U.S. Perspectives on Exploiting Tight Gas Resources

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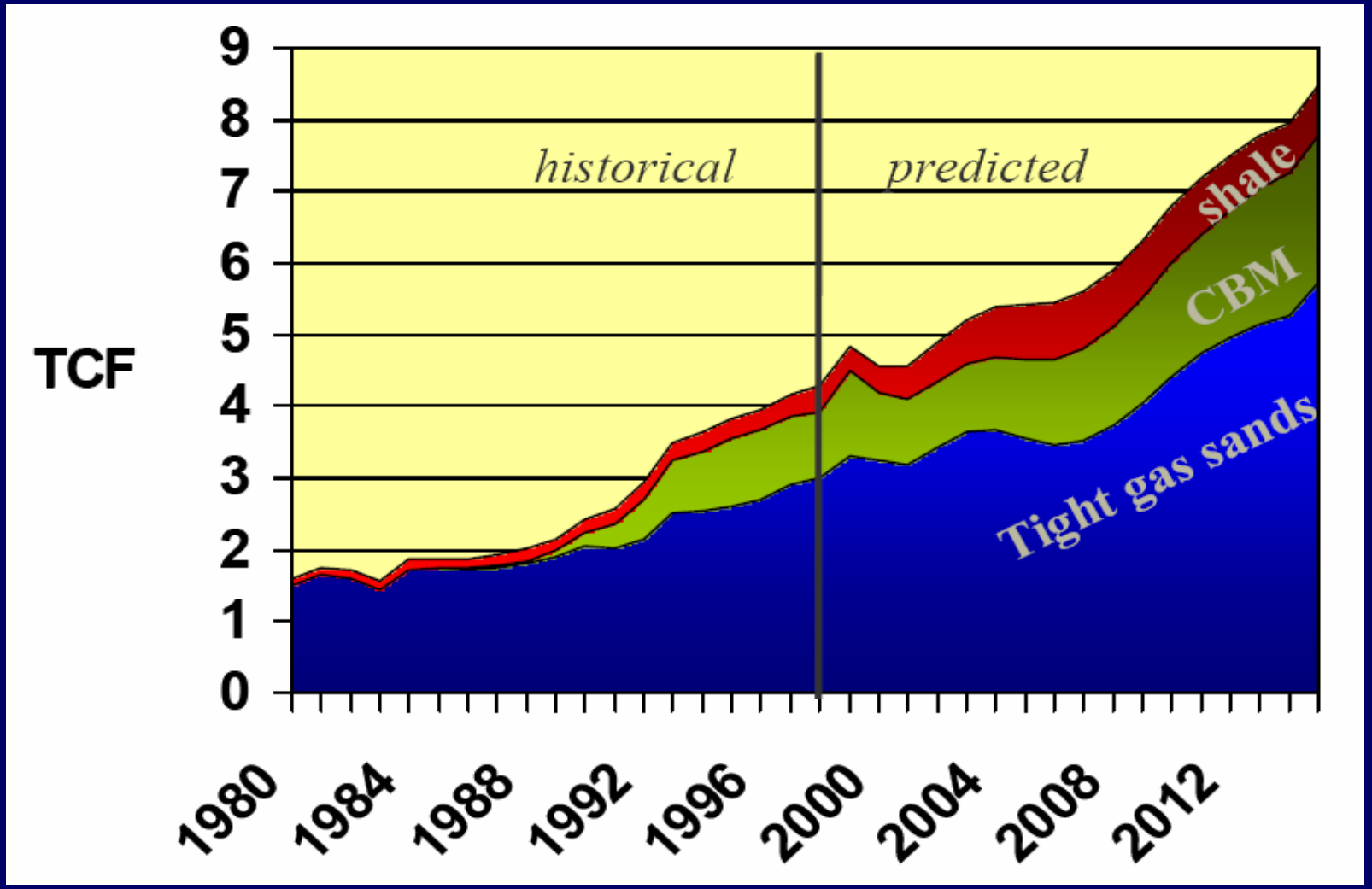
Definition of "Tight Gas"

