Shale Plays in the McArthur Basin

John Warburton
27th August 2015
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All amounts in this presentation are US$ unless otherwise stated. Empire Energy’s presentation currency is $US.
• Empire Energy Group
• 100% owned subsidiary Imperial Oil & Gas
• The rocks; a remarkable petroleum system
• Unique acreage footprint
• Resource estimation
• USA examples & expertise
• Commercialisation
• Traditional Owners
Empire Energy Group: An independent exploration & production company focused on acquisition & development of conventional & unconventional oil & natural gas resources

Operating Asset Base

**Australia**

- **27,000 net acres**
- **290,000 net acres**

Conventional & unconventional oil & gas exploration

Prospective Resource P(50) (unrisked)

1,847MMBoe (~12 Tcfe)

**USA**

- **27,000 net acres**
- **290,000 net acres**

Conventional oil & gas production

- NY, PA, KS, OK - 2P ~14.3MMBoe

Potential Unconventional development*

- NY - 3P ~93MMBoe
- NY - Prospective P(50) (unrisked) ~203MMBoe

*NY State position is that fracking has been banned. Under future Governance this may change. Also current State guidelines concerning the use of frack energizers is unclear, as such propane gel fracks, nitrogen foam fracks etc may be acceptable.

Prospective Resource – ‘Those quantities of petroleum estimated, as at a given date, to be potentially recoverable from undiscovered accumulations by application of future development projects. Prospective resources have both an associated chance of discovery and chance of development.’
## Snap Shot - ASX: EEG

### USA (Empire Energy USA, LLC - 100% subsidiary)
- **Producing**: ~1,250 Boe/d
- **2P Reserves**: 14.3 MMBoe
- **2P PV10**: US$ 87 million
- ~27,000 net acres conventional & unconventional - Kansas & Oklahoma
- ~250,000 net acres Marcellus - New York State*
- ~145,000 net acres Utica Shale - New York State*

*NY State position is that fracking has been banned. Under future Governance this may change. Also current State guidelines concerning the use of frack energizers is unclear, as such propane gel fracks, nitrogen foam fracks etc may be acceptable.

### Australia (Imperial Oil & Gas Pty Ltd - 100% subsidiary)
- ~14.6mm net acres - McArthur Basin & Beetaloo Sub Basin, 100% WI
  - ~4.8mm net acres Walker/Barney Creek Shale Trough
  - ~0.6mm net acres Velkerri (Beetaloo) Basin Shale
  - ~2.2mm net acres Tawallah Group (McDermott & Wollogorang Formations)
- **Proven petroleum system**
- **Non-binding US$75 million Farm-in LOI to earn up to an 80% working interest signed with an affiliate of American Energy Partners**, an oil & natural gas operating & asset management company founded by Aubrey K. McClendon, and based in Oklahoma City, Oklahoma – 18th Aug 2015
• Secured following Regional Screening over 2009/10
• Tenements cover 14.6 million acres
• 100% working interest
• Includes ~80% of the onshore McArthur Basin Trough
• Proven petroleum system
  • Known gas composition $\text{C}_1$ 77%, $\text{C}_2$ 11%, $\text{C}_3$ 11%
  • $\text{C}_4$ 0.6%, $\text{C}_5$ 0.2%, negligible $\text{CO}_2$
  • Strong liquids potential
  • Recent nearby wells flowed gas from target formations without hydraulic fracture
• 2 tenements awarded, 4 in negotiation
• Negotiations with Traditional Owners near complete
Central Trough Multiple Stacked Targets

Proterozoic laminated black organic sulphurous carbonaceous silt & mudstone petroleum source rocks

