



DEVELOPMENTS IN UTICA SHALE ECONOMIC POTENTIAL

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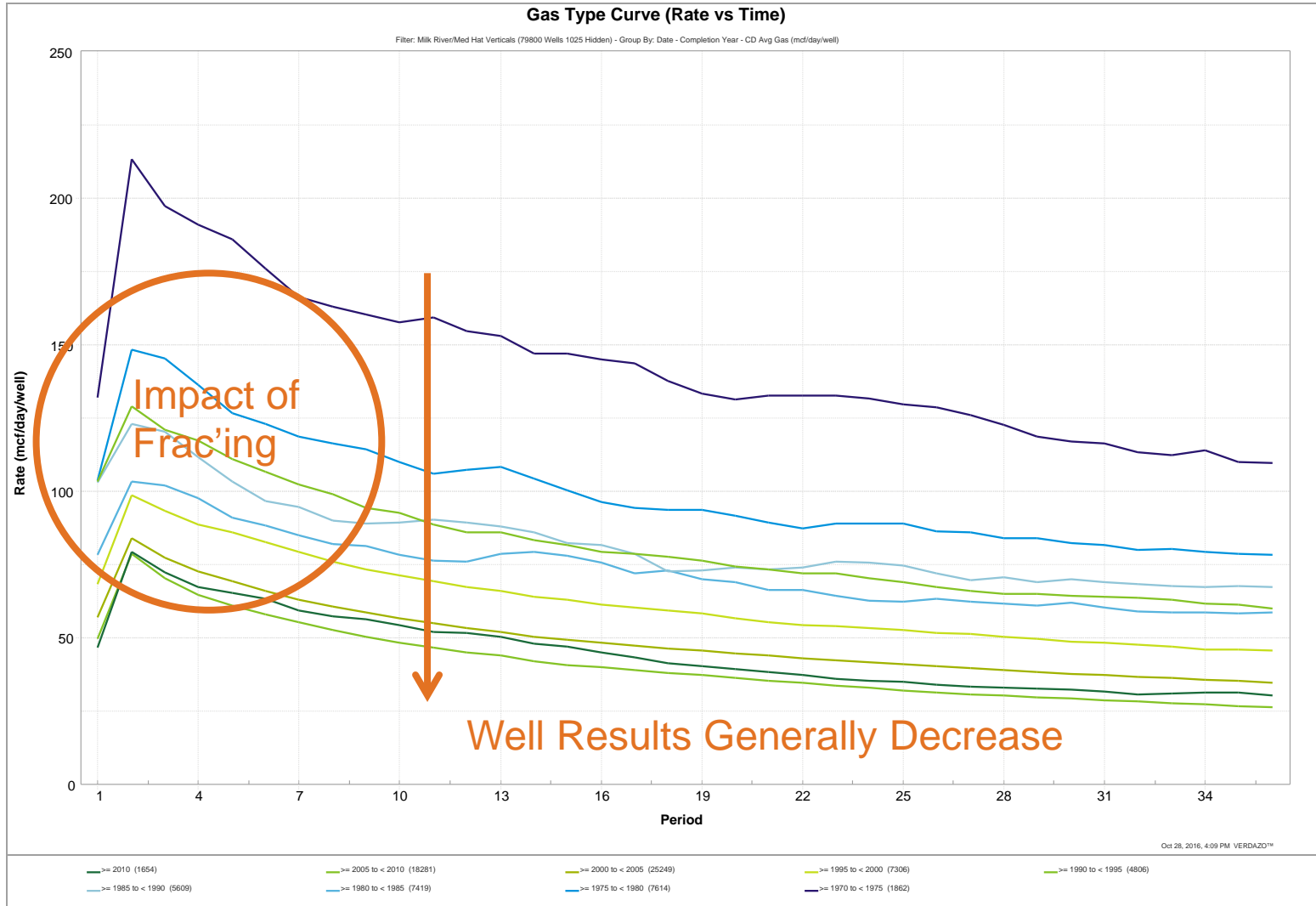
THREE MAIN POINTS

- How are new technologies implemented in the oil and gas sector?
- Which new technologies and/or new applications are the most promising?
- How can technologies best be used in Quebec?

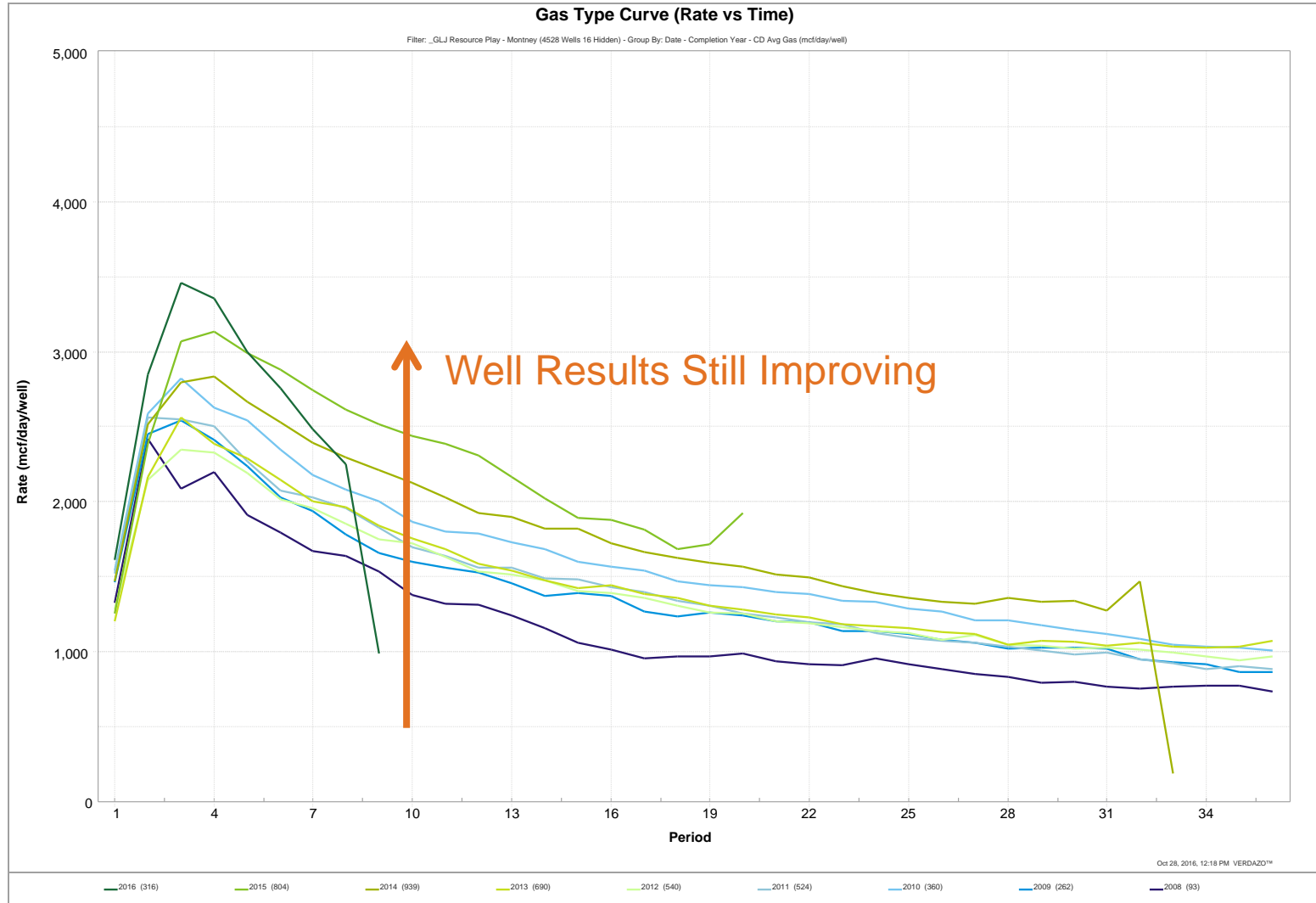
NEW TECHNOLOGIES ARE IMPLEMENTED INCREMENTALLY