- U. S. Government, 1970's (tax regulations): expected reservoir permeability < 0.1 md (0.1 μm^2)
- More useful (Holditch, 2006): reserves "that cannot be produced at economic rates … unless the well is stimulated by a large hydraulic fracture treatment or produced by use of a horizontal wellbore or multilateral wellbores." May depend on more than just permeability

Size of Resource in U.S. - GTI Estimate

3 TCF ~
85 B m³



Total U.S. production ~ 20 TCF (560 B m³)

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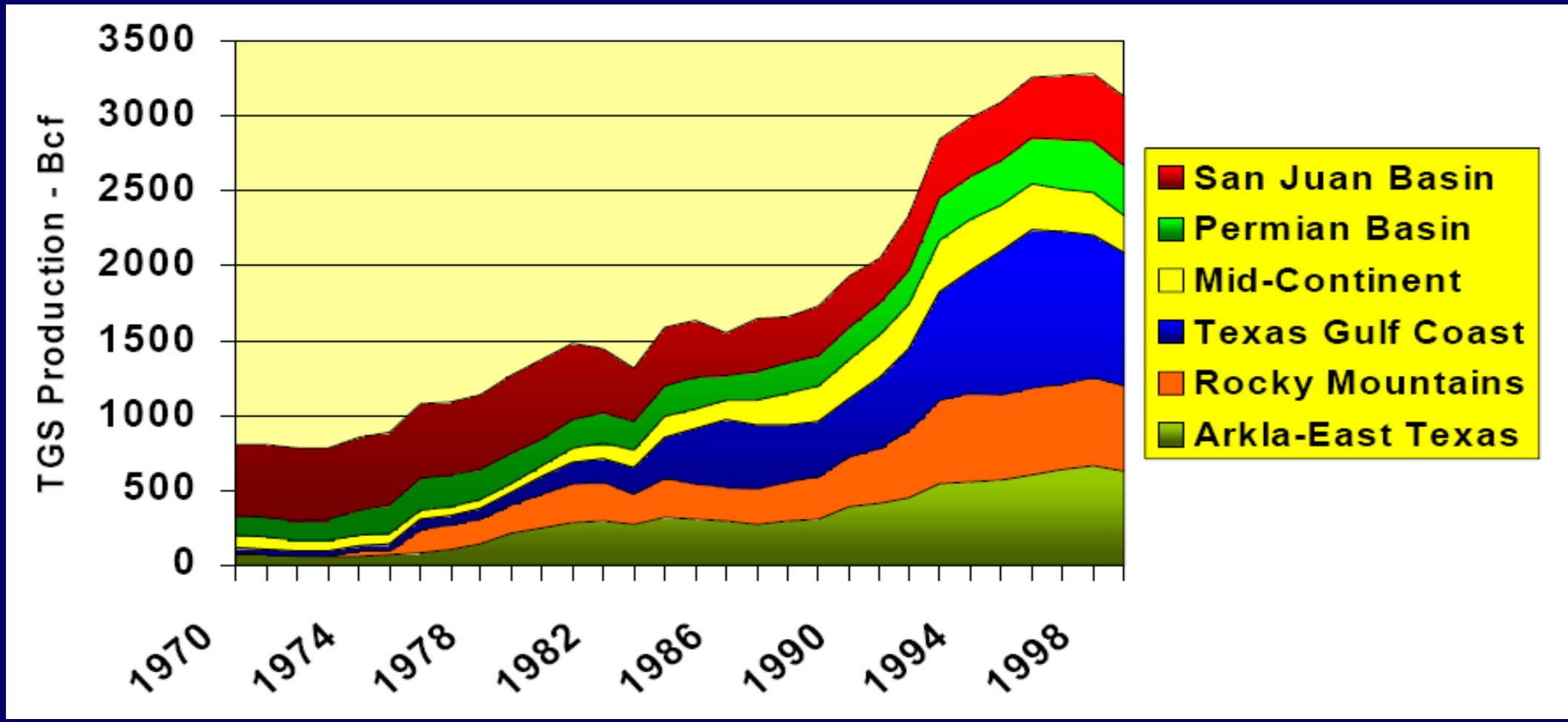
Current Tight-Gas Production in U.S.