<table>
<thead>
<tr>
<th>Shale</th>
<th>Velkerri</th>
<th>Barney Creek</th>
<th>Tawallah</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Meso-</td>
<td>Paleo-</td>
<td>Paleo-</td>
</tr>
<tr>
<td>Pressured</td>
<td>Over</td>
<td>Over</td>
<td>Over</td>
</tr>
<tr>
<td>TOC</td>
<td>Up to 7.5%</td>
<td>Up to 10.4%</td>
<td>Up to 7%</td>
</tr>
<tr>
<td>Gas</td>
<td>Free Flowing</td>
<td>Free Flowing</td>
<td>?</td>
</tr>
<tr>
<td>Reservoir</td>
<td>Sandstone beneath</td>
<td>Dolomite beneath</td>
<td>Dolomite &amp; Sandstone beneath</td>
</tr>
<tr>
<td>Deposition</td>
<td>Marine anoxic</td>
<td>Basinal marine anoxic</td>
<td>Marine anoxic - lacustrine?</td>
</tr>
<tr>
<td>Thickness</td>
<td>Up to 1,968’</td>
<td>Up to 3,000’</td>
<td>Up to 1,800’</td>
</tr>
</tbody>
</table>
Organic Carbon

- **Prokaryotic Cyanobacteria** (Blue-green ‘Algae’)
- **1st Eukaryote?**
- **LIFE?**
- **3.47 Bn yr**
- **‘Great Oxygenation Event’**
- **1.87 Bn yr**
- **1.49 Bn yr**
- **1.2 Bn yr**

- **Archean**

- **Paleo-**
- **Meso-**
- **Neo-**

- **Phanerozoic**

- **Age of the Earth**
  - 4.6
  - 2.5
  - 1.6
  - 1.0
  - 0.54 Bn Years

- **Ancient Petroleum Systems**
  - Tawallah
  - Barney Creek
  - Velkerri

Biosphere Evolution

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**Great Oxygenation Event**

- Biologically induced O₂ produced by Cyanobacteria
- Prior to 2.3 Bn yr all O₂ captured in ‘BIFs’
- After ~ 2.3 Bn yr O₂ sinks were saturated and O₂ was liberated into atmosphere

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Organic Carbon Preservation

McArthur Basin Shelf
Partial oxia above 12m water depth

Central Trough
Okenane bio-marker &
Sulphur isotopes in pyrite in
Barney Creek Fm consistent with local ocean anoxia

Anoxia unavoidable below 25m

Central Trough likely has
- Greatest palaeo-water column
- High TOC concentration
- High TOC preservation
- Shale depositional thick
- Fine clastic (silt & shale)
- High Frackability (29 cores in SVF/BCF show high Si/low clay)

<table>
<thead>
<tr>
<th>% of Present Day Atmospheric O₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
</tr>
<tr>
<td>25%</td>
</tr>
<tr>
<td>10%</td>
</tr>
<tr>
<td>1%</td>
</tr>
<tr>
<td>0.1%</td>
</tr>
</tbody>
</table>

Modified after
3. Dick, Evans, Holman, Leach & Grice (2014); Brocks & Schaeffer (2007)
Imperial has the ingredients ....

Organic Carbon Presence

3.465 Bn Yr onwards

Anoxic Basin depositional environment

1.64 Bn yr Barney Creek

1.43 Bn yr Velkerri

3.465 Bn Yr onwards

Mature Source Rocks & Hydrocarbons


Modified after Craig et al. 2013
Shale depositional environments

Central Trough restricted basin

- Narrow restricted fault-bounded depo-centre
- Contemporaneous shelf, slope & basin (proximal-to-distal N to S)
- Lithofacies associations
  
  | Shelf       | St Vidgeon Fm | ‘SVF’ |
  | Slope       | Vaughton Siltstone Fm | ‘VS’ |
  | Basin       | Barney Creek Fm | ‘BCF’ |

*Age correlative & genetically linked* (supported by Imperial age dating)

- Greatest organic carbon preservation & thickness predicted in restricted Barney Creek Formation Basin *in Imperial’s acreage*
- TOC present in shales along flooding surfaces in shelf
  - *St Vidgeon Fm (Imperial 2014 Well BCFSC-04)*
- .... hence intervening slope facies likely to contain significant TOC

Organic Carbon *Preservation* in restricted anoxic trough
Central Trough GDE at 1.64 Bn yr

Imperial acreage has the depo-centre with the greatest predicted TOC preservation & shale thickness

McArthur Basin Central Trough

- Shelf - St Vidgeon Fm (partial anoxia)
- Slope - Vaughton Siltstone (increased anoxia)
- Basin - Barney Creek Fm (anoxic)

Palaeo-Sea Level

Increasing anoxia & TOC

‘Old’ Barney Creek F

Imperial Oil & Gas Licenses
Imperial acreage has the depo-centre with the greatest predicted TOC preservation & shale thickness.

