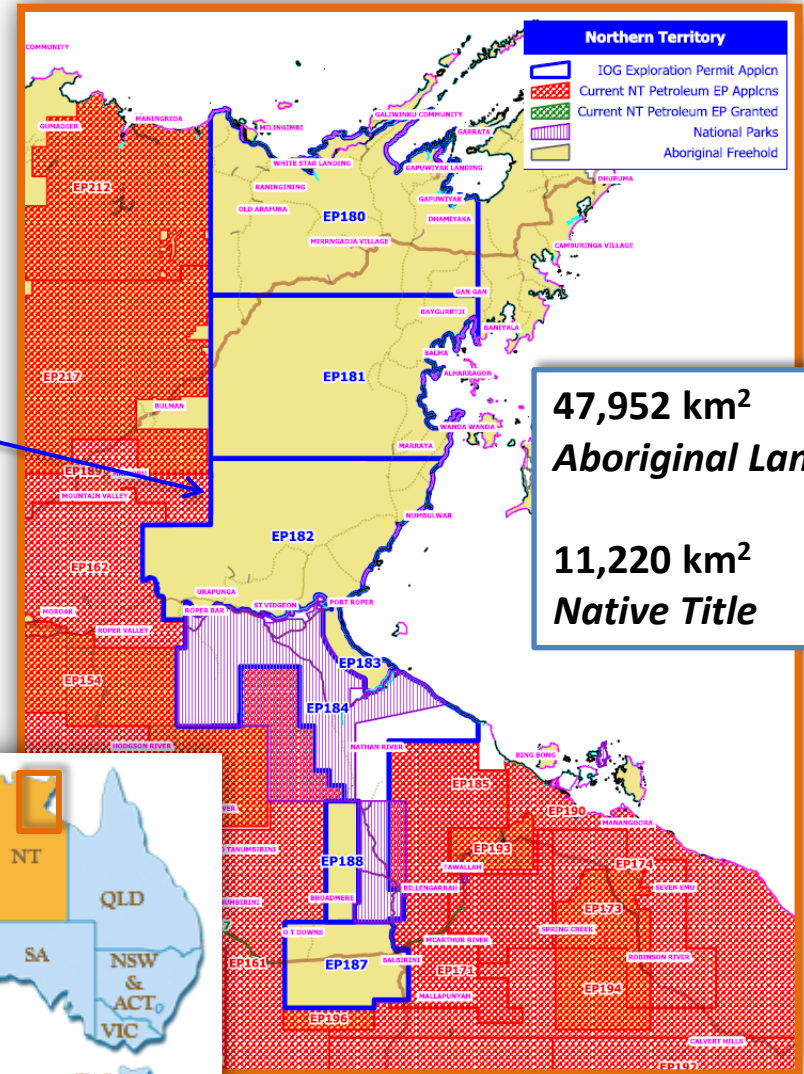
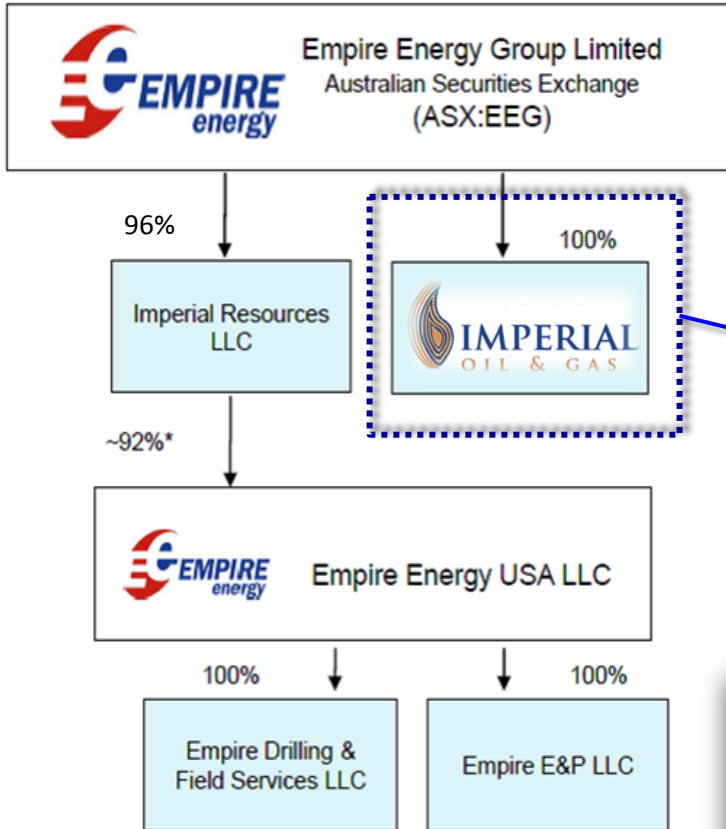
- ➔ Demonstrate why cultural heritage & natural environment must take precedence over petroleum
  - ➔ Challenge technology providers to deliver necessary & timely breakthrough
    - ➔ Imperial's stand to preserve culture & environment *and* exploit resource

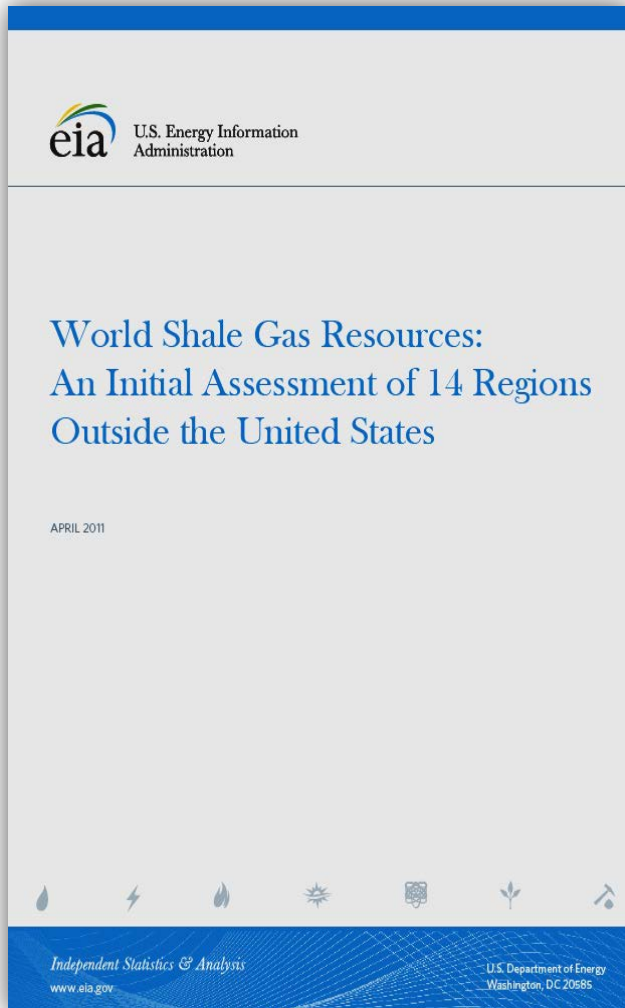
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## McArthur Basin Shale Gas Play

- ➔ Imperial Oil & Gas
- ➔ Competitive landscape in Australia
- ➔ Shale Gas Play
- ➔ Aboriginal Land & Environment
- ➔ V + V + S
- ➔ Footprint
- ➔ *Call to Action* for petroleum technologists



