TECHNOLOGY AND INTELLIGENCE: Converting Tight Resources into Reserves

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Authors:
R.P. (Pete) Singbeil, B.Sc., P.Eng., Introspec Energy Group Inc.
Heather McCrank, B.Des., MBA, CMA, Canadian Discovery Ltd.

Canadian Discovery Ltd.

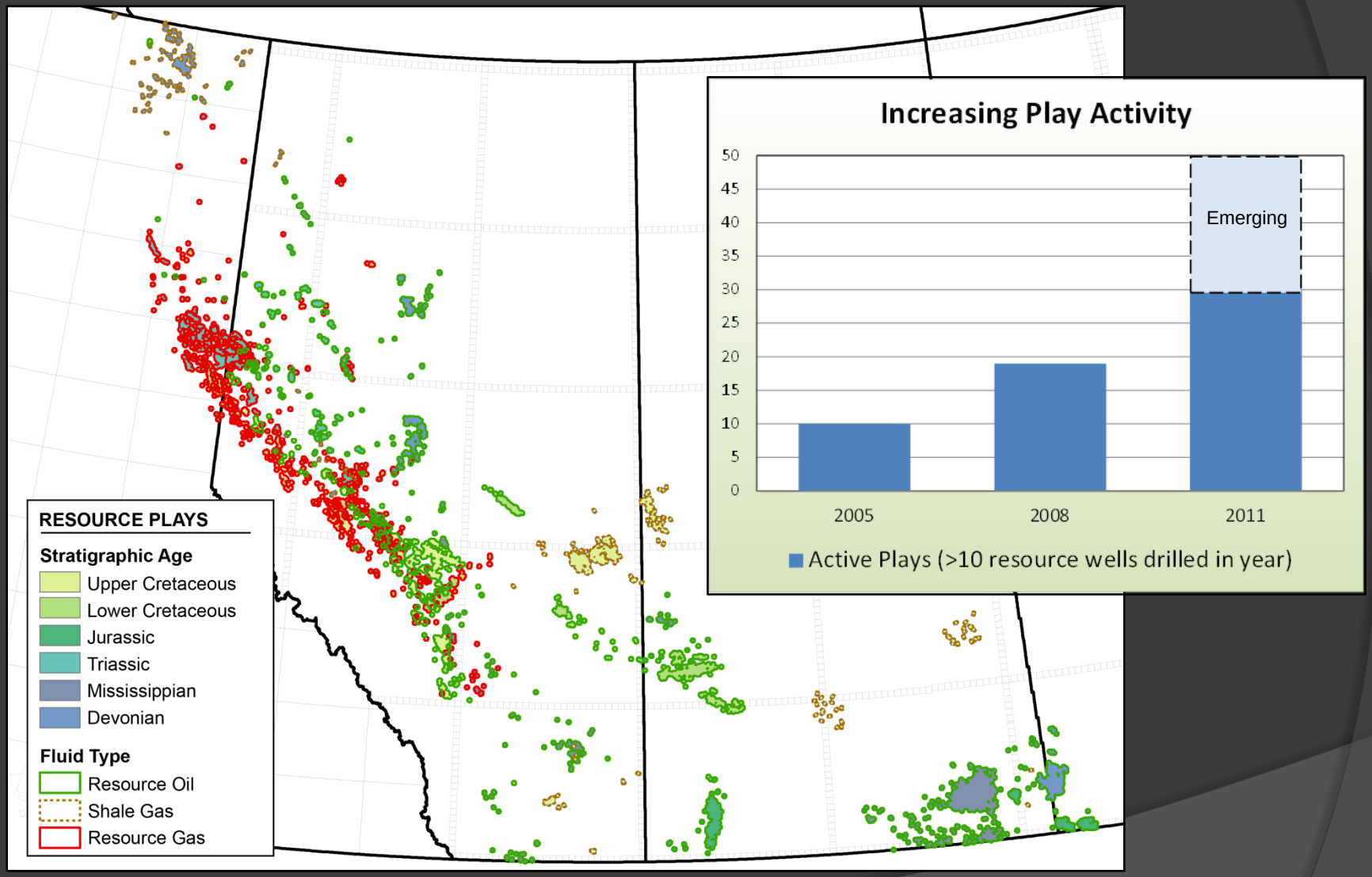
Introspec Energy Group Inc.

WELL COMPLETIONS & FRAC DATABASE

Agenda

- Resource Play Activity and Investment
- Case Study: Cardium Oil
- Case Study: Montney Distal Shelf Gas
- Case Study: Swan Hills/Slave Point Oil
- Aggregate Trends and Conclusions