- Conventional oil and gas resources
 - Reservoir quality dominates
 - Technical improvements cannot keep up with decreases in reservoir quality
 - Overall results worsen over time
- Unconventional oil and gas resources
 - Well stimulation dominates
 - Technical improvements exceed decreases in reservoir quality
 - Overall results improve over time
- General progression: incremental everything
 - Drilling rate (bit selection, weight on bit)
 - Cost control
 - Pumping rates
 - Working fluids
 - Proppant
 - Number of fracture stages
 - Frac job sizes

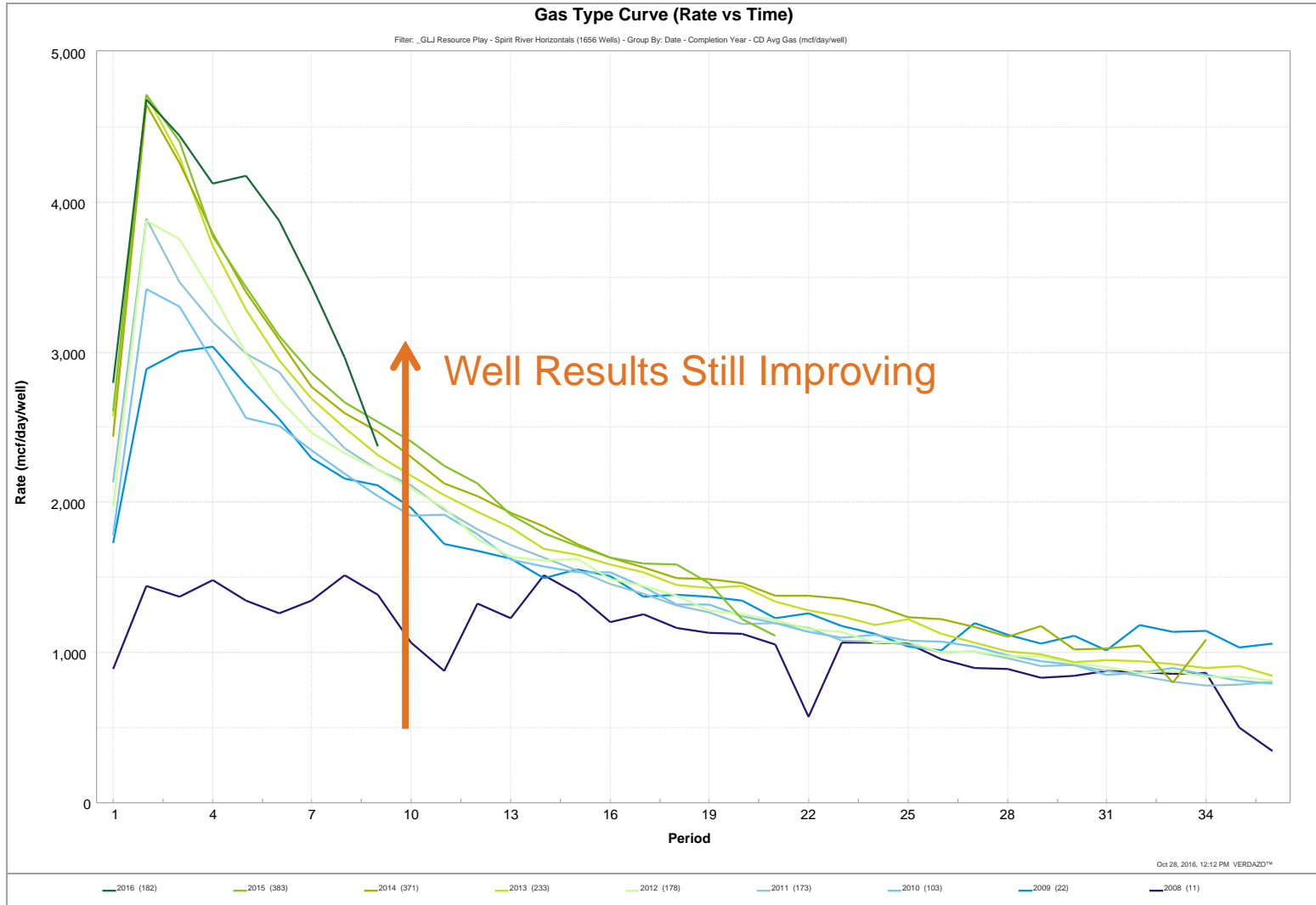
MILK RIVER/MEDICINE HAT (CONVENTIONAL) PRODUCTION



