

## **National Petroleum Council Study**

“Prudent Development – Realizing the Potential of North America’s Abundant Natural Gas and Oil Resources” (September 2011)

Onshore Gas Topic Paper Update

October | 2013

# NPC Onshore Gas Topic Paper #1-8 Update

Revisiting the Onshore Gas resource cases

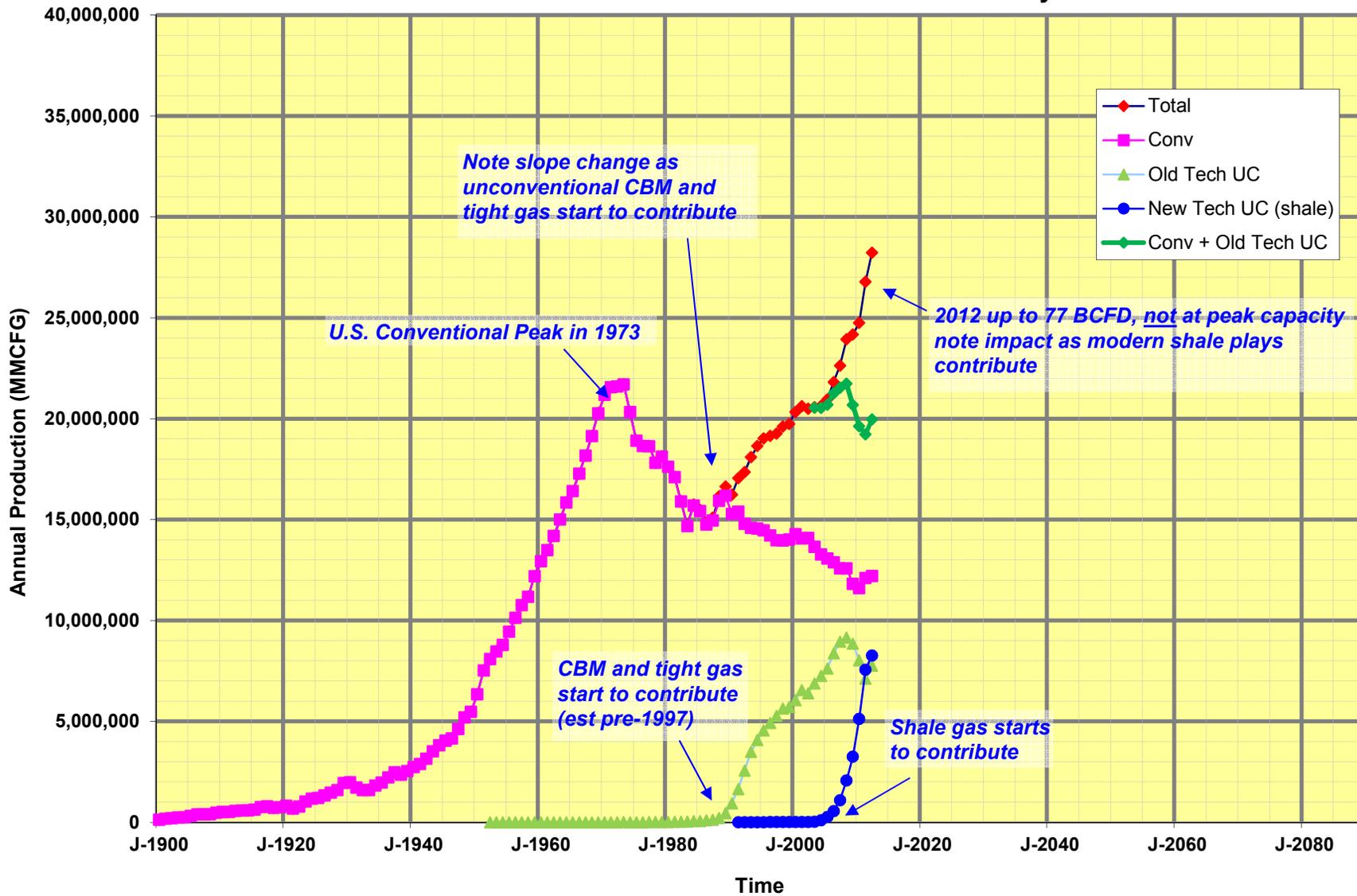
- **Case 1 (low) no longer fits historical trends**