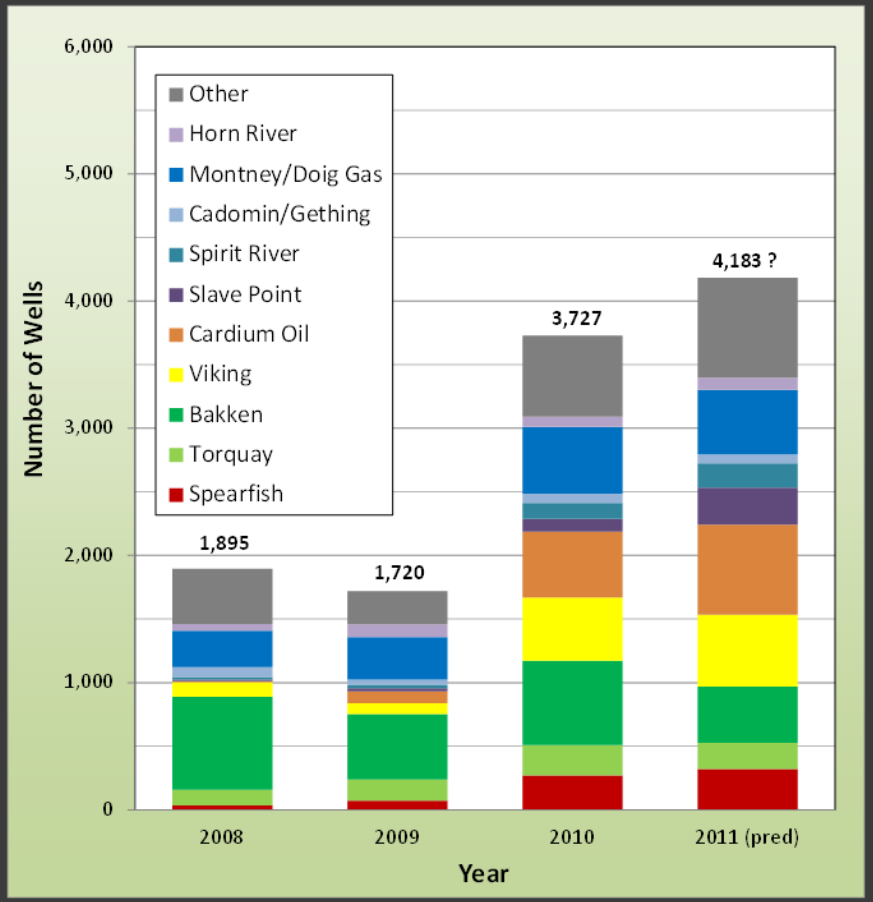
Resource Plays in Western Canada



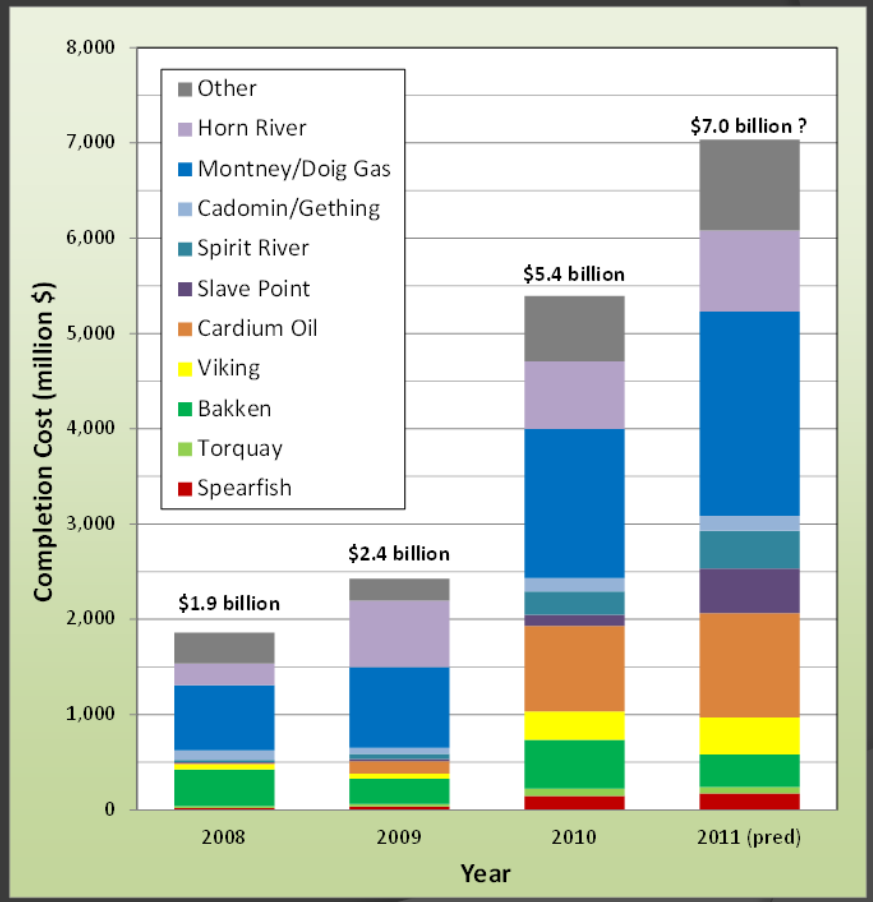
WELL COMPLETIONS & FRAC DATABASE

Resource Plays in Western Canada

Number of Wells by Resource Play Group

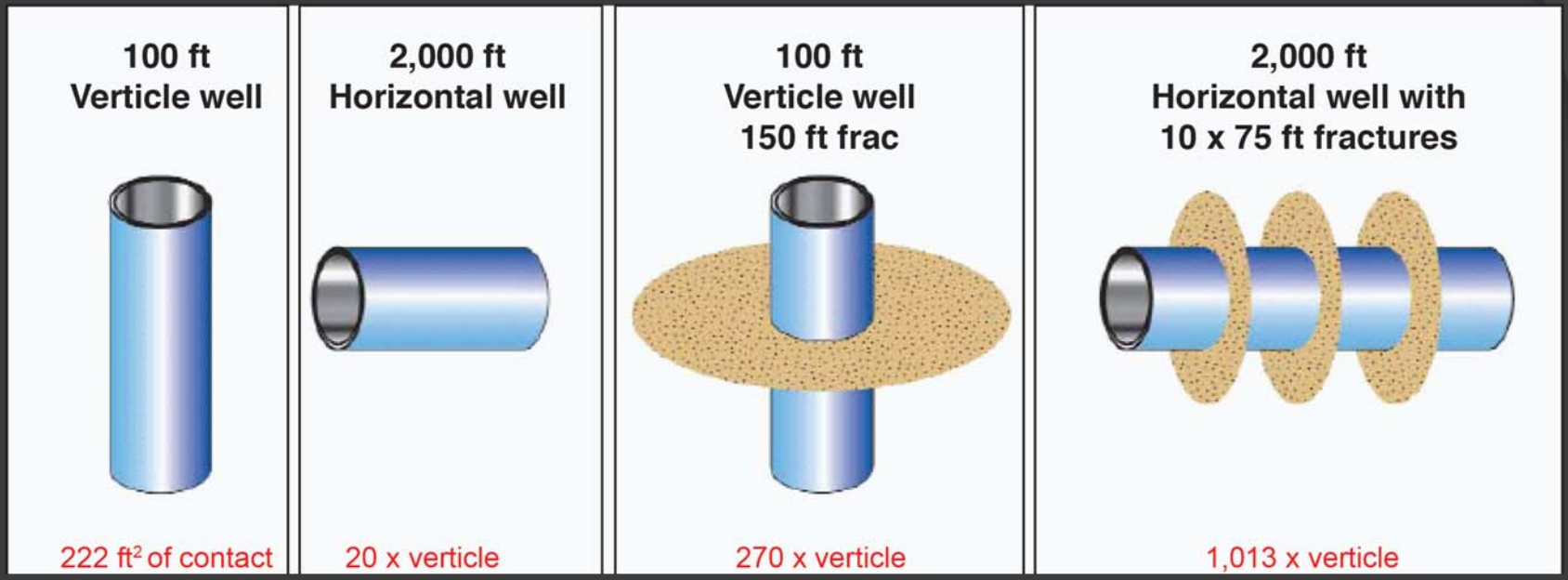


Total Completions Investment ($M) by Resource Play Group



WELL COMPLETIONS & FRAC DATABASE

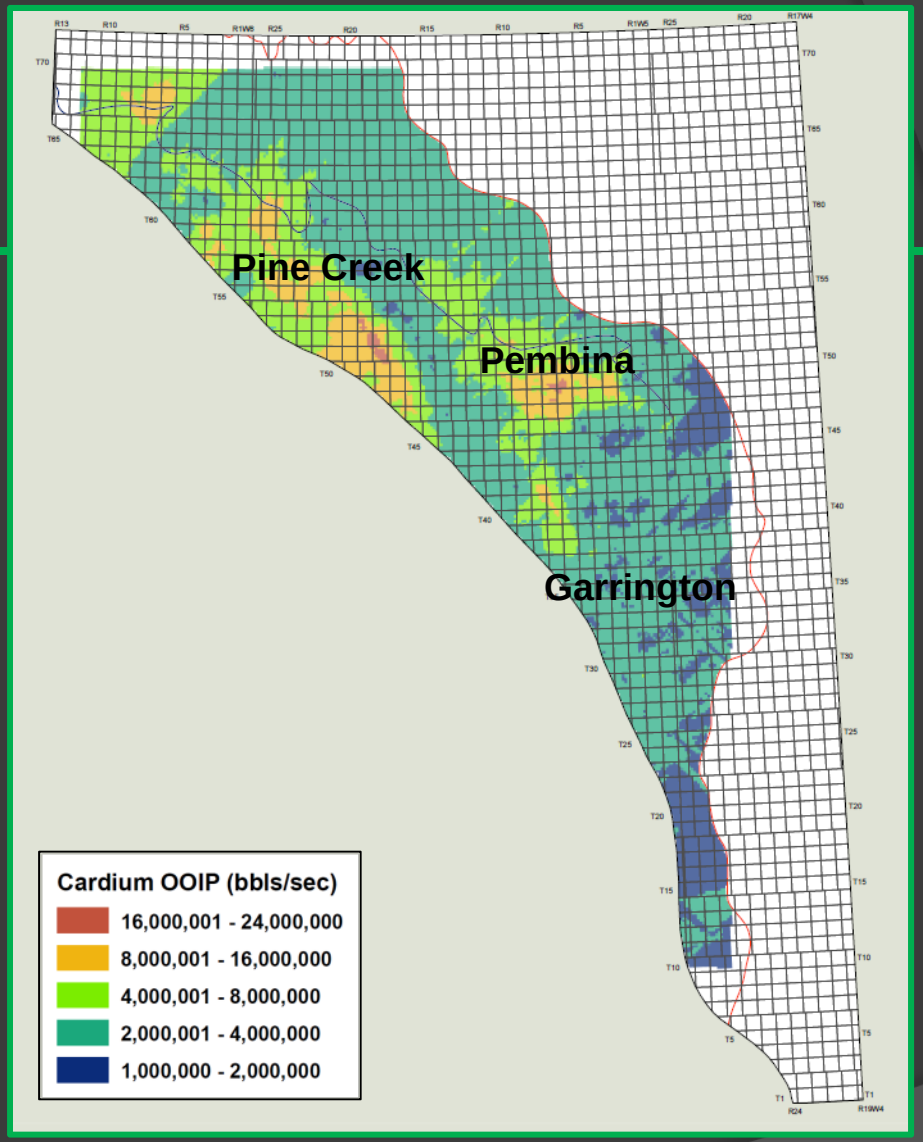
What's Driving the Activity?



Reservoir contact for a typical 8½-in. borehole grows significantly when hydraulic fracturing is employed. When combined with horizontal drilling the growth is exponential.

(From Schlumberger, website)

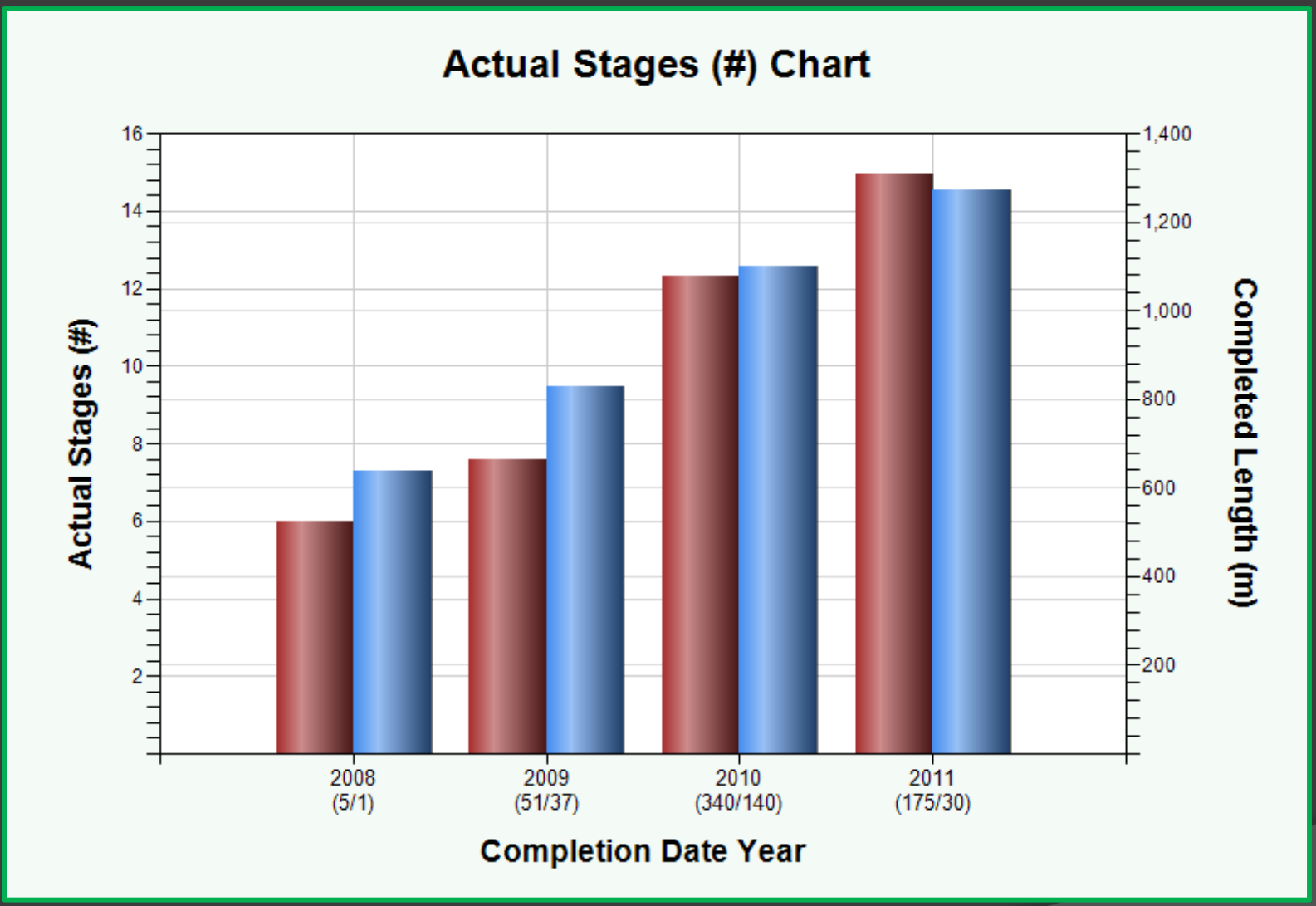
CARDIUM OIL



Source: CDL Cardium Overview Study, 2010

Cardium Resource Development Milestones

Cardium: Increasing Stages and Length



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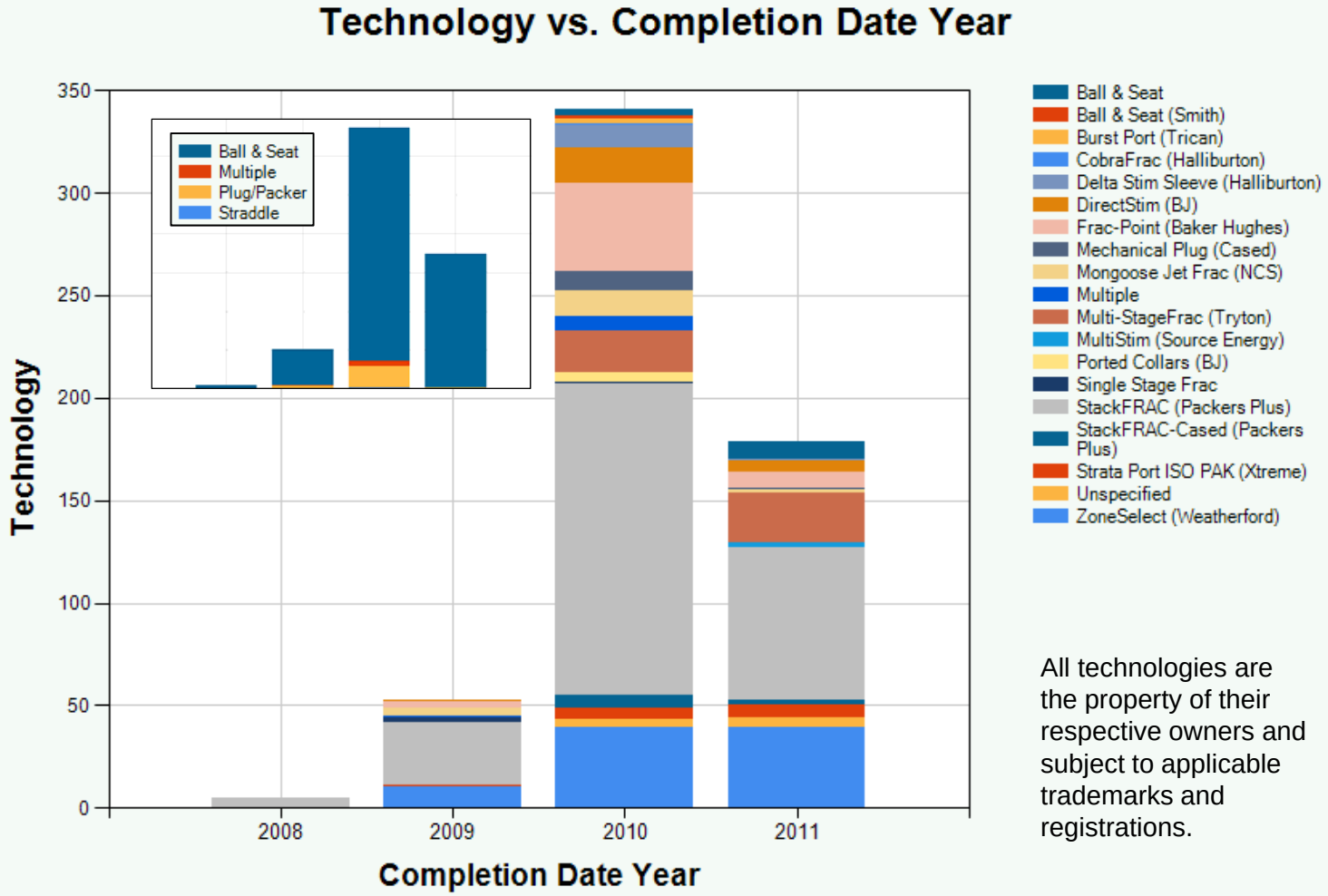
Cardium: New Technologies