- **Proximal**
  - Highest anoxia & TOC in basin centre
  - Imperial 2014 Exploration Wells

- **Distal**
  - Major Regional High in Imperial acreage with conventional potential
  - Onlap edge of Barney Creek Fm

- **Trough Axis**
  - Imperial 2014 Exploration Wells

Source: Imperial Oil & Gas 2015

From Armour Energy July 2015
Petroleum Generation

**Source Rock Analyses - average of core samples**

<table>
<thead>
<tr>
<th>Source</th>
<th>n</th>
<th>TOC %</th>
<th>S1</th>
<th>S2</th>
<th>Tmax</th>
<th>C% Ro</th>
<th>HI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velkerri</td>
<td>100</td>
<td>6.16</td>
<td>0.52</td>
<td>9.08</td>
<td>422</td>
<td>0.61</td>
<td>84</td>
</tr>
<tr>
<td>St Vidgeon</td>
<td>15</td>
<td>4.51</td>
<td>0.06</td>
<td>0.06</td>
<td>399</td>
<td>0.58</td>
<td>54</td>
</tr>
<tr>
<td>Barney Creek</td>
<td>178</td>
<td>4.55</td>
<td>0.37</td>
<td>3.2</td>
<td>437</td>
<td>0.72</td>
<td>160</td>
</tr>
<tr>
<td>Wollogorang*</td>
<td>8</td>
<td>2.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specific Proterozoic Analogues

Siberia, Russia
• Conventional dolomite reservoirs
• 25 hydrocarbon discoveries
• Largest field 2P = 260MMBbl & 11 Tcf
• Proven 80 BBoe & 477 Tcf
• Oil & Gas Shales
  • Black, bituminous, limy, silty carbonaceous
  • Average TOC = 0.2%, locally 5-10%

Proterozoic source rocks are major petroleum systems

- China - Sichuan/Tarim Basin
  Proven 18 BBoe & 9 Tcf
- Oman Basin
  Proven 5.5 BBoe & 30 Tcf
- McArthur Basin
  Proven TBD

Prospect Evaluation

Common Risk Segment Approach

1. Play Fairway Definition

2. Common Risk Segments

3. Prospect Definition

Shale Risk Elements

- Presence
- Depositional environments
- Quality (TOC & Mineralogy)
- Maturity
- Thickness
- Depth

Prospect Evaluation & Resource Estimation for Tawallah Group not yet completed
Resource Estimates

- Imperial WI = 100%  Royalties  = ~12%
- **Resource estimates are conservative**
  - Total thickness of Velkerri & Barney Creek Shale assumed ~350ft, but in some sections up to 1,500ft thick
  - Geological discount factor 50 - 75% to account for variation in rock quality and lack of data
  - Tawallah resource not included
  - No conventional petroleum
- Barney Creek is the primary target and only McArthur Basin formation to date to flow potentially commercial quantities of natural gas in wells drilled

### Estimated Prospective Resources (Unrisked)

<table>
<thead>
<tr>
<th>Shale Target</th>
<th>Acres*</th>
<th>Gas/Cond</th>
<th>P90</th>
<th>P50</th>
<th>P10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barney Creek</td>
<td>4,844,000</td>
<td>Bcf</td>
<td>3,304</td>
<td>8,699</td>
<td>20,172</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>MM bbl</strong></td>
<td>66</td>
<td>174</td>
<td>403</td>
</tr>
<tr>
<td>Velkerri</td>
<td>628,000</td>
<td>Bcf</td>
<td>383</td>
<td>1,192</td>
<td>3,086</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>MM bbl</strong></td>
<td>8</td>
<td>24</td>
<td>62</td>
</tr>
<tr>
<td>Tawallah</td>
<td>~2,200,000</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>TOTAL</td>
<td>7,672,000</td>
<td><strong>MM BOE</strong>**</td>
<td>689</td>
<td>1,847</td>
<td>4,341</td>
</tr>
</tbody>
</table>

* Based on P10 calculations  ** Conversion Factor 6 :1 for Bcf to MMBOE

The Prospective Resource (total hydrocarbon resource) - estimated by Muir and Associates Pty Ltd (MAA) & Fluid Energy Consultants (FEC)

