UNCONVENTIONAL GAS RESOURCES AND DEVELOPMENT

Prepared for:

Mid-Continent Coalbed Methane Symposium

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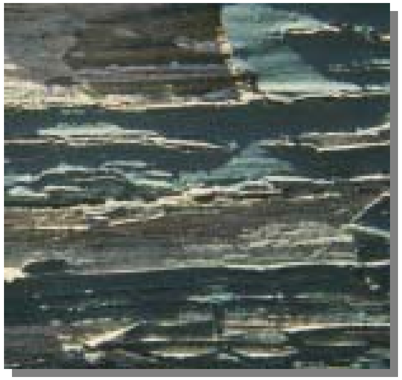
ABSTRACT

In a span of 20 years, the outlook for unconventional gas resources has grown from modest expectations to a major source of domestic natural gas supply, now exceeding natural gas production from the offshore Gulf of Mexico.

During this time, coalbed methane, one of the three primary unconventional gas sources, has changed from a scientific curiosity to providing, last year, over 1.6 Tcf (4.4 billion cubic feet per day) of pipeline quality natural gas.

Looking forward to the next 20 years, unconventional gas is expected to become the largest single source of domestic natural gas supply, with growth in all three resources - - tight gas, gas shales and coalbed methane.

The presentation reviews the major progress in knowledge and technology that has provided the foundation for the remarkable growth of this domestic natural gas resource.



OUTLINE OF PRESENTATION

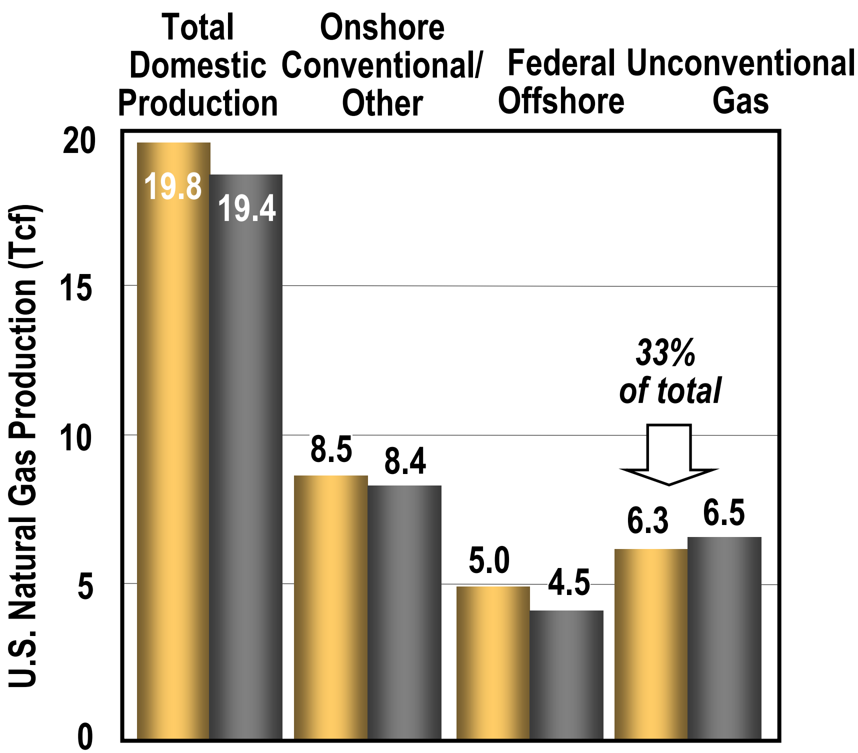
1. Background and Outlook for Unconventional Gas
2. A Look at Key Plays
    - Powder River Basin (CBM)
    - Fort Worth Basin (Barnett Shale)
    - Piceance Basin (MV Tight Gas Sands)
3. Concluding Remarks