- Three more years of data is available since the National Petroleum Council study was performed ( [www.npc.org](http://www.npc.org) )
- Gas production performance continues to be very strong despite falling prices
- From a “bottom-up” point of view:
  - New discoveries have been (and continue to be) made
  - Associated gas has become much more significant
  - More recent studies, like the PGC and EIA/ARI, continue to increase their gas resource estimates which are now consistent with the NPC, MITeI, and RSTG data used in the original study
- The following slides provide additional “top-down” points of view

# U.S. Plus Canada Onshore Production Profile

Excerpt of Figure 16, with three additional years added

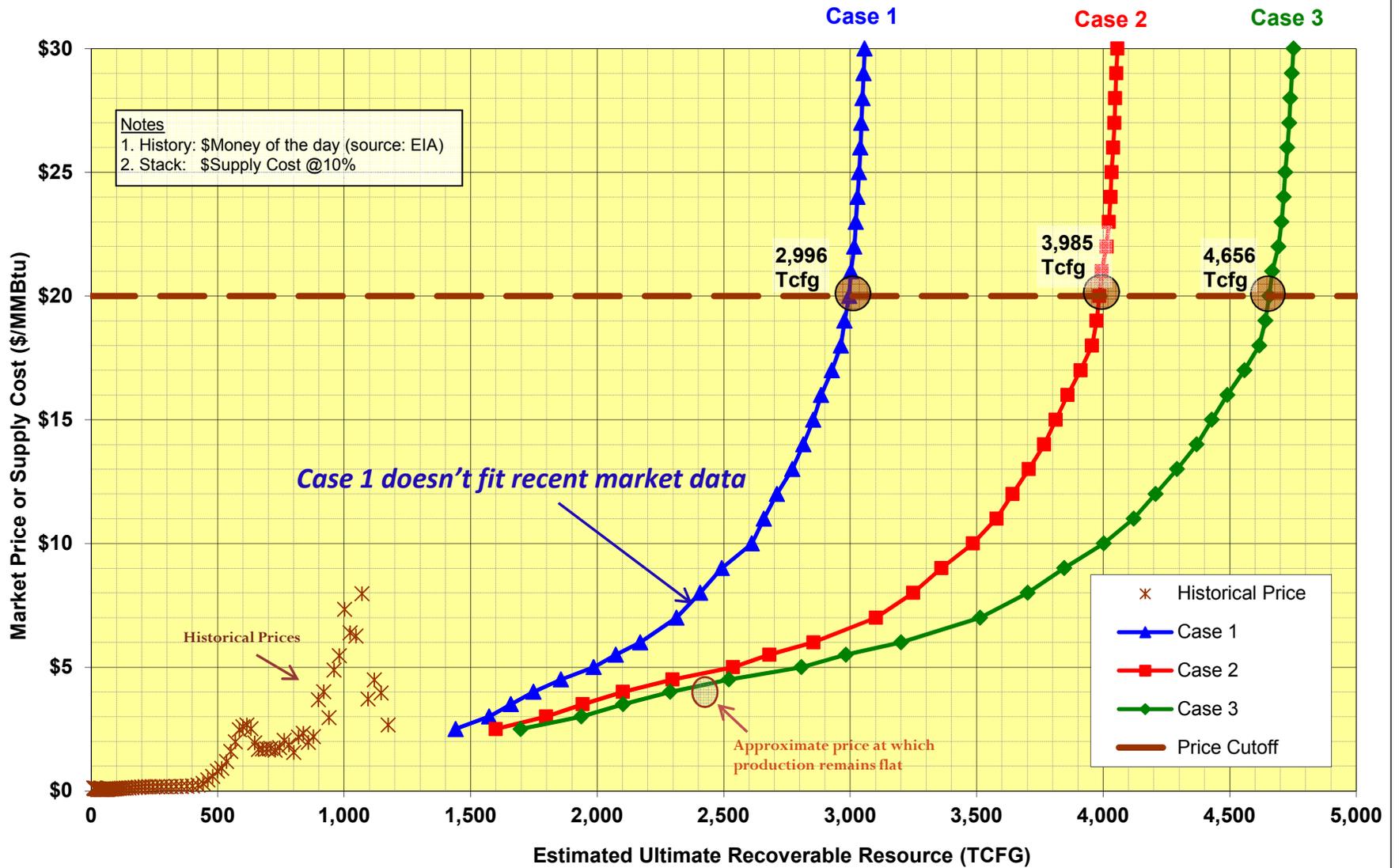
## USL-48 + Canada Onshore Natural Gas Production History



data sources: US EIA, USGS, CAPP, NEB Canada, Cedigaz, IHS CERA

# Supply Stack Curves

Excerpt of Figure 17, with cumulative production through YE2012



Notes  
1. History: \$Money of the day (source: EIA)  
2. Stack: \$Supply Cost @10%

