

TECHNOLOGY AND INTELLIGENCE: Converting Tight Resources into Reserves

SPE Luncheon
Thursday, November 10, 2011
Calgary Chamber of Commerce

Authors:

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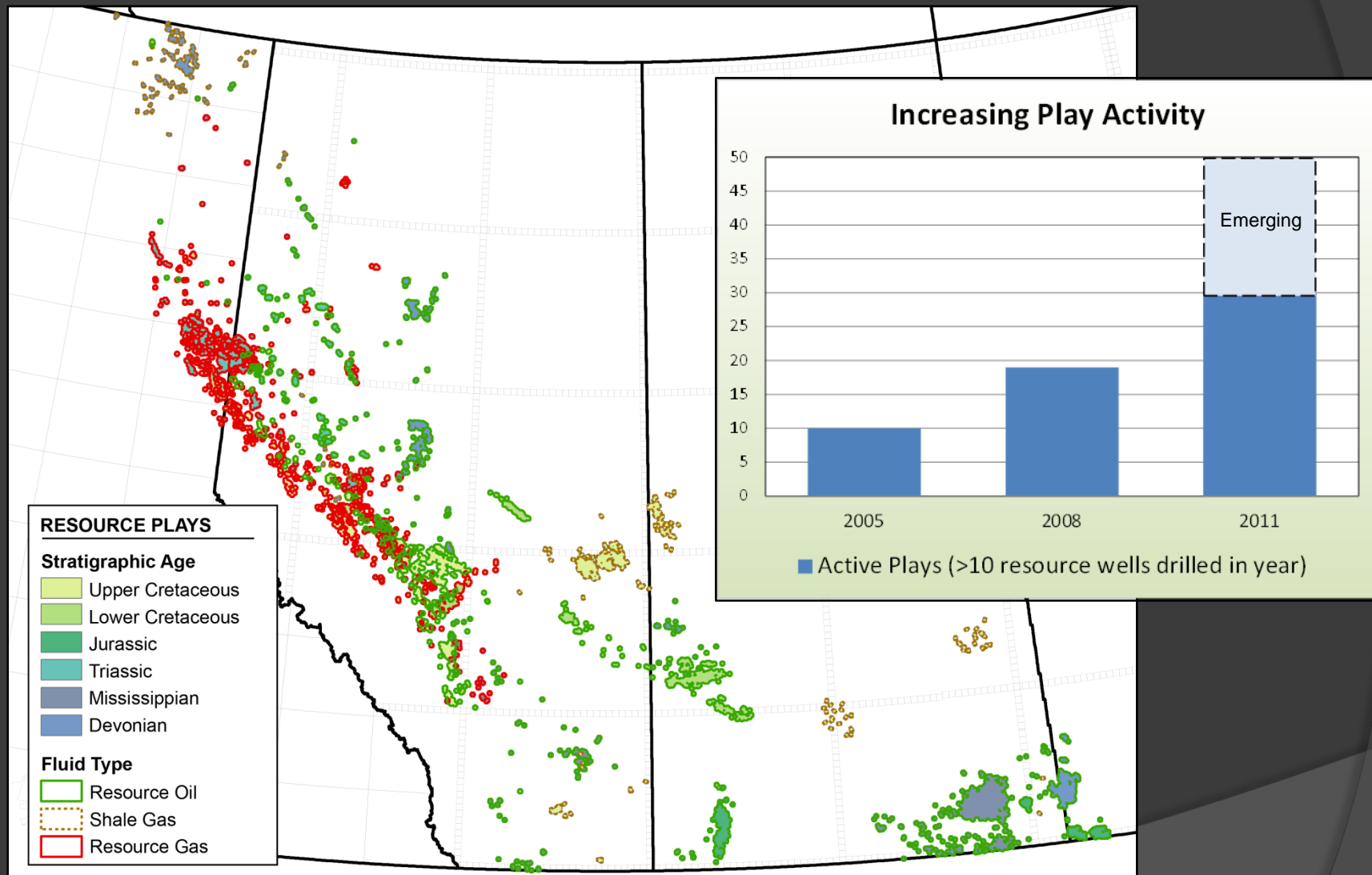
Heather McCrank, B.Des., MBA, CMA, Canadian Discovery Ltd.



Agenda

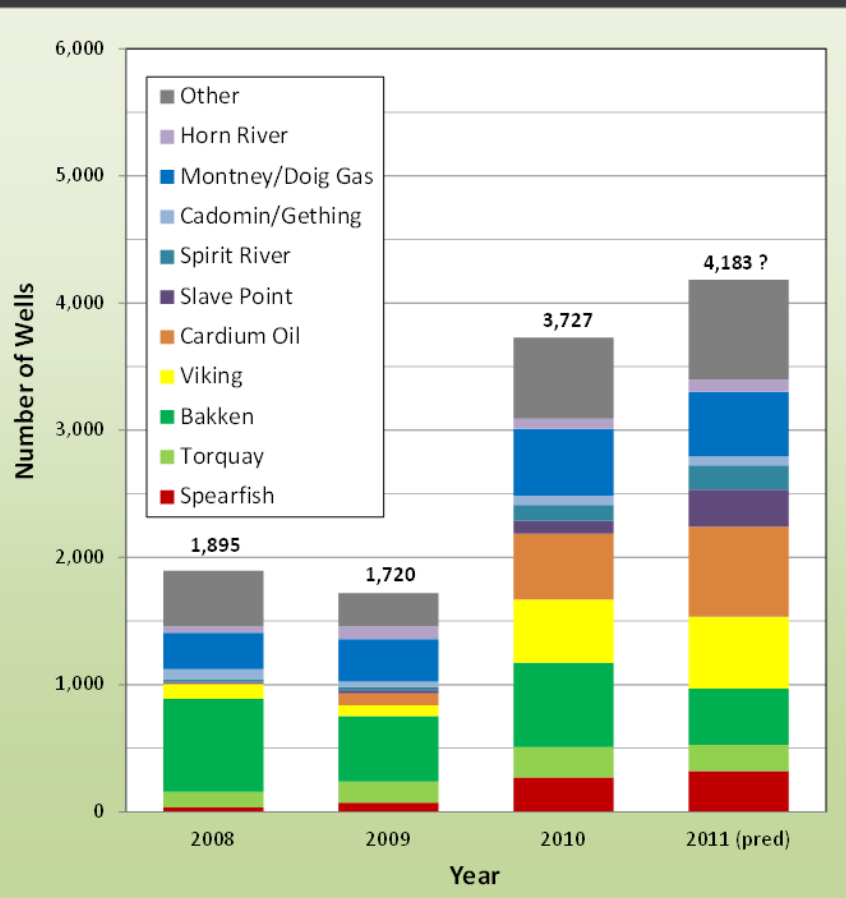
- ◉ Resource Play Activity and Investment
- ◉ Case Study: Cardium Oil
- ◉ Case Study: Montney Distal Shelf Gas
- ◉ Case Study: Swan Hills/Slave Point Oil
- ◉ Aggregate Trends and Conclusions