MONTNEY WELL PRODUCTION



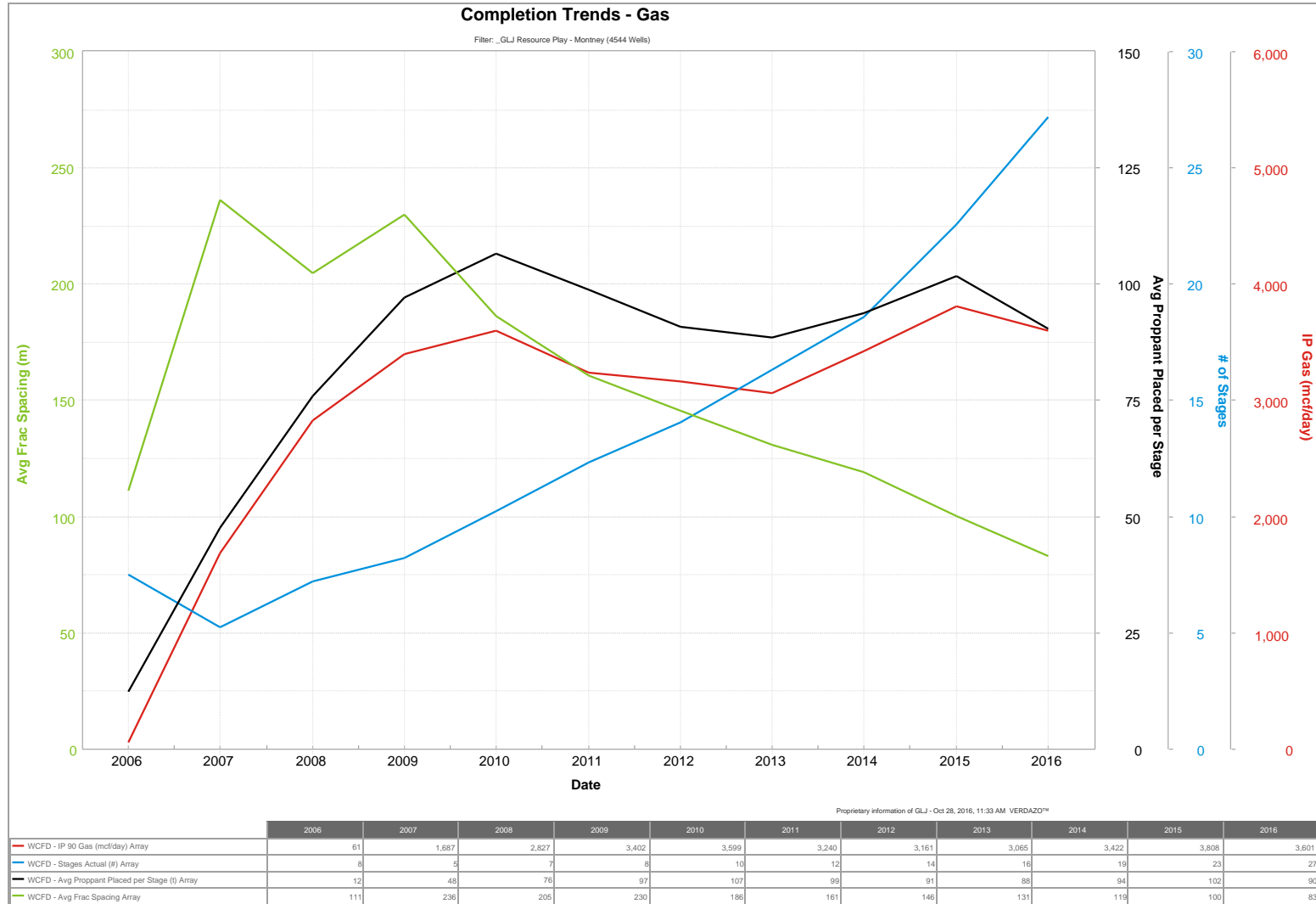
SPIRIT RIVER WELL PRODUCTION



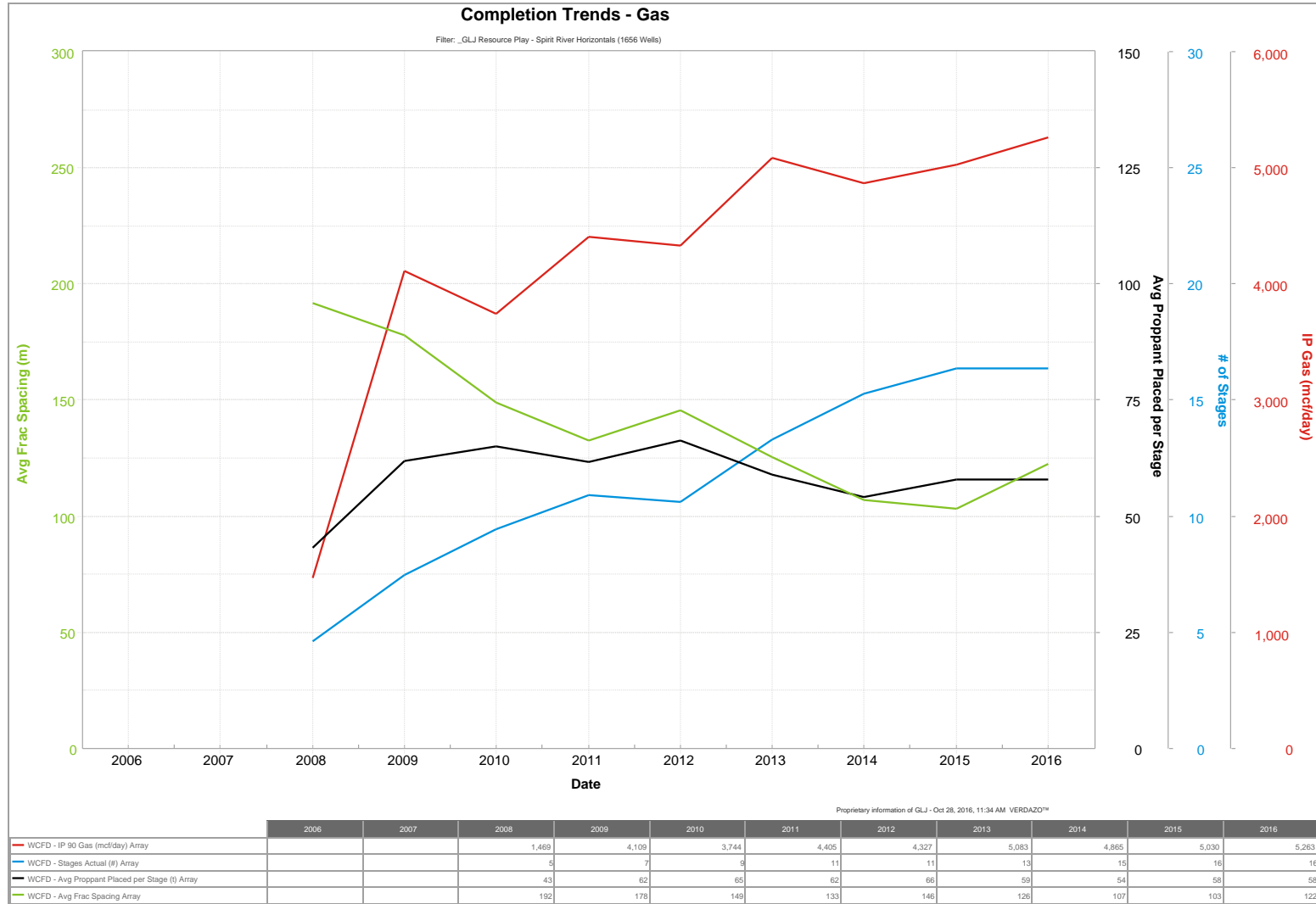
THE MOST PROMISING TECHNOLOGIES INCREASE COMPLETION PRECISION