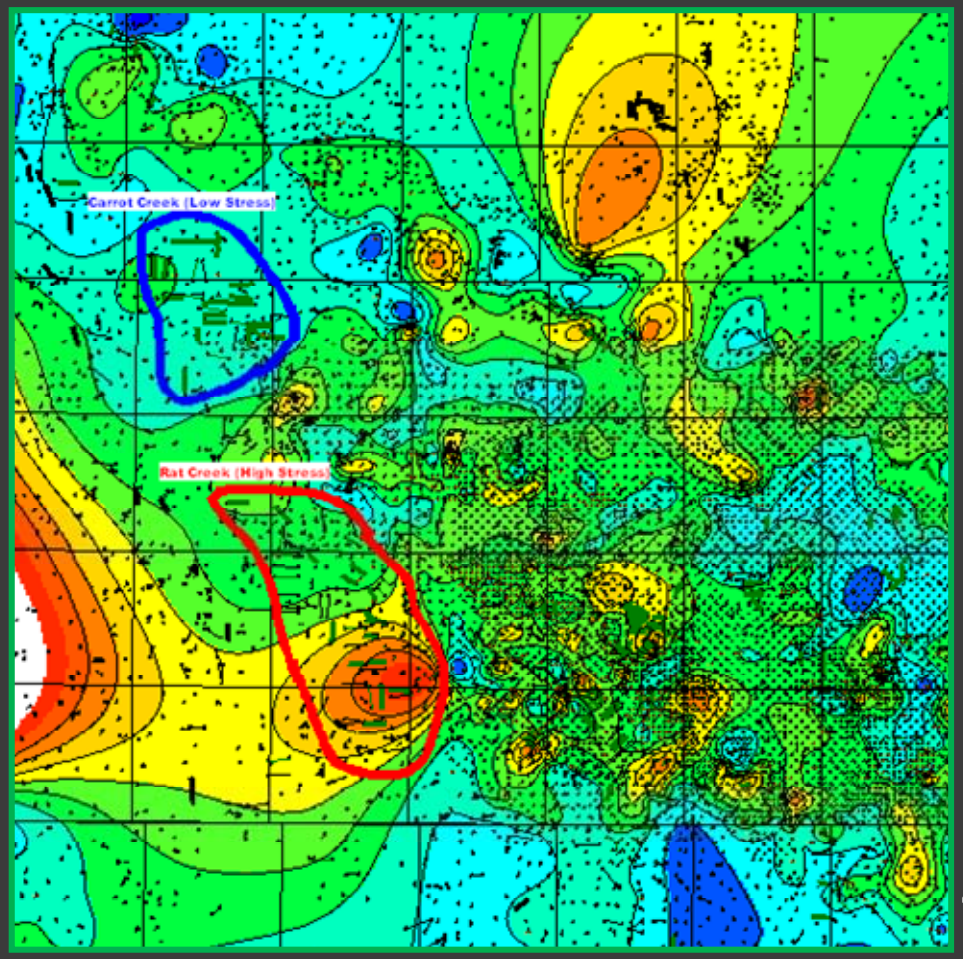


Cardium: Ball & Seat vs. Plug/Packer

Comparative Metric	Ball & Seat (389 wells)	Plug/Packer (29 wells)
Avg Frac Time	14 hrs	27 hrs
Problem Time >50%	8%	36%
Downhole Problems	2.4%	3.3%
Avg # of Stages	13	9
Avg IP3 Oil	137 bopd	86 bopd
Avg D&C Cost	$3.3M	$3.7M

Cardium: Stress

Detail: Minimum Principle Stress , Pembina Field



Source: Stress Analysis Study, RPCL & BJ, 2005 + Frac Database

Carrot Creek

Low Stress Area

5.9% Frac* Failures

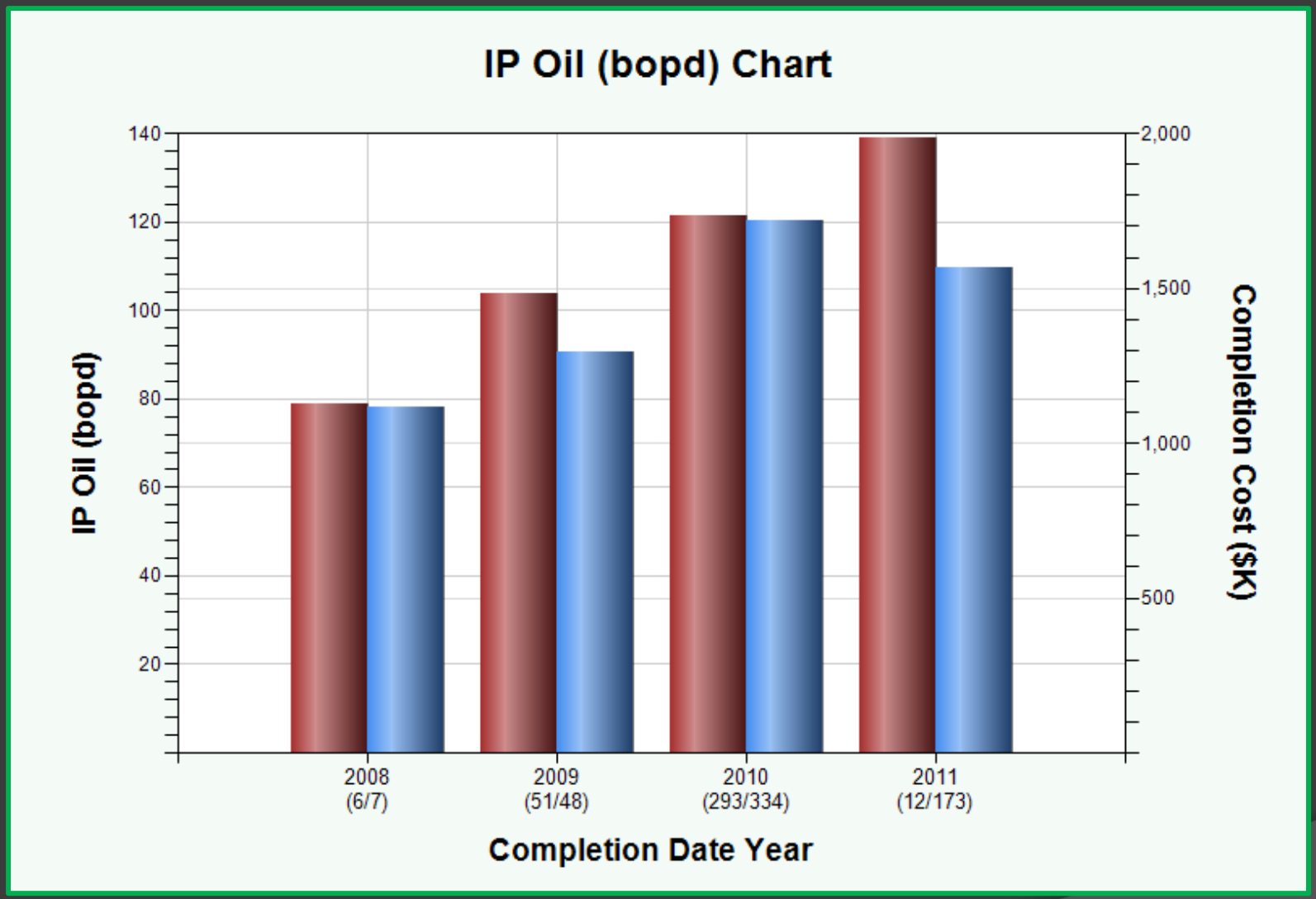
Rat Creek

High Stress Area

8.7% Frac* Failures

*No Breakdown,
Omitted,
Partial Frac
Re-Frac

Cardium: Increasing IP3s, Flattening Costs



*Not normalized for load oil return

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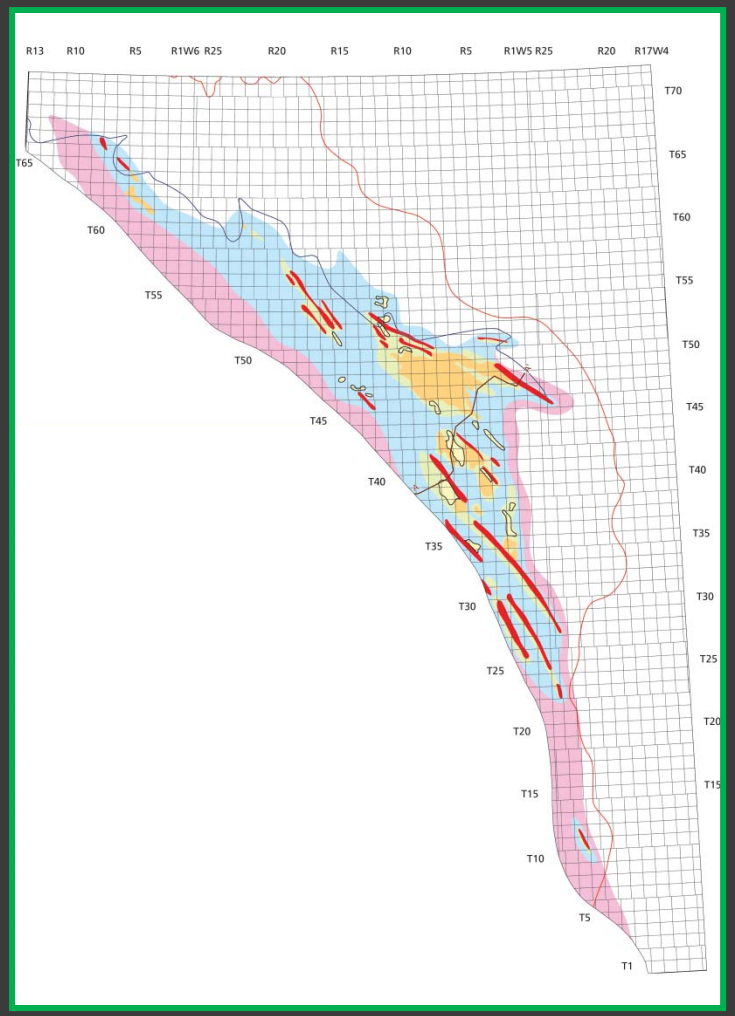
Cardium: Size of the Prize