1. BACKGROUND AND OUTLOOK FOR UNCONVENTIONAL GAS

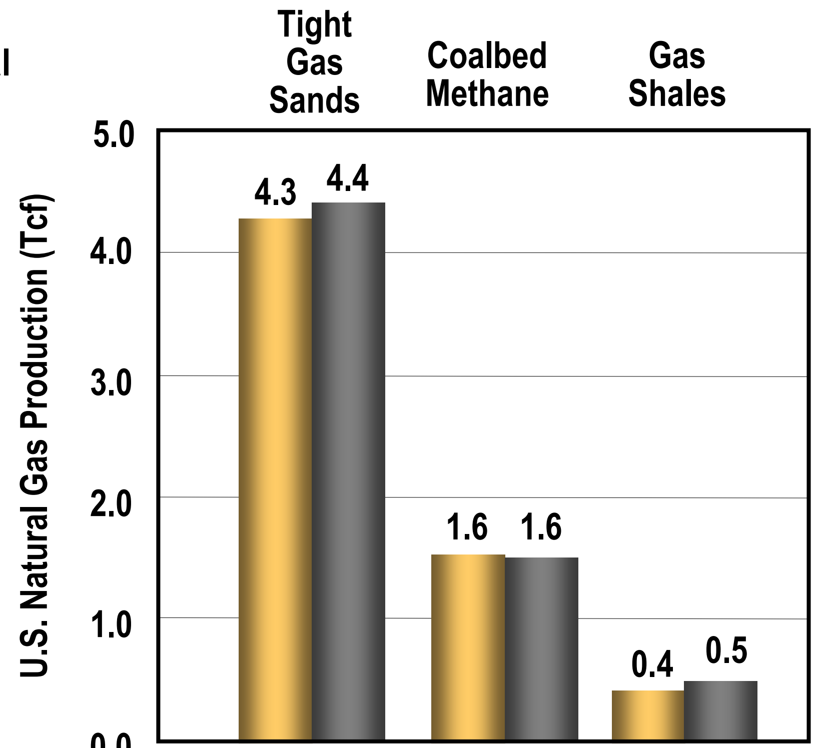
BACKGROUND AND OUTLOOK

1. The future of domestic natural gas supply rests on the successful development of unconventional gas.
   - Maturity of conventional gas plays
   - Large unconventional gas resources
   - Critical issues of technology and costs
2. Many of the concepts and technologies of CBM are applicable to other unconventional gas resources:
   - "Continuous" deposition
   - Subtle "sweet spots"
   - Advanced completion/stimulation
   - Potential for cost-efficiencies

MATURITY OF CONVENTIONAL GAS PLAYS



Source:
- *Conventional/Offshore – EIA 2001 Annual Reserve Report.*
- *Unconventional – Advanced Resources International data base.*



Source: Advanced Resources International data base.

2001 | 2002

Advanced Resources International, Inc.

MATURITY OF CONVENTIONAL GAS PLAYS

Decline In Gulf Of Mexico OCS Reserves And Production

	GOM Shelf		GOM Slope	
	Reserves* (Tcf)	Production* (Bcfd)	Reserves* (Tcf)	Production* (Bcfd)
2000 (Beginning of Year)	18.4	10.2	7.7	3.3
2003	14.8	7.8	10.5	4.2
2004	12.5	6.6(e)	10.0	4.1(e)
Change 2000-2004	-5.9	-3.5	+2.3	+0.8