Resource Plays in Western Canada

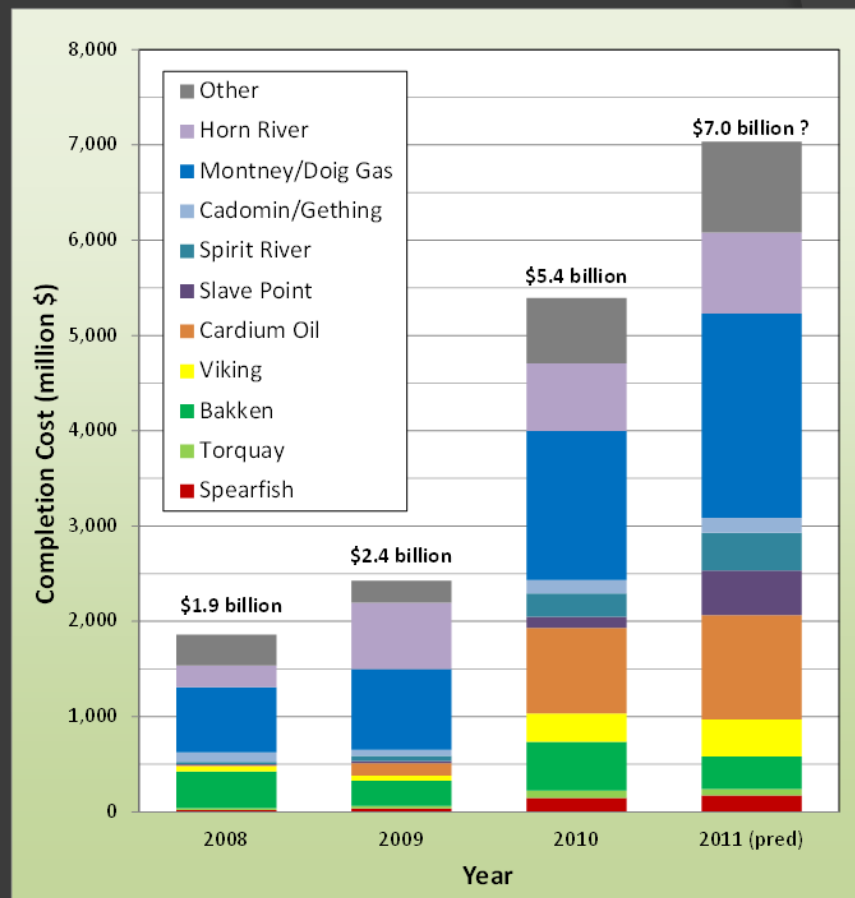


Resource Plays in Western Canada

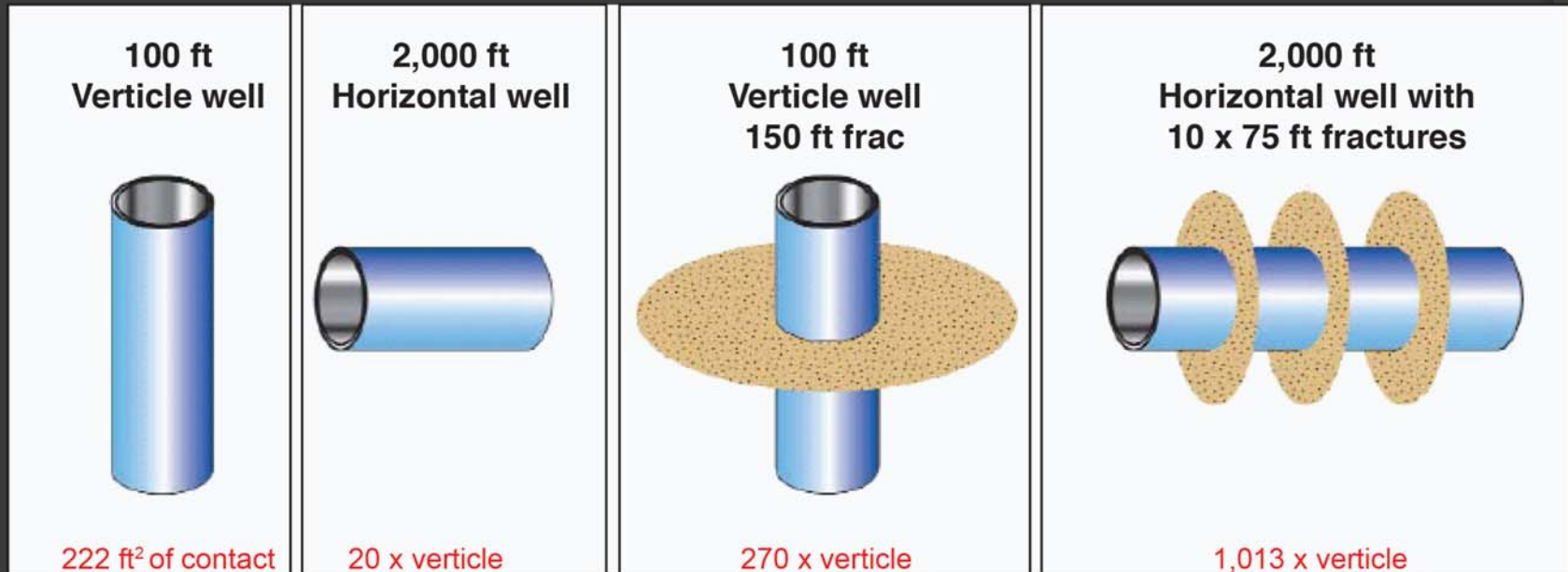
Number of Wells
by Resource Play Group



Total Completions Investment (\$M)
by Resource Play Group



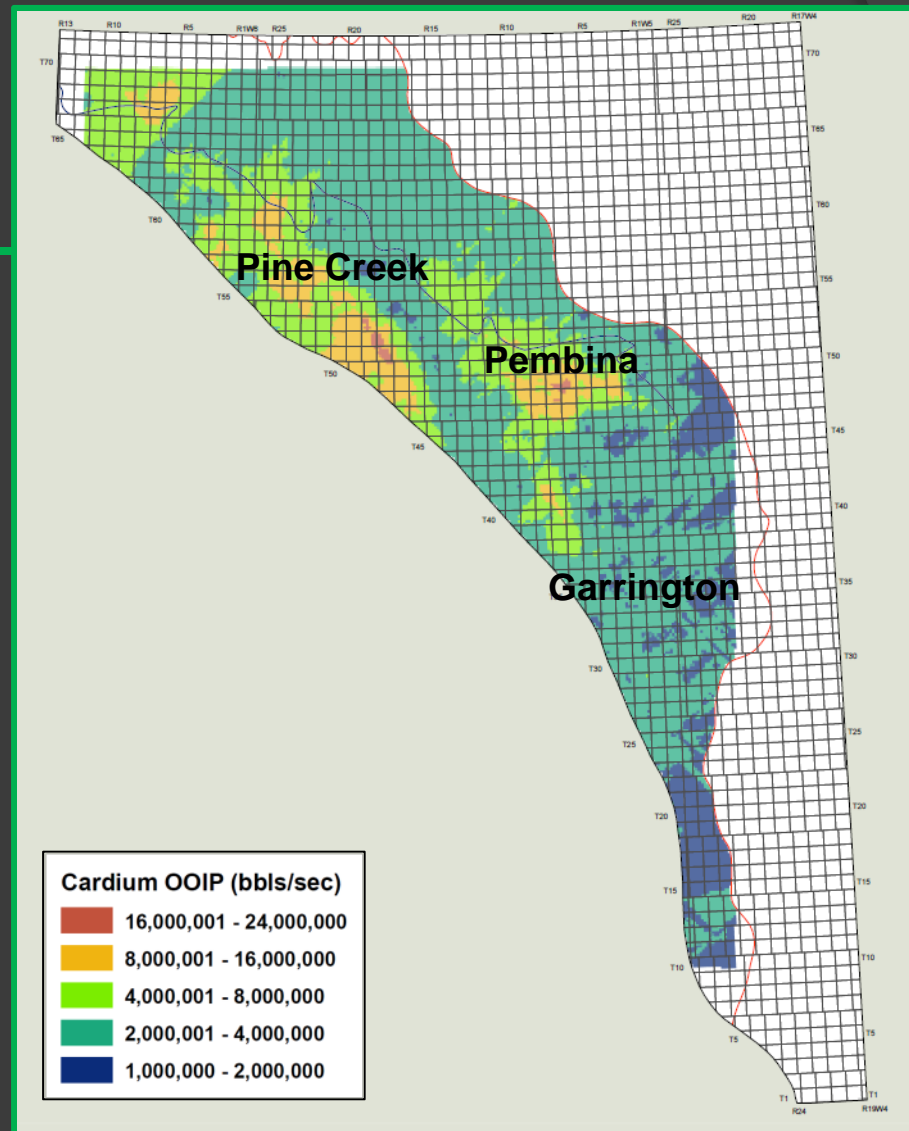
What's Driving the Activity?