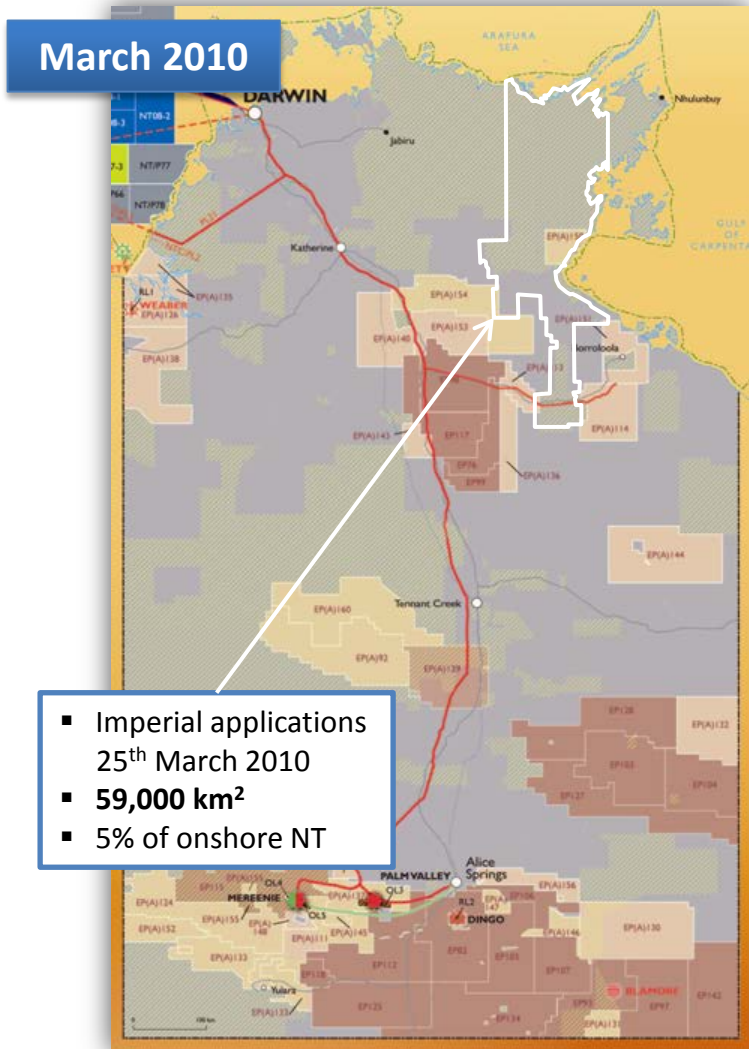
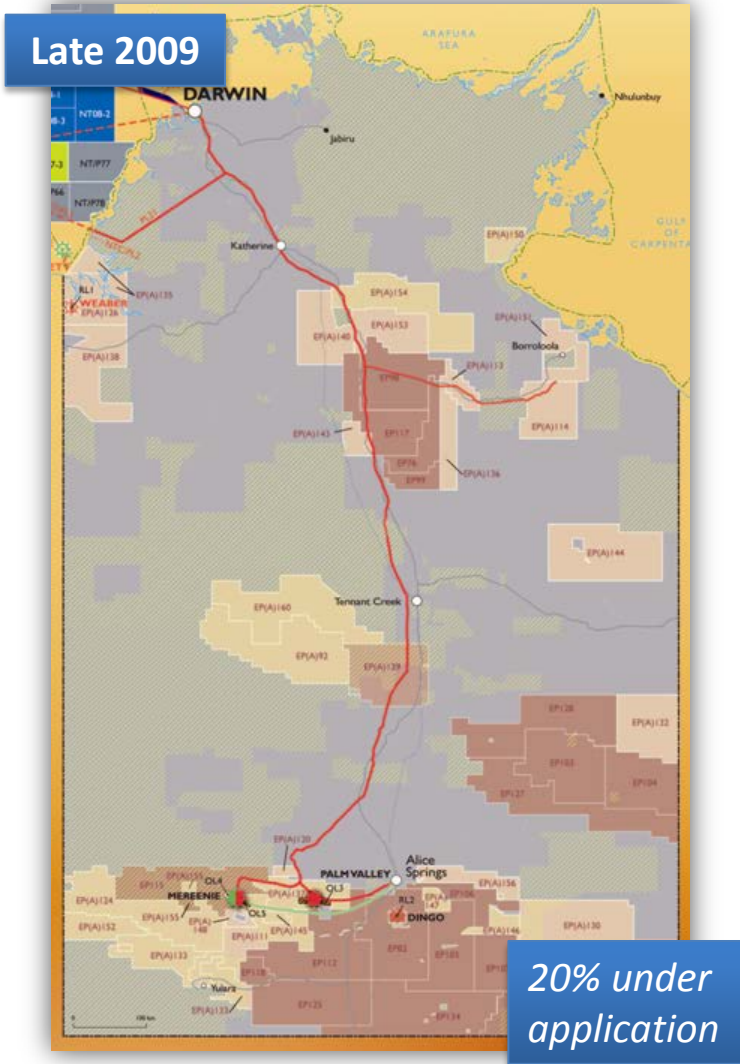


## Australia

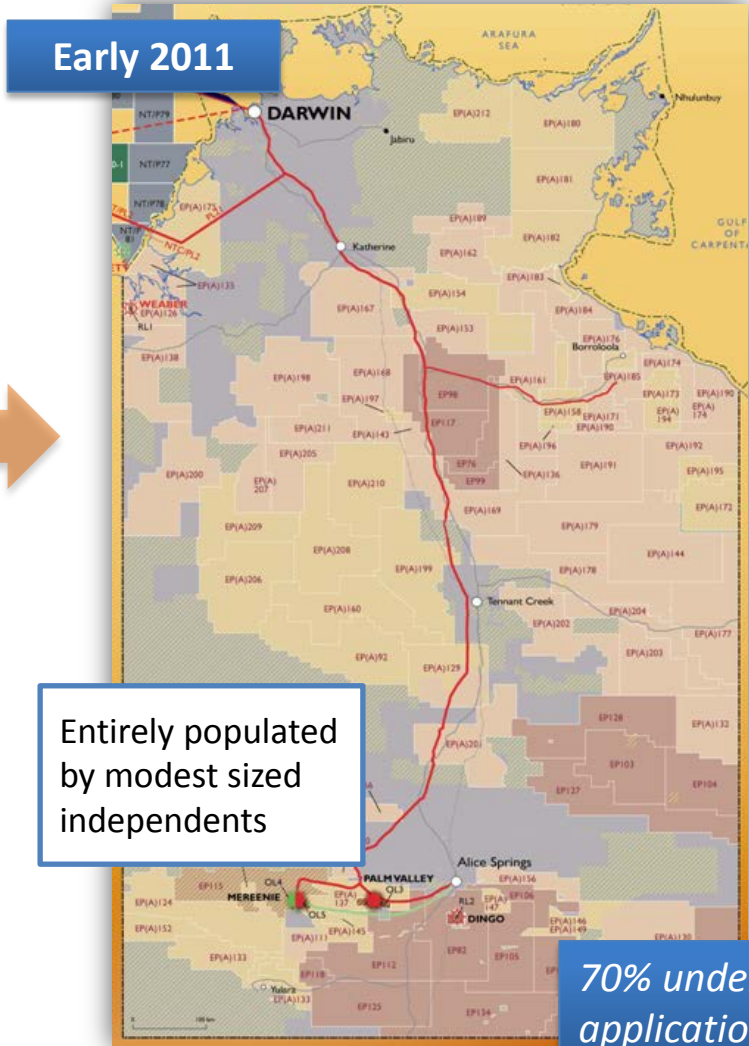
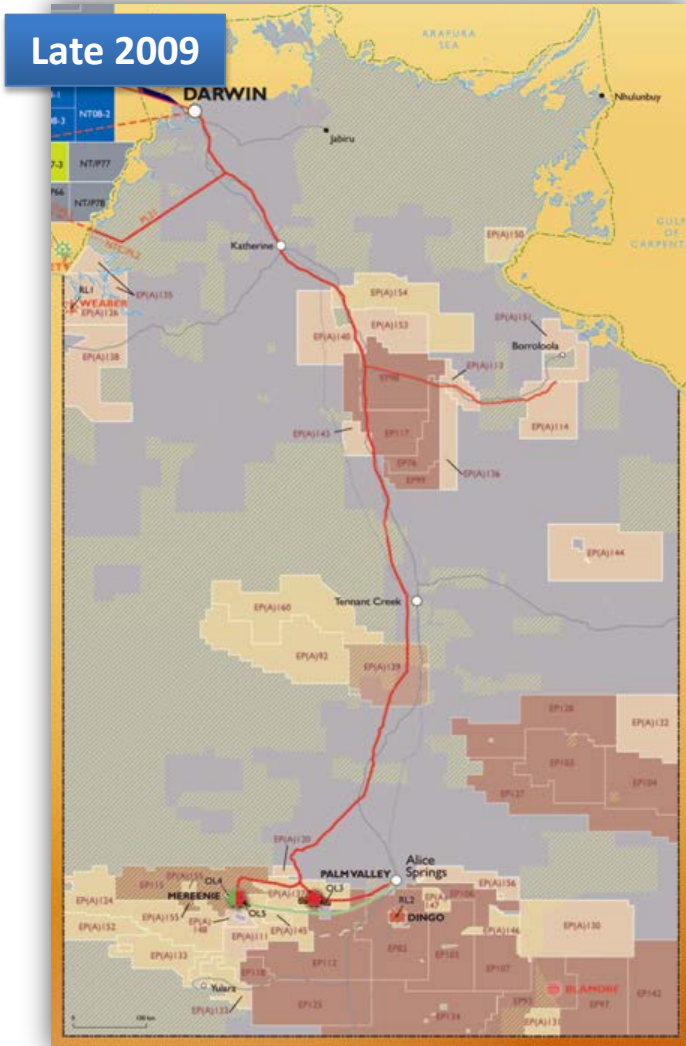
- ➔ Shale Gas is still in infancy  
Little exploration & no-commercial production
- ➔ 396 Tcf TRR Shale Gas
- ➔ Greater than estimated CSG reserves that will...  
underpin 3 recent LNG projects  
deliver capacity of 25 million tonnes a year

