

# **JUST HOW ENORMOUS IS THE “ENORMOUS” U.S. GAS RESOURCE?**

## **Implications for Future Supply**

**AAPG New Orleans ACE**

**April 13, 2010**

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# AN UNFAMILIAR CONCEPT

- **The idea of enormous U.S. gas resources is now commonplace**
- **Until 2008, “Enormous” was not a familiar concept**
- **The emergence of shale gas has enlarged both our resource estimates and our vocabulary**

# A DRAMATIC REVERSAL

- **From the constant spectre of depletion to enormous resources**
- **Many false hopes – several highly touted gas resources fell far short of expectations**
- **Early unconventional – tight sandstone, CBM – only big enough to sustain gas production**

# KEY CONSIDERATIONS

- **Definitions**
- **Composition**
- **Technical Uncertainty**
- **Economics**
- **Policy Implications**

# HOW MUCH IS “ENORMOUS”?

- **Two key criteria**
  - **Globally significant**
  - **Very large relative to national demand**
- **Propose minimum of one quadrillion cubic feet**
  - **Satisfies both criteria**

# KNOWN AND ESTIMATED U.S. GAS RESOURCES

- **Proved (EIA) - 237.0 TCF**
- **Probable (PGC mean) - 418.8**
- **Possible (PGC mean) - 744.9**
- **Speculative (PGC mean) - 428.9**
- **Total 1829.6**

# WHAT IS NECESSARY FOR AN ENORMOUS GAS RESOURCE?

- **Conventional Gas**
  - Supergiant fields (30 TCF+)
- **Unconventional Gas**
  - Megaplays (30 TCF+)

# U.S. POTENTIAL IS HIGHLY CONCENTRATED

- **Shale gas megaplays (6) - 444.4 TCF**
- **Tight SS megaplays (5) - 209.4**
- **CBM megaplays (2) - 29.0**
- **All other plays - 480.9**
- **Total Probable & Possible - 1163.7**

# WHAT ARE THE REQUIREMENTS FOR A SHALE GAS MEGAPLAY?

- **Very large area is necessary**
  - Thousands of square miles
- **But a very large area is not sufficient**
- **Requirements mean that shale gas megaplays are rare**

**WHAT CHARACTERISTIC IS  
ALWAYS ASSOCIATED WITH A  
VERY LARGE PLAY AREA?**

**HETEROGENEITY!**

**WHAT DOES HETEROGENEITY  
MEAN FOR RESOURCE  
ESTIMATES?**

**UNCERTAINTY!**

# KEY UNCERTAINTIES FOR SHALE GAS

- **In-place resources**
- **Per-well recoveries**
- **Recovery factors**

# WHY IS UNCERTAINTY OVERLOOKED?

- **We depend on summaries**
- **Summaries show only means**
- **Difficult to sum extremes**
  - **Wholly independent: Monte Carlo**
  - **Wholly dependent: Arithmetic**
  - **Mixed (in unknown ways): Somewhere in between**