Case 1 doesn't fit recent market data

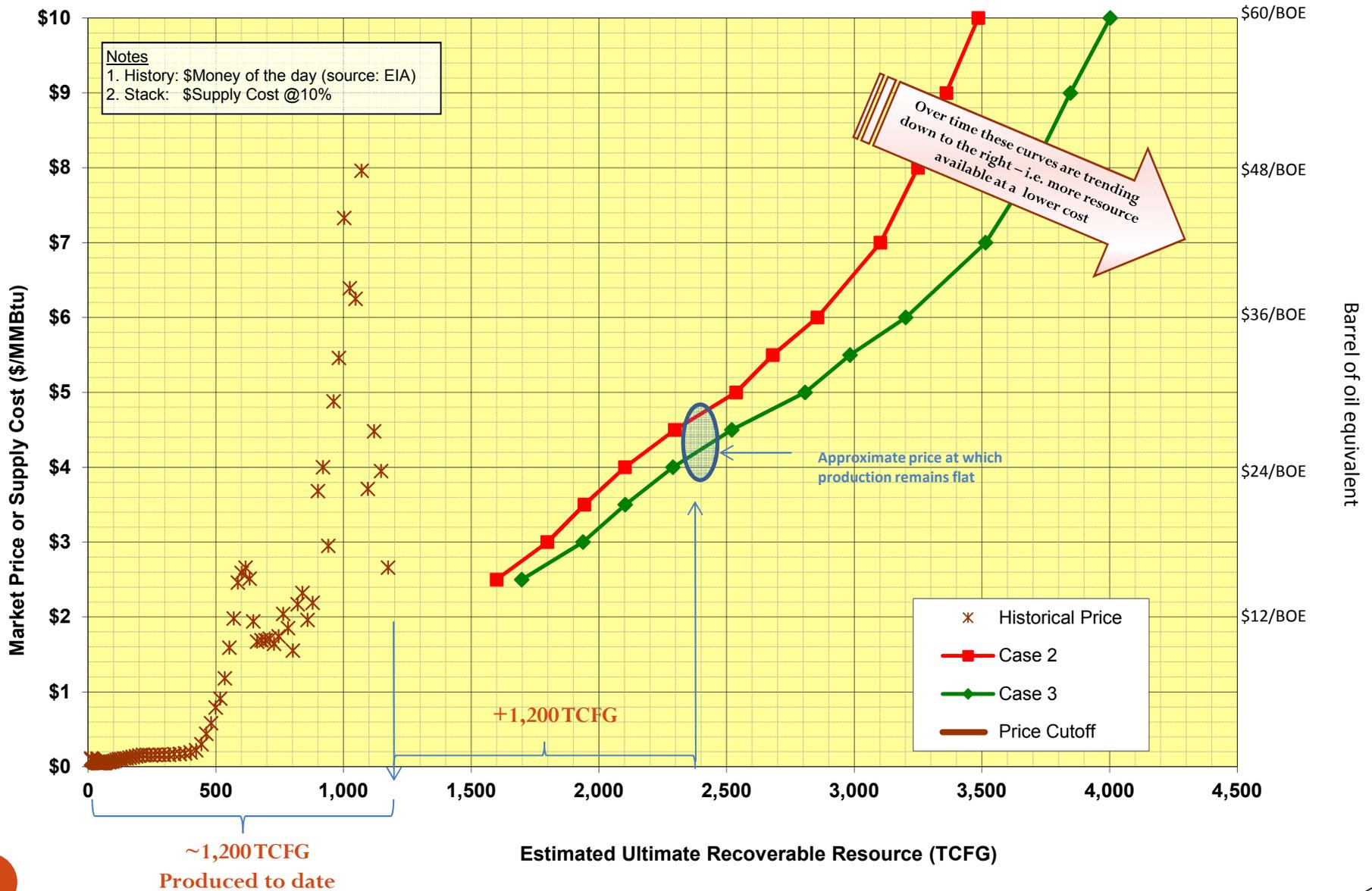
Historical Prices

Approximate price at which production remains flat

× Historical Price  
—▲ Case 1  