“Prospective Resource”– This estimate of prospective petroleum resources must be read in conjunction with the cautionary statement on page 4.
### USA Basin Scale Analogue

<table>
<thead>
<tr>
<th>Basin</th>
<th>Prospective Area km² (million acres)</th>
<th>Un-risked Prospective Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperial Licenses</td>
<td>22,258 (5.5 mm)</td>
<td>P10 24 Tcfe * P50 10 Tcfe * *BCF &amp; Velkerri only</td>
</tr>
<tr>
<td>Marcellus</td>
<td>246,000 (61 mm)</td>
<td>262 Tcfe</td>
</tr>
<tr>
<td>Fayetteville</td>
<td>23,309 (6 mm)</td>
<td>42 Tcf</td>
</tr>
<tr>
<td>Haynesville</td>
<td>23,310 (6 mm)</td>
<td>251 Tcf</td>
</tr>
<tr>
<td>Barnett</td>
<td>12,950 (3.2 mm)</td>
<td>44 Tcf</td>
</tr>
</tbody>
</table>

**Imperial’s resource estimates are conservative**

**McArthur Basin**
- Imperial Acreage
- *Palaeo-Proterozoic*
- 5.5 million acres
- (gross thickness up to 3,000 ft)

**Marcellus Basin**
- USA
- Devonian
- 61 million acres
- (gross thickness up to 890 ft)

**Fayetteville Basin**
- USA
- Carboniferous
- 6 million acres
- (gross thickness up to 550 ft)

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Modified after Modern Shale Gas Development in the US; a Primer. US Department of Energy April 2009

"Prospective Resource"—This estimate of prospective petroleum resources must be read in conjunction with the cautionary statement on page 4.
What we can learn from AELP

- Unconventional resource development
  - Exploration / appraisal to full field production for maximum shareholder value
- Targeting & landing-point optimization
  - Identifying the best interval for cost effective horizontal drilling and post-frac production
- Drilling & completion techniques optimized across US Shale plays
  - Proven bit / BHA designs and processes focused on subsurface conditions and performance results
  - Air drilling techniques perfected in Fayetteville, Utica & Marcellus
  - Proven perforating, fracturing, production and facility design strategies conceptualized by simulation models and validated by production results across multiple basins
- Value engineering
  - Experienced subsurface & operations team and executive management with a track record of success having ‘cracked the code’ on multiple US plays, and currently focused on Northern Territory
  - Nimble & flexible approach combined with standard operating procedures proven to minimize NPT*, minimize cost volatility, identify value and maximize high return low cost horizontal wells
  - Operation ROC** processes to systematically attack cost at a detailed line-item basis

*Note: *NPT: non-productive time; **Operation ROC is an AELP cost reduction campaign & program which resulted in significant D&C cost savings across all affiliated operating companies
'Leading Edge’ Technology

Why In-house Expertise Counts

Source: Energy & Capital, Aug 2015
Imperial has a unique opportunity for very early stage development with target located beneath & aside an existing pipeline & roadway

Stage 1 - Velkerri Shale Potential
Potentially both conventional & unconventional play
Estimated Resource (P50) ~1.2Tcf
Volumes based on:
- Up to 390ft thick net pay
- TOC up to 7.5%
- Oil & Oil/Gas maturity

East Coast Gas Demand Shock

Source: Company Statements, AEMO

Proposals for NE Gas Interconnector
NT & Federal Gov’t working to facilitate development of the North-East Gas Interconnector to meet the energy demands of Eastern Australia

“Prospective Resource” – This estimate of prospective petroleum resources must be read in conjunction with the cautionary statement on page 4.
Traditional Owners are supportive of Imperial’s Plans

EP184 & 187
- EP 187 (along with 1 other) was the 1st ALRA license granted in NLC history
- EP 184 in early Yr 3 exploration program
- EP 187 in mid-Yr 1 exploration program

EP(A) 180, 181, 182 & 183
- Supportive TOs throughout Arnhem Land
- Documentation in final stages of negotiation
McArthur Basin Summary