Continent	Risked Gas In-Place (Tcf)	Risked Technically Recoverable (Tcf)
North America	3,856	1,069
South America	4,569	1,225
Europe	2,587	624
Africa	3,962	1,042
Asia	5,661	1,404
Australia	1,381	396
<b>Total</b>	<b>22,016</b>	<b>5,760</b>

# 6







Entirely populated by modest sized independents

70% under application



**Big moving on the *small***

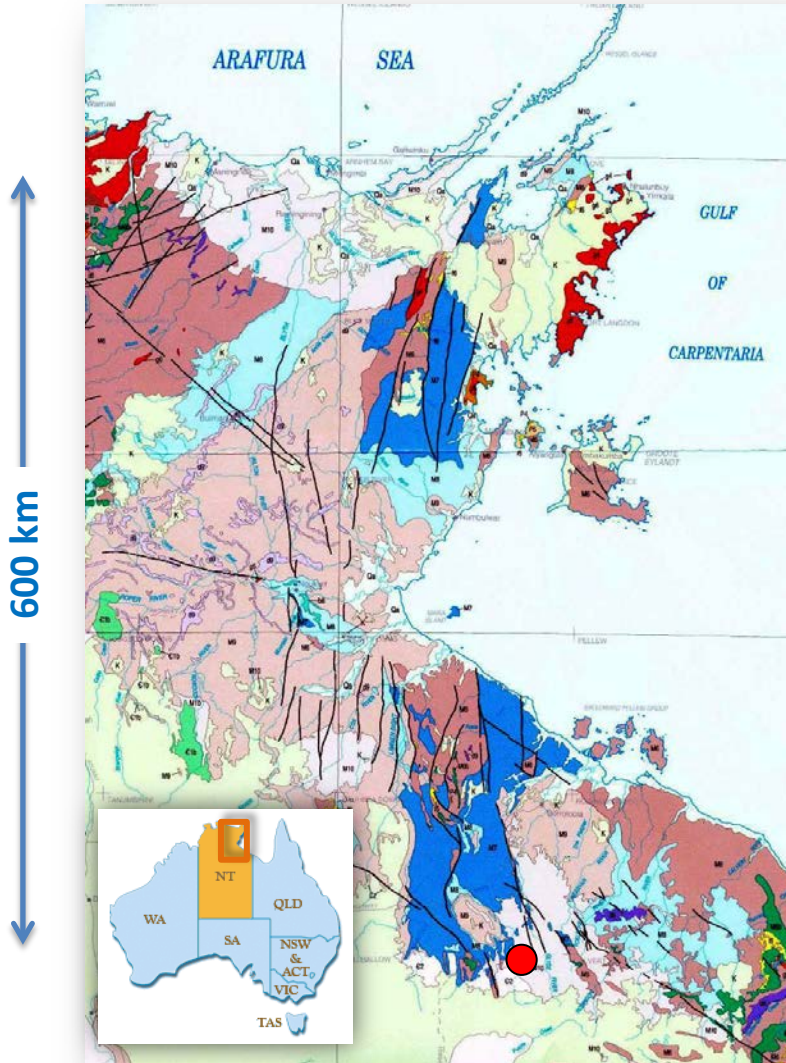
Jun 2010	<b>Mitsubishi</b>	A\$ 152.4 million	50%	<b>Buru Energy</b>	Canning Basin
Dec 2010	<b>CNOOC</b>	A\$50 million	50%	<b>Exoma Energy</b>	Galilee Basin
Apr 2011	<b>Hess</b>	U\$60 million (+10 mm shares)	62.5%	<b>Falcon Oil &amp; Gas</b>	Beetaloo Basin
Jul 2011	<b>CoP</b>	A\$ 109.5 million (+back costs)	75%	<b>New Standard Energy</b>	Canning Basin
	<b>BG</b>	A\$ 130 million (+back costs)	60%	<b>Drillsearch Energy</b>	Cooper Basin