Incremental Cardium Resource Potential

Incremental Conventional

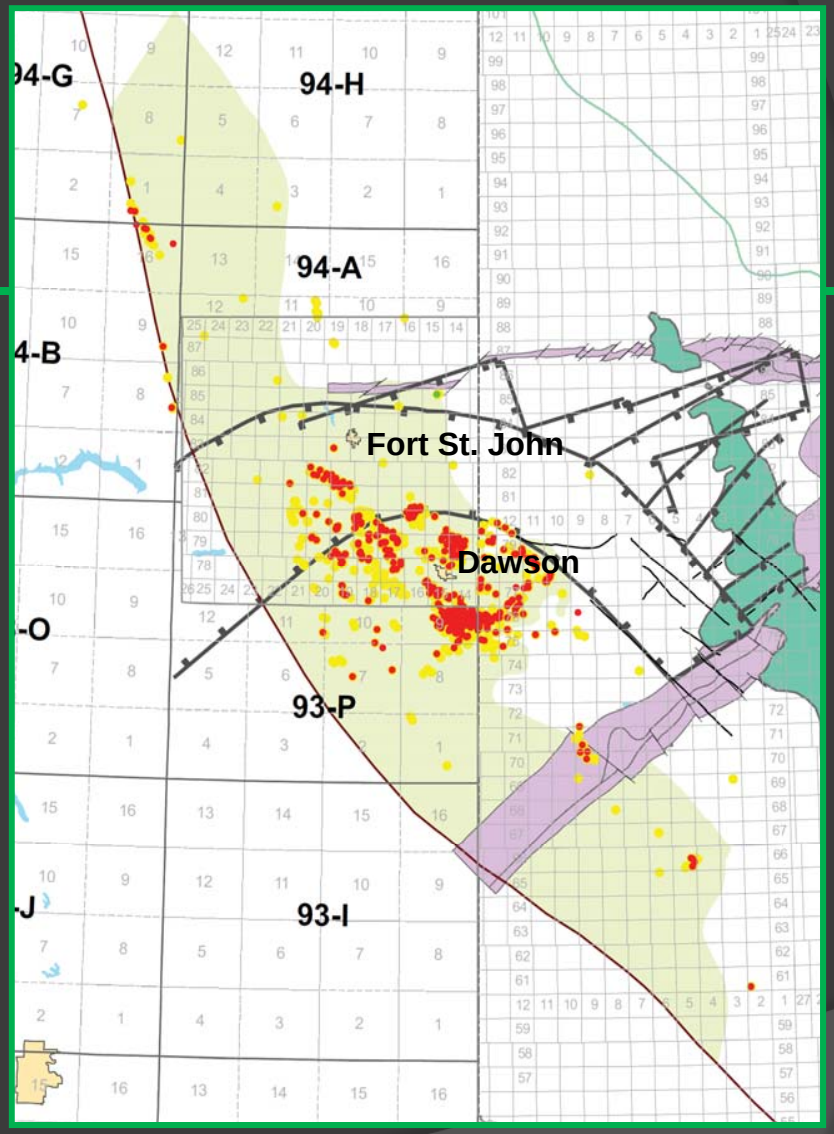
Barrier Bar	52 mmboe
Shoreface A	85 mmboe
Shoreface B	10 mmboe

Resource Halos

Resource Halo A	406 mmboe
Resource Halo B	667 mmboe
Resource Halo C	5 mmboe
Unestablished	

Total Additions: **1,225 mmboe**

MONTNEY GAS
Distal Shelf Play



Source: CDL EDGE

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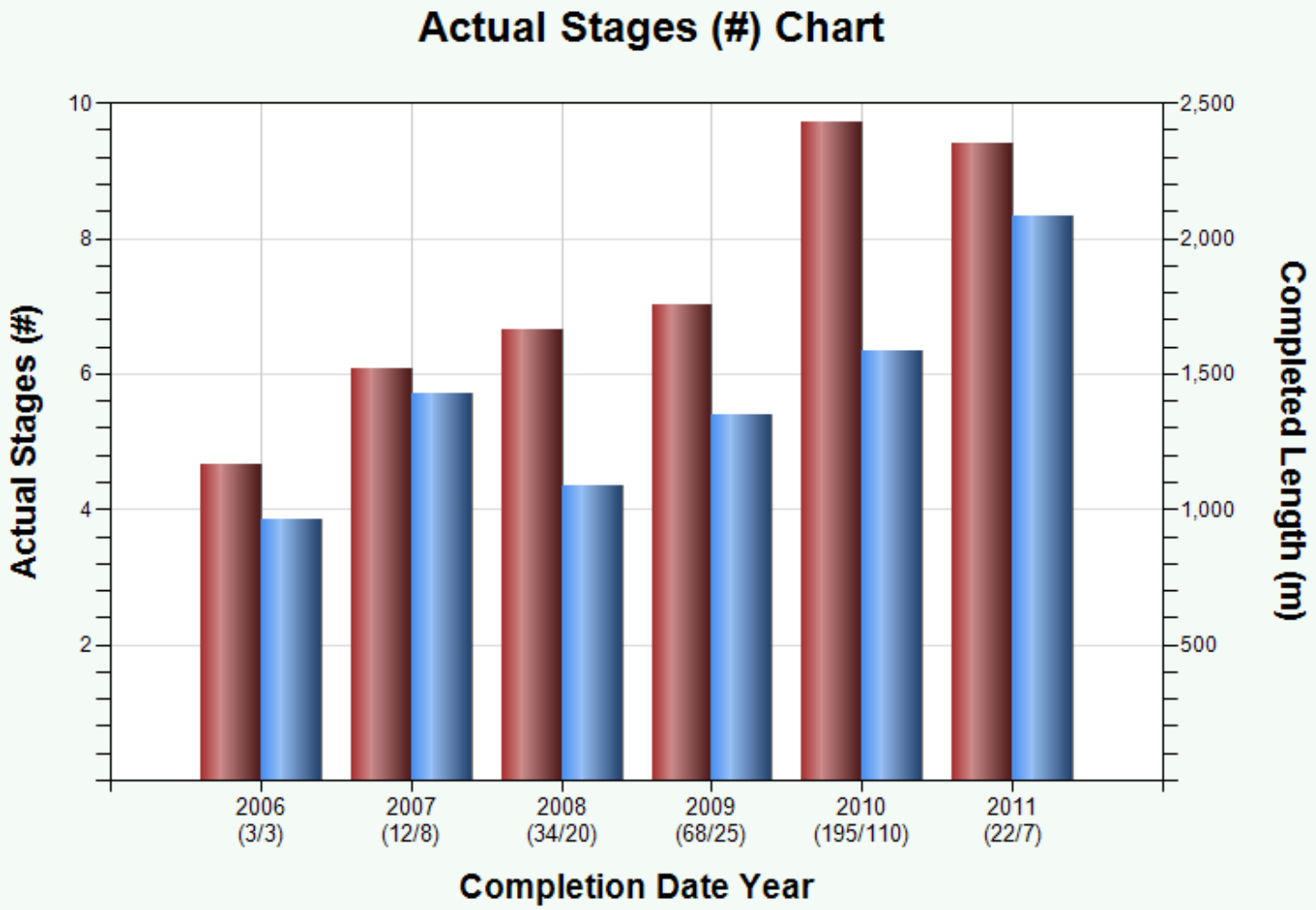
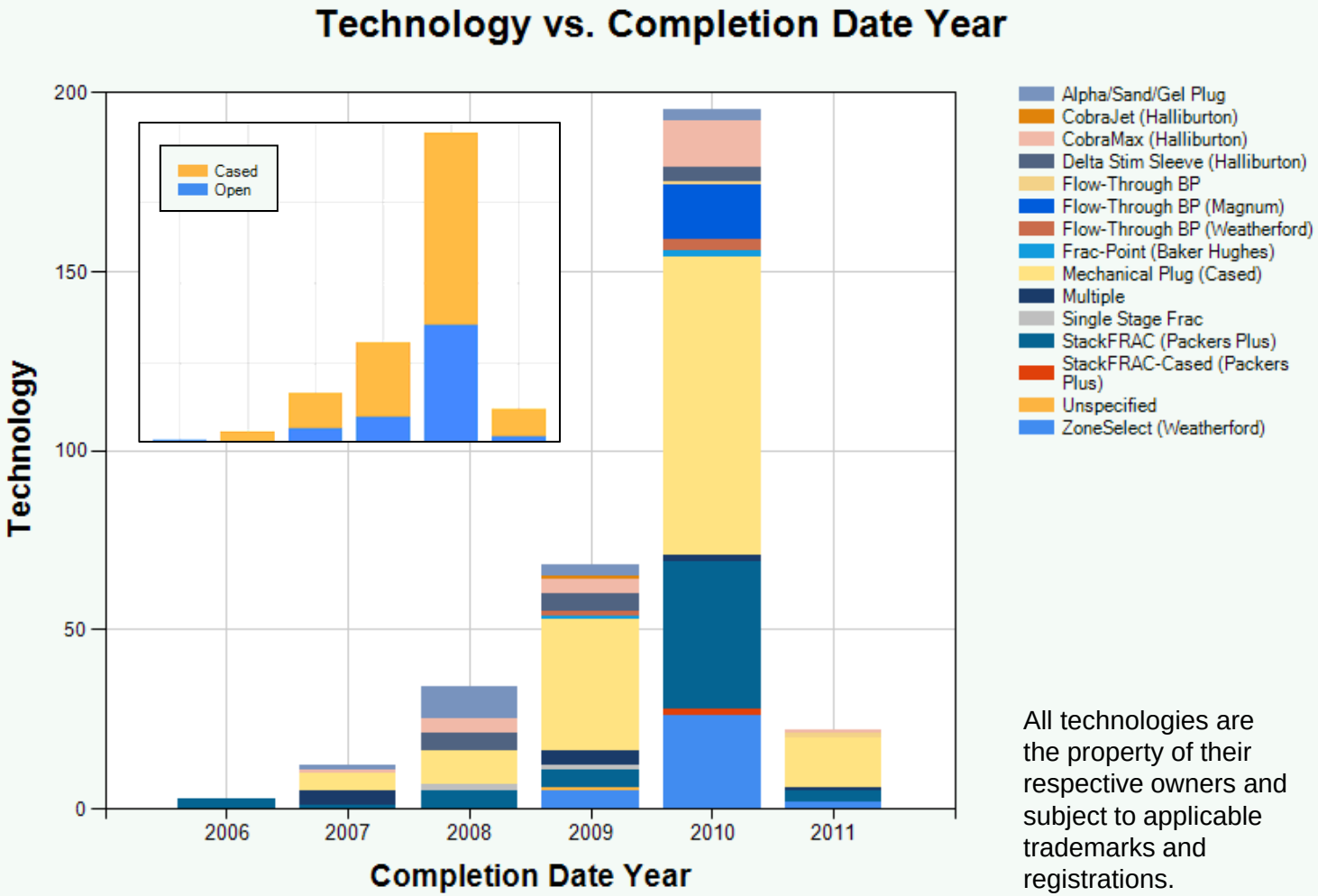
Montney Resource Development Milestones