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

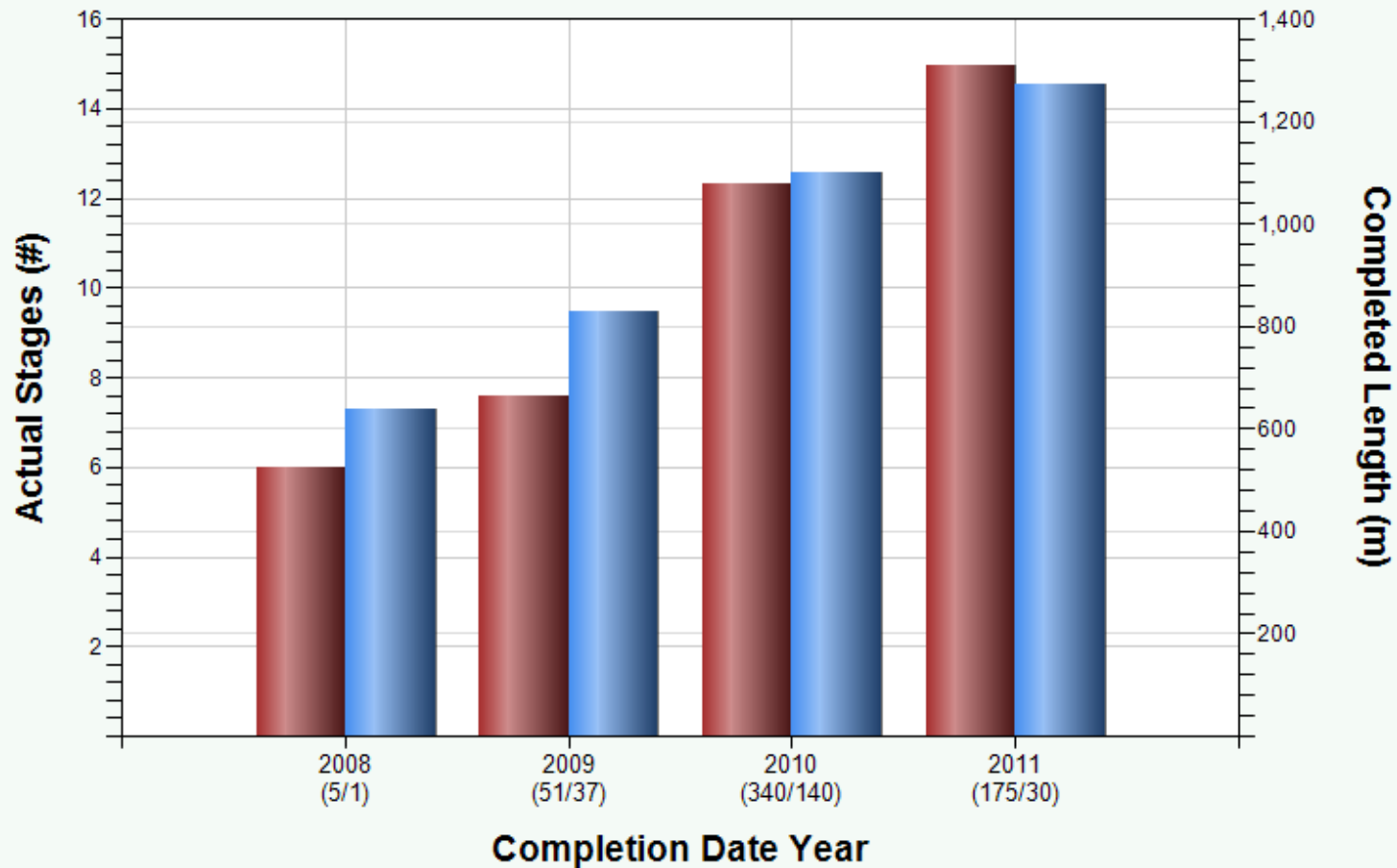


Cardium Resource Development Milestones



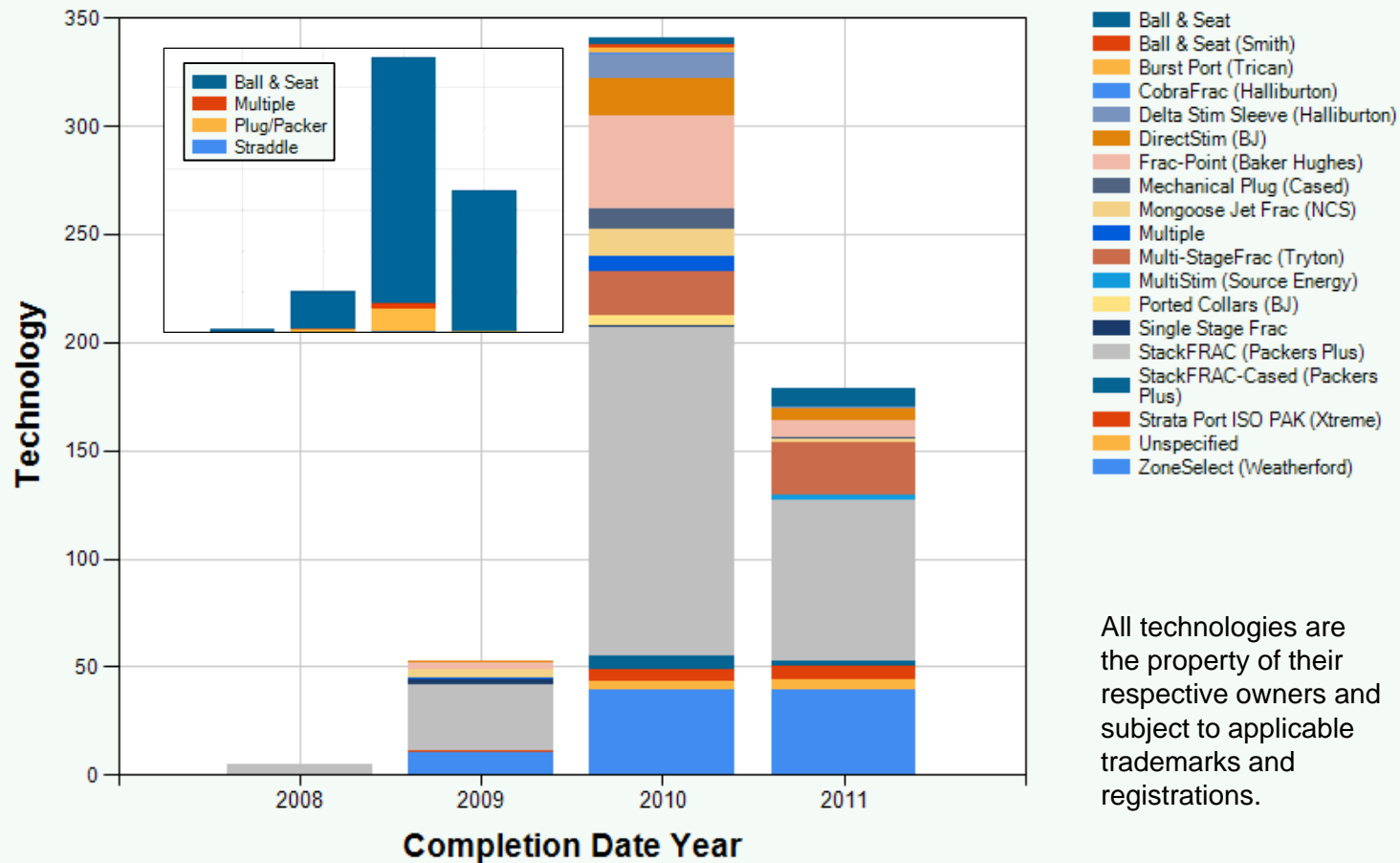
Cardium: Increasing Stages and Length

Actual Stages (#) Chart



Cardium: New Technologies

Technology vs. Completion Date Year



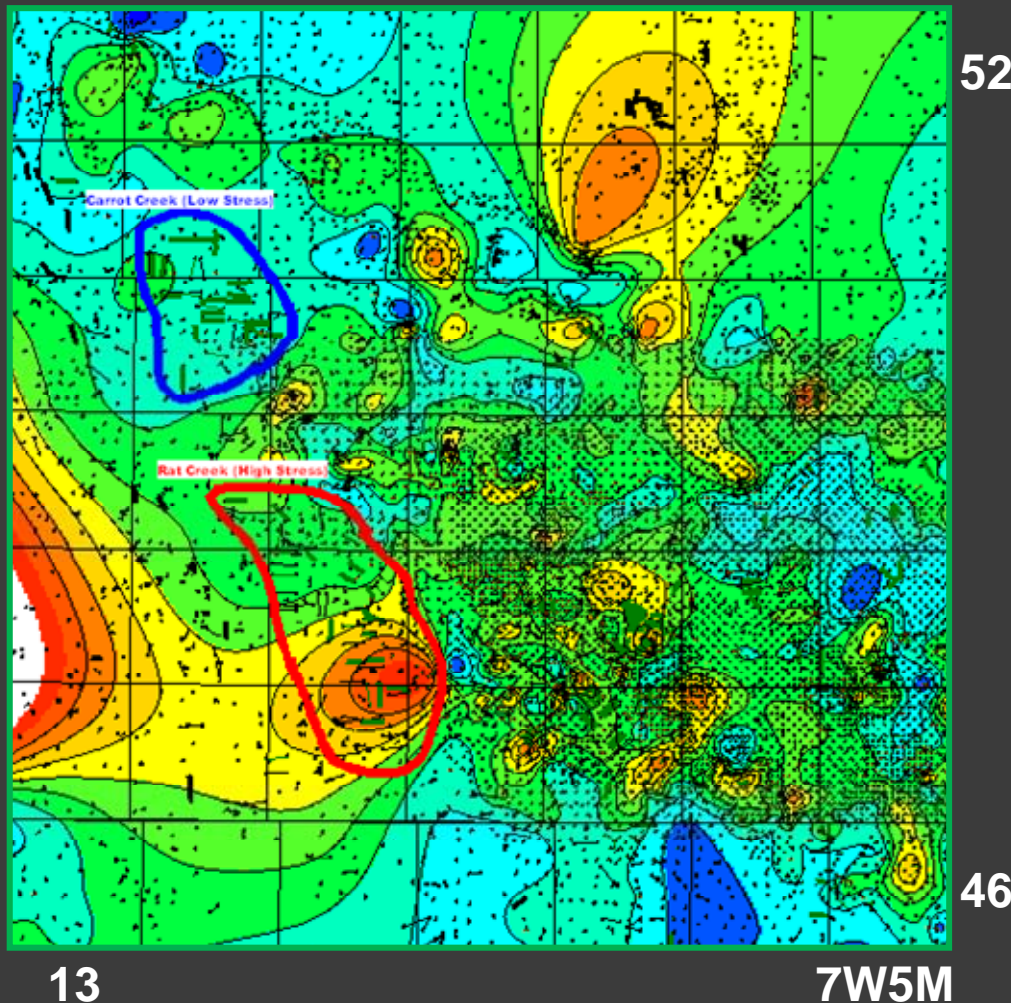
All technologies are the property of their respective owners and subject to applicable trademarks and registrations.

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



Carrot Creek