- More selective fracturing
 - Openhole bullhead
 - “Plug and Trust” multi-frac
 - Individual stage sealing
- Increasing number of stages
 - Vertical (1)
 - Single-stage hz (1)
 - Multi-stage bridge plug hz (4)
 - Plug and perf (8 to 16)
 - Ball drop (12 to 24)
 - NCS (40 to 90+)
- More sensitive monitoring
 - Pressure and rate monitoring
 - Mini-frac tests
 - Micro-seismic
 - Experimental DTS and DAS
- Increasing frac job sizes
- Tighter spacing between wellbores (400 m to 300 m to 200 m)

MONTNEY COMPLETION TRENDS

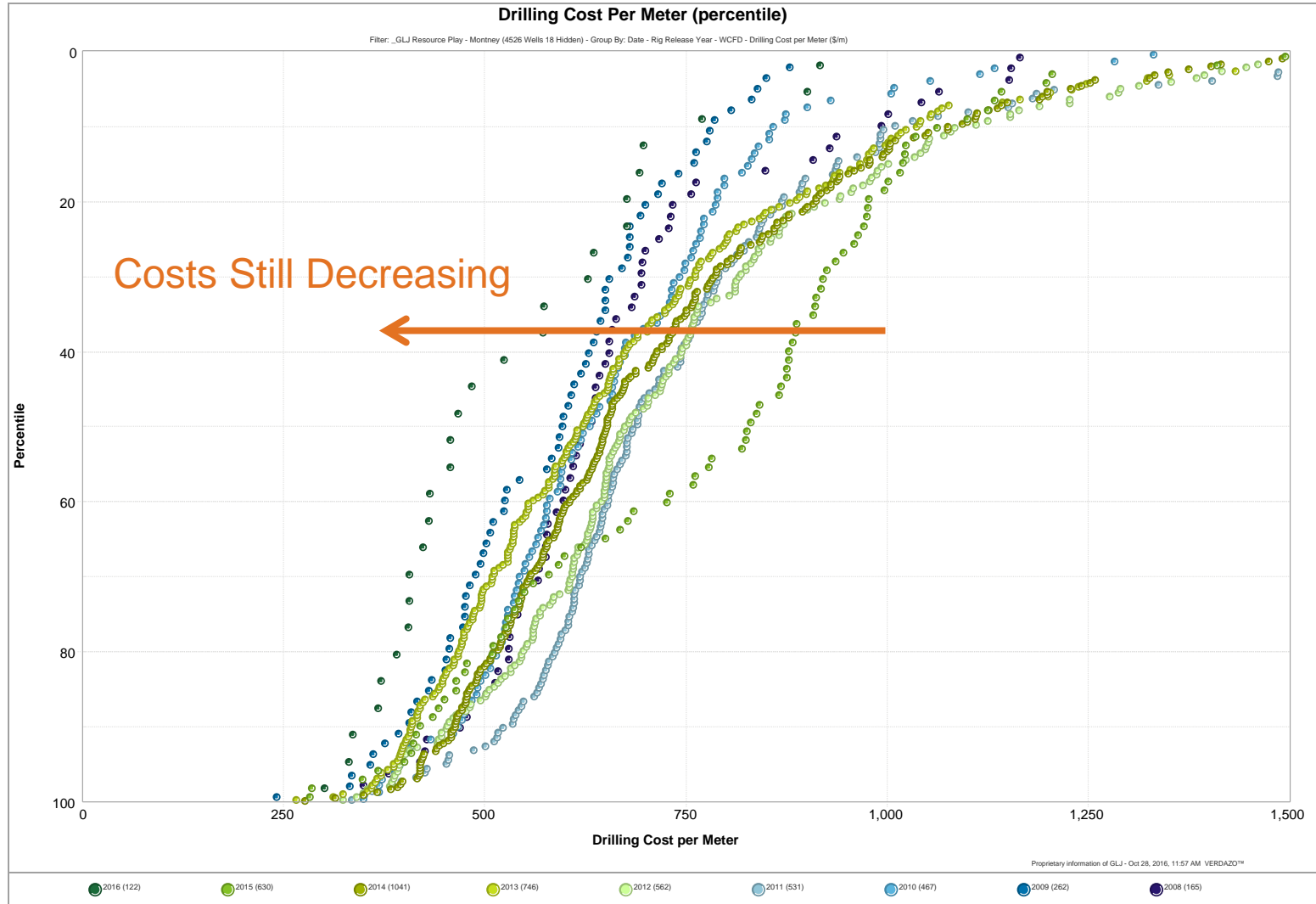


SPIRIT RIVER COMPLETION TRENDS

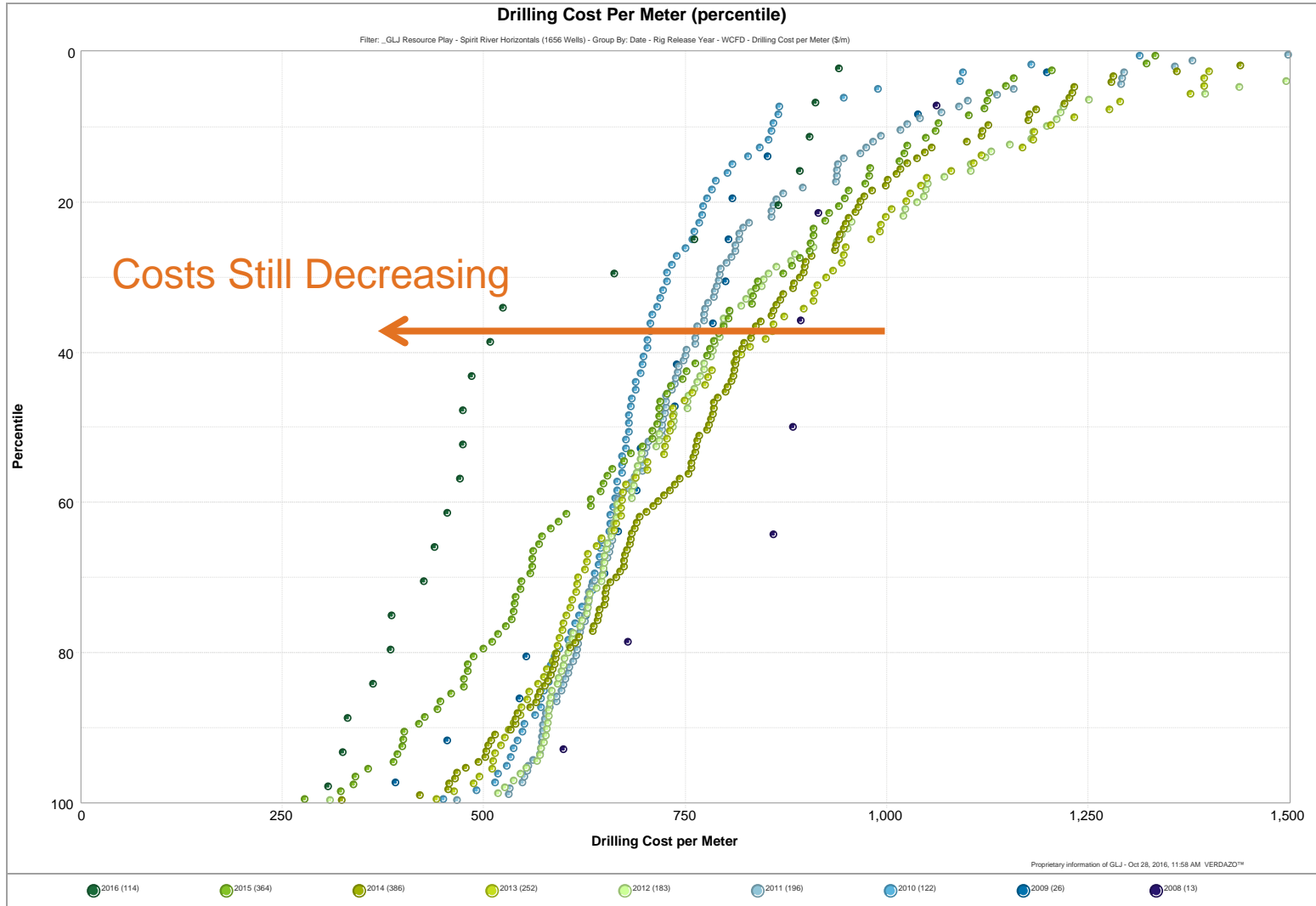


- Longer horizontal wells
 - 1 mile was common
 - 1.5 mile is now routine
 - 2+ mile has been successfully demonstrated
 - Reduced need for well pads and other surface disturbances
 - Greater offset distance from neighbours
- More wells per pad
 - 12 wells was planned
 - 24+ wells now planned
- Reduced completion time
 - Overall reduction in surface operations
- Dedicated water pipelines and centralized water handling
 - High initial cost, but expect economy of scale
 - Reduced road traffic

