East Side Duvernay: Hey Budda Boom, Budda Bing

PADA Society Presentation

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BMO Capital Markets
Outline

1. Play Overview and History
2. Geology
   - Cross sections, ‘El Diablo’ Limestone
   - Net Shale Pay, Upper and Lower Duvernay
   - Core
   - Depth
3. Land
   - Crown land sales
   - Acreage by company
4. Activity
   - Well count by company
   - Well Results
   - Lateral Lengths, Completion Trends
   - Key Upcoming Wells
5. Economics
   - IRR, payback period, NPV; Tier 1 and Tier 2 Type Curves
   - Comparison to other North American plays
East Duvernay – Play Overview

- EOG entered the play in 2012, drilling a Hz well at Cygnet for >$18mm. Numbered company drilled first Hz well in Ghost Pine Embayment for >$12 million in 2014.

- Well cost reductions and improving well results have made the play economic.

- East/West Shale Basins separated by Rimbey – Meadowbrook Leduc reef trend. Activity has expanded into West Shale Basin oil window, where data and well control is limited.

- Current production is >8,000bbl/d
Cross Section: East Shale Basin

- The shale is identified by high apparent porosity on the density and sonic logs (due to the low density of kerogen), high resistivity, and higher gamma ray.
- Shale interval gets thicker as you step away from the reef margins.
- Data quality is poor due to the vintage of the well logs. Many of the deeper wells were drilled in the 1950’s and early 60’s following the initial Leduc oil discovery in 1947.
- Carbonate rich shales and overpressured in central basin away from reef margins.

Source: geoSCOUT, BMO Capital Markets
Cross Section: West Shale Basin

- West Shale Basin oil window is currently data poor in our focus area, with limited well control in comparison to the Kaybob and/or Willesden Green regions.
- Morningside/Ferrybank as well as portion of West Shale Basin are more quartz-rich.
- Data also suggests there to be a slightly higher clay component in the shale although the quartz/carbonate proportion remains sufficiently high in most areas.
Net Shale Pay – Total and Upper Duvernay

Source: geoSCOUT, BMO Capital Markets
‘El Diablo’ Limestone Isopach

- ‘El Diablo’ tight limestone separates Upper and Lower Duvernay Shales
- Industry consensus that >3-5m of tight limestone may act as an effective vertical frack barrier.
- El Diablo thin or absent in the Westerdale Embayment.
- Thick tight limestone in the Ghost Pine Embayment. Development in benches likely necessary to maximize resource capture. Lower Duvernay to be targeted by Outlier in one well in 2018.

Source: geoSCOUT, BMO Capital Markets
East Duvernay Core

- Consistent, organic rich sections in the Upper Duvernay in the Westerdale Embayment
- Carbonate stringers/reef detritus common in areas adjacent to Leduc reefs

Source: geoSCOUT, BMO Capital Markets
True Vertical Depth – Top Duvernay

• Well costs sensitive to True Vertical Depth which ranges from ~1,800 – 3,600m in the East Duvernay.

• Optimal depth range of 2,000 – 2,600m for minimal rig days/monobore drilling
## OOIP Estimates by Area

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<td>Cygnet-Joffre</td>
<td>Ferrybank</td>
<td>Huxley-Twining</td>
<td>Bigoray-Pembina</td>
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<td>Net Pay (m)</td>
<td>30</td>
<td>11</td>
<td>25</td>
<td>13</td>
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<tr>
<td>Porosity (%)</td>
<td>5.0</td>
<td>6.0</td>
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<td>Sw</td>
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<td>1.2</td>
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<tr>
<td>OOIP/sec (mmbbl)</td>
<td><strong>18.3</strong></td>
<td><strong>8.1</strong></td>
<td><strong>13.7</strong></td>
<td><strong>7.5</strong></td>
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- OOIP estimate range of 7-18 mmbbl per section.
- Net pay has largest impact on estimates. OOIP highest at Cygnet-Joffre and lowest in the thinner pay areas of Ferrybank and Bigoray/Pembina.
- Water saturation very low throughout the play at 10-15%.
- More data required at Bigoray-Pembina.
East Duvernay – Sweet Spots

• BMO interpretation of geological sweet spots:
  1. Continuous net shale pay in the Upper Duvernay of >10m
  2. Relatively shallow depths of ~2,000-2,600m,
  3. Thermal maturity within the oil window (Tmax 435-455°C).
  4. Location in central basinal areas, not directly adjacent to Leduc reefs in over pressured regions.

• Geology in the Cygnet-Joffre, Twining-Huxley, and Pigeon Lake regions exhibit all these qualities.
East Duvernay – Crown Landsales

- Total crown bonuses in the play were >$300 million in 2017.
- Some parcels exceeded $2,000/acre, with the most expensive located in the Huxley/Twining area in the Ghost Pine Embayment and Cygnet in the Westerdale Embayment.
- Most of the prospective fairway now leased. Expect further postings in the more frontier areas of the West Shale Basin in 2018.
• Artis, Raging River, and Vesta hold the largest land positions at ~250,000 acres each

• PrairieSky has over 1 million acres of Duvernay royalty lands, of which ~80% is currently leased

• Positions of Crescent Point and Teine currently not fully disclosed

• Near term transactions possible from TAQA, Blackspur, Outlier, Raging River, Chronos, and Crescent Point
East Duvernay – Activity (Oil Window)

- 59 wells on production, largely by Vesta and Artis, and 35 awaiting completion and/or tie-in.
- New entrants include Raging River and Crescent Point as well as privately held Teine, Mancal, Outlier, Rife Resources.
- Two brokers (Black Bear and Canadian Coastal) drilling horizontal exploration wells in West and East Shale Basin.
East Duvernay – Well Results (Oil Window)

- Historical data reflect choke/management of production results to maximize land capture strategies.
- In addition, results pre-2017 reflect experimentation of the completion recipe/lateral lengths.
- Recent 2017 results have been stronger, with average peak rates in the 300-400bbl/d range vs <200bbl/d in previous years.