Low Stress Area

5.9% Frac* Failures

Rat Creek

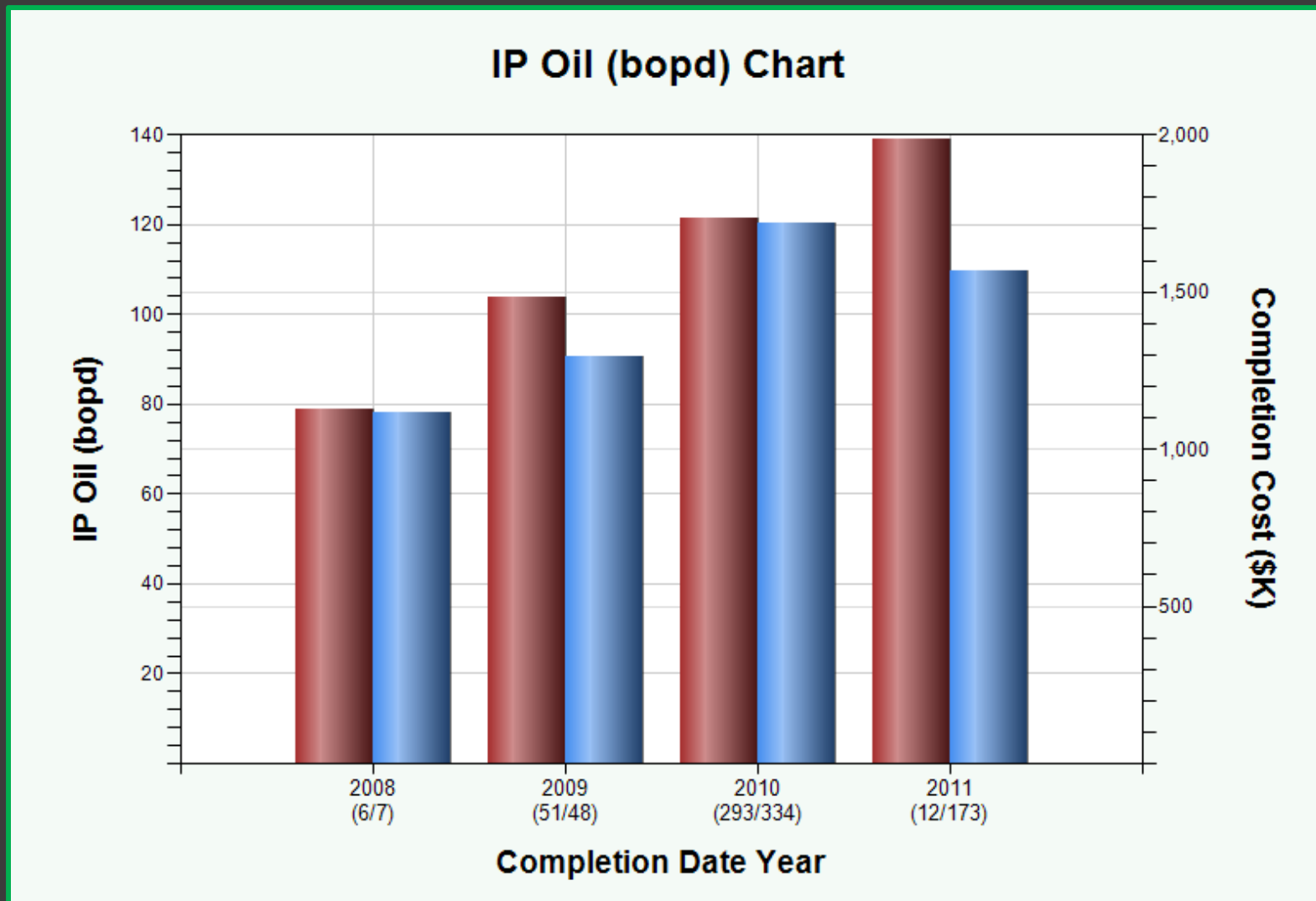
High Stress Area

8.7% Frac* Failures

*No Breakdown,
Omitted,
Partial Frac
Re-Frac

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

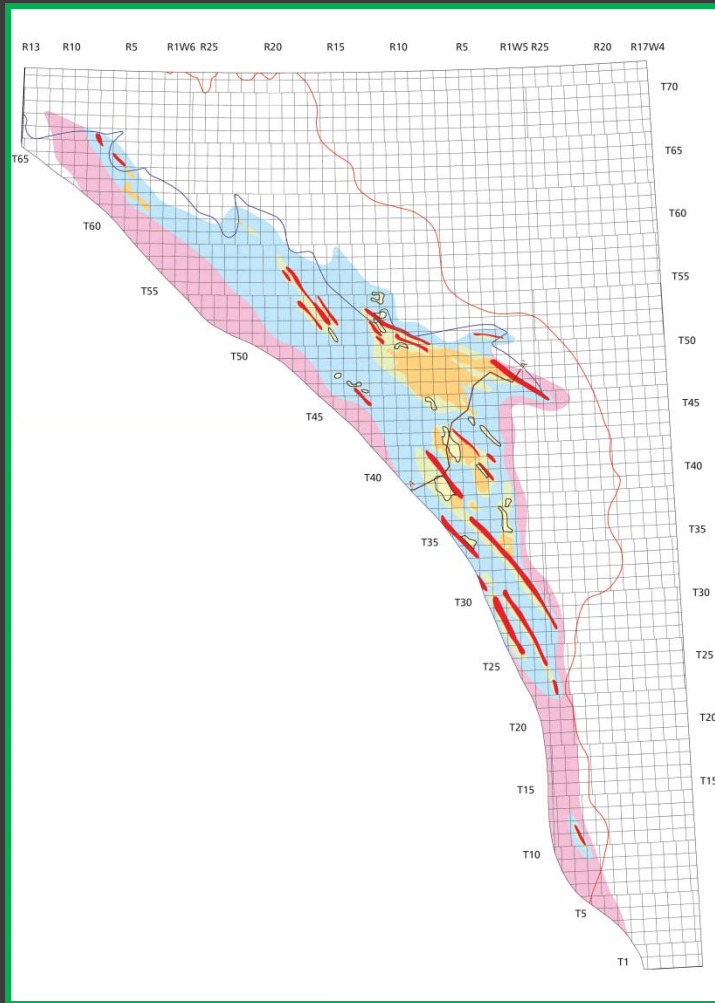
Cardium: Increasing IP3s, Flattening Costs



*Not normalized for load oil return



Cardium: Size of the Prize



Incremental Cardium Resource Potential

Incremental Conventional

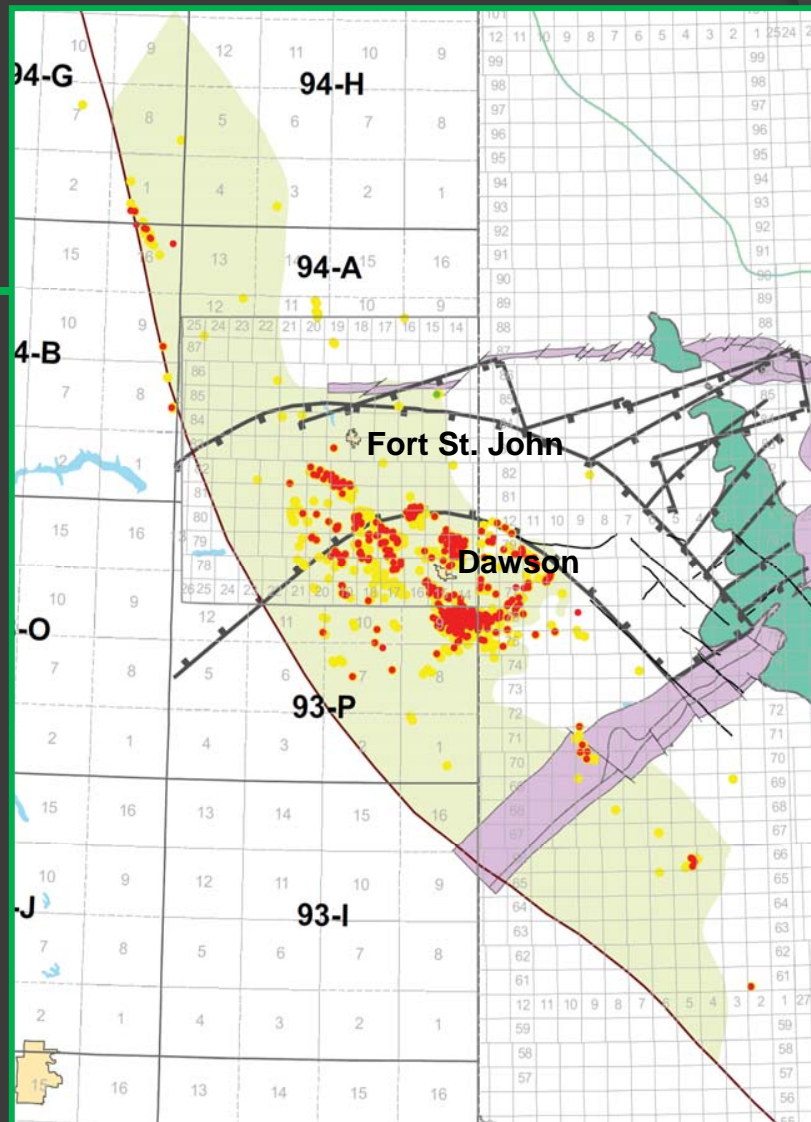
Barrier Bar	52 mmboe
Shoreface A	85 mmboe
Shoreface B	10 mmboe