Montney: # Stages and Length Trends

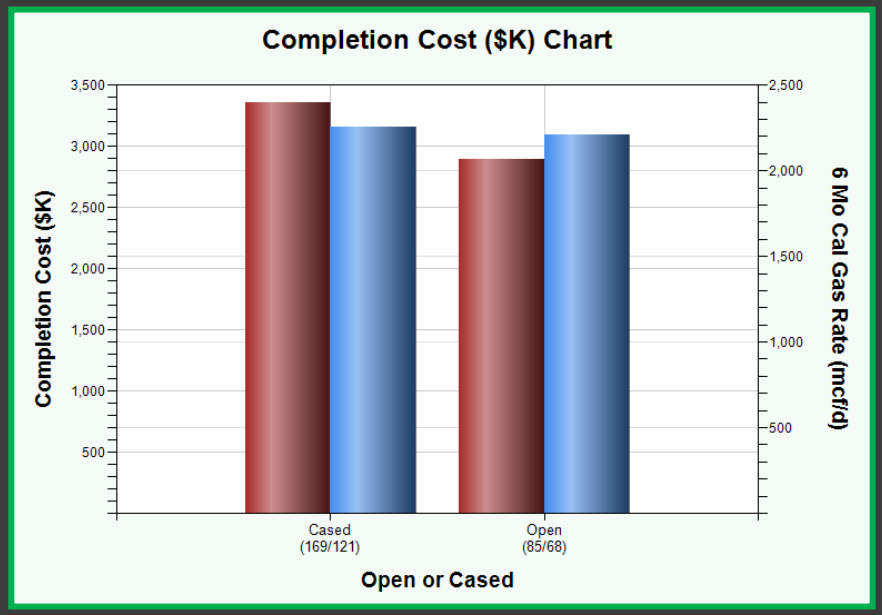


Montney: Experimentation w/ Technology

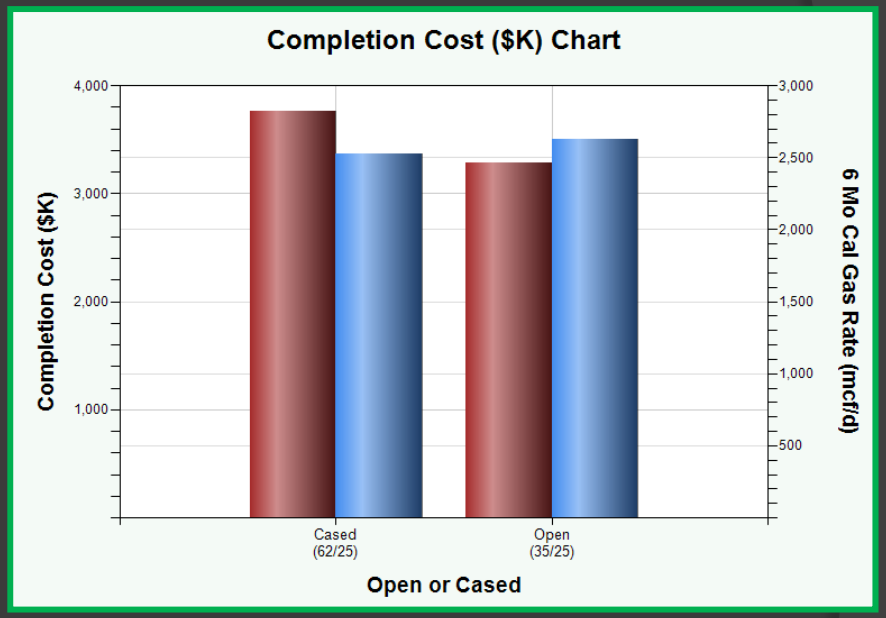


Montney: Open versus Cased

2006 to Present



June 2010 to Present



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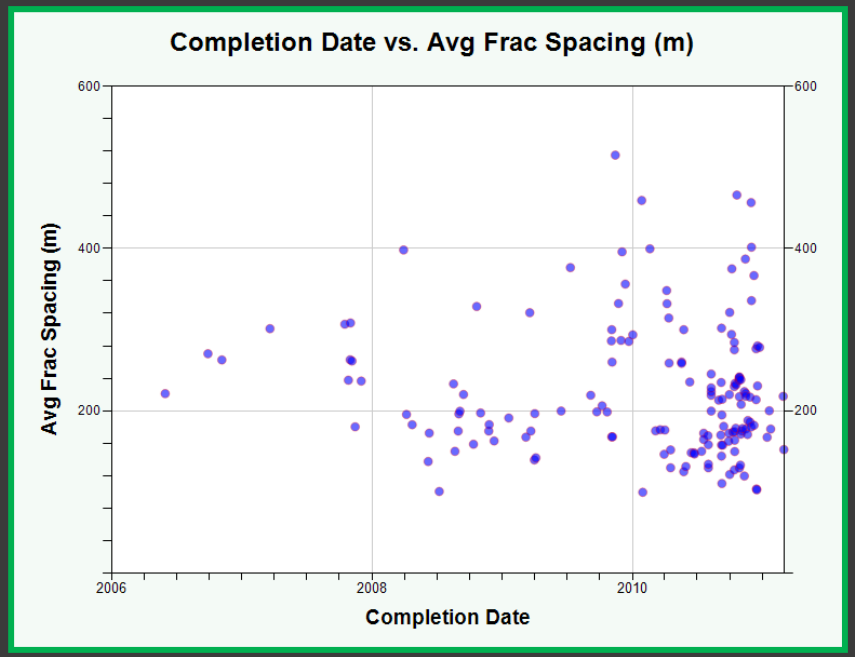
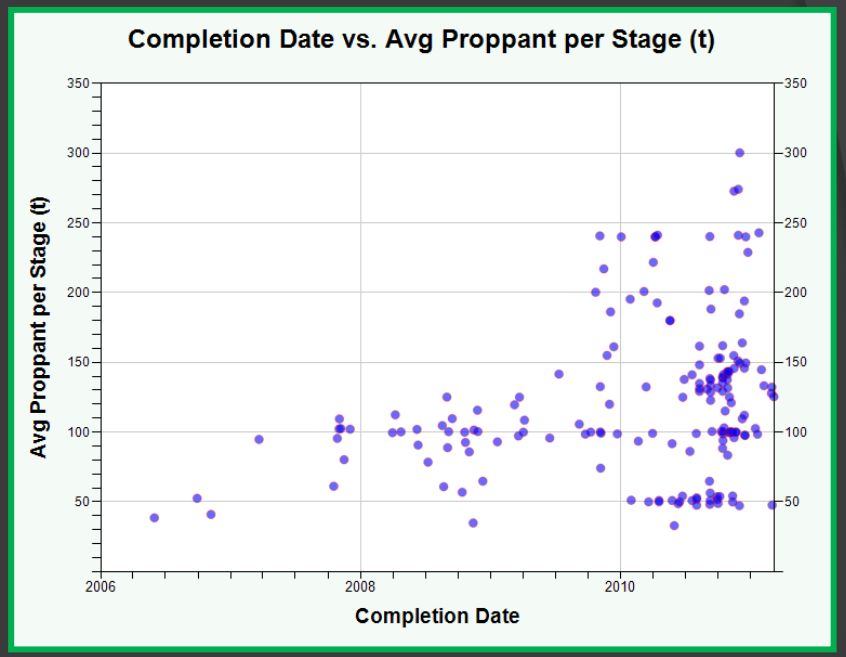
Montney: Frac Spacing and Proppant Trends





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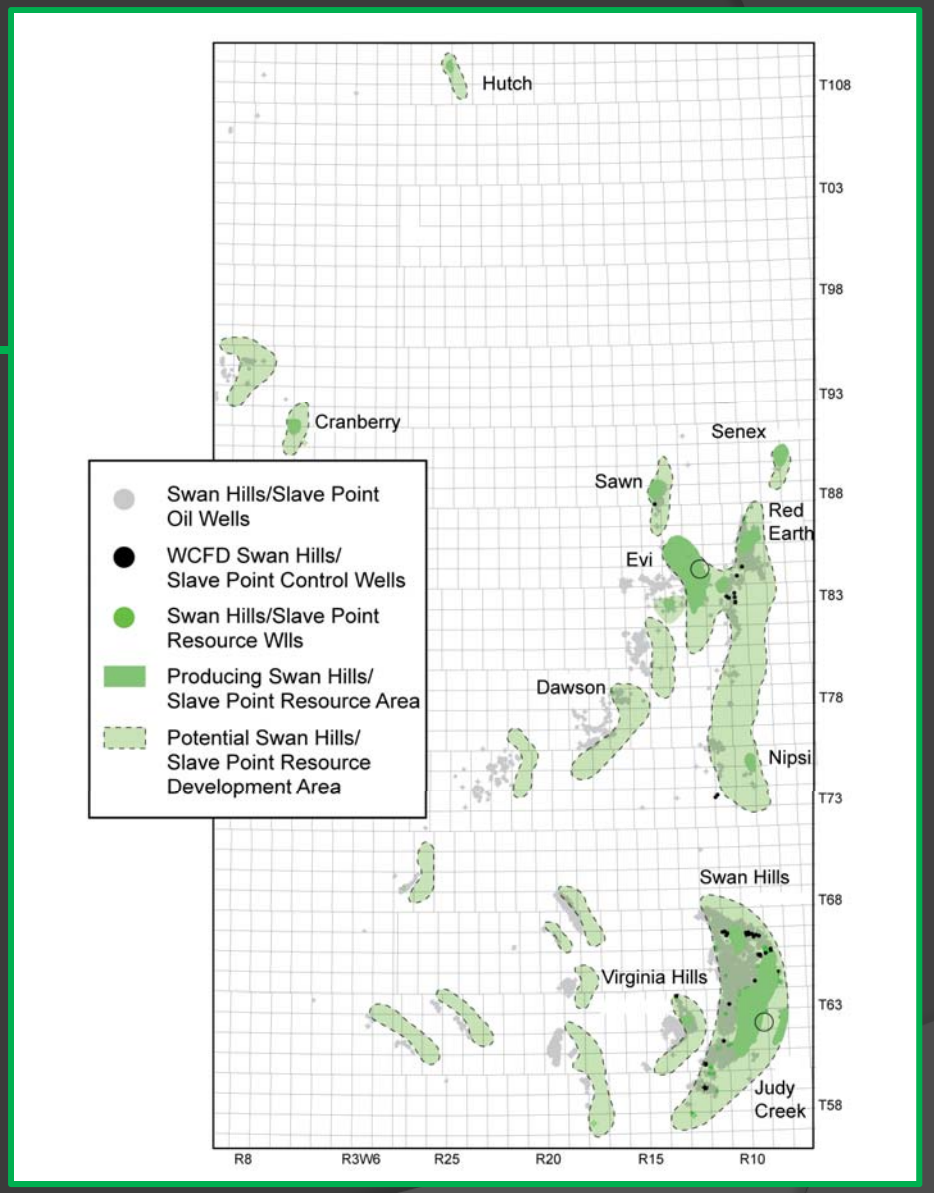
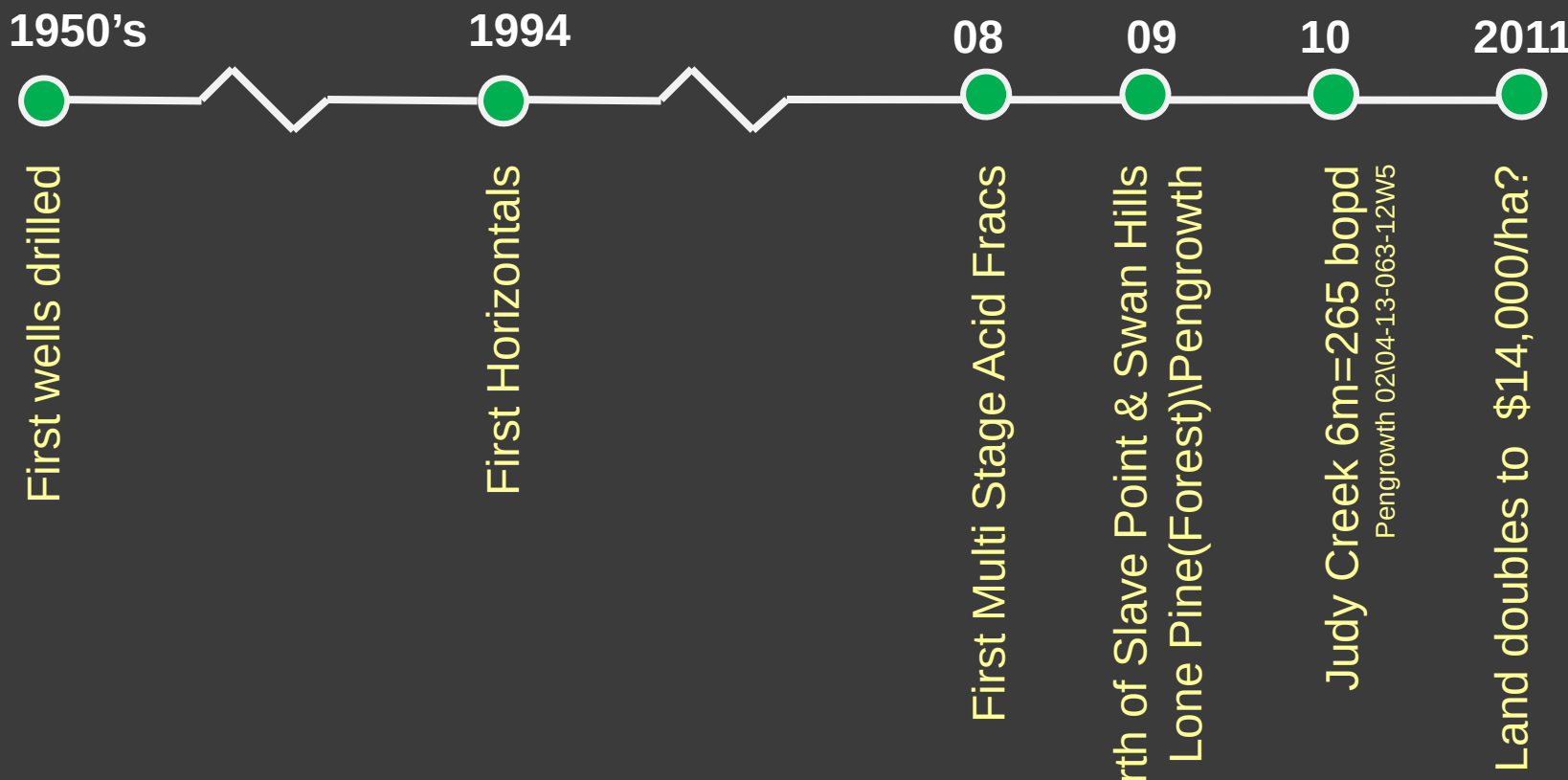
SWAN HILLS/ SLAVE POINT OIL