✚ **Beach** flowed 2 mm scfd shale gas booking contingent 2Tcf in Cooper Basin

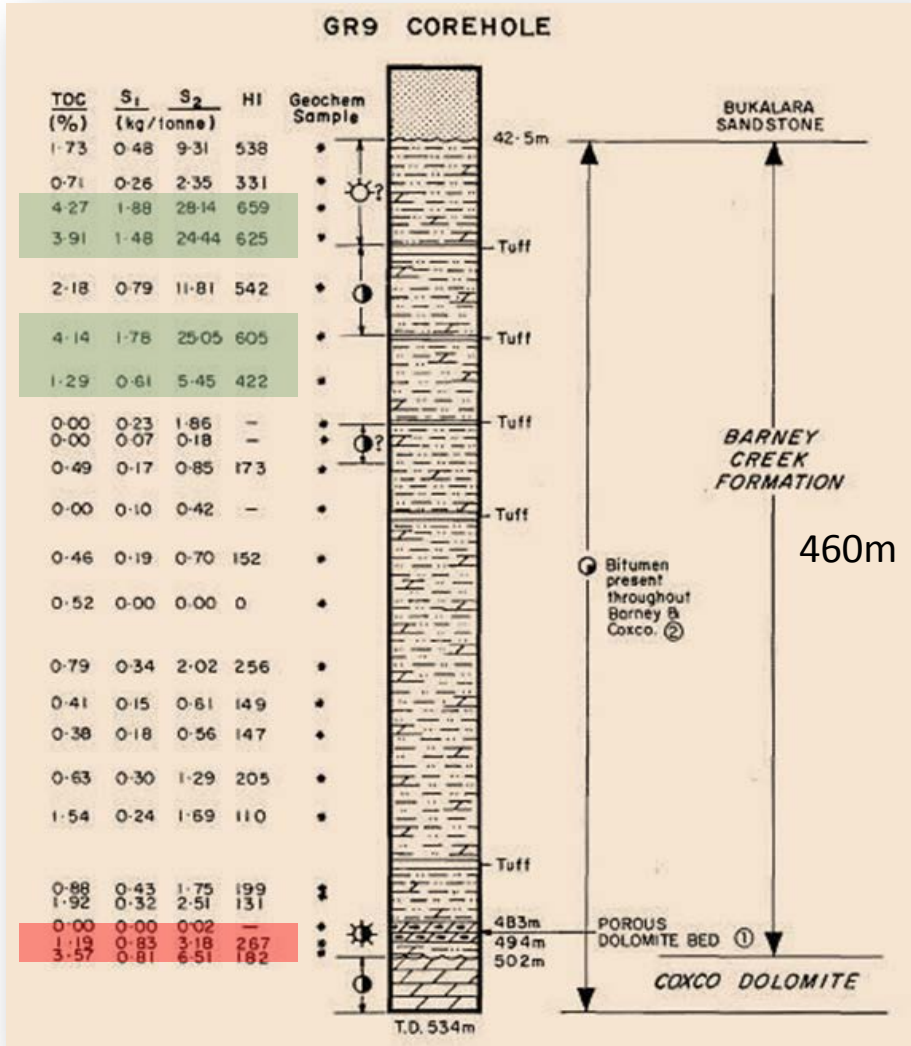
Oz deals currently modest compared with USA & Canada

Jul 2011 **BHP U\$12.1 billion Petrohawk Energy**  
*(Texas & Louisiana Eagle Ford, Haynesville & Permian shale plays)*

# McArthur Basin



# Shale Play



The most spectacular indication of live hydrocarbons encountered to date in the McArthur Group was in the Kennecott-Amoco mineral exploration corehole GR 9, drilled in the Glyde area. A summary log of this drillhole is shown as Figure 5, and the location is shown in Figure 2. Upon unintentional swabbing at the end of drilling (in December 1979), the corehole experienced a gas blow-out which yielded a 5-6m (15-20 ft) long flame. Condensate flow accompanying the gas, was indicated by the bright orange-yellow colour of the flame, and by an accompanying sooty tail. The hole flowed gas for an indeterminate period during the immediately following "Wet" season. By the end of the "Wet" the hole was filled with water and the gas flow had degenerated to a series of gas bubbles percolating through hydrostatic head. A sample of the gas taken at this stage yielded the following analysis:-

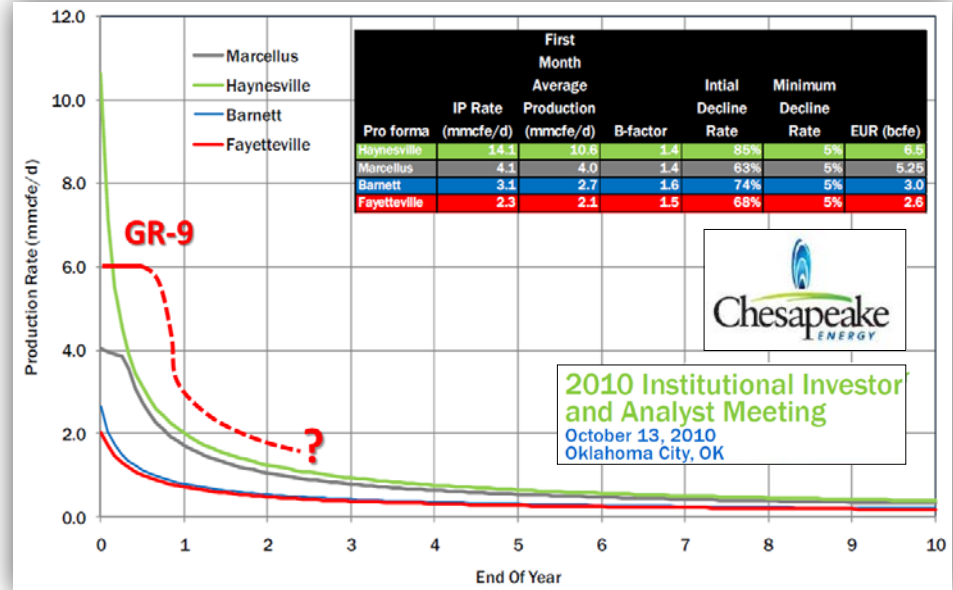
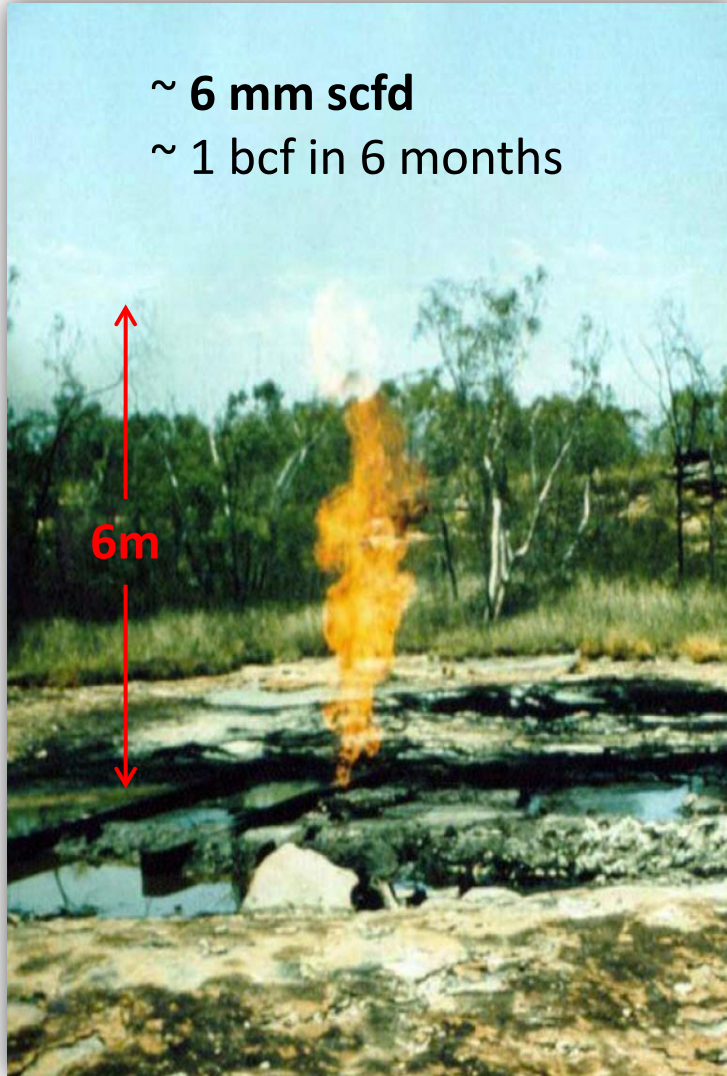
Methane	74.25%
Ethane	10.25%
Propane	3.25%
Iso-Butane	0.175%
N-Butane	0.60%
N-Pentane	0.105%
Hexane	0.165%
Heptane	0.08%
Nitrogen	10.75%
Carbon Dioxide	0.20%

The hole was plugged with cement in April 1980.