Resource Halos

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

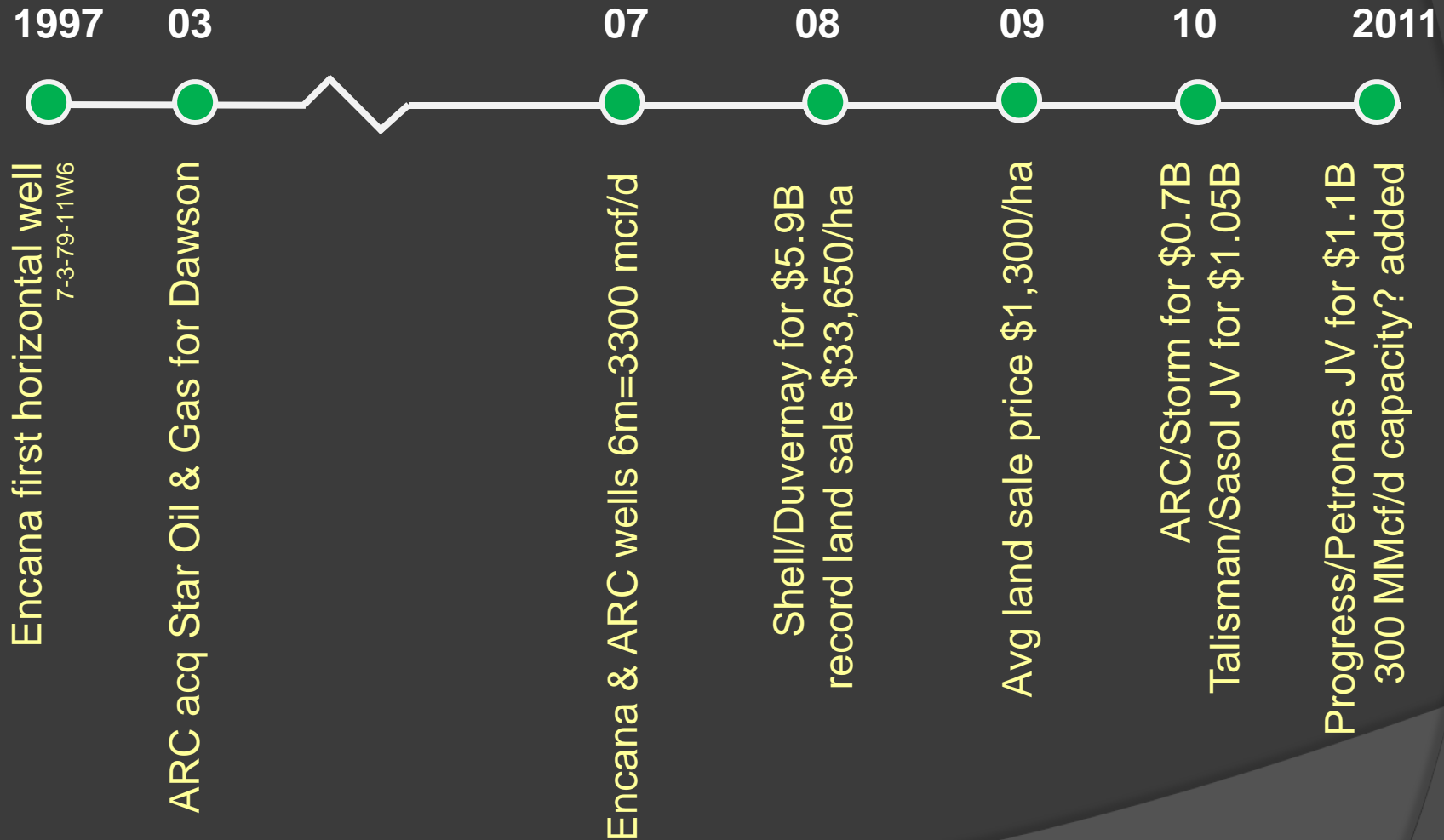
Total Additions: **1,225 mmboe**

MONTNEY GAS Distal Shelf Play



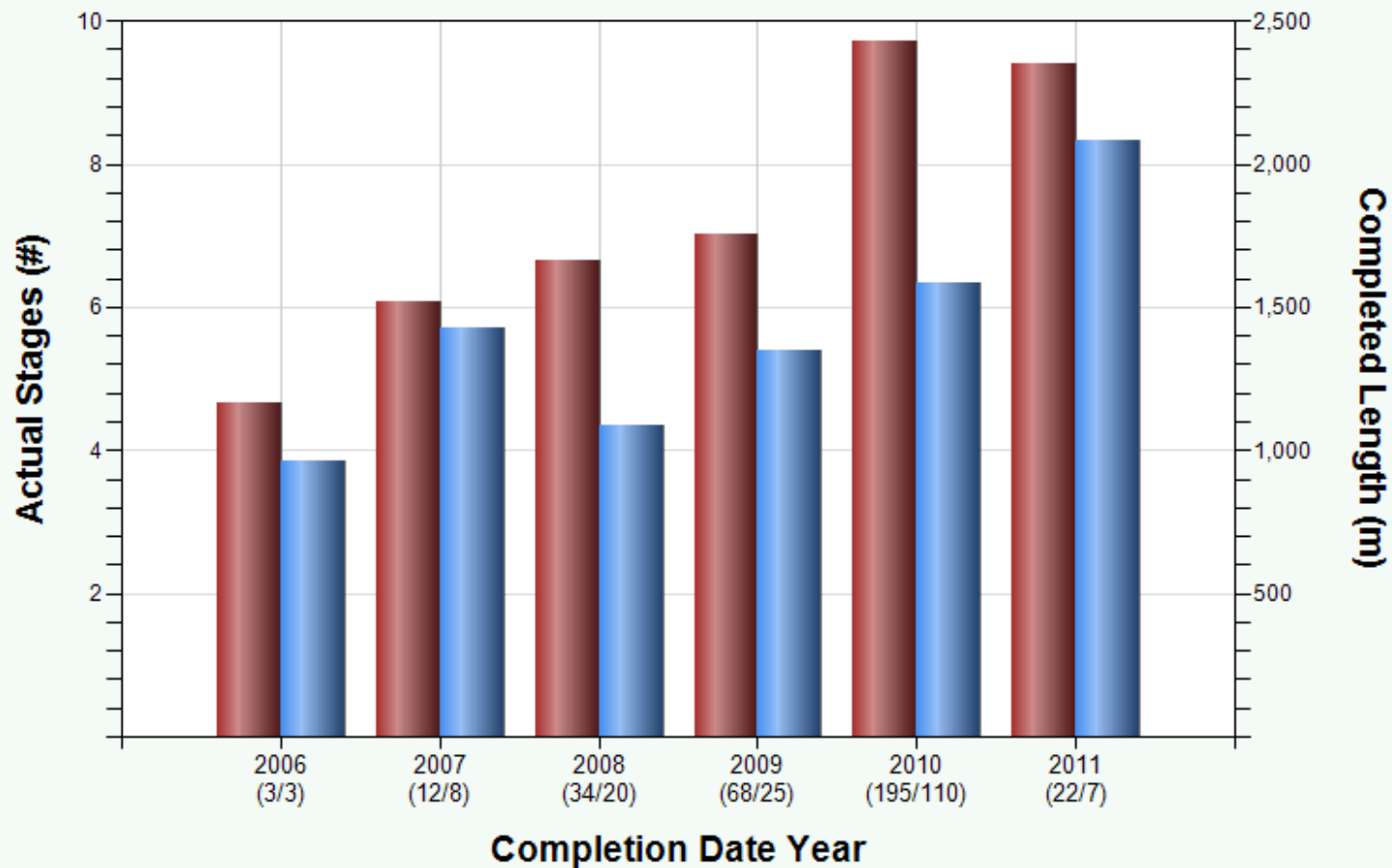
Source: CDL EDGE

Montney Resource Development Milestones



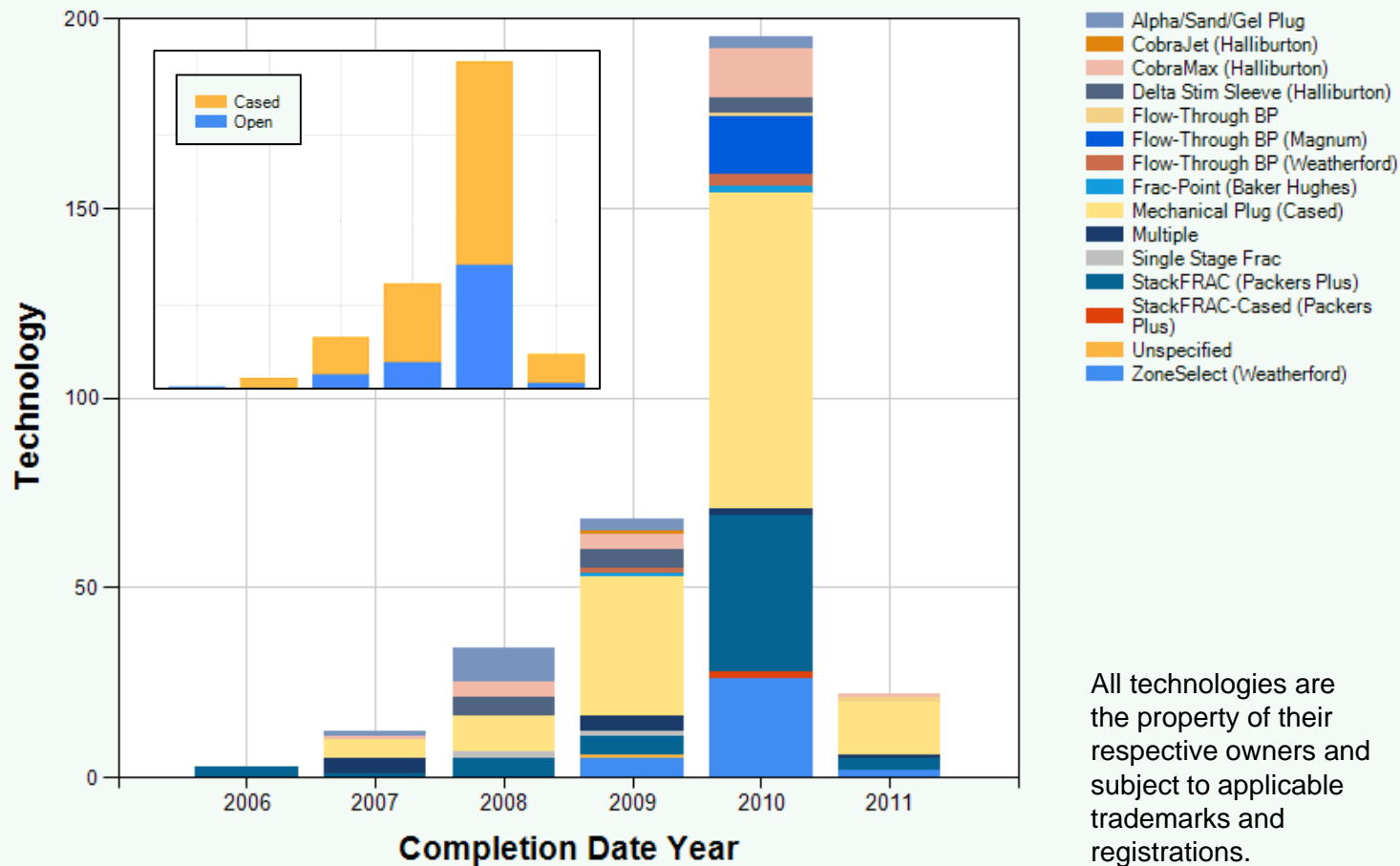
Montney: # Stages and Length Trends

Actual Stages (#) Chart



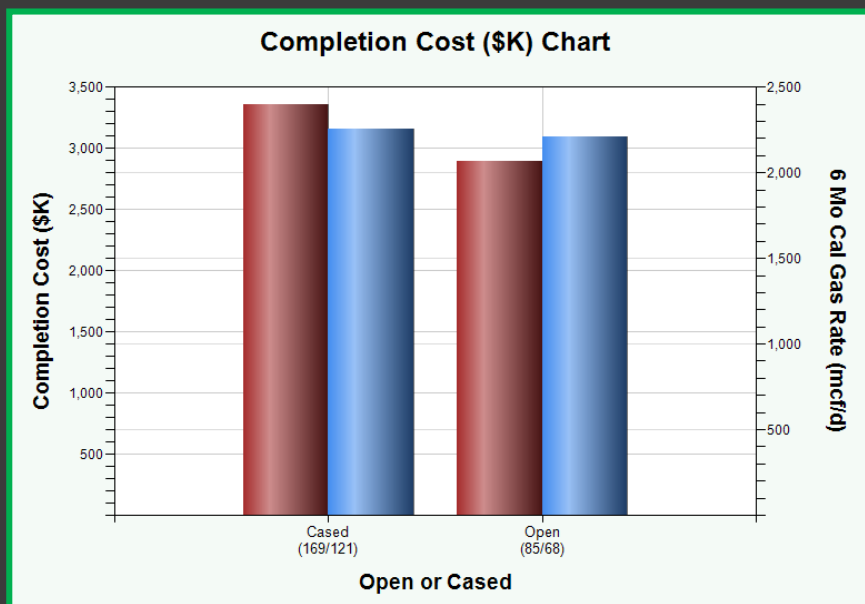
Montney: Experimentation w/ Technology

Technology vs. Completion Date Year

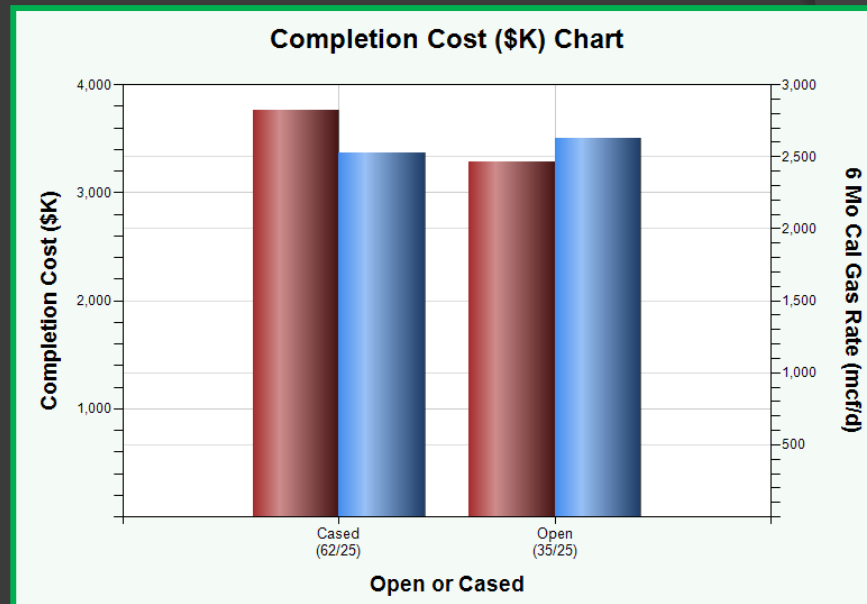


Montney: Open versus Cased

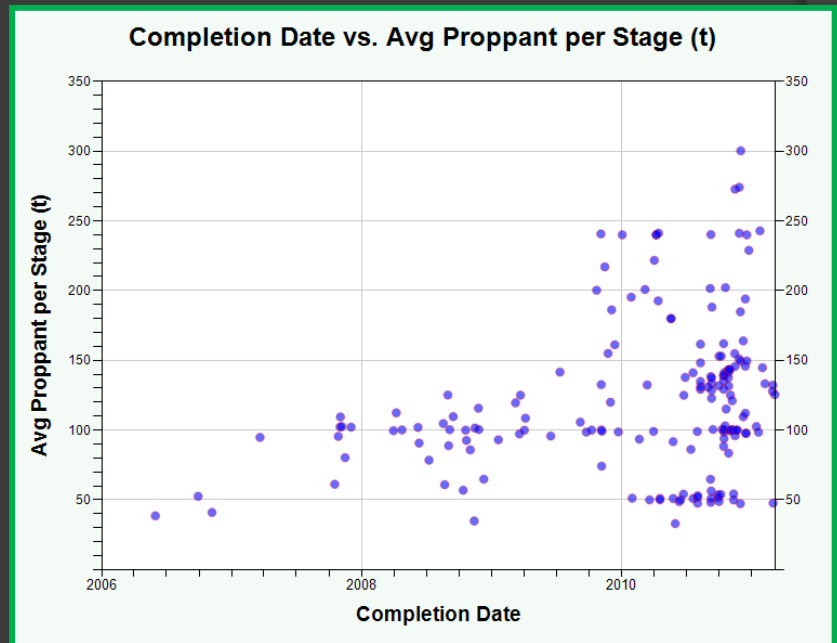
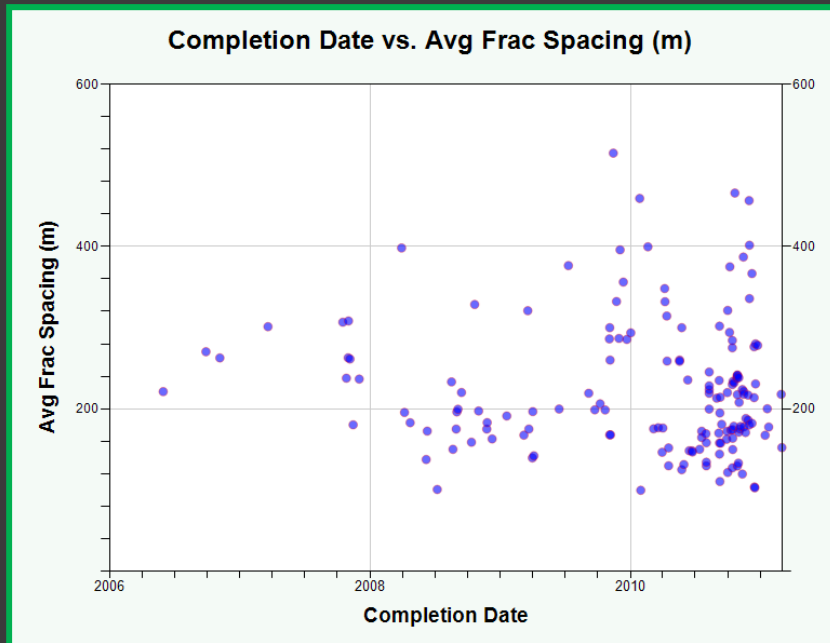
2006 to Present