# POTENTIAL UNCERTAINTY

- **Approximate total remaining resources:**

**1190 – 1830 – 2885 TCF**

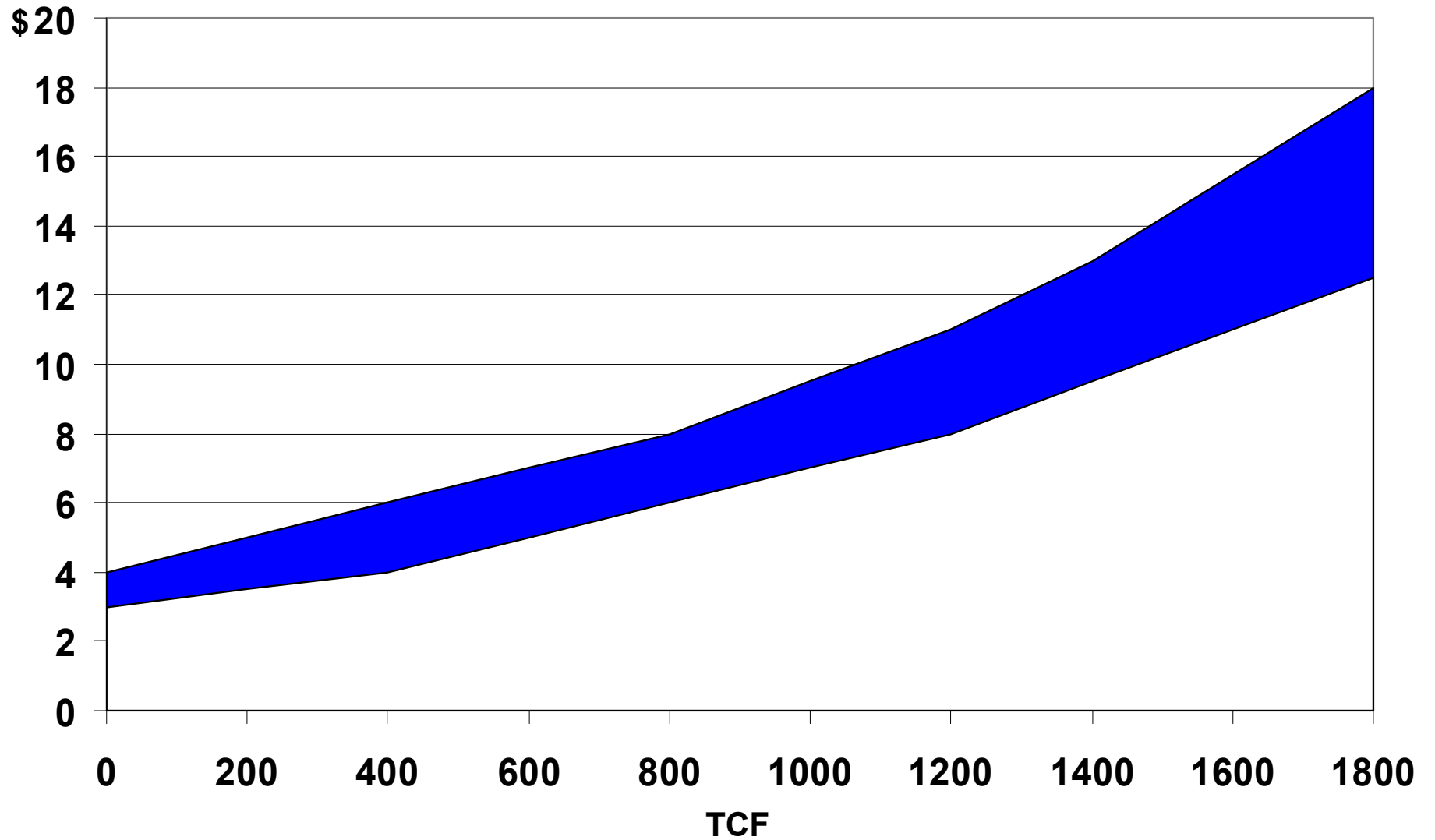
# IMPLICATIONS FOR FUTURE SUPPLY

- Years remaining
  - @ 23 TCF/YR: 52 – 80 – 125
  - @ 30 TCF/YR: 40 – 61 - 96

# ECONOMICS OF THE GAS RESOURCE

- Published estimates are for technically recoverable
- Costs of recovery are also crucial
- Two conflicting economic considerations
  - Enormous resources drive price down
  - Maximizing unconventional recovery rate drives cost up