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Size of Resource Worldwide

- Probably underestimate; less exploration in rest of world than in U.S.
- Holditch (2006) suggest permeabilities in all basins distributed log-normally; can estimate tight reserves from what found now

TABLE 1—TABLE 1—DISTRIBUTION OF WORLDWIDE UNCONVENTIONAL-GAS RESOURCES (AFTER ROGNER 1996, TAKEN FROM KAWATA AND FUJITA 2001)

Region	Coalbed Methane (Tcf)	Shale Gas (Tcf)	Tight-Sand Gas (Tcf)	Total (Tcf)
North America	3,017	3,840	1,371	8,228
Latin America	39	2,116	1,293	3,448
Western Europe	157	509	353	1,019
Central and Eastern Europe	118	39	78	235
Former Soviet Union	3,957	627	901	5,485
Middle East and North Africa	0	2,547	823	3,370
Sub-Saharan Africa	39	274	784	1,097
Centrally planned Asia and China	1,215	3,526	353	5,094
Pacific (Organization for Economic Cooperation and Development)	470	2,312	705	3,487
Other Asia Pacific	0	313	549	862
South Asia	39	0	196	235
World	9,051	16,103	7,406	32,560

7.4 TCF ~ 210 B m^3

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Technology Needs

- Identified in series of meetings (GTI, N Mexico Tech) with producers around U.S.; grouped needs by priority and region

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Topic	San Juan	Permian	Mid continent	Appalachians	Rocky Mts.
Reservoir characterization, imaging, fracture assessment, desorption data	❶	•	❶	❶	❶
Stimulation	•	❶	❶		•
Play-based resource assessment	•	❶		❶	❶
Data mining, data collection			❶	❶	
Producibility models			❶		
Handling, treating and disposal of produced water	❶	•			•
Extending well life	•			❶	
Advanced drilling technologies, drilling cost reduction	•	•	•	•	•
Completion strategies for horizontal wells	•	•			
Expert systems and best practices	•	•	•	•	•
Processing of low-BTU gas		•			
Removal of liquids from deep gas wells		•	•		
Core drilling/evaluation				•	
Production performance monitoring and evaluation	•				❶

❶ = Top Priority • = major priority

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Technology Needs (Holditch)

- Reservoir characterization; properties at depth
- Well tests may take years to reach effective reservoir boundary
- Mechanical properties of formation (fracturing)
- Better stimulation (fracturing) technology: fracturing gels that break at < 250°F (120°C)

Ways to Improve Fracture Performance (Sharma)

- Hybrid fracture treatments
- Optimizing fluid rheology and rates
- Small or lightweight proppant
- Minimizing impact of water blocking in tight sands
- Multi-stage fracture treatments
- Reverse hybrid fractures

Reference: http://www.pge.utexas.edu/faculty/sharma.cfm

Research and Development

- U.S. 2004 Energy Bill authorized $150MM/yr for 10 years for oil and gas R&D research, 30% ($45MM/yr) for "unconventional gas"
- RPSEA was sole bidder to administer this program
- Fate of previous federal oil and gas R&D program in doubt

Resourses on Web

- **RPSEA web site** www.rpsea.org
- **GTI Unconventional Gas Technology Roadmap** http://www.rpsea.org/webroot/download/en/RPSEAmember/roadmap-report.pdf
- **Article "Tight Gas Sandstones," Stephen Holditch, Texas A&M** SPE 103356, from SPE e-library, www.spe.org; also *J. Petroleum Technology*, June 2006
- **Article "Optimal Stimulation Treatments of Tight Gas Sands" by Holditch** SPE paper 96104, from spe e-library, www.spe.org
- **AAPG article on unconventional gas** http://www.rpsea.org/webroot/download/en/ResearchAct/BEGUnconventionalGas.pdf
- **Testimony of GTI CEO Riordan to US House of Representatives** http://www.rpsea.org/webroot/download/en/Newsroom/Riordan_testimony.pdf

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