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)

- 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

- **Total**
- **Conv**
- **Old Tech UC**
- **New Tech UC (shale)**
- **Conv + Old Tech UC**

**Note slope change as unconventional CBM and tight gas start to contribute**

**U.S. Conventional Peak in 1973**

**CBM and tight gas start to contribute (est pre-1997)**

**Shale gas starts to contribute**

**2012 up to 77 BCFD, not at peak capacity; note impact as modern shale plays contribute**

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

data sources: US EIA, MITei
Supply Stack Curves - Annotated

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

Over time these curves are trending down to the right – i.e. more resource available at a lower cost.

Approximate price at which production remains flat

Historical Price
- Case 2
- Case 3
- Price Cutoff

~1,200 TCFG
Produced to date

Estimated Ultimate Recoverable Resource (TCFG)

Zoom-in of Slide 4 – 1,200 TCFG available at < $5 supply cost
Based on updated market and production data, Case 1 no longer fits historical trends.
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

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

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**Footnotes:**

1. No adjustments have been made for interim production between years.
2. MiTei’s figures as published.
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.


Meggs, Anthony J.M.; MIeTei, 2010 emails on supply and cost information.


USGS/MMS/EIA. (2009).


ICF, 2009.


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EIA (June 2013). Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States