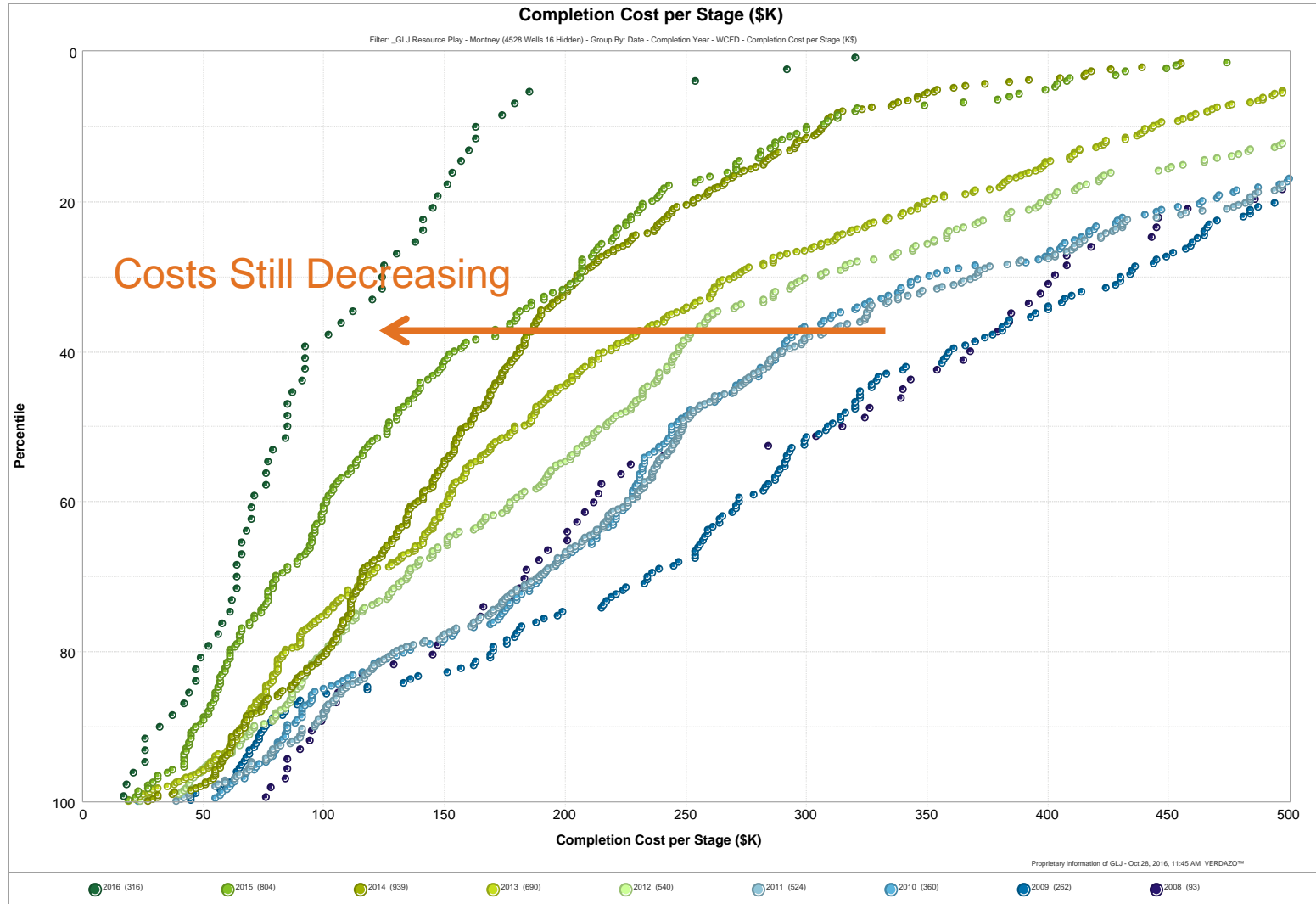
MONTNEY DRILLING COSTS



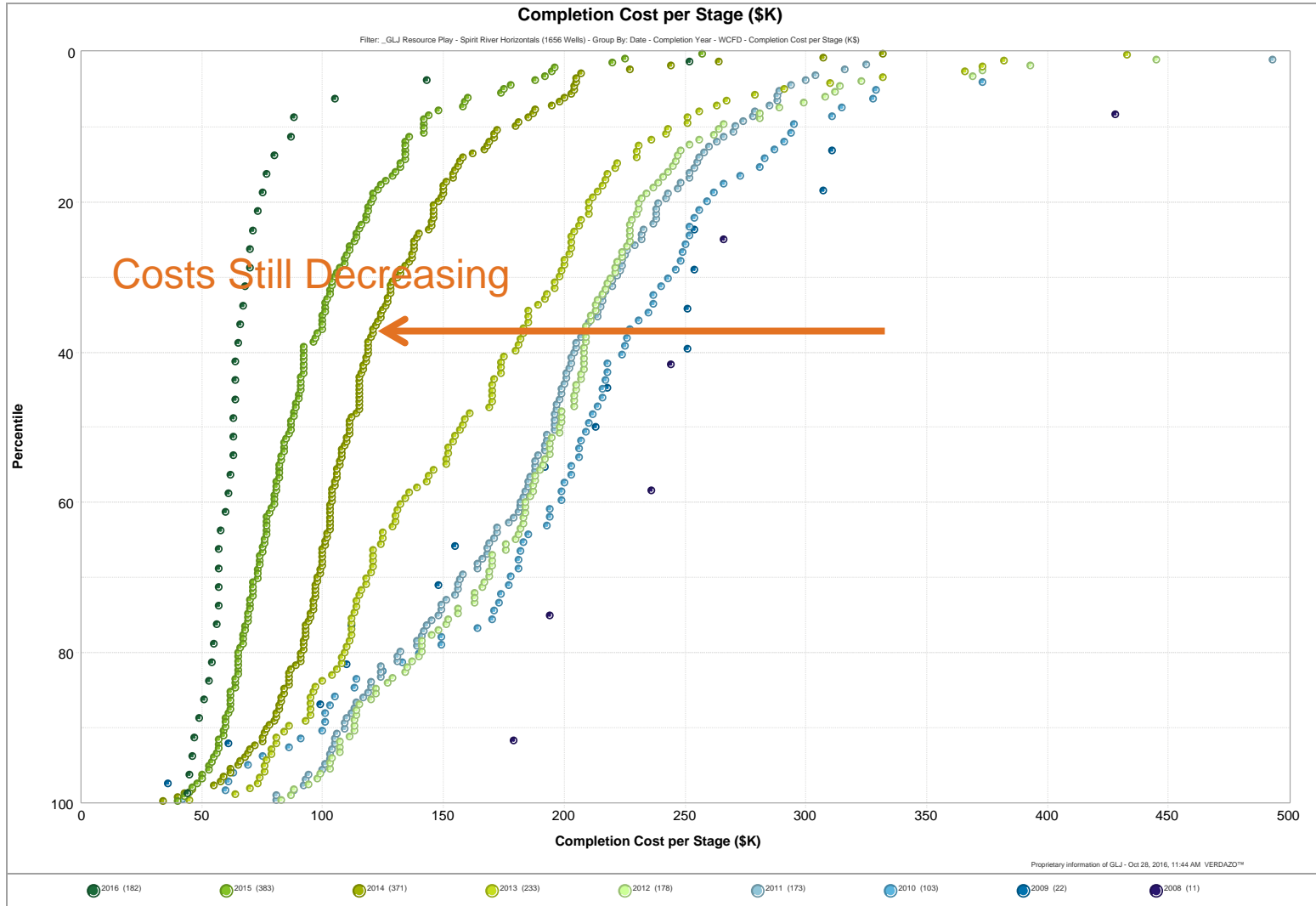
SPIRIT RIVER DRILLING COSTS



MONTNEY COMPLETION COSTS



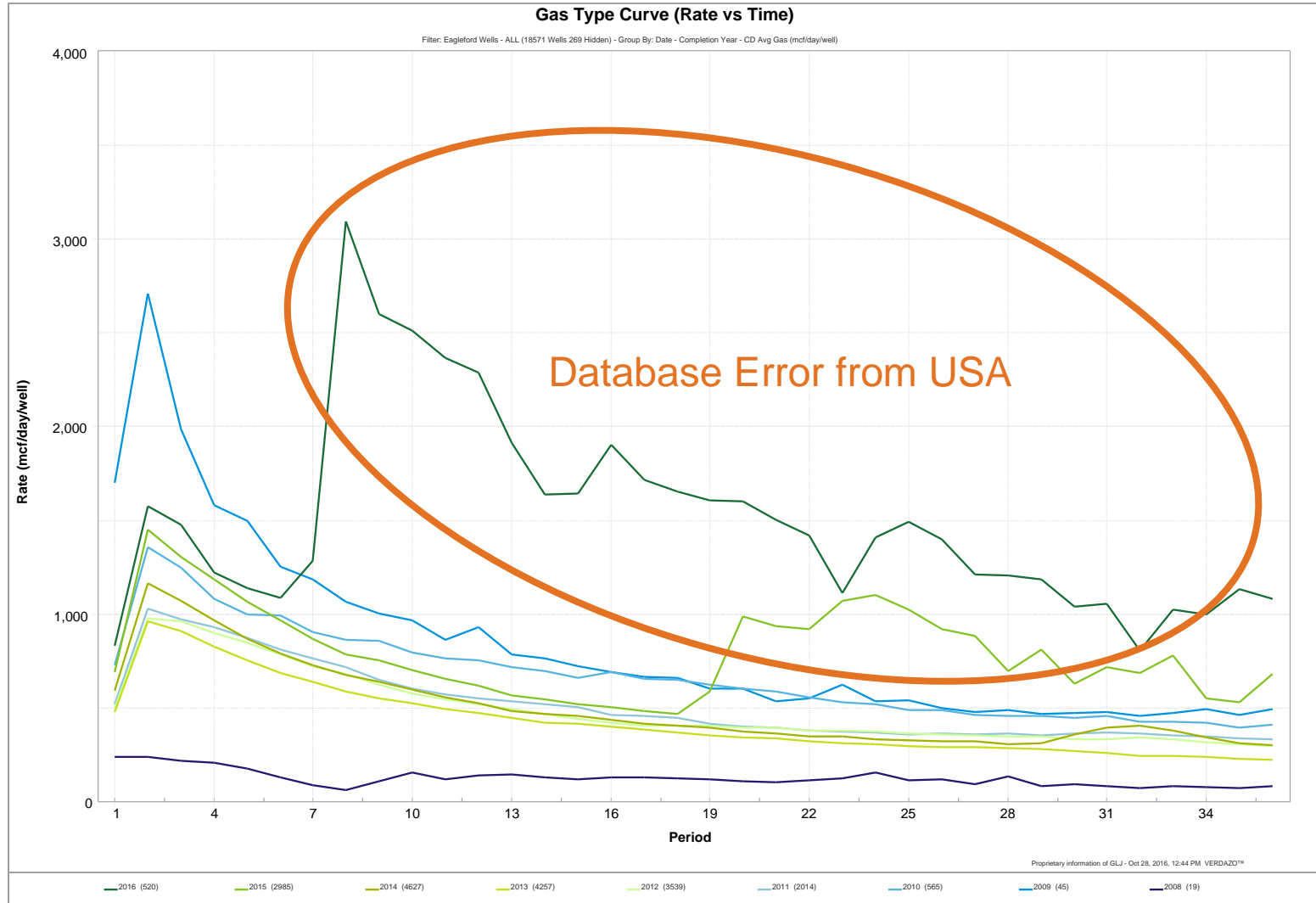
SPIRIT RIVER COMPLETION COSTS



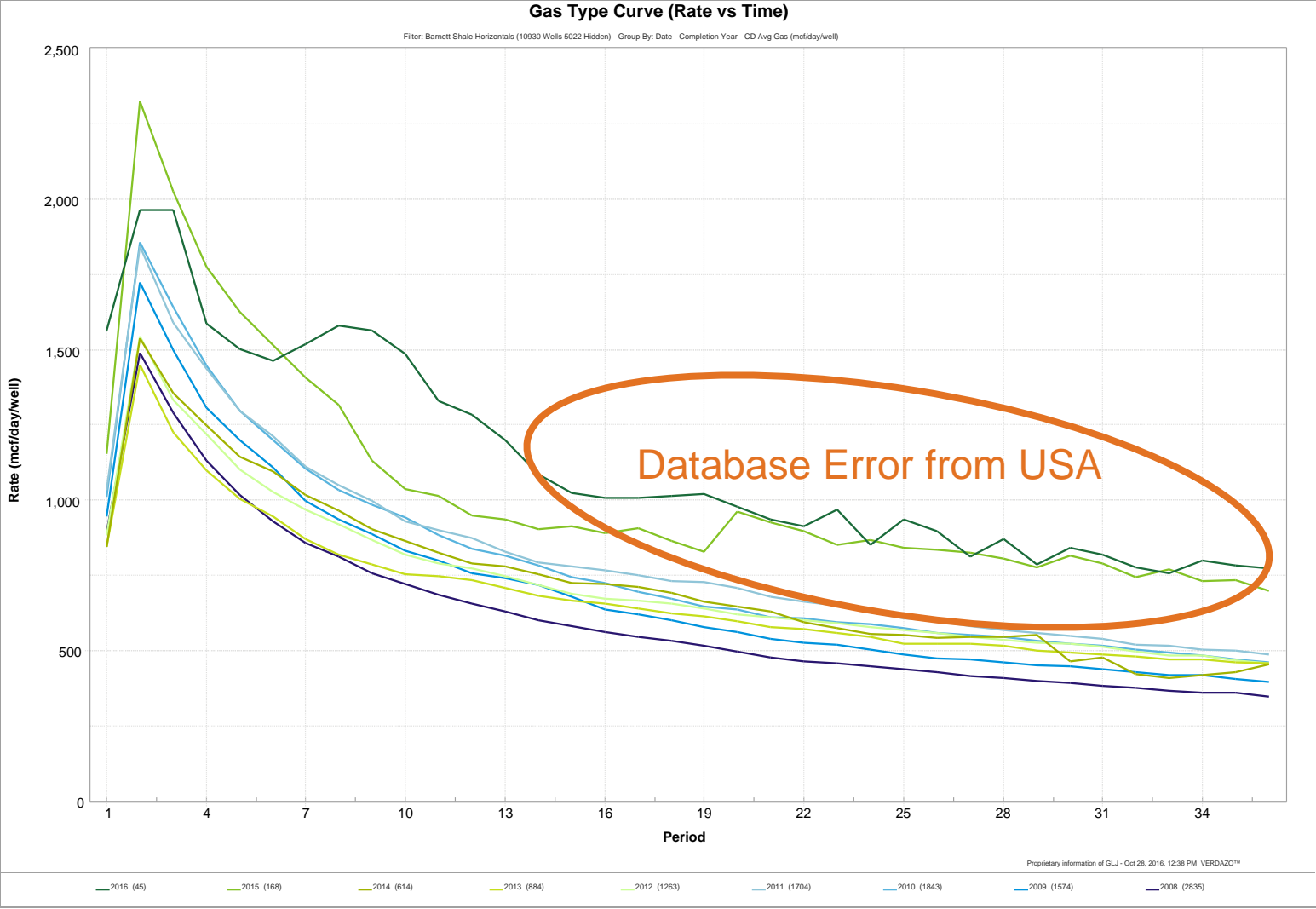
TECHNOLOGIES CAN BEST BE USED IN QUEBEC BY:

- Facilitating access to data
 - Geotechnical
 - Environmental baseline
 - Production and operational results
 - Capital costs
 - Integration with existing datasets
- Transparency is critical when there's elevated public scrutiny