—■ Case 2  
—◆ Case 3  
— Price Cutoff

# Supply Stack Curves - Annotated

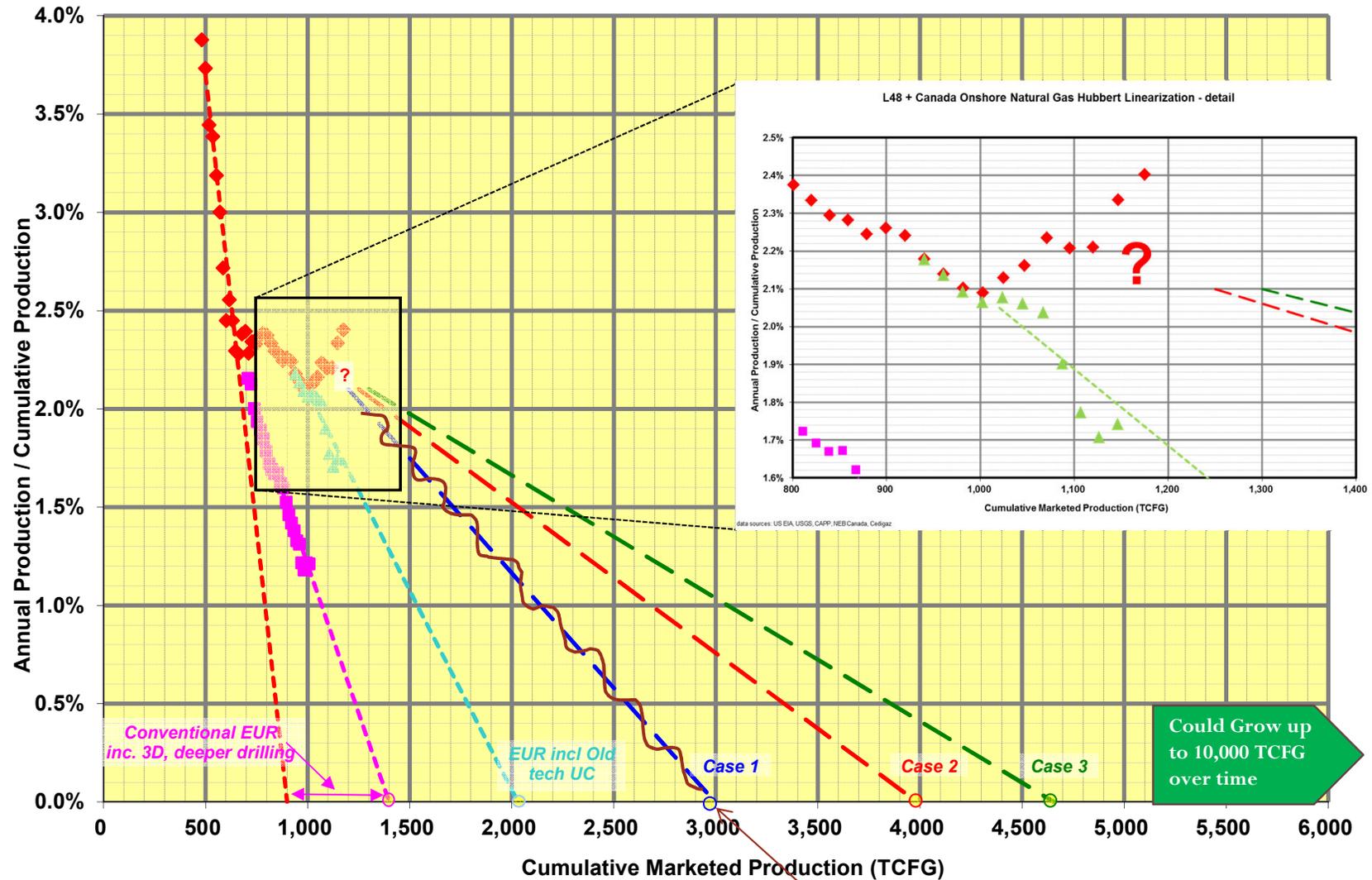
Zoom-in of Slide 4- 1,200 TCFG available at < \$5 supply cost