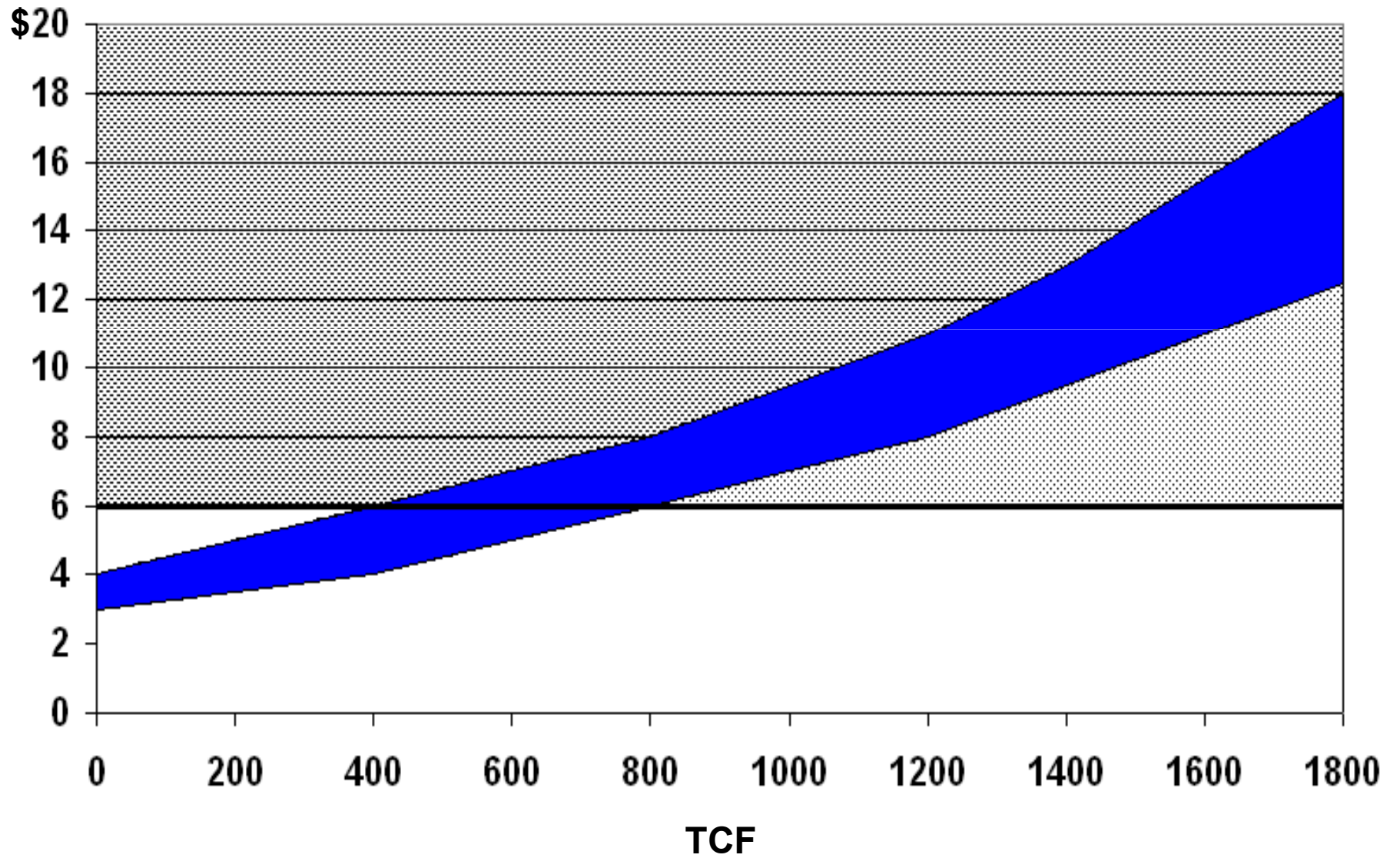
# U.S. GAS RESOURCE COST CURVE



# ECONOMICS AND UNCERTAINTY

- **Considerable variation in resource costs**
- **Lower cost resources will be developed first, keeping price low**
- **Low price means minimal information about higher cost resources**
- **Zone of ignorance reduced gradually as resource is produced**

# ZONE OF IGNORANCE



# KEY CONCLUSIONS

- **Are U.S. gas resources enormous? -  
Yes, with high confidence**
- **How enormous are they? – Uncertain,  
likely 95-5% range of 1200-2600 TCF**
- **How long will it take to reduce this  
uncertainty significantly? – A few  
decades**

# IMPLICATIONS FOR POLICY

- **Basic stance: Cautious Optimism**
- **Supply continuity for current markets**
- **Expansion of current markets**
  - **Electrical generation**
  - **Displace fuel oil for heating**
- **Explore new markets**
  - **CNG for transportation**

## **POLICY IMPLICATIONS (2)**

- **LNG unnecessary and uneconomic for next twenty years**
- **Arctic gas ditto**
- **Gas exports to eastern Canada?**