# GR-9 Well



*“... mineral exploration hole drilled at the Glyde River prospect by Amoco in 1979 flowed gas and condensates at 140psi for 6 months .....”*



Armour Energy ASX announcement 11<sup>th</sup> October 2010

## Uncertainties

### Shale Quality

- ➔ Distribution of gas-shale
- ➔ Regional quality trends

### Shale Effectiveness

- ➔ Position of OGW/GGW
- ➔ Timing
- ➔ Sweet spots

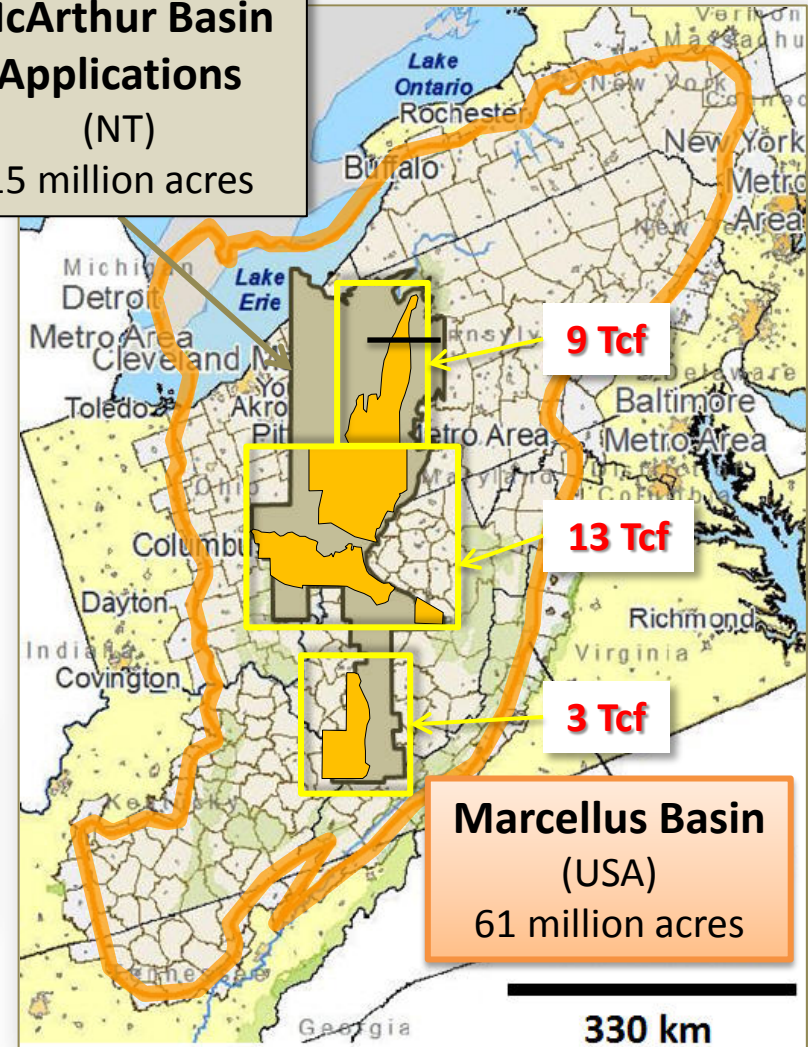
## Marcellus Analogue for volume



## Access to Aboriginal Land.....

### McArthur Basin Applications (NT)

15 million acres



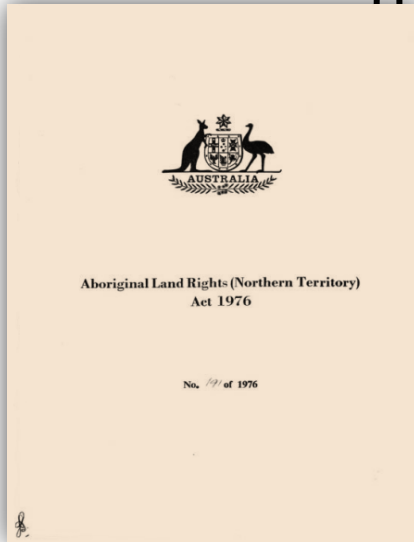
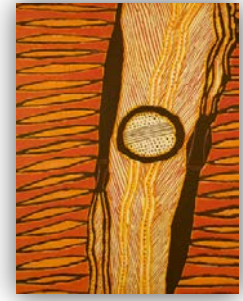
**Marcellus Basin (USA)**  
61 million acres



# Aboriginal Land

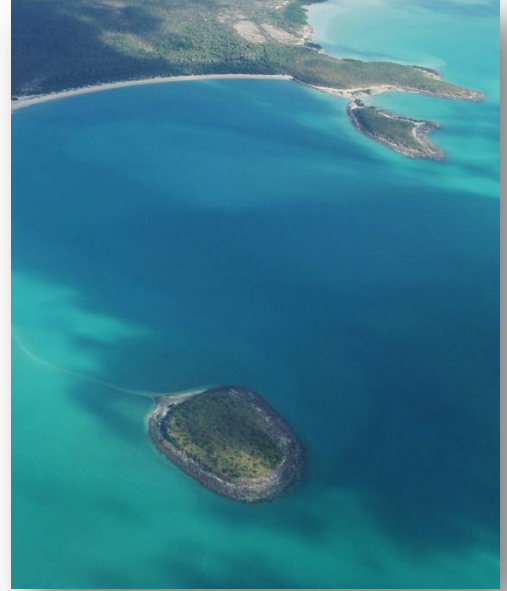
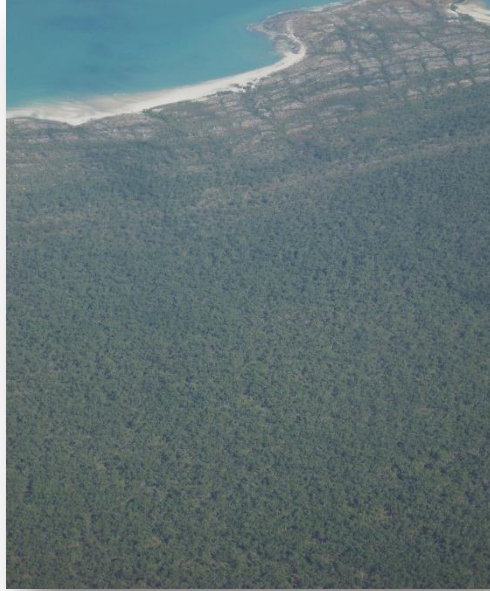
## Imperial Acreage

47,952 km<sup>2</sup> *Aboriginal Land* 80%  
 11,220 km<sup>2</sup> *Native Title* 20%

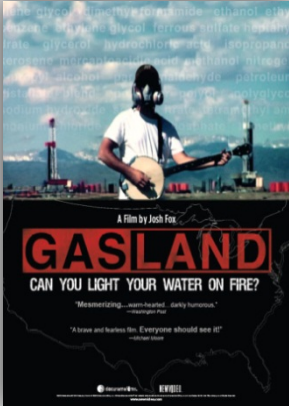




# Environment



Now



Future ?

..... is not necessarily fact

On the one hand....