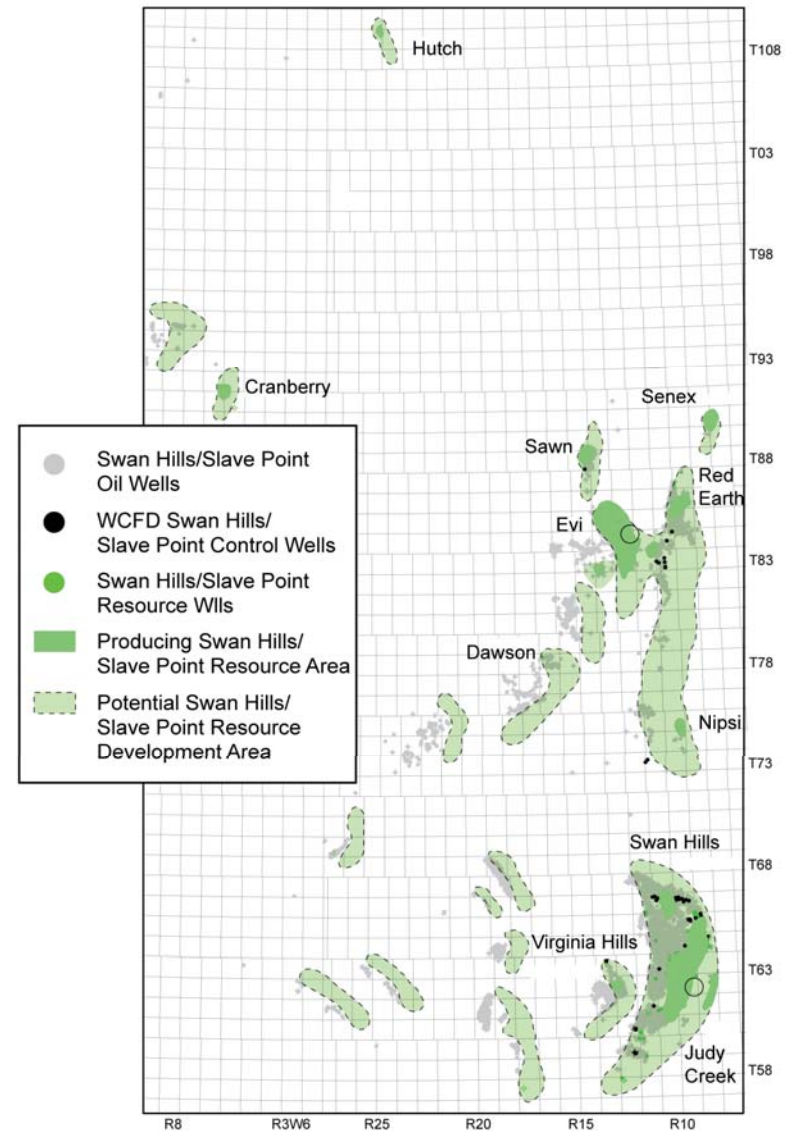
June 2010 to Present



Montney: Frac Spacing and Proppant Trends

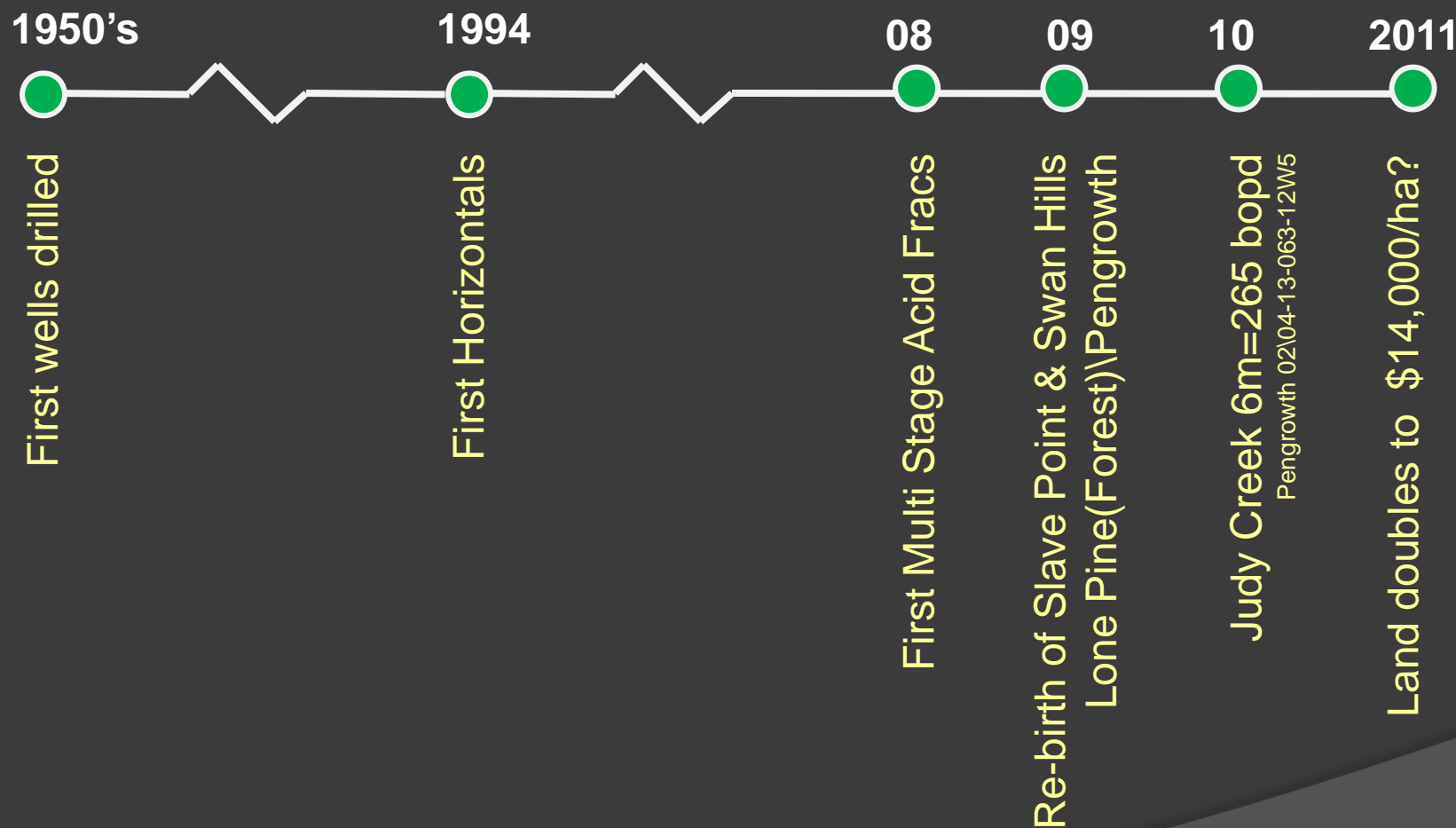


SWAN HILLS/ SLAVE POINT OIL

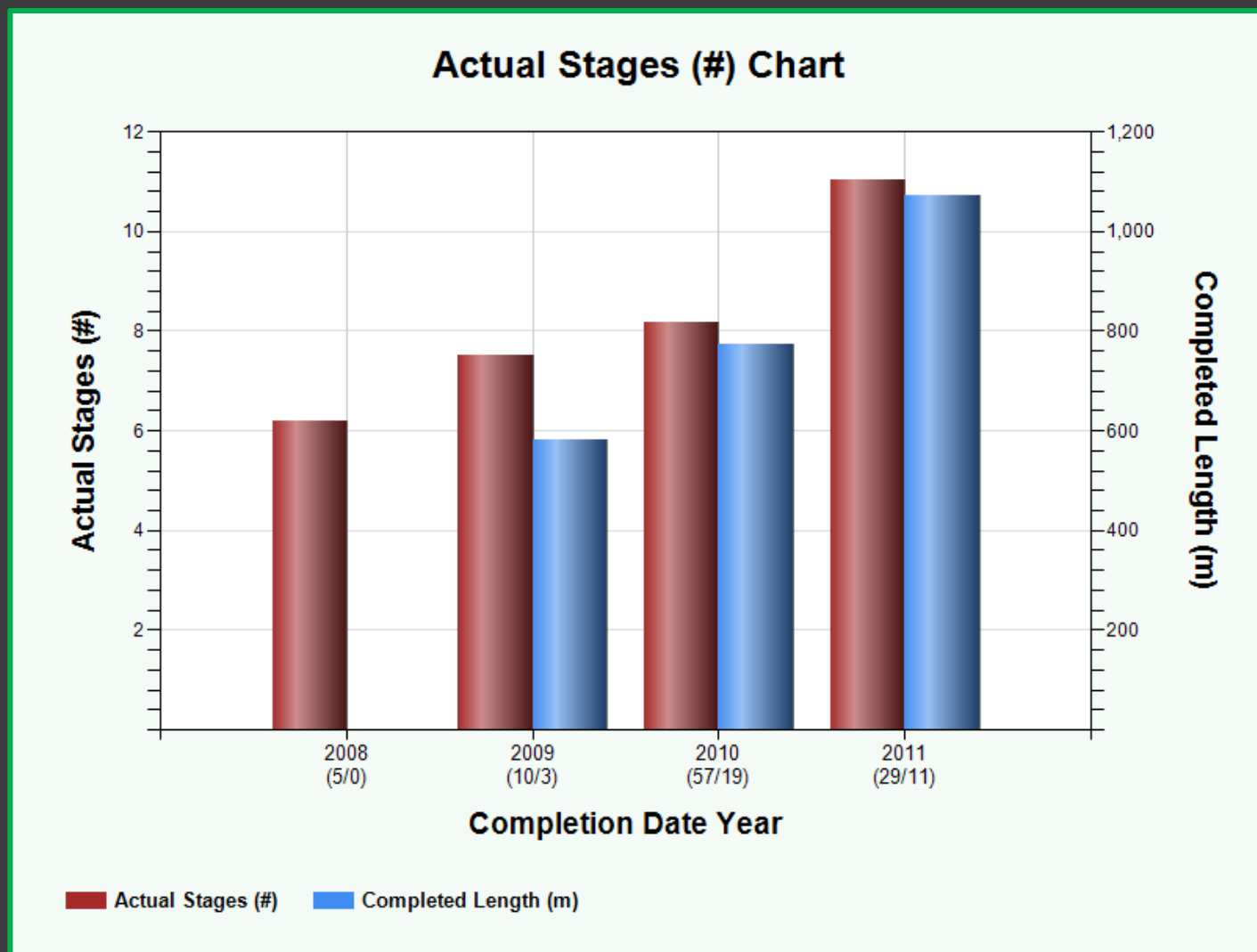


Source: CDL

Slave Point Resource Development Milestones

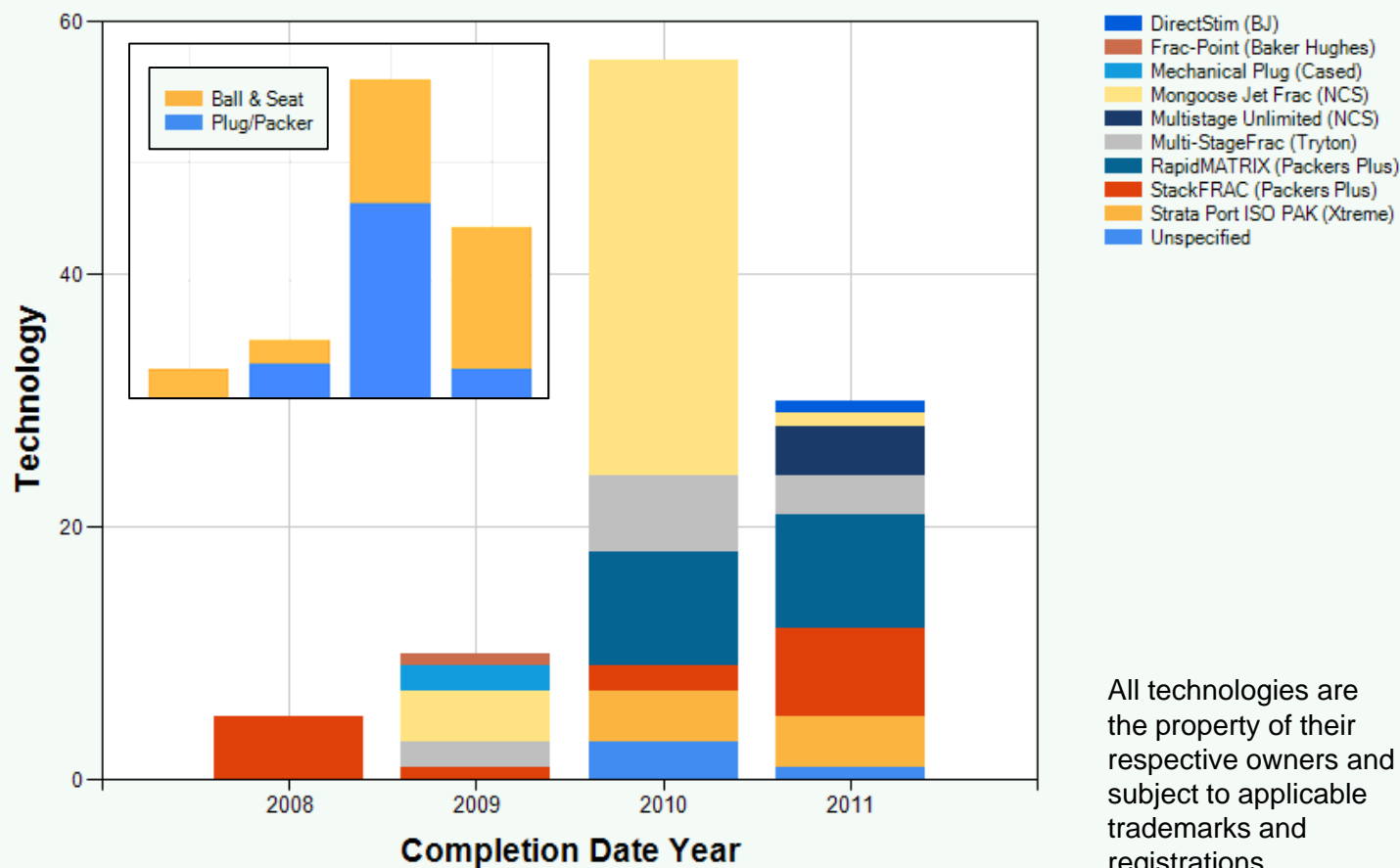


SWHL/SLVP : # Stages and Length Trends



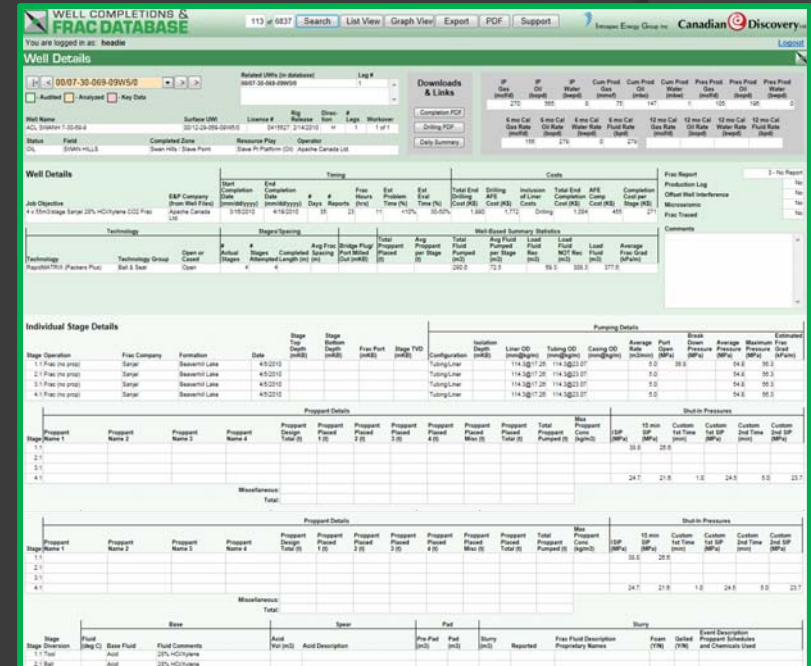
SWHL/SLVP: Experimentation w/ Technology


Technology vs. Completion Date Year



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

- Apache Feb 2010
- 4 x 55m³/stage Sanjel
28% HCl/Xylene CO₂ Frac
- RapidMATRIX
Ball/Seat (Packers Plus)
- \$3.1M D&C





Introspec Energy Group Inc.