Wet, after lease separation

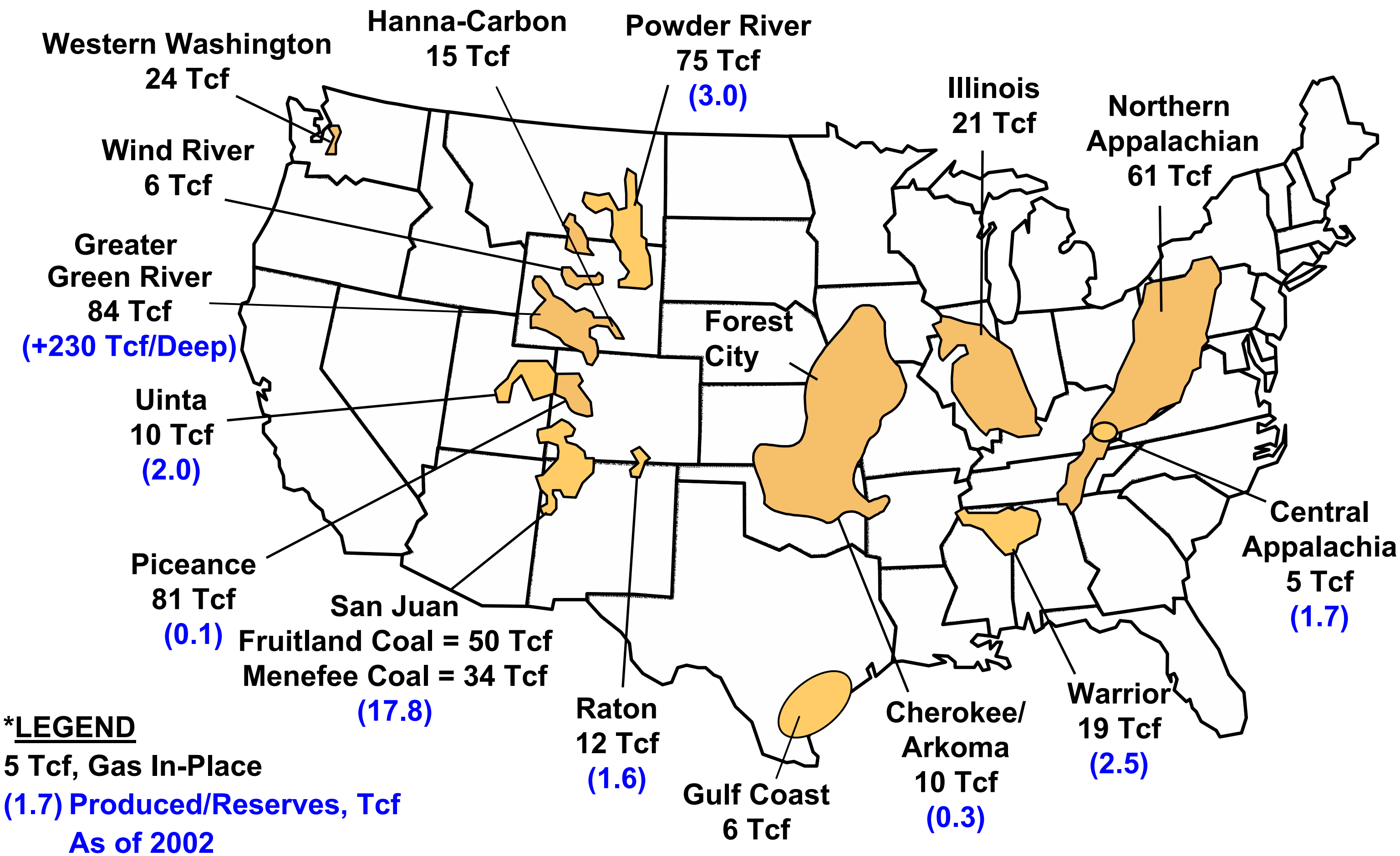
LARGE UNCONVENTIONAL GAS FIELDS

Nine Of The Twelve Largest U.S. Natural Gas Fields Are Unconventional Gas Fields**

Rank (in 2002)	Field Name	Basin/State	Type of Resource	Year 2002 Production (Bcfd)
1	Blanco/Ignacio-Blanco	San Juan, NM/CO	CBM/Tight Gas Sands	2.3
2	Basin	San Juan, NM	CBM/Tight Gas Sands	1.6
4	Wyodak/Big George*	Powder River, WY	CBM	0.9
5	Jonah*	GGRB, WY	Tight Gas Sands	0.6
6	Newark East*	Ft. Worth, TX	Gas Shale	0.6
8	Carthage	East Texas, TX	Tight Gas Sands	0.5
9	Antrim	Michigan, MI	Gas Shale	0.5
10	Wattenberg/DJ Basin	Denver, CO	Tight Gas Sands	0.5
11	Giddings	East Texas, TX	Tight Gas/Chalk	0.4