- Imperial a 100% owned subsidiary of EEG
- Non-binding US$75 million Farm-in LOI with an affiliate of American Energy Partners to earn up to 80% WI
- High quality anoxic basin shale fairway
- Ancient source rocks with proven prolific analogues
- 3 shale oil & gas plays + conventional
- Scale & quality comparable with producing US plays
- Conservative P50 1,847 mm boe resource
- Multiple commercialisation options (early days)
- Supportive Traditional Owners

“Prospective Resource”—This estimate of prospective petroleum resources must be read in conjunction with the cautionary statement on page 4.
Thank you

Imperial’s Vision is safely to develop the petroleum resources while preserving cultural heritage, customs & natural environment.

www.empireenergygroup.net
Notes to Reserves

- The scope of the Reserve Studies reviewed basic information to prepare estimates of the reserves and contingent resources.
- The quantities presented are estimated reserves and resources of oil and natural gas that geologic and engineering data demonstrate are “In-Place”, and can be recovered from known reservoirs.
- Oil prices are based on NYMEX West Texas Intermediate (WTI).
- Gas prices are based on NYMEX Henry Hub (HH).
- Prices were adjusted for any pricing differential from field prices due to adjustments for location, quality and gravity, against the NYMEX price. This pricing differential was held constant to the economic limit of the properties.
- All costs are held constant throughout the lives of the properties.
- The probabilistic method was used to calculate P50 reserves.
- The deterministic method was used to calculate 1P, 2P & 3P reserves.
- The reference point used for the purpose of measuring and assessing the estimated petroleum reserves is the wellhead.
- “PV0” Net revenue is calculated net of royalties, production taxes, lease operating expenses, and capital expenditures but before Federal Income Taxes.
- “PV10” is defined as the discounted Net Revenues of the company’s reserves using a 10% discount factor.
- “1P Reserves” or “Proved Reserves” are defined as Reserves which have a 90% probability that the actual quantities recovered will equal or exceed the estimate.
- “Probable Reserves” are defined as Reserves that should have at least a 50% probability that the actual quantities recovered will equal or exceed the estimate.
- “Possible Reserves” are defined as Reserves that should have at least a 10% probability that the actual quantities recovered will equal or exceed the estimate.
- “Bbl” is defined as a barrel of oil.
- “Boe” is defined as a barrel of oil equivalent, using the ratio of 6 Mcf of Natural Gas to 1 Bbl of Crude Oil. This is based on energy conversion and does not reflect the current economic difference between the value of 1 Mcf of Natural Gas and 1 Bbl of Crude Oil.
- “M” is defined as a thousand.
- “MM” is defined as a million.
- “MMBoe” is defined as a million barrels of oil equivalent.
- “Mcf” is defined as a thousand cubic feet of gas.
- All volumes presented are net volumes and have had subtracted associated royalty burdens.
- Utica shale gas potential resources have only been calculated for the region where drill data is available. Very few wells have been drilled into the Utica in Western NY and NW Pennsylvania. Estimates for GIP have been made were the few existing wells have been drilled. Empire holds additional acreage outside the current potential resource region. It is expected that as with shale characteristics, the shale formations will continue within the remaining acreage. The potential GIP should increase if more data was available.

Qualified petroleum reserves and resources evaluators

The information in this report which relates to the Company’s reserves is based on, and fairly represents, information and supporting documentation prepared by or under the supervision of the following qualified petroleum reserves and resources evaluators, all of whom are licensed professional petroleum engineer’s, geologists or other geoscientists with over five years’ experience and are qualified in accordance with the requirements of Listing Rule 5.42:

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Qualifications</th>
<th>Professional Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen Barron</td>
<td>Ralph E Davis Associates, Inc</td>
<td>BSc</td>
<td>Society of Petroleum Engineers</td>
</tr>
<tr>
<td>William Kazmann</td>
<td>LaRoche Petroleum Consultants, Ltd</td>
<td>MSc</td>
<td>Society of Petroleum Engineers</td>
</tr>
<tr>
<td>John P Dick</td>
<td>Pinnacle Energy Services, LLC</td>
<td>BPE</td>
<td>Society of Petroleum Engineers</td>
</tr>
<tr>
<td>Wal Muir</td>
<td>Muir and Associate P/L</td>
<td>BSc,MBA</td>
<td>Petroleum Exploration of Australia</td>
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