EAGLEFORD WELL PRODUCTION



BARNETT WELL PRODUCTION



UTICA PROPERTIES

- 40 - 200 m thick
- 2.5 to 5.0% TOC
- Mostly methane
- 300 to 500 m deep at northwest edge
- 1,800 m deep at southeast edge
- This is shallower, often thinner, than other gas resources
- Average of 60 Bcf/section
 - 85 Bcf/section for best Ohio Utica
 - 150 Bcf/section for best Marcellus
 - 250 Bcf/section for best Montney

REPORTED PLANS FOR WELL LENGTH

Company	Formation	Length (ft)	Length (m)
Consol Energy	Ohio Utica	7,000	2,135
Gulfport Energy	Ohio Utica	8,000	2,440
RICE Energy	Pennsylvania Marcellus	7,000	2,135
RICE Energy	Ohio Utica	9,000	2,745
PDC	Ohio Utica	6,000 (10,000 proposed)	1,830 (3,050 proposed)
Eclipse Resources	Ohio Utica	13,000 (proposed)	3,960 (proposed)
Eclipse Resources	Ohio Marcellus	10,000 (proposed)	3,050 (proposed)
Cabot Oil and Gas Corp	Pennsylvania Marcellus	7,000	2,135
Range Resources	Ohio Utica	7,000	2,135
Range Resources	Pennsylvania Marcellus - Dry	7,000	2,135
Chesapeake Resources	Marcellus	7,900 (10,000 proposed)	2,410 (3,050 proposed)