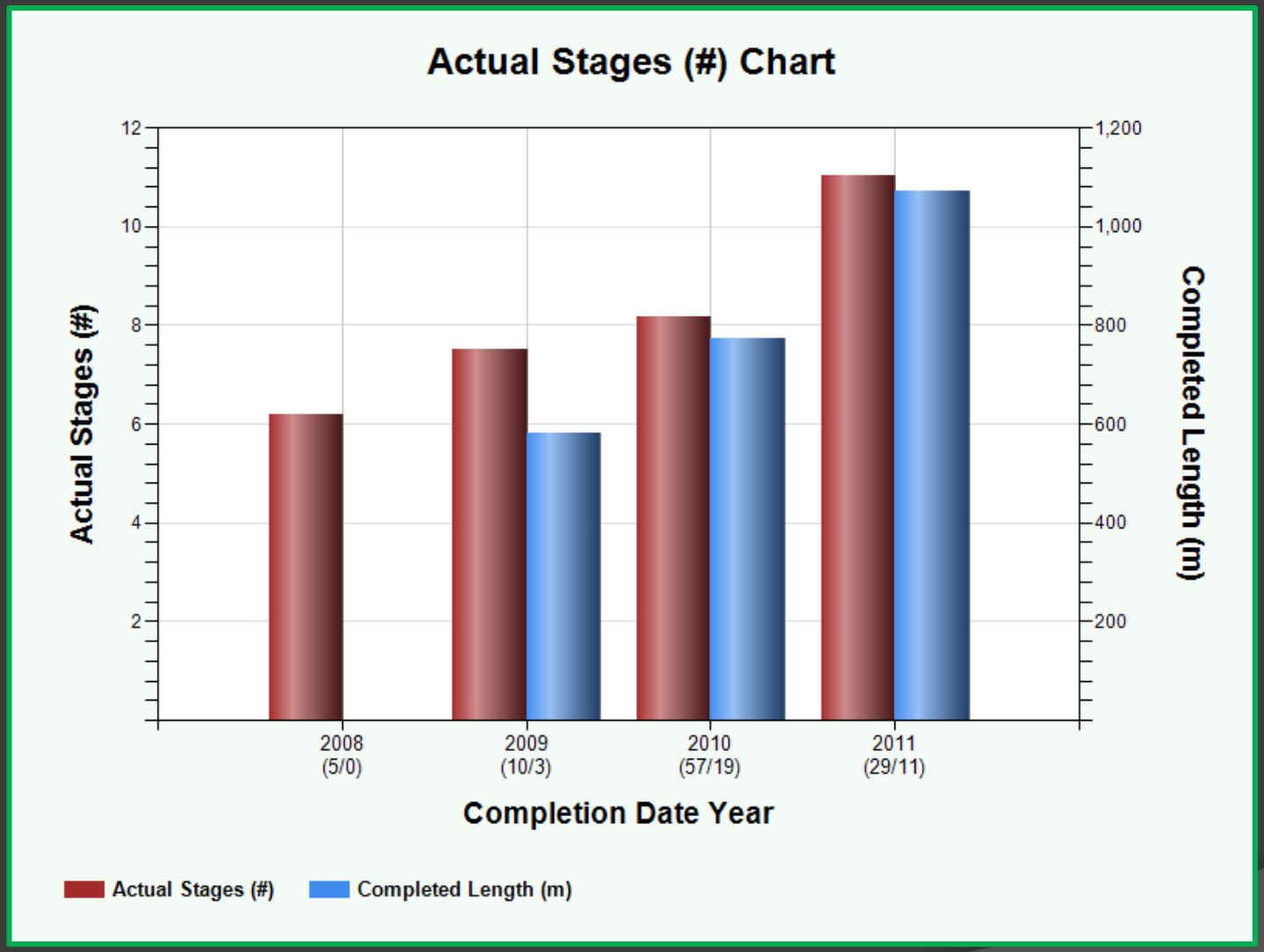


Source: CDL

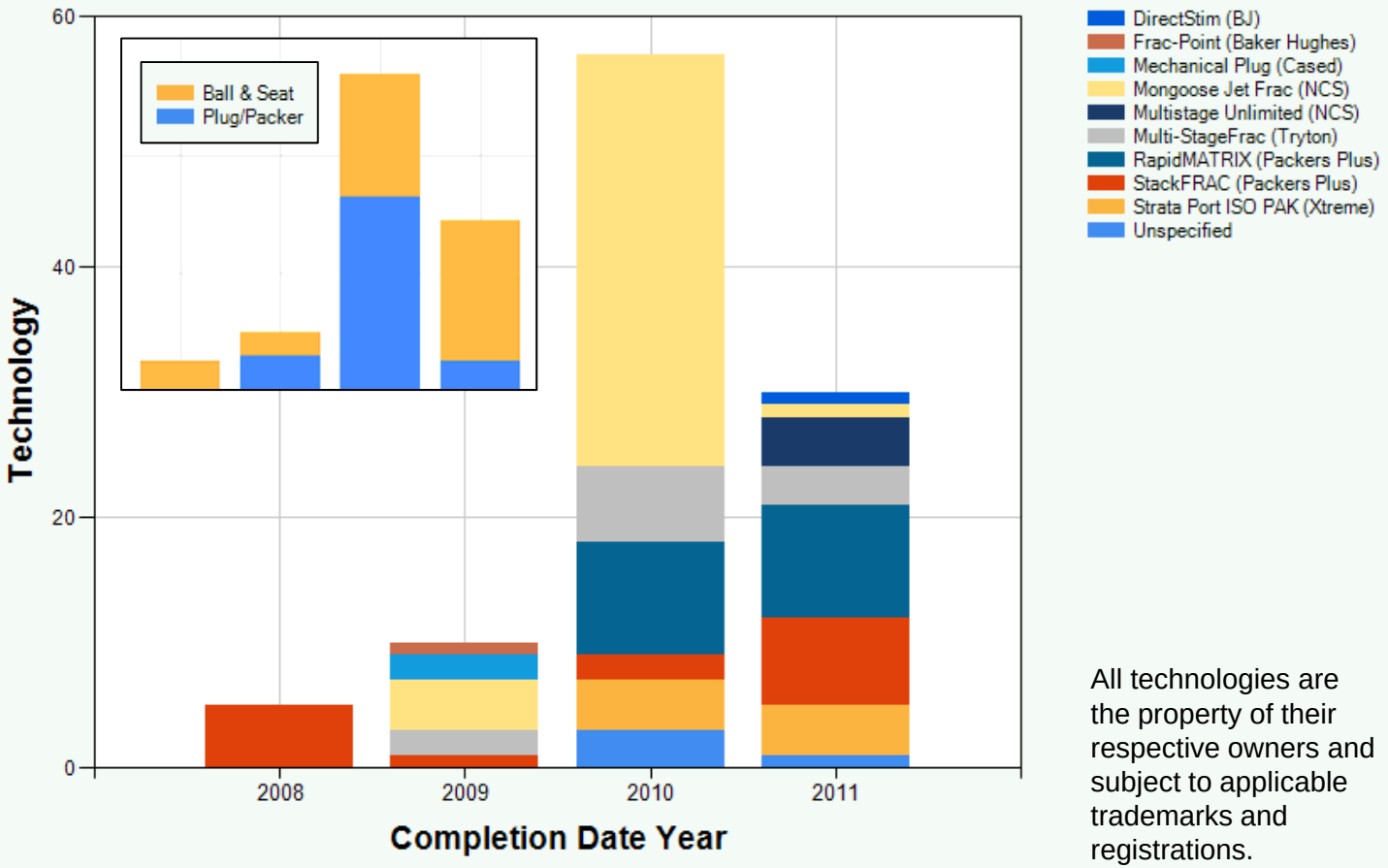
Slave Point Resource Development Milestones



SWHL/SLVP : # Stages and Length Trends

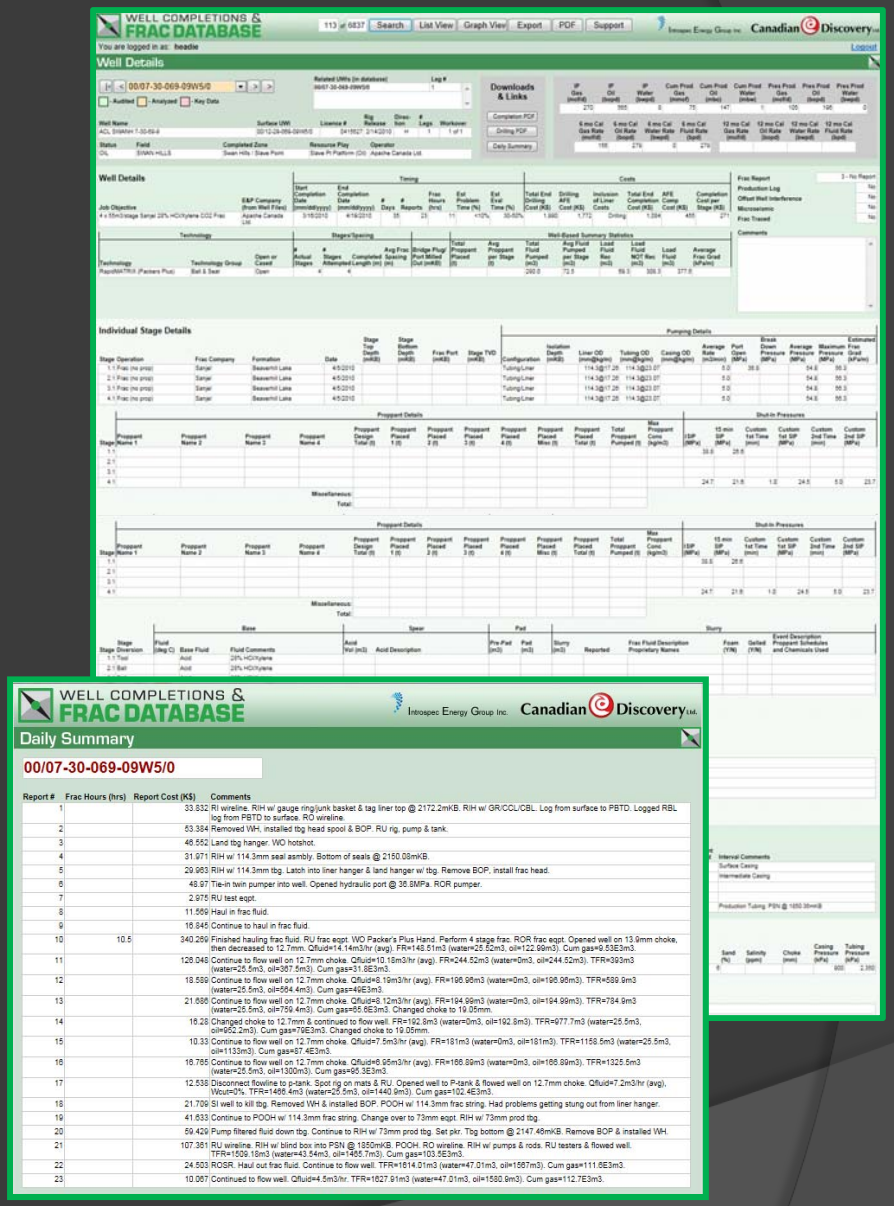


SWHL/SLVP: Experimentation w/ Technology



7-30-069-9W5
Swan Hills
IP3 Oil = 565 bopd

- Apache Feb 2010
- 4 x 55m^3/stage Sanjel
  28% HCl/Xylene CO_2 Frac
- RapidMATRIX
  Ball/Seat (Packers Plus)
- $3.1M D&C