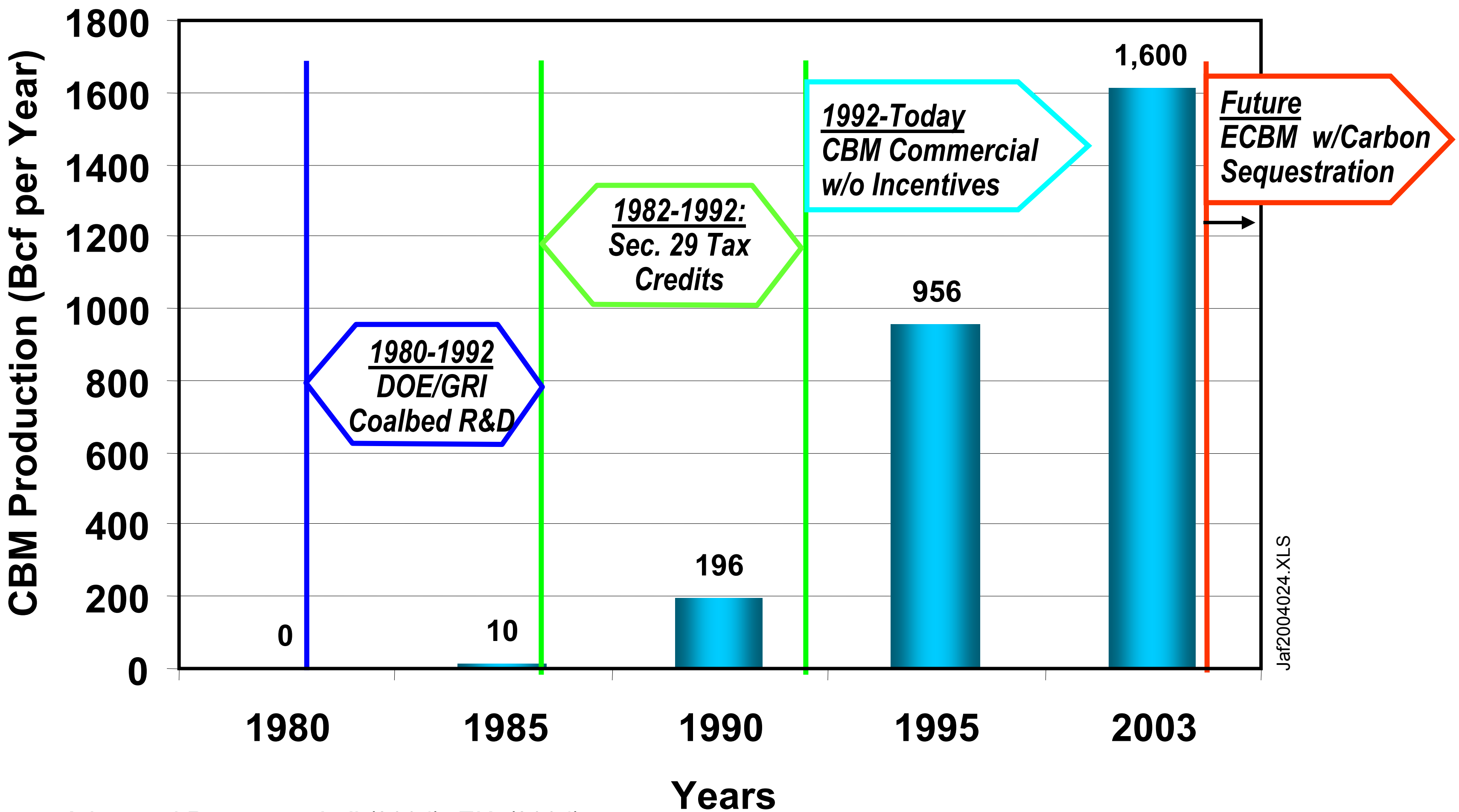
*Recent discoveries or rediscoveries.
**Fifteen of twenty largest gas fields, based on proved reserves, hold unconventional or high CO_2 gas.
Sources: EIA 2002 Annual Reserve Report; Advanced Resources Data Base.

LARGE DOMESTIC COALBED METHANE RESOURCES