REPORTED PLANS FOR WELL SPACING

Company	Formation	Spacing (ft)	Spacing (m)
Consol Energy	Ohio Utica	1,100	335
Gulfport Energy	Ohio Utica	1,000	305
RICE Energy	Pennsylvania Marcellus	750	230
RICE Energy	Ohio Utica	1,000	305
PDC	Ohio Utica	700	215
Eclipse Resources	Ohio Utica	850	260
Eclipse Resources	Ohio Marcellus	750	230
Cabot Oil and Gas Corp	Pennsylvania Marcellus	700 to 800	215 to 245

REPORTED WELL COST ESTIMATES

Company	Formation	Cost per Well (USD)	Cost per Length
Consol Energy	Ohio Utica	6.5 \$MM	
Gulfport Energy	Ohio Utica	9.6 \$MM	1.200 \$MM/1000 ft
RICE Energy	Pennsylvania Marcellus		0.925 \$MM/1000 ft
RICE Energy	Ohio Utica		1.380 \$MM/1000 ft
Chesapeake Resources	Marcellus	8.2 \$MM	1.040 \$MM/1000 ft
Eclipse Resources	Ohio Utica	11.5 \$MM	1.170 \$MM/1000 ft
Eclipse Resources	Ohio Marcellus	7.4 \$MM	
Cabot Oil and Gas Corp	Pennsylvania Marcellus	6.7 \$MM	
Range Resources	Pennsylvania Marcellus - Dry	5.2 \$MM	
Antero Resources	Pennsylvania Marcellus		1.140 \$MM/1000 ft
Antero Resources	Utica Ohio		1.290 \$MM/1000 ft

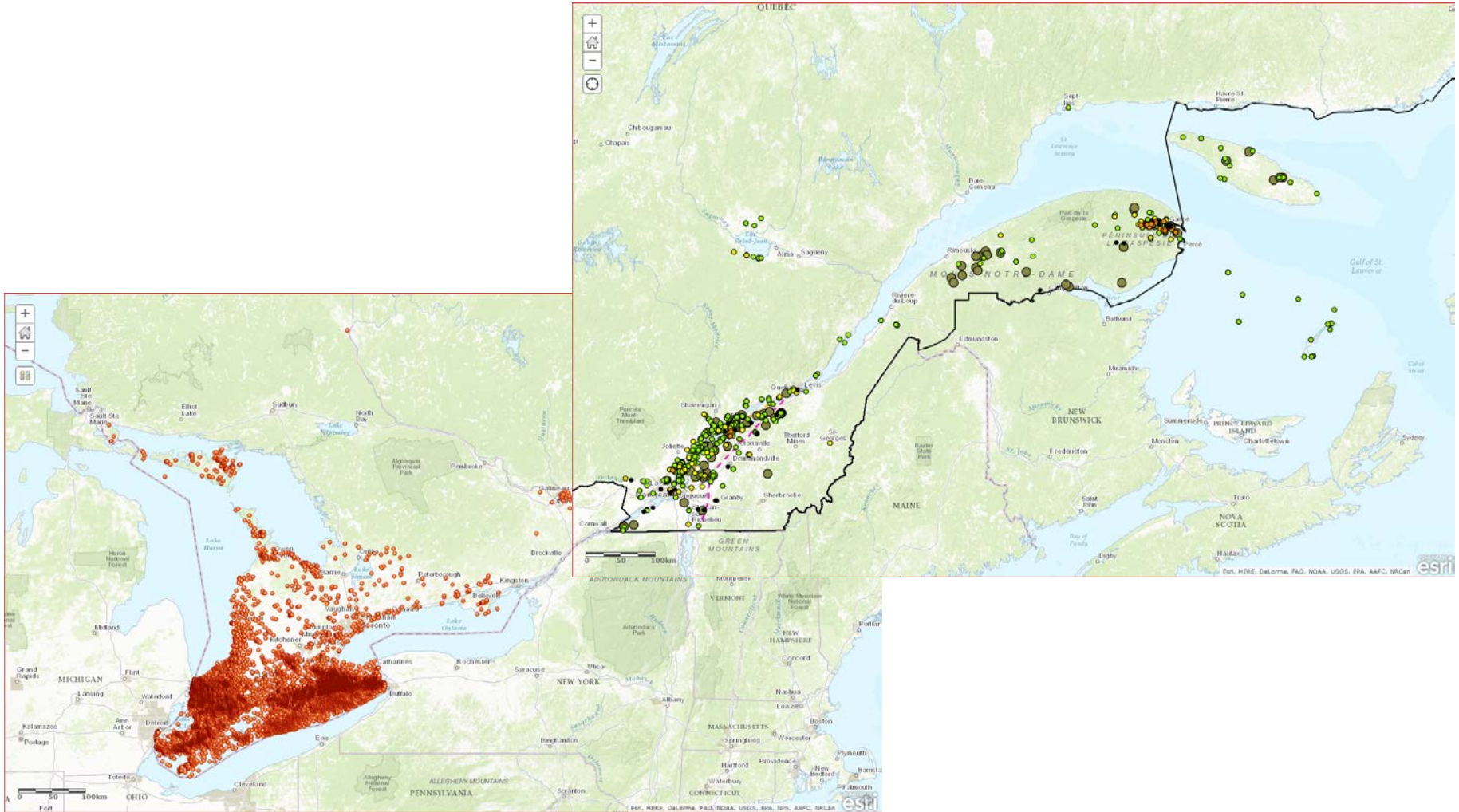
CURRENT ANALYSIS (TECHNICAL)

- 8 wells per pad with 2,400 m horizontals at 400 m spacing
- Each well is estimated to drain 3/8 sections (square mile)
- Limited data set with very preliminary test results that are encouraging
- Four years ago, expected 3 to 4 Bcf per well
- Now expect 6.5 to 8 Bcf per well
- Recovery factors estimated between 20 and 40%

CURRENT ANALYSIS (ECONOMIC)

- Drilling cost of 8 \$MM
- Premium price for gas: \$0.50/Mcf to \$1.50/Mcf over Henry Hub
- Expect solid economic results if development allowed
- Half cycle economics (drill, complete, tie-in) have expected development IRR of greater than 40%
- Full cycle economics (pipelines, plants, drill, complete, tie-in) have expected development IRR of greater than 20%

MOST ALBERTA'S DON'T KNOW: QUEBEC EXPLORED FOR GAS FIRST!



QUESTIONS AND COMMENTS

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