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Shale Plays in the Intermountain West: Legal
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2010

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SLIDES: Transforming and Disrupting: Shale Gas and Oil in U.S. Energy Supply

Richard Nehring

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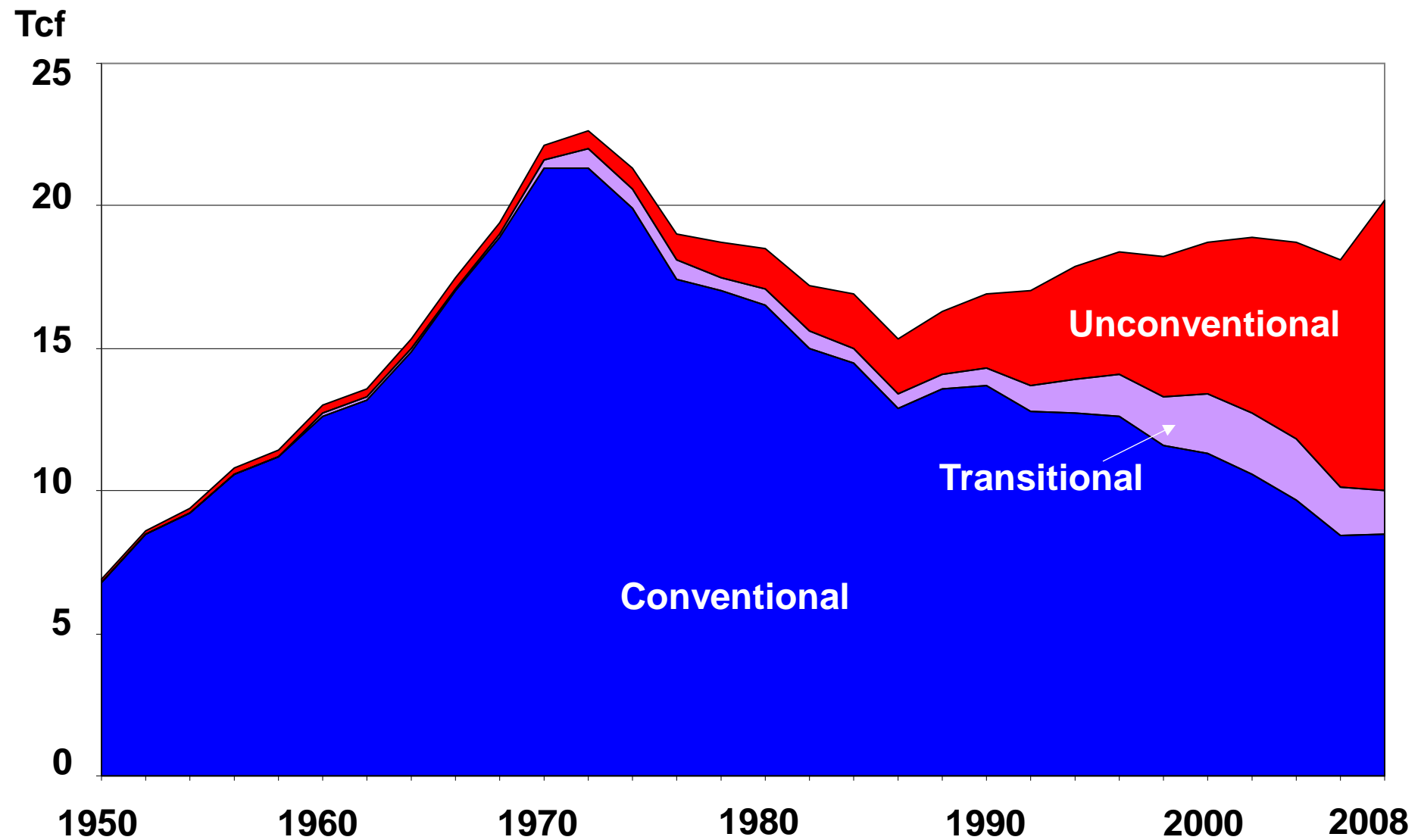
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**TRANSFORMING AND
DISRUPTING
SHALE GAS AND OIL IN U.S.
ENERGY SUPPLY**