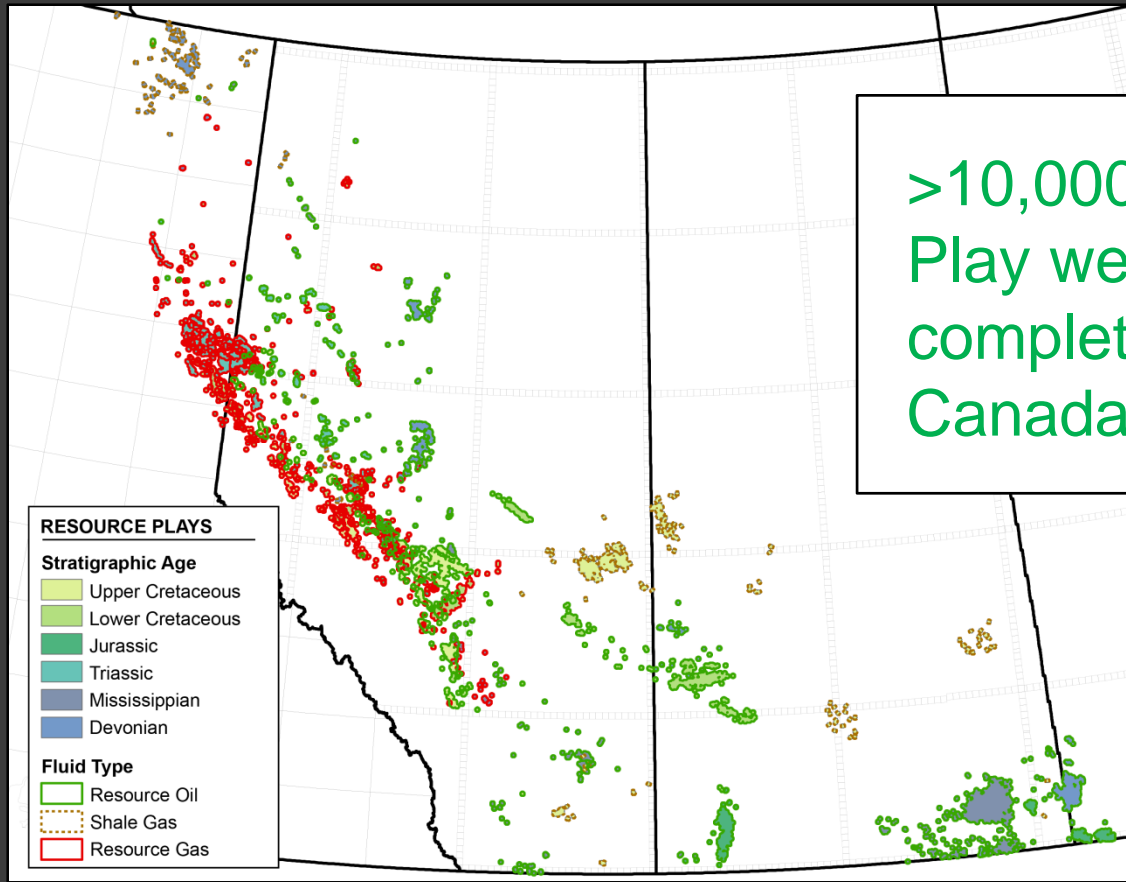
Canadian Discovery

Daily Summary

00/07-30-069-09W5/0

Report #	Frac Hours (hrs)	Report Cost (K\$)	Comments
1			33.832 RI wireline. RIH w/ gauge ring line top @ 2172.2mKB. RIH w/ ORC/CCLB. Log from surface to PBTD. Logged RBL log from PBTD to surface. RO wireline.
2			53.384 Removed WH. installed tbg head spool & BOP. RIU rig, pump & tank.
3			48.655 Land tbg hanger. W/O hoist.
4			31.971 RIH w/ 114.3mm seal assembly. Bottom of seals @ 2150.08mKB.
5			20.993 RIH w/ 114.3mm tbg. Latch into liner hanger & land hanger w/ tbg. Remove BOP, install frac head.
6			48.97 Tie-in ball pump into well. Opened hydraulic port @ 38.8MPa. ROR pumper.
7			2.975 RIU test eqpt.
8			11.569 Haul in frac fluid.
9			16.845 Continue to haul in frac fluid.
10	10.8		340.289 Finished hauling frac fluid. RIU frac eqpt. W/O Packers Plus Hand. Perform 4 stage frac. ROR frac eqpt. Opened well on 13.9mm choke. then decreased to 12.7mm. Qfluid=14.14m3/hr (avg). FR=148.01m3 (water=22.62m3, oil=125.39m3). Cum gas=9.53E3m3.
11			120.045 Continue to flow well on 12.7mm choke. Qfluid=10.15m3/hr (avg). FR=144.52m3 (water=0m3, oil=144.52m3). TFR=903m3 (water=25.5m3, oil=307.5m3). Cum gas=31.8E3m3.
12			18.588 Continue to flow well on 12.7mm choke. Qfluid=9.19m3/hr (avg). FR=166.96m3 (water=0m3, oil=166.96m3). TFR=999.9m3 (water=25.5m3, oil=94.4m3). Cum gas=46E3m3.
13			21.696 Continue to flow well on 12.7mm choke. Qfluid=12m3/hr (avg). FR=194.96m3 (water=0m3, oil=194.96m3). TFR=1794.9m3 (water=25.5m3, oil=759.4m3). Cum gas=55.8E3m3. Changed choke to 19.05mm.
14			18.28 Changed choke to 12.7mm & continued to flow well. FR=192.5m3 (water=0m3, oil=192.5m3). TFR=1777.7m3 (water=25.5m3, oil=965.2m3). Cum gas=76E3m3. Changed choke to 19.05mm.
15			10.33 Continue to flow well on 12.7mm choke. Qfluid=7.5m3/hr (avg). FR=181m3 (water=0m3, oil=181m3). TFR=1158.5m3 (water=25.5m3, oil=1133m3). Cum gas=87.4E3m3.
16			16.785 Continue to flow well on 12.7mm choke. Qfluid=9.65m3/hr (avg). FR=166.96m3 (water=0m3, oil=166.96m3). TFR=1325.5m3 (water=25.5m3, oil=1300m3). Cum gas=95.3E3m3.
17			12.538 Disconnect flowline to p-tank. Spool rig on mats & RIU. Opened well to P-tank & flowed well on 12.7mm choke. Qfluid=7.2m3/hr (avg). Wfluid=0%. TFR=1495.4m3 (water=22.5m3, oil=1440.9m3). Cum gas=102.4E3m3.
18			21.700 SI well to kill tbg. Removed WH & installed BOP. POOH w/ 114.3mm frac string. Had problems getting stung out from liner hanger.
19			41.633 Continue to POOH w/ 114.3mm frac string. Change over to 73mm eqpt. RIH w/ 73mm prod tbg.
20			59.420 Pump string. Roll down tbg. Continue to RIH w/ 73mm prod tbg. Set pkr. Tbg bottom @ 2147.40mKB. Remove BOP & installed WH.
21			107.361 RIU wireline. RIH w/ lined bore into PSN @ 1950mKB. POOH RIU wireline. RIH w/ pumps & rods. RIU testers & flowed well. TFR=1909.19m3 (water=43.54m3, oil=1455.7m3). Cum gas=103.5E3m3.
22			24.503 ROR. Haul out frac fluid. Continue to flow well. TFR=1614.01m3 (water=47.01m3, oil=1567m3). Cum gas=111.6E3m3.
23			10.091 Continued to flow well. Qfluid=4.5m3/hr. TFR=1627.91m3 (water=47.01m3, oil=1580.9m3). Cum gas=112.7E3m3.