*"...the push to drill for natural gas is turning vast swaths of beautiful American country into dangerous sludge dumps..."*

*"... dirty business..."*

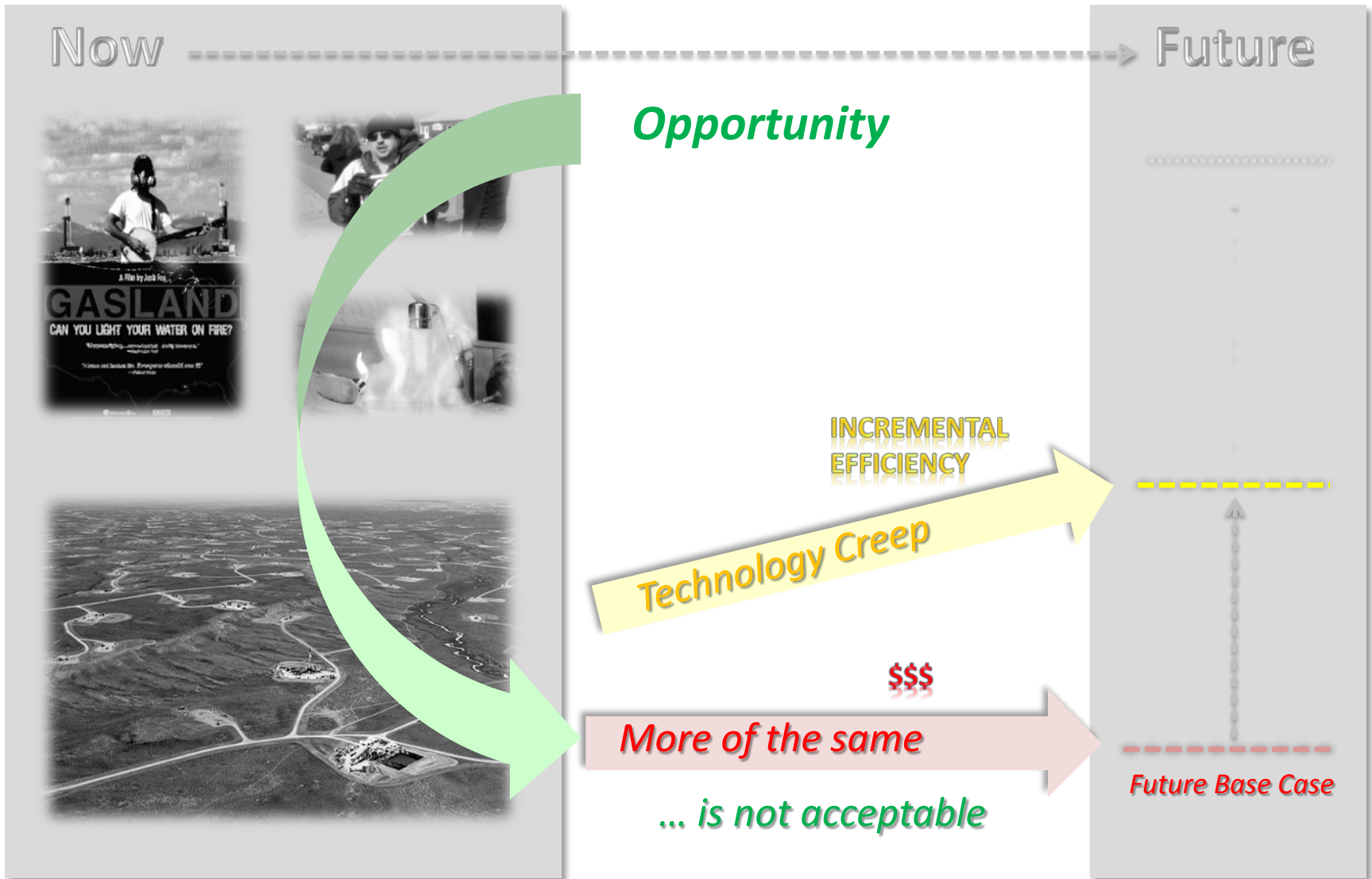
.... yet on the other

*"...2 out of the 3 wells that Gas-Land featured were contaminated biogenic gas unrelated to oil and gas activity"*

*"...natural gas falsely accused (of) 35 mile fish kill. U.S. Environmental Protection Agency tied the fish kills to coal mine run-off"*

.... SO....

# Incremental Change

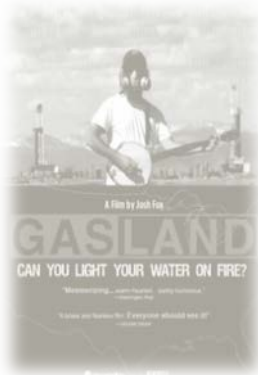




# Game Change

Now

Future



VALUES, ETHICS &  
COMMITMENT

Technology Breakthrough

Technology Creep

More of the same

Ambition

**Thomas Kuhn (1962)  
Paradigm Shift**  
"... scientific advancement is not evolutionary, rather is a series of peaceful interludes punctuated by intellectually violent revolutions"

## Imperial's Vision

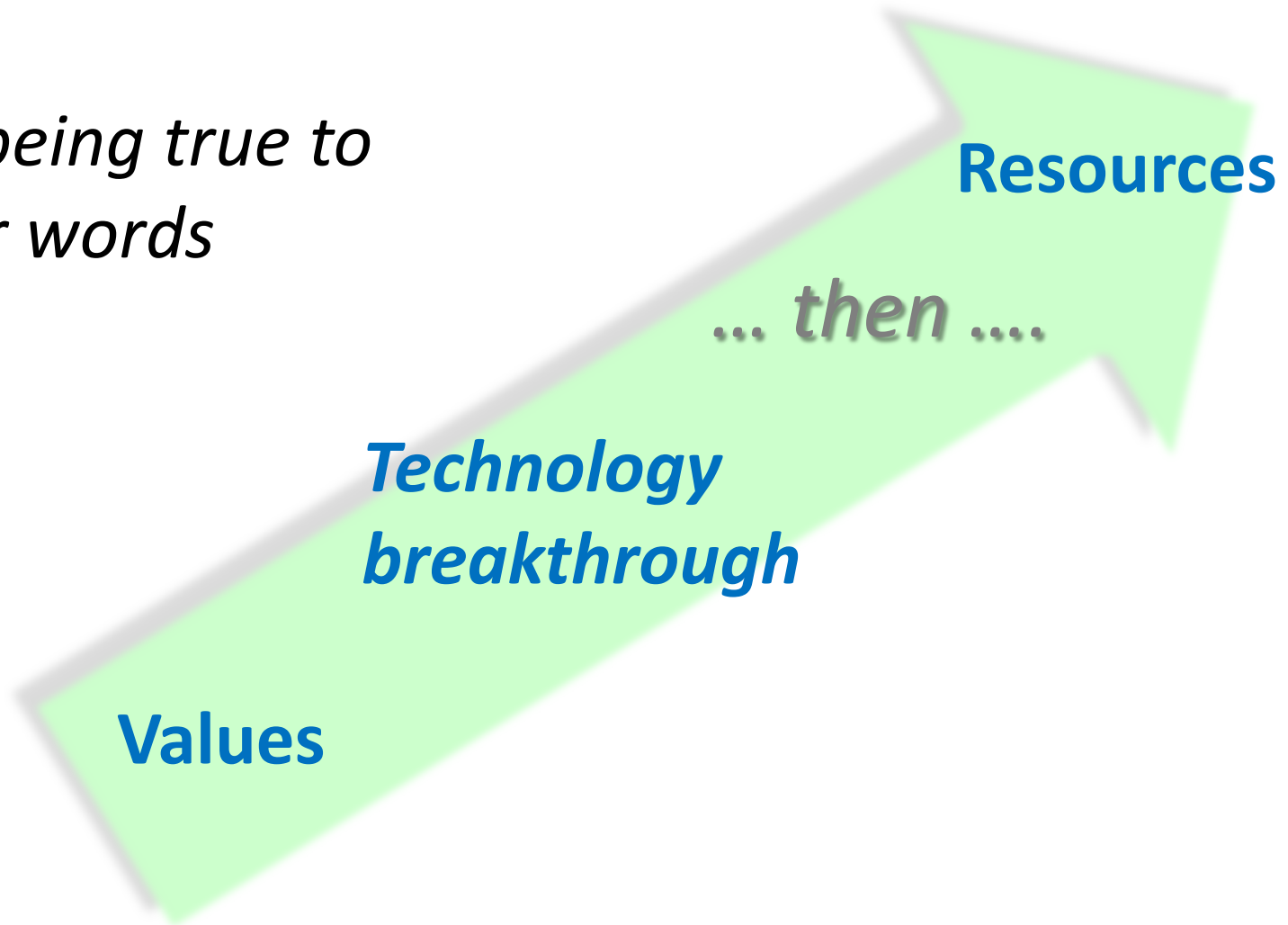
Safely develop the shale gas resources while preserving cultural heritage, customs & natural environment