**Vintage Production vs. Time**

**Vintage Cumulative Production vs. Time**

Notes: BMO Tier 1 Type Curve: IP30 rate of 400bbl/d and EUR of 370mbbl, BMO Tier 2 Type Curve: IP30 rate of 300bbl/d and EUR of 277mbbl
East Duvernay – Key Recent Wells

Source: geoSCOUT, BMO Capital Markets
East Duvernay – Lateral Lengths

- Lateral lengths in the play have generally increased with time, improving productivity vs. costs.
- Vesta currently drilling 2-mile laterals and Artis at ~1.5 miles. Newcomers to the play are drilling between 1-2 mile wells.

Source: geoSCOUT, BMO Capital Markets
East Duvernay – Completion Trends

# of Stages

Tonnes per Stage

Tonnes per Lateral Length
Key Upcoming wells

- Raging River’s delineation wells at Pigeon Lake (WSB), Chigwell (2-mile), and Gilby
- Vesta delineation wells in ‘southern extension’ area at Cygnet/Penhold
- Broker wells (Canadian Coastal and Black Bear) in the West Shale basin oil window
- Teine’s 4 well vertical strat test program at Pembina-Bigoray in the West Shale Basin
- Step out wells to the east in the Ghost Pine Embayment by Mancal, Canadian Coastal, Rife, and Outlier.
## East Duvernay – Economics

<table>
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<tr>
<th>Rates and Costs</th>
<th>ESB Tier 1 - Crown - ERH</th>
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<th>ESB Tier 2 - Crown - ERH</th>
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<td>453</td>
<td>340</td>
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<td>EUR/well (boe)</td>
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<tr>
<td>% Liquids</td>
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<td>88%</td>
<td>88%</td>
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<td>Total Costs</td>
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<td>F&amp;D Costs ($/boe)</td>
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<td>Recycle Ratio</td>
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<td>Average royalty rate</td>
<td>9.9%</td>
<td>17.5%</td>
<td>6%</td>
<td>17.5%</td>
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<td>Capital Efficiency - 12mo ($/boe/d)</td>
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<td>Operating Netback ($/boe)</td>
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<td>39.34</td>
<td>45.74</td>
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### Economics - Before Tax

| NPV10 | $mm | 6.8 | 5.4 | 3.9 | 2.5 |
| NPV10 | $/boe | 16.19 | 12.97 | 12.45 | 8.10 |
| P/I Ratio | 1.2x | 1.0x | 0.7x | 0.5x |
| IRR | 77% | 55% | 41% | 28% |
| Payback period | years | 1.4 | 1.8 | 2.3 | 2.9 |

### Economics - After Tax

| NPV10 | $mm | 4.6 | 3.6 | 2.5 | 1.5 |
| NPV10 | $/boe | 11.02 | 8.66 | 8.01 | 4.84 |
| P/I Ratio | 0.8x | 0.7x | 0.5x | 0.3x |
| IRR | 50% | 38% | 29% | 21% |
| Payback period | years | 1.9 | 2.3 | 2.8 | 3.6 |

Notes: Assumes $55/bbl WTI flat price, C$1.88/mcf AECO, and $0.80 CAD/USD

Source: geoSCOUT, BMO Capital Markets
East Duvernay – Economics

**US$ WTI Breakeven (10% Hurdle Rate)**

- ESB Tier 1 - Crown - ERH
- ESB Tier 1 - Freehold - ERH
- ESB Tier 2 - Crown - ERH
- ESB Tier 2 - Freehold - ERH

**US$ WTI Breakeven (20% Hurdle Rate)**

- ESB Tier 1 - Crown - ERH
- ESB Tier 1 - Freehold - ERH
- ESB Tier 2 - Crown - ERH
- ESB Tier 2 - Freehold - ERH

Source: geoSCOUT, BMO Capital Markets
East Duvernay – Economics

Source: geoSCOUT, BMO Capital Markets
The Prize and The Risks

Prize:
- Lots of oil: >20bnbbl of OOIP in East Shale Basin alone. Potentially one of the biggest oil plays in Western Canada
- High netback production, with limited solution gas at moderate drilling depths. Outside gas takeaway bottlenecks.
- Relatively lower well costs vs. Kaybob Duvernay.

Risks:
- Early days on type curve, productivity, and the understanding of the geology. Tail of type curve also still unknown and can impact EUR and economics.
- Delineation drilling/completion costs are initially high at +$7 million per well. To achieve reasonable full cycle economics, well costs need to move to $4.75-5.5 million per well.
- Water usage for fracture stimulation could be an issue, if activity ramps up significantly in the region. Activity is near some populated regions (Sylvan Lake, Red Deer, etc).
- Increased offset drilling obligations due to freehold checkboard lands.
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