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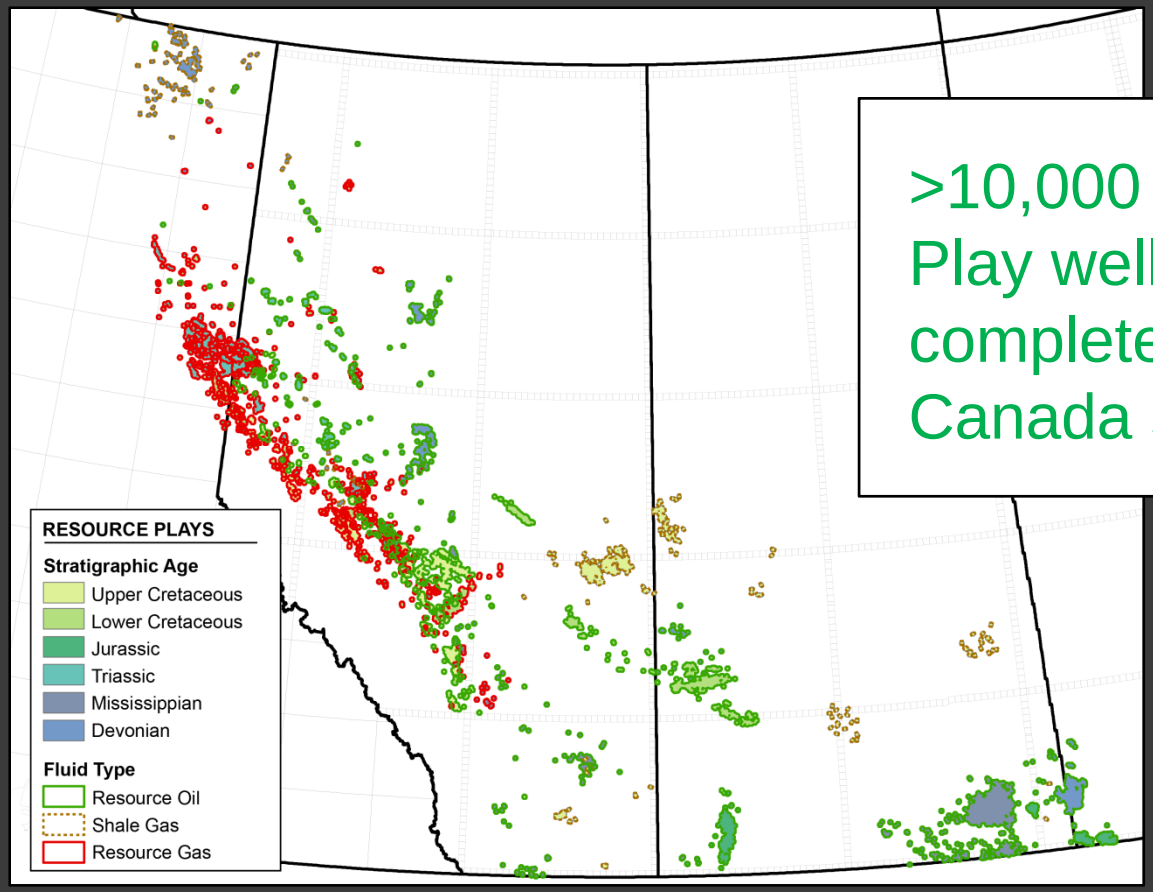
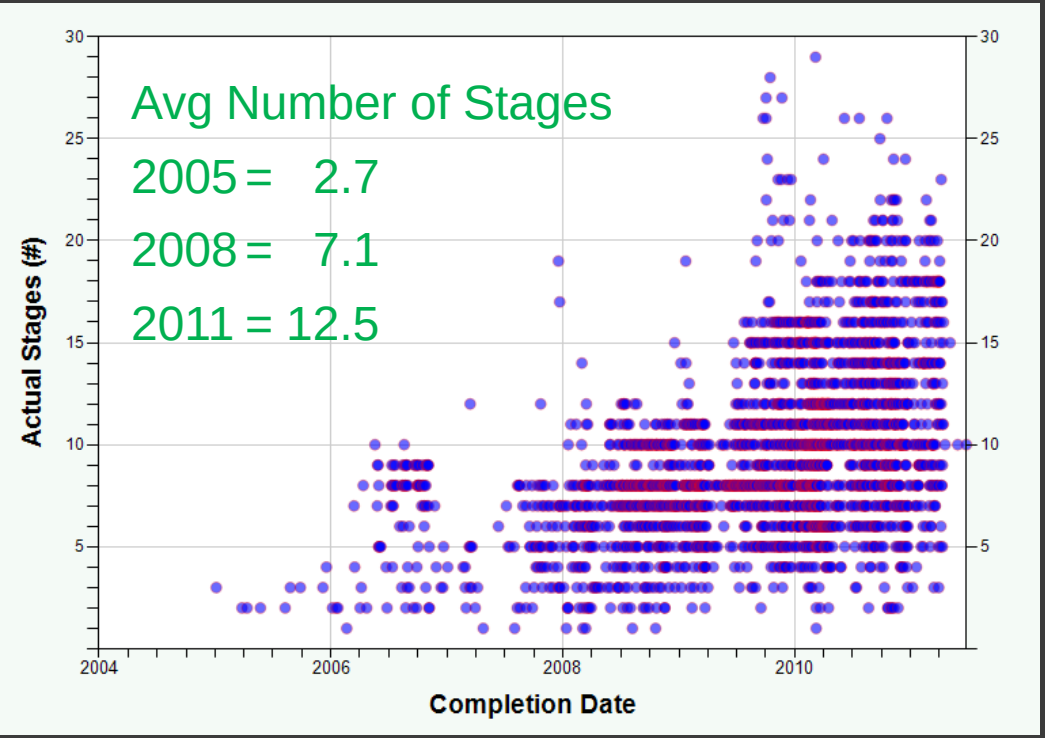
MACRO-PICTURE – WESTERN CANADA



>10,000 Resource Play wells drilled and completed in Western Canada since 2005.

Increasing Number of Stages

Completion Date versus Number of Stages



In Combination with:

- Increased Horizontal Length
- Multi-Laterals
- Cluster Fracking
- Monobore Systems

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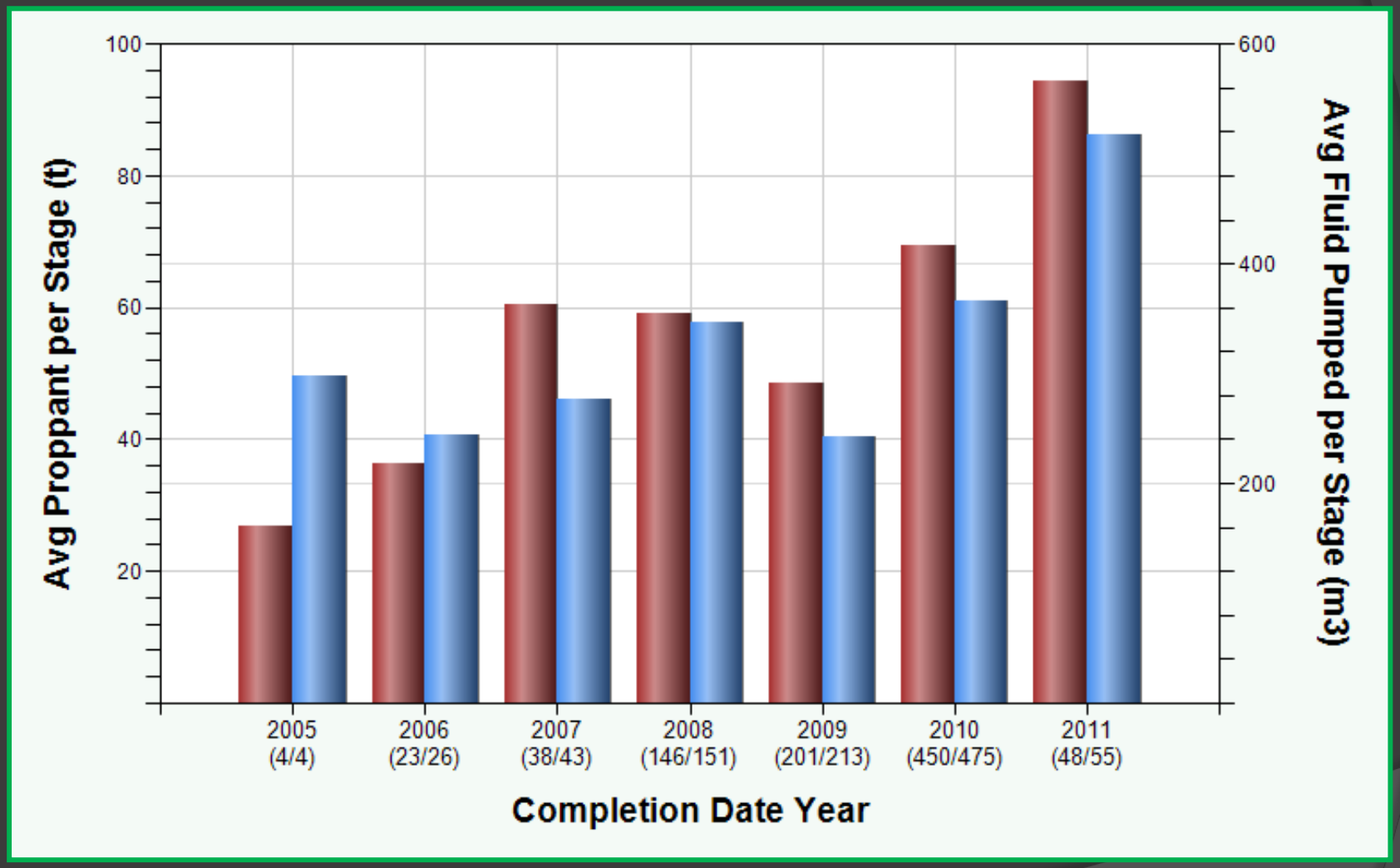
Larger Fracs: More Proppant and Fluid