# U.S. Plus Canada Onshore Resource Estimates – Update

Excerpt of Figure 19, with cumulative production through YE2012

## L48 + Canada Onshore Natural Gas Hubbert Linearization - detail



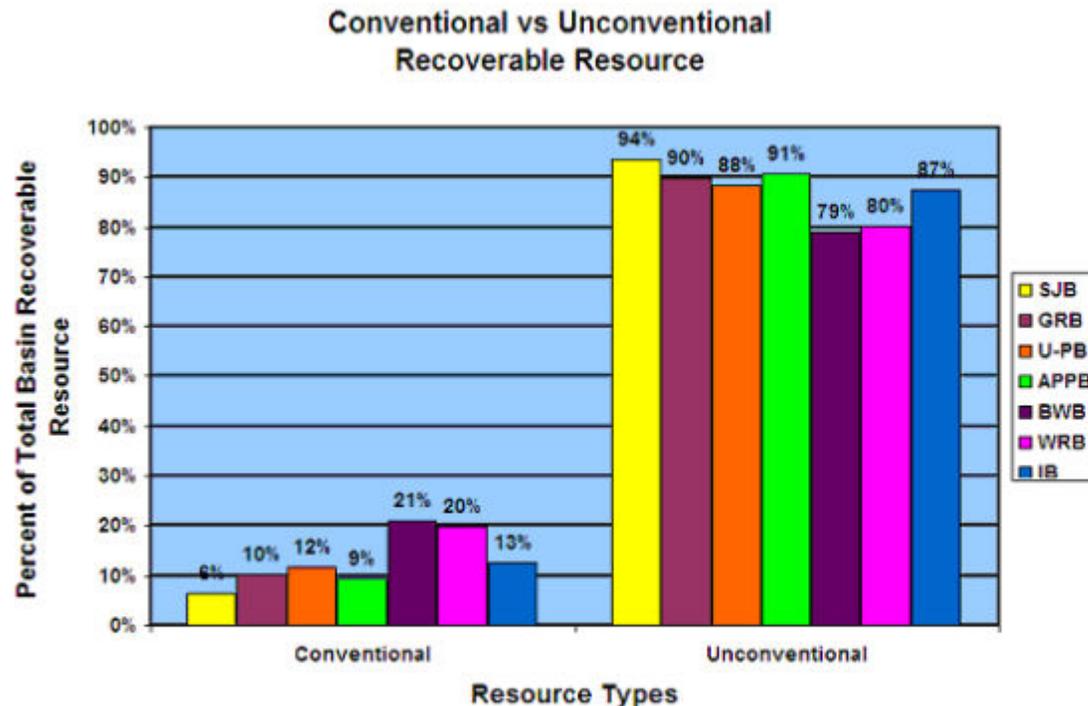
data sources: US EIA, USGS, CAPP, NEB Canada, Cedigaz

Based on updated market and production data, Case 1 no longer fits historical trends

# U.S. Plus Canada Onshore Natural Gas Resource Estimates

Relationship of conventional to unconventional resources

Excerpt from Appendix A - annotated



*Figure A4: Conventional vs. Unconventional Recoverable Resource*

- \* SJB - San Juan Basin
- GRB - Green River Basin
- \* U-PB - Uinta-Piceance Basin
- \* APPB - Appalachian Basin
- BWB - Black Warrior Basin
- \* WRB - Wind River Basin
- IB - Illinois Basin

Source: Old, Holditch, Ayers, and McVay, 2008 (SPE 117703)

From Slide 6: Could Grow up to 10,000 TCFG over time  
**EXPLANATION:**

\*Basins with significant new unconventional discoveries since 2008 are likely to increase the unconventional fraction to >90% (or 10 times the conventional recoverable resource).

**Based only on conventional recovery to date of ~1,000 TCFG (Slide 6); ultimate unconventional recovery could be ~10,000 TCFG.**

Note that this is over twice the Case 3 estimate of ultimate recoverable resource (4,656 TCFG from Slide 4).