*... which means ....*

# Guiding Principle

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*... being true to  
our words*





*So, the reality is .....*

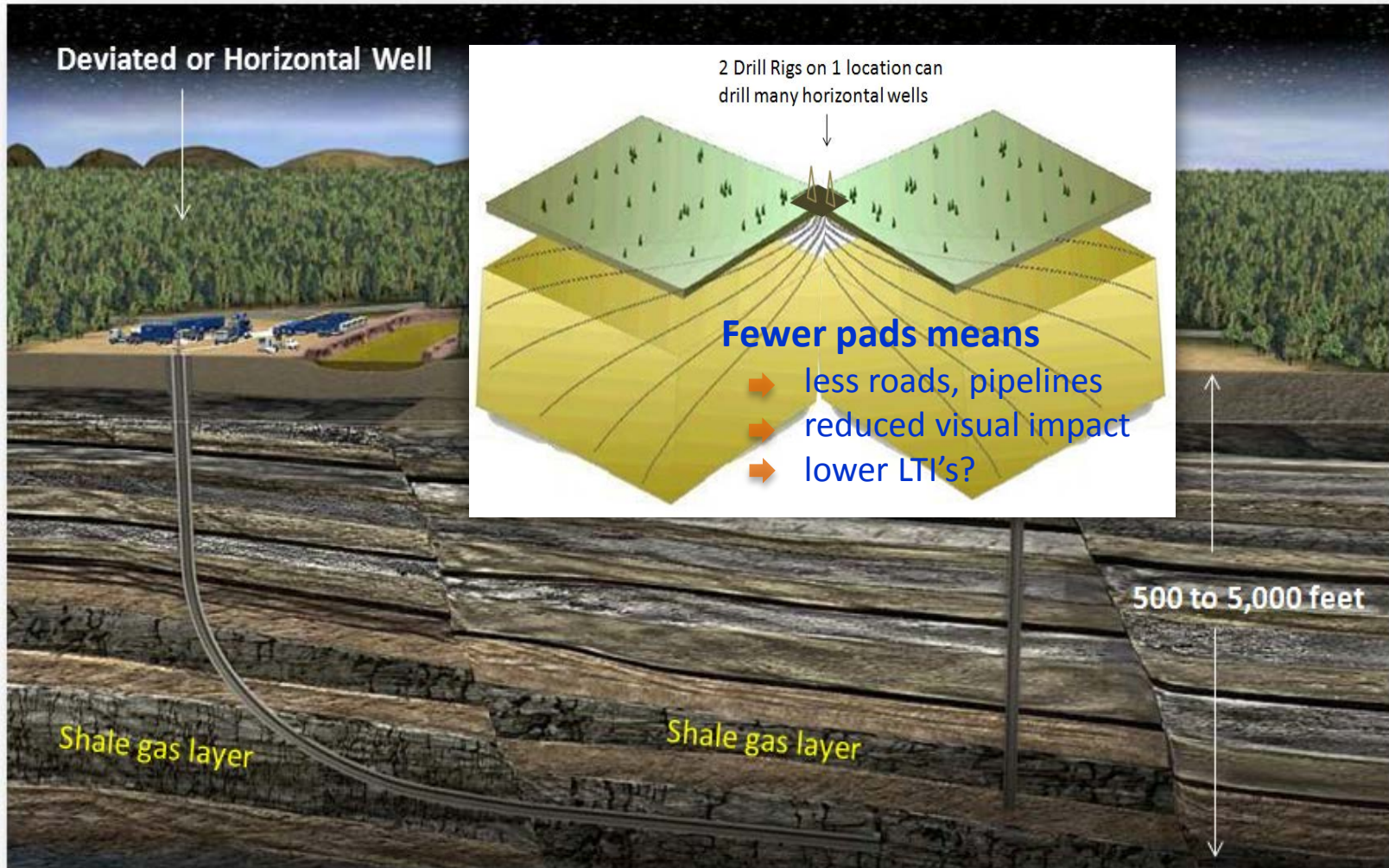
- ➔ access to resource is constrained by environment & culture
- ➔ protect these or forget the resources

## Strategy

Drive the **timely development** & implementation of drilling & production **technology** to

- ➔ remove risk to environment & culture
- ➔ maximise recovery
- ➔ optimise shale gas economics

# Minimising Footprint





# Natural Rehabilitation

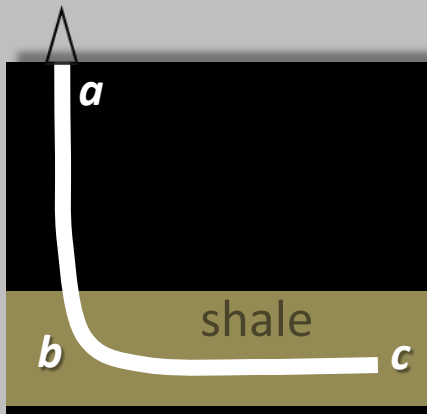


6 months - regrowth  
10 years - complete  
regrowth

# Shale Gas Drilling Limit

## Current

- Deepest (MD) 7,620m *a-c*
- Deepest (TVD) 4,481m *a-b*
- Lateral Length 3,048m *b-c*
- Highest Initial Production
  - 10,000 BOPD
  - 60 MMCF/Day
- Up to 22 fracs per well



Values provided by Packers Plus April 2011



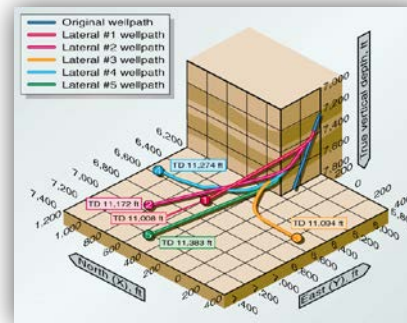
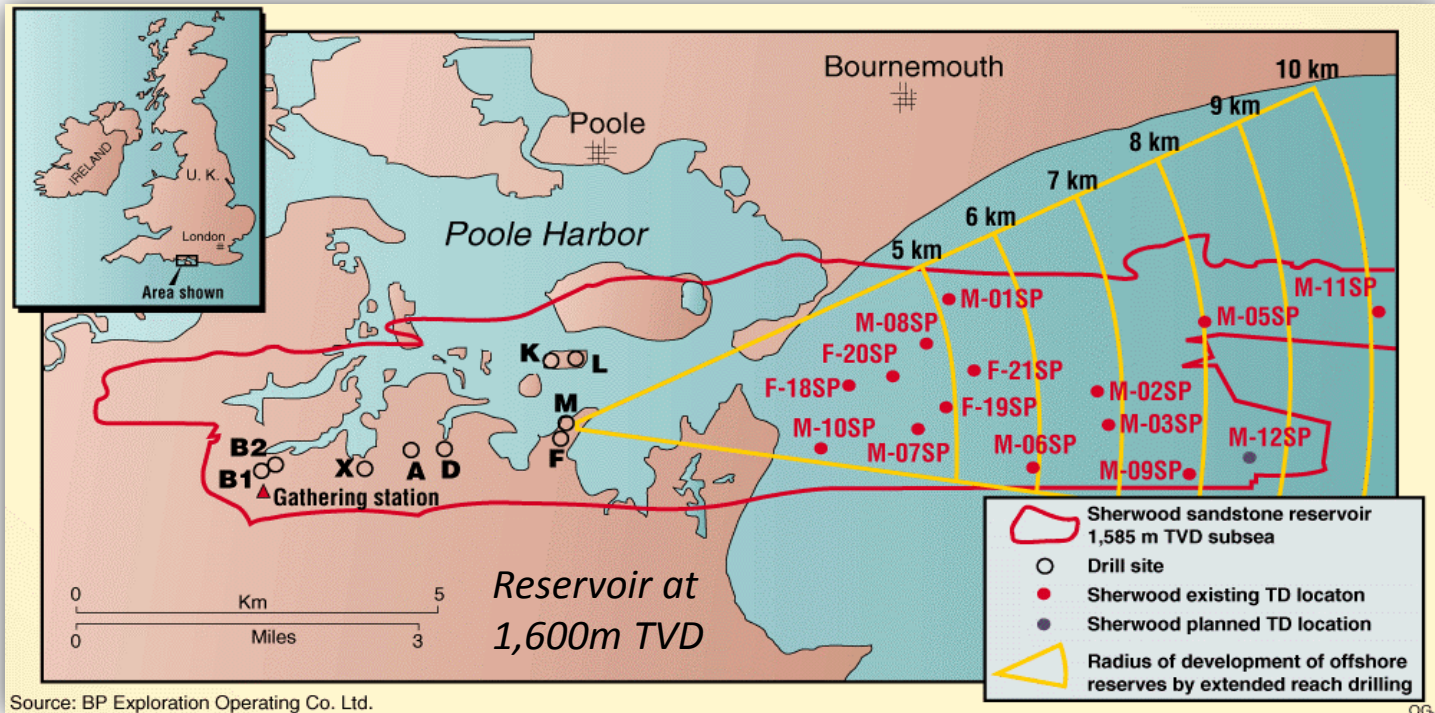
## Trends