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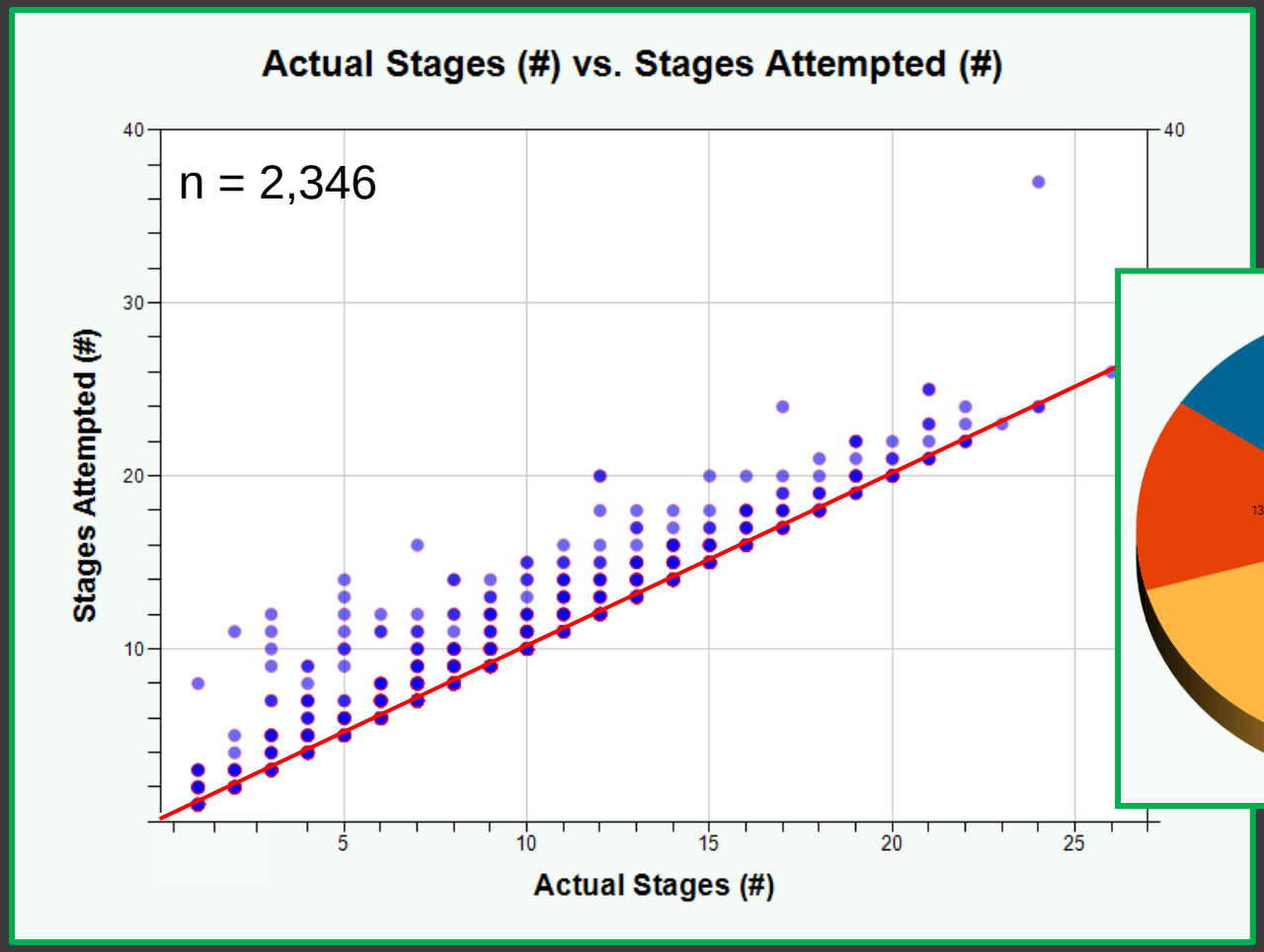
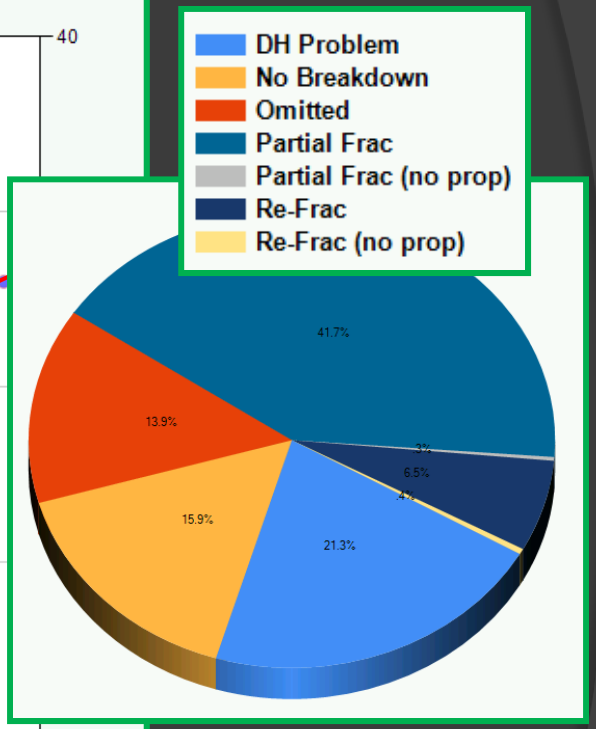
Experimentation and Fine-Tuning





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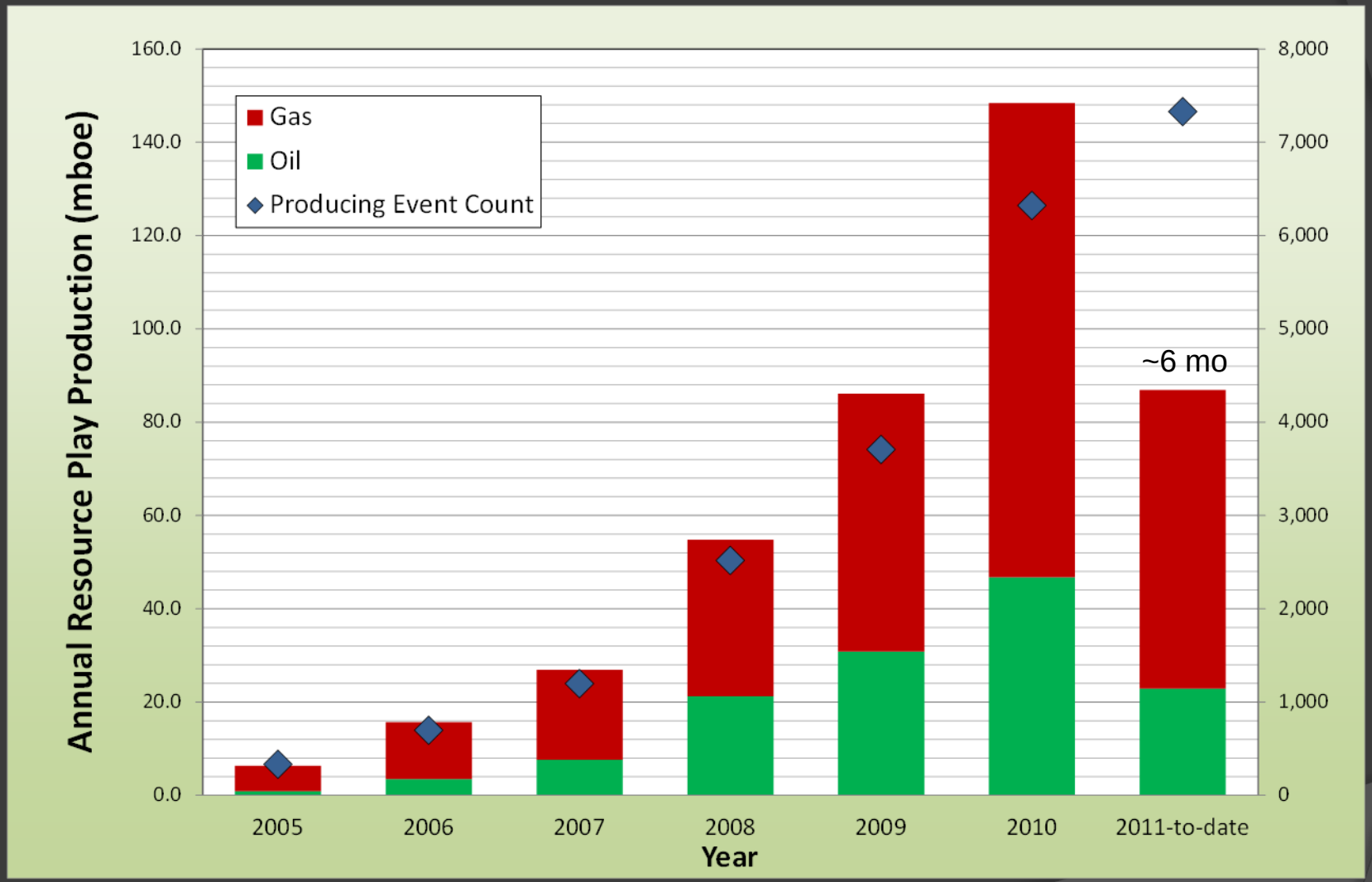
Growing Resource Play Production



Size of the Prize: Western Canada (Oil)

1. Increased Conventional Production
2. Developing Halos
3. Emerging Resource Plays

RISK

	Original-in-Place (2009, CAPP)	Established Reserves (CAPP)	+5% * Recovery Adds X
Light Oil (mmbo)	78,126	20,069 (26%)	3,906

*Cardium = 147 mmboe incremental / 2,934 mmboe produced + remaining = 5%

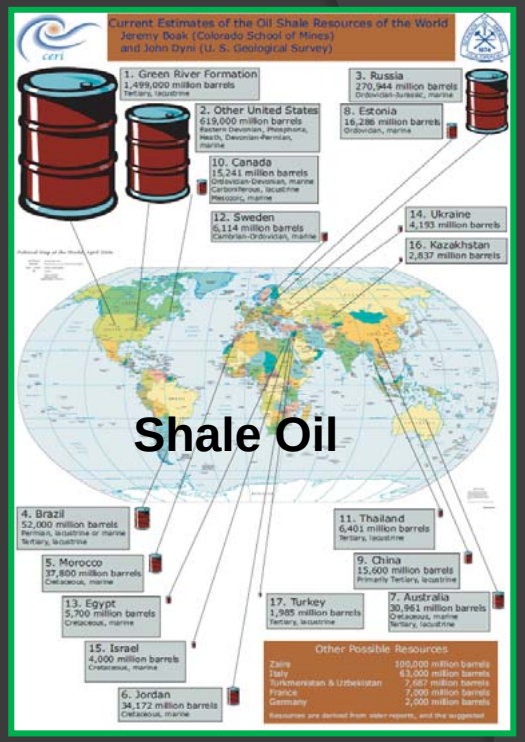
Bakken
Cardium
Viking
Swan Hills/Slave Point

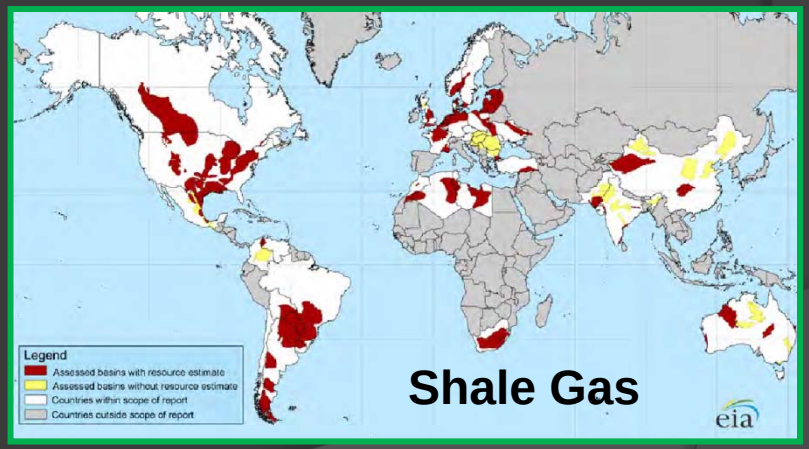
Duvernay
AB Exshaw
2WS
Nordegg

?

Worldwide Implications

- Western Canada is just the tip of the iceberg
- However, on the world-stage, Western Canada delivers on several fronts:
  - Publicly available data (knowledge-sharing)
  - Vertical offsets
  - Scale of activity (>10,000 wells)
  - Infrastructure
  - Business-ready





WELL COMPLETIONS & FRAC DATABASE

Conclusions

- Resource plays in Western Canada are delivering increased production and reserves
- Key drivers of success include ball & seat technology, more stages, larger fracs
- Results vary by play, with geology (and stress) contributing to final results
- Technology and intelligence will continue to expand what is possible
- Western Canadian activity is, and will continue to play a major roll on the world stage

Acknowledgements

WELL COMPLETIONS & FRAC DATABASE

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Canadian Discovery Ltd.

- Resource Play Overview Studies
- Digest / EDGE / CEO

- Heather McCrank
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- Ben McKenzie
- Kaush Rakhit
- Dave Hume
- Neil Watson
- Mike Seifert
- Matt Baird


WSJ 2011
Winter

Contact Information

Canadian Discovery Ltd.

www.canadiandiscovery.com
403-269-3644
Calgary, Alberta

Heather McCrank, B.Des., MBA, CMA
Managing Director
hmccrank@canadiandiscovery.com

Introspec Energy Group Inc.

www.introspec-energy.ca
403-775-0046
Calgary, Alberta

R.P. (Pete) Singbeil, B.Sc., P.Eng.
Principal
psingbeil@introspec-energy.ca