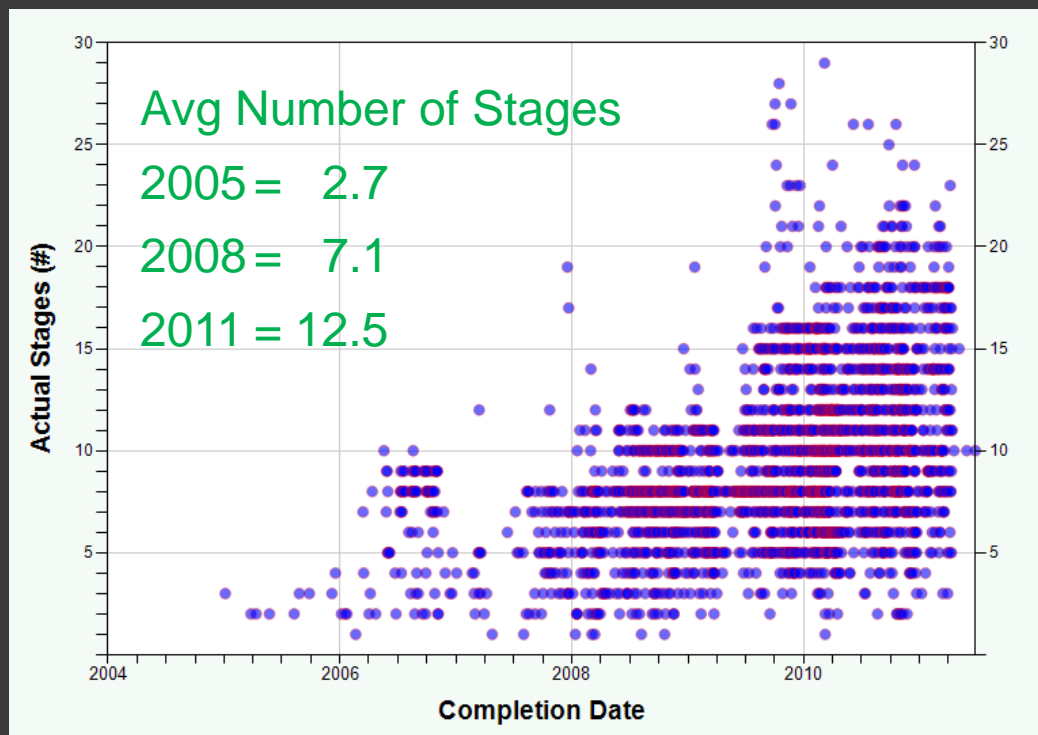
MACRO-PICTURE – WESTERN CANADA



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

Increasing Number of Stages

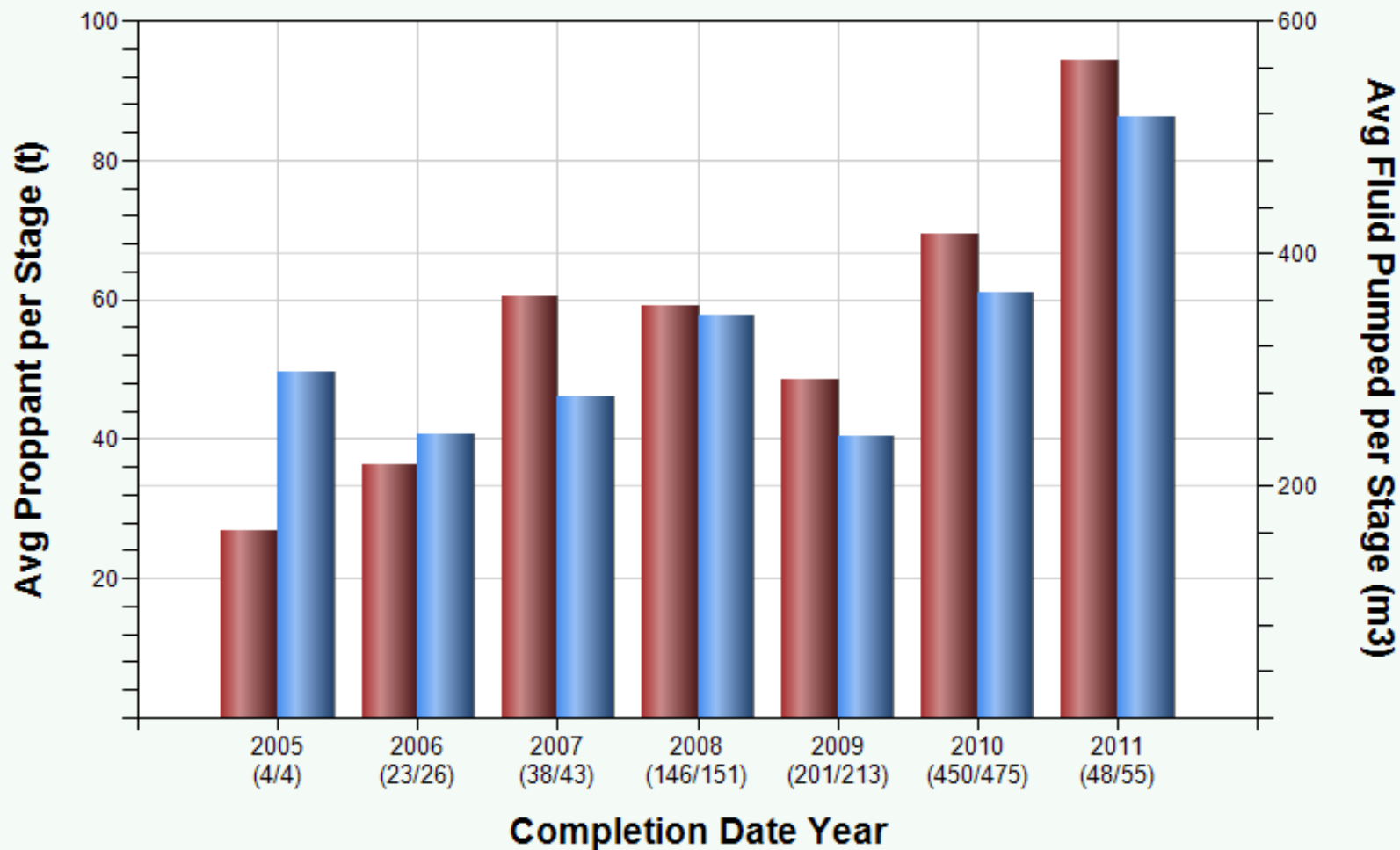
Completion Date versus Number of Stages



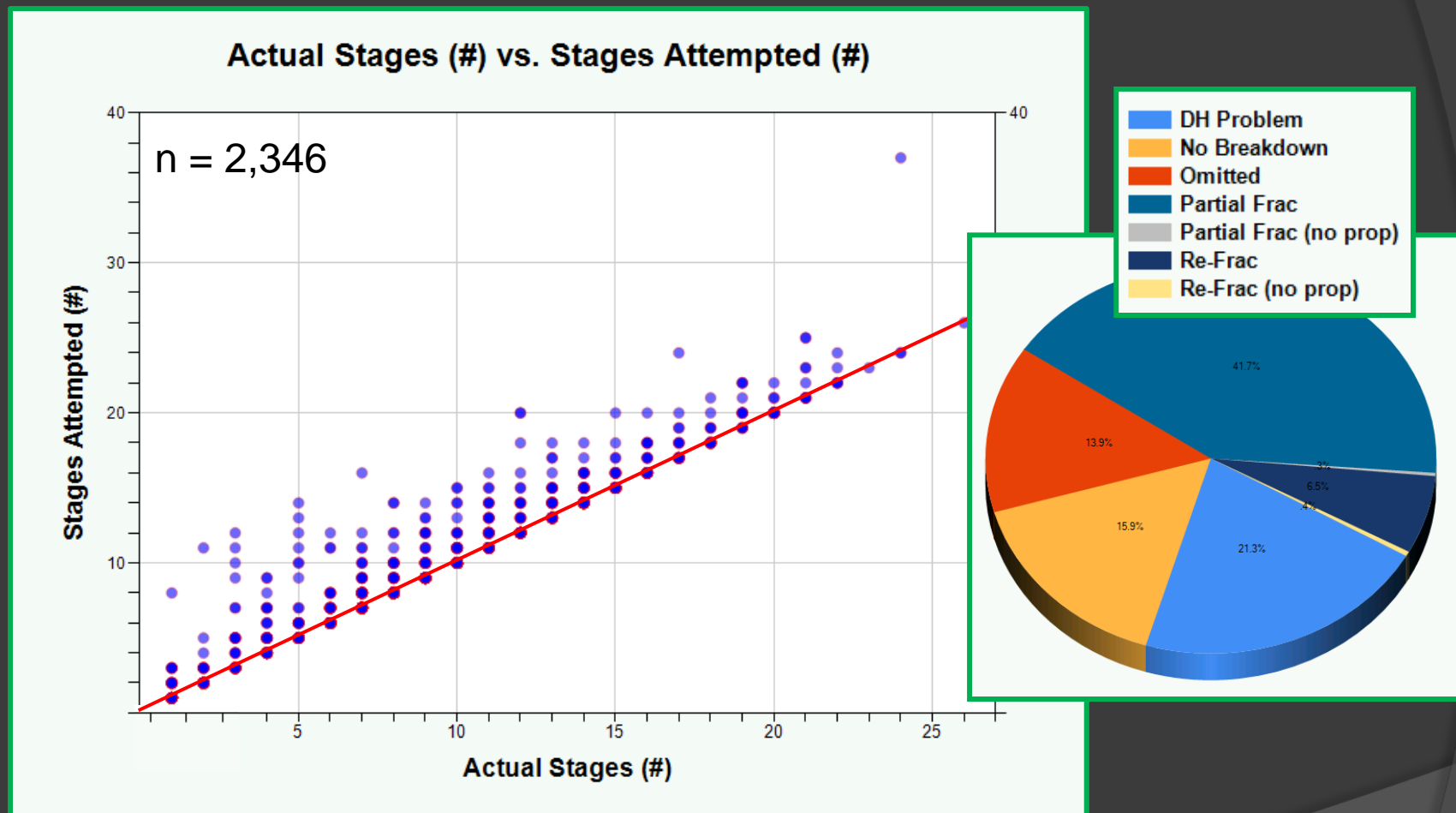
In Combination with:

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

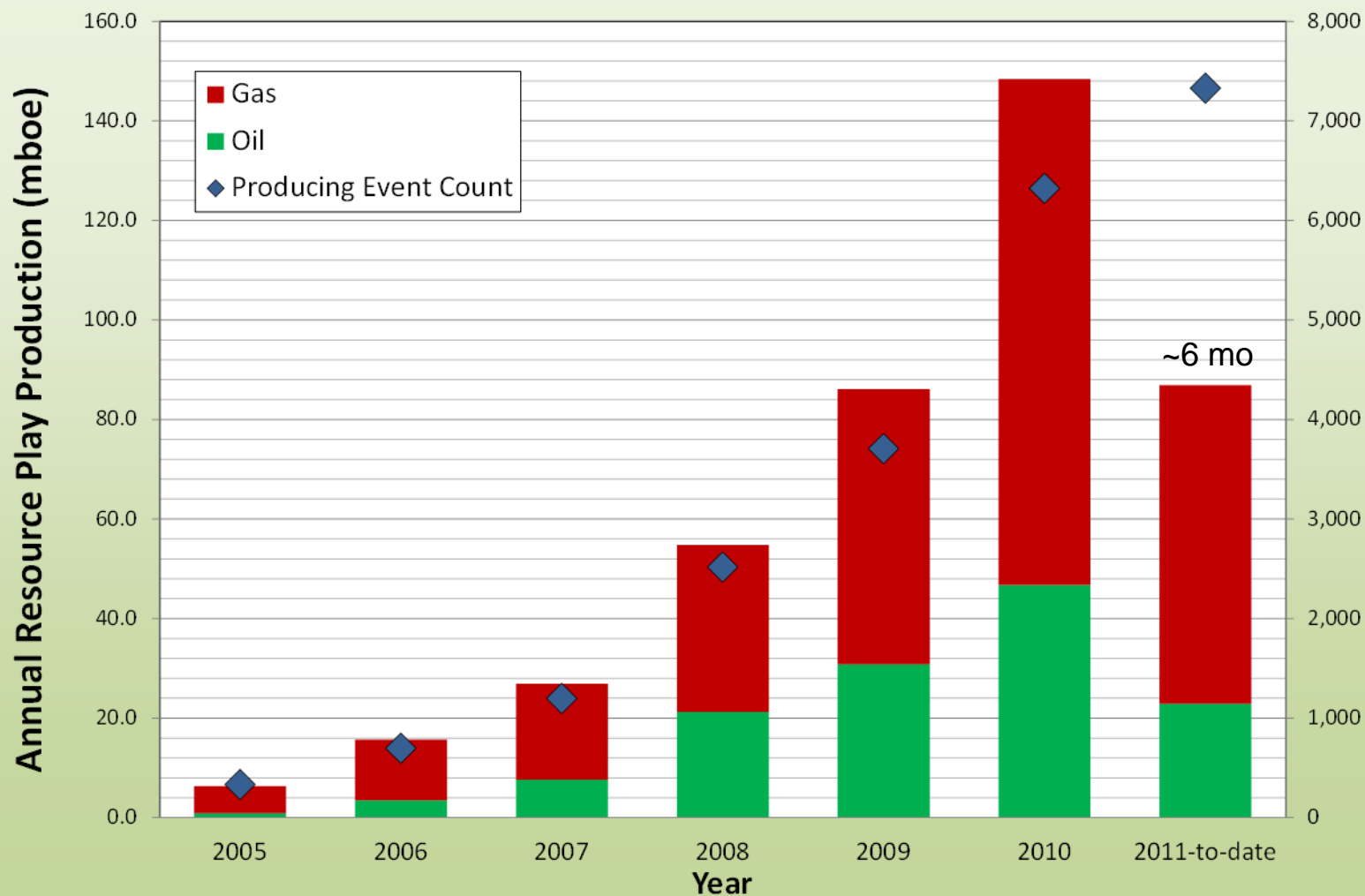
Larger Fracs: More Proppant and Fluid



Experimentation and Fine-Tuning



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

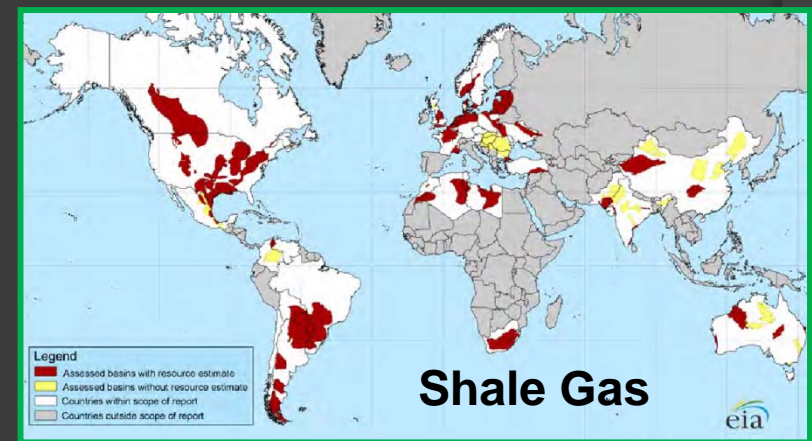
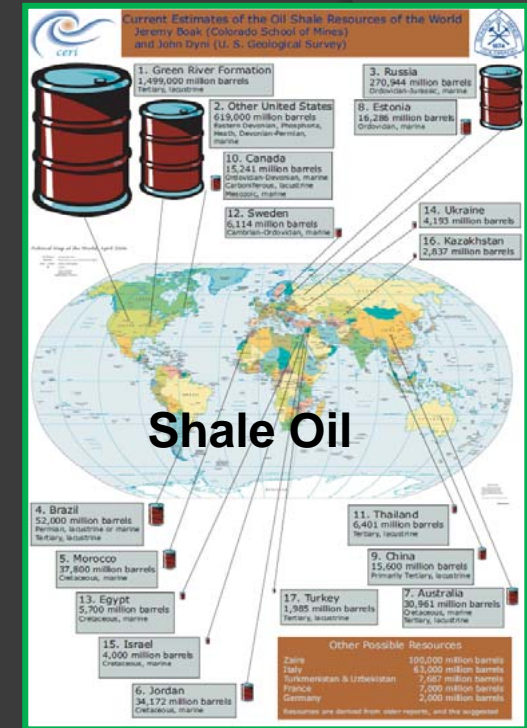
Nordegg



WELL COMPLETIONS &
FRAC DATABASE

Worldwide Implications

- ② Western Canada is just the tip of the iceberg
- ② 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



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



Introspec Energy Group Inc.



- Resource Play Overview Studies
- Digest / EDGE / CEO

- Heather McCrank
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- Mike Seifert
- Matt Baird



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