- *Cleaner*
- *Deeper*
- *Hotter*
- *Longer*
- *More Laterals*
- *More fracs per well*
- *Cheaper*





# Push the limit



**1999**  
World record for  
11km long reach  
horizontal well

## Strategy

Drive the **timely development** & implementation of **drilling & production technology** to

- remove environment risk
- maximise recovery
- optimise shale gas economics



### Technology Challenge

- *Cheap*
- *Safe*
- *10km+ fraced horizontal wells*
- *with multi-lateral, multi-level & multi frac*
- *that have no lasting impact on environment*



# Call for Action

➔ Acknowledge the past but no precedent for future

➔ Responsibility to protect heritage & natural environment

- *no compromise!*

*“...I’ll tell you what I want,  
what I really, really want...”*

➔ Technology breakthrough in 2-5 years

- *Safe, cheap & clean*
- *10km+ fraced horizontal wells as standard*
- *multi-lateral/level/frac*



The first predominantly Aboriginal-led petroleum exploitation company with focus on the East Arnhem Region



..... a 'NOC' like **PetroMin** in PNG

Petromin PNG Holdings Limited is an independent company created by the State of Papua New Guinea to hold the State's assets and to maximise indigenous ownership and revenue gains in the mineral and petroleum sectors.

It is empowered as the vehicle to better leverage the State's equity holdings and encourage more production and downstream processing of oil, gas and minerals in PNG through proactive investment strategies either wholly or in partnership with resource developers.

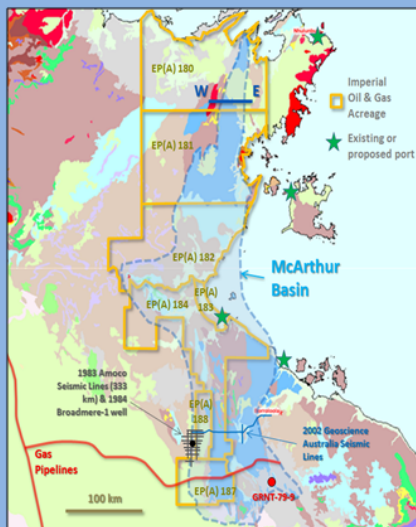


## McArthur Basin Shale Gas Play Northern Territory Onshore Australia



### Opportunity

In 2010 Imperial Oil & Gas secured **100% interest** in 59,000km<sup>2</sup> of prospective shale gas exploration acreage in the Proterozoic McArthur Basin (*Exploration Permit Applications EP (A) 180 – 188*). The McArthur is a petroleum frontier basin at **low exploration maturity** and no prior shale gas activity. It is an inverted Proterozoic basin with **thick carbon-rich black shale** petroleum source rocks also mined for Pb-Zn. There are **direct indications of oil & gas** in the basin and existing gas pipe lines. Analogue shale gas basins suggest Imperials acreage contains of the order of **24 Tcf of potential recoverable resources**. For the permits to be granted and exploration work to start agreements must be negotiated with Traditional Land Owners. This process has commenced.



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Amour Energy ASX, 11<sup>th</sup> Oct 2010



**Exploration Plays** The target gas resource is in 1,640 million year old Palaeo-Proterozoic organic-rich black shales of the **Barney Creek Formation** and equivalents, proven gas-prone in the South McArthur Basin. In particular the 1979 mineral core hole GRNT-79-9 ignited and sustained a 6m high yellow smoky gas flare for approximately 6 months producing an estimated 0.5 Bcf at 6mmscfd. Gas analysis revealed C1-C7. In addition oil bleeds are common in cores and hence shale oil offers secondary potential.

The Meso-Proterozoic **Velkerri Formation** also contains carbon-rich black shales & siltstones and is present in the southern EP(A)s 187 & 188. This formation is the focus of shale gas exploration by others in the adjacent Beetaloo Basin to the south.

**Key Uncertainties & Risk** Consistent with a frontier basin the regional extent, quality, and thermal maturity of the Barney Creek & Velkerri Formation shales have yet to be adequately constrained due chiefly to past focus on mineral exploitation from the former. Potential gas-prone sweet spots are yet to be delineated and hence Imperials strategy of acquiring a very large initial acreage position.

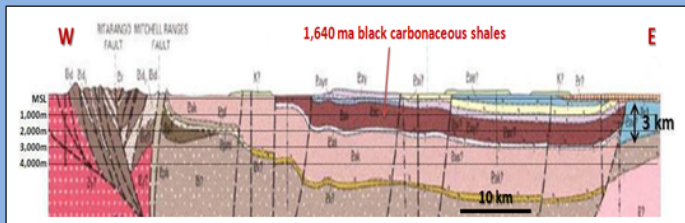
Land access and permit grant in six of the seven permit applications requires approval of the Traditional Owners given they are in Aboriginal Freehold Land. This is a risk given the licenses may not be granted for some time or at all. If negotiations are successful then some permits could be granted and work commence as early as 1H 2012. If not then the majority of the permits enter a 5 year veto period after which negotiations may re-commence.

**Exploration Work Programmes** Once each permit is granted, the work programmes in all 7 permit areas are essentially the same. **Years 1 & 2** of the 5 Year initial Exploration Term will be concerned with demonstrating the quality of any potential gas shales by geological fieldwork, sampling, and by acquiring drill core samples. This work will form the basis for a Petroleum System Analysis to constrain whether, and in what locations, these shales may be capable of gas (or oil) production. The option to exit can be exercised at the end of any permit year.

**Year 3** will focus on 2D seismic acquisition to define the basin shape and depth as well as subsurface targets for vertical test drilling in **Year 4**. If proven to contain shale-gas then **Year 5** will include the drilling and evaluation of a deviated or horizontal well involving fracking and gas production testing.

### Barney Creek Formation

<b>Lithofacies</b>	Carbonaceous black silty dolomitic shale
<b>Depth</b>	Outcrop to 4,000m
<b>Gross</b>	500 – 1,000m
<b>Net</b>	13% (in GR-9) to 2%
<b>TOC</b>	0.4 – 10.4%
<b>S1+S2</b>	5 – 70 kg/ton
<b>Maturity</b>	Immature to GGW



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