# Various Gas Remaining Resource Estimates

Excerpt Table 2 – Annotated and Updated with latest EIA and PGC Figures

## Estimates of Remaining Resource <sup>1</sup>

Organization	Date	Offshore	Conventional	Tight	Shale	CBM	Total Lower 48	AK	Total US	Proved reserves	All US	Canada Onshore non-Arctic	Canada Offshore and Arctic	Total Canada	Total North America	Onshore non-Arctic N.A. Total
USGS/MMS/EIA	1997		657	308		50	1,015	223	1,238							
USGS/MMS/EIA	2009		454	276		71	801	362	1,163	245	1,408					
NPC	1999		881	230	52	74	1,252	303								
NPC	2003		691	190	35	58	974	294	1,268	184	1,452	397		397	1,849	
PGC	2001			742		98	840	251	1,091							
PGC	2006			961		166	1,127	194	1,321	211	1,532					
PGC	2008		863		616	163	1,642	194	1,836	238	2,074					
PGC	2012	131		1,892		158	2,181	194	2,384	305	2,689					
ICF	2009		693	174	631	65	1,563	294	1,857	245	2,102					
INGAA	2008		904	174	385	65	1,528	302	1,830	204	2,034	508		508	2,338	
NEB	2009											627		627		
CSUG	2010											1,020		1,020		
MITeI Canada P10 <sup>2</sup>	Q2 2010													1,185	4,035 <sup>6</sup>	
MITeI U.S. P10 <sup>2</sup>	Q2 2010										2,850					
MITeI Pmean <sup>2</sup>	Q2 2010										2,100			800	2,900	
MITeI U.S. P90 <sup>2</sup>	Q2 2010										1,500					
MITeI Canada P90 <sup>2</sup>	Q2 2010													460	1,960 <sup>6</sup>	
RSTG Onsh Gas Case 3 <sup>3</sup>	Q3 2010		120	523	1,658	142	2,443					1,118				3,561
RSTG Onsh Gas Case 2 <sup>4</sup>	Q3 2010		120	523	1,198	142	1,983					907				2,890
RSTG Onsh Gas Case 1 <sup>5</sup>	Q3 2010		120	523	514	142	1,299					602				1,901
ANGA	Q1 2010		692	438	1,759	70	2,959	294	3,253	245	3,498	1,026			4,524	
GTI Current	2010		958	223	32	49	1,321	484	1,805	inc.?	1,805					
GTI Advanced	2010		1,002	337	53	77	1,528	530	2,058	inc.?	2,058					
NPC Survey High	Q4 2010	375	440	550	1,800	150	3,315	345	3,660	inc.	3,660	1,025	230	1,255	4,915	3,965
NPC Survey Medium	Q4 2010	260	290	350	1,000	120	2,020	210	2,230	inc.	2,230	695	175	870	3,100	2,455
NPC Survey Low	Q4 2010	160	215	200	700	90	1,365	130	1,495	inc.	1,495	370	130	500	1,995	1,575
EIA / ARI	Q2 2011				862					273						
EIA <sup>7</sup> / ARI	Q2 2013		1,469		1,161				2,630	302	2,932					
EIA <sup>7</sup>	Q2 2013		1,469		539				2,007	302	2,309					

Note that updated PGC and EIA data are in the range of NPC, MITeI and RSTG data sets

footnotes:

- 1 No adjustments have been made for interim production between years
- 2 MITeI's figures as published
- 3 NPC RSTG Onshore Gas Sub-Group, sourced from detailed dataset from the MITeI Report prepared by ICF; \$20/mcf supply cost cut-off assumed; High "Advanced" (2007) Tech Case
- 4 NPC RSTG Onshore Gas Sub-Group, sourced from detailed dataset from the MITeI Report prepared by ICF; \$20/mcf supply cost cut-off assumed; Mean "Advanced" (2007) Tech Case
- 5 NPC RSTG Onshore Gas Sub-Group, sourced from detailed dataset from the MITeI Report prepared by ICF; \$20/mcf supply cost cut-off assumed; Mean "Current" (2007) Tech Case
- 6 Sum of U.S. and Canada; but not really a valid statistical function
- 7 includes 5% shrinkage factor

# NPC Onshore Gas Update – References

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