Pembina Cardium Oil Forecasting: A Modern Approach

Randy Freeborn, P. Eng.
Agenda

• Methodology description: Value Navigator Analog Forecasting and Auto-forecasting
• Validation of methodology
• Results
• Further investigation: Principle operators oil EUR per well by year
• Tips, Pitfalls and Conclusions
Scope: How would Energy Navigator Forecast these wells?

- 984 wells drilled into the Pembina Cardium on production 2003-2013 for forecasting [45-01W5 to 51-13W5].
- Four major operators have placed more than 500 wells on production
- EN divided the dataset into 19 geographical areas, well counts ranged from 4 to 193
- Four areas were selected to validate the Analog Forecast methodology.
- 14 wells were not forecast because they were suspended, injecting water, gas producers or sub-economic.
SCOPE:
- 984 Cardium wells on production 2003-2013 provided by client for forecasting.
- Created 19 geographical areas, well counts from 4 to 193
- Four areas selected to validate Analog Forecast methodology.
Methodology

- Approximately 700 wells with sufficient history were forecast using the Five Year Equation, a hyperbolic transitioning to exponential five years from the start of the forecast.
- The balance of forecasts were created using Energy Navigator’s Analog forecast method that imposes a type well shape onto existing production.
- Analog wells were created for each of the 19 areas.
Validation of Methodology

• Predict 2011 wells using type wells created from prior years drilling, compare against 2012 production for four areas with well counts ranging from five to 36.

• P50 type wells were created from wells placed on production during 2009 to 2010 with production to YE2010.

• Type well forecasts were vertically shifted to align with available from new wells on production in 2011 with production to YE2011.

• Actual data from January 2012 to February 2013 was compared with results from type well approach. Forecasts ranged from -7% to +9% versus actual oil production.
Validation Using Historical Data

**West Pembina-North 85 Wells Forecast Test**

- Actuals: Green line
- Forecast: Red line
- Forecast Error: Blue box

**West Pembina 31 Wells Forecast [Sparse Early Data Test]**

- Actuals: Green line
- Forecast: Red line
- Forecast Error: Blue box

**Rat Creek 70 Wells Forecast Test**

- Actuals: Green line
- Forecast: Red line
- Actual Error: Red box

**East Pembina Tight Rock 55 Wells Forecast Test**

- Actuals: Green line
- Forecast: Red line
- Actual Error: Red box
## Validation Details

<table>
<thead>
<tr>
<th>AREA</th>
<th>Nominal Location</th>
<th># Early wells available for Type Well development</th>
<th>Average TW Production [months]</th>
<th># 2011 Wells Forecast</th>
<th>EN vs. Jan 2012-Feb 2013 Actuals [cumulative oil volume]</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Pembina-North</td>
<td>50-11 to 51-13W5</td>
<td>28</td>
<td>6</td>
<td>85</td>
<td>-6%</td>
</tr>
<tr>
<td>West Pembina</td>
<td>49-12 to 51-13W5</td>
<td>5</td>
<td>8</td>
<td>31</td>
<td>+9%</td>
</tr>
<tr>
<td>Rat Creek</td>
<td>48-11 to 49-12W5</td>
<td>36</td>
<td>17</td>
<td>70</td>
<td>+3%</td>
</tr>
<tr>
<td>East Pembina Tight Rock</td>
<td>47-01 to 50-10W5</td>
<td>19</td>
<td>9</td>
<td>55</td>
<td>-7%</td>
</tr>
</tbody>
</table>
Finally, Forecast Results

**PEMBINA CARDIUM FORECAST vs. Time**

- ALL CARDIUM WELLS BOCD
- WELLCOUNT

**PEMBINA CARDIUM FORECAST vs. Cumulative Oil**

- ALL CARDIUM WELLS BOCD
- FORECAST START
- WELLCOUNT
Has the Pembina Cardium Oil EUR improved over time?

Pembina Cardium Wells; Principal Operators
Caution: 2013 data not statistically significant

VERMILION ENERGY INC.
PENN WEST PETROLEUM LTD.
PETROBAKKEN ENERGY LTD.
SINOPEC DAYLIGHT ENERGY LTD.
OVERALL AVERAGE EUR
OVERALL COUNT

Oil, bbl

2010 2011 2012 2013Q1

140,000
120,000
100,000
80,000
60,000
40,000
20,000
0

115
206
178
17
Tips and Pitfalls

- The Val Nav auto-forecast feature [below left] should generally be applied rather than type curves when more than a handful of ‘fit’ points are found:

13-26-045-11W5M:
Tips and Pitfalls continued

- Review results carefully for reasonableness:
  - When groups of wells are fit with the Tools > Apply/Remove Type Curve, forecasts must be reviewed for reasonableness. In rare cases an N/A forecast is returned which drops a well from the forecast.
  - Wells with less than a few hundred hours of production were assigned a type curve factor of 1 to 1.5. The auto type-fit in Value Navigator would sometimes pick values far too high [for example, an EUR of three million barrels] over short production periods.
  - The evaluator must be careful the type wells created in Value Navigator point to the desired EUR.
Conclusions and Extensions

- Over 900 Pembina Cardium wells were forecast; a quarter of these were validated and resulted in accuracy of -7% to +9% versus observed actuals.
- Results could be extended with volumetric calculations and geological mapping.
- Wells appear to be performing on the order of 35% less than published in various news releases, this was not analysed in detail.
Resources

- [http://www.onepetro.org/](http://www.onepetro.org/)