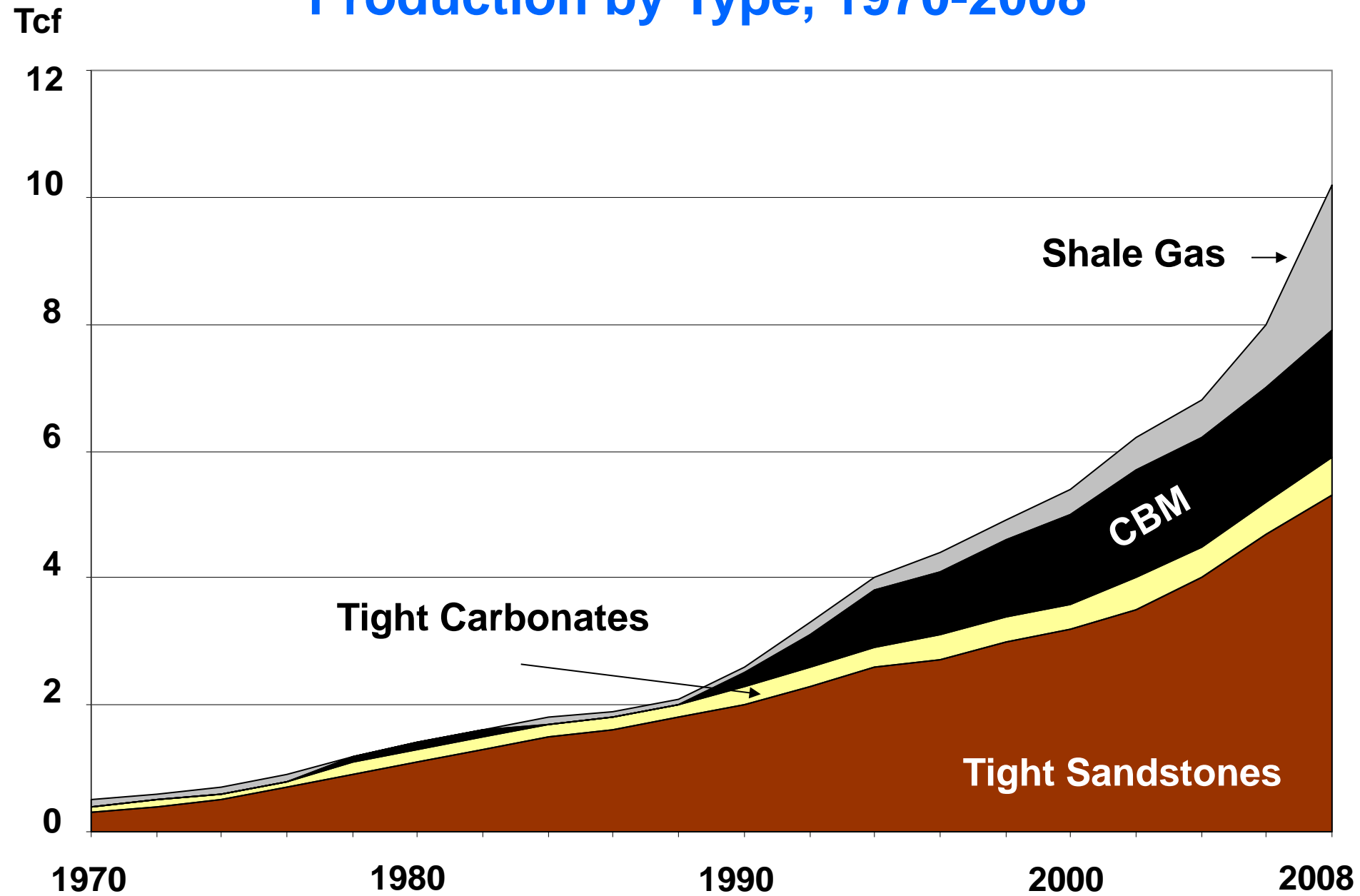
**RICHARD NEHRING
SHALE PLAYS IN THE
MOUNTAIN WEST**

DENVER, NOVEMBER 12, 2010

Annual U.S. Natural Gas Production by Category (1950-2008)



Composition of U.S. Unconventional Natural Gas Production by Type, 1970-2008



KNOWN AND ESTIMATED U.S. GAS RESOURCES

- **Proved (EIA) - 237**
- **Probable (PGC mean) - 419**
- **Possible (PGC mean) - 745**
- **Speculative (PGC mean) - 429**
- **Total 1830 TCF**

HIGH UNCERTAINTY

- Range of remaining resources:

—

1190 – 1830 – 2885 TCF

IMPLICATIONS FOR FUTURE SUPPLY

- Years remaining

- @ 23 TCF/YR: 52 – 80 – 125

- @ 30 TCF/YR: 40 – 61 -- 96

VERY LARGE RESOURCE

- **PGC estimates c. 375-1050 TCF**
- **Concentrated in six potential megaplays**
- **Marcellus and Haynesville/Bossier plays are likely world class (100+ TCF each)**

RELATIVELY LOW COST

- **Rapid growth of production drove price down**
- **Price has remained low despite many predictions of a rebound**
- **Amount of low cost resource is uncertain**
- **Signs of drilling cutbacks recently**

OUTSIDE OF ROCKIES

- **Only 10% of PGC shale gas potential in Rockies**
- **Most shale gas megaplays replacing declining GOM production**
- **Marcellus is displacing other sources of supply to Northeast**

ECONOMICS OF THE GAS RESOURCE

- **Published resource estimates are for technically recoverable**
- **Costs of recovery are also crucial**
- **Three conflicting economic considerations**
 - **Very large resources drive price down**
 - **Operators are reducing costs**
 - **Maximizing unconventional recovery rate drives cost up**

KEY CONCLUSIONS

- **Are U.S. gas resources large? -
Yes, with high confidence**
- **How large are they? – Highly uncertain,
90% probability of 1600-1800 TCF range**
- **How long will it take to reduce this
uncertainty significantly? –
10-30 years**

IMPLICATIONS FOR POLICY

- **Basic outlook: Cautious optimism**
- **Supply continuity for current markets**
- **Expansion of current markets**
 - **Electrical generation**
 - **Displace fuel oil for heating**
- **Evaluate new markets**
 - **CNG for transportation**

“SHALE OIL” -- A MISLEADING CONCEPT

- Pure shales unlikely to have major impact on oil production**
- Promising plays are not shales, but other rock types**
- More accurate and useful to speak of poor reservoir quality oil plays**

POOR RESERVOIR OIL PLAYS

- **Middle Bakken (Williston Basin)**
 - Undergoing rapid development
 - Likely to peak by 2015
 - Could reach 10% of U.S. crude oil production
- **Permian Basin**
 - Several plays
 - Undergoing substantial and accelerating development
 - Likely to provide 5-10% of U.S. crude, 2015-2020

PROGNOSIS

- **Very large in-place resources (larger than Prudhoe Bay)**
- **Low recovery rates (10-20%) place substantial restraint on recoverable resource size**
- **Main impact –stabilizes U.S. oil production by offsetting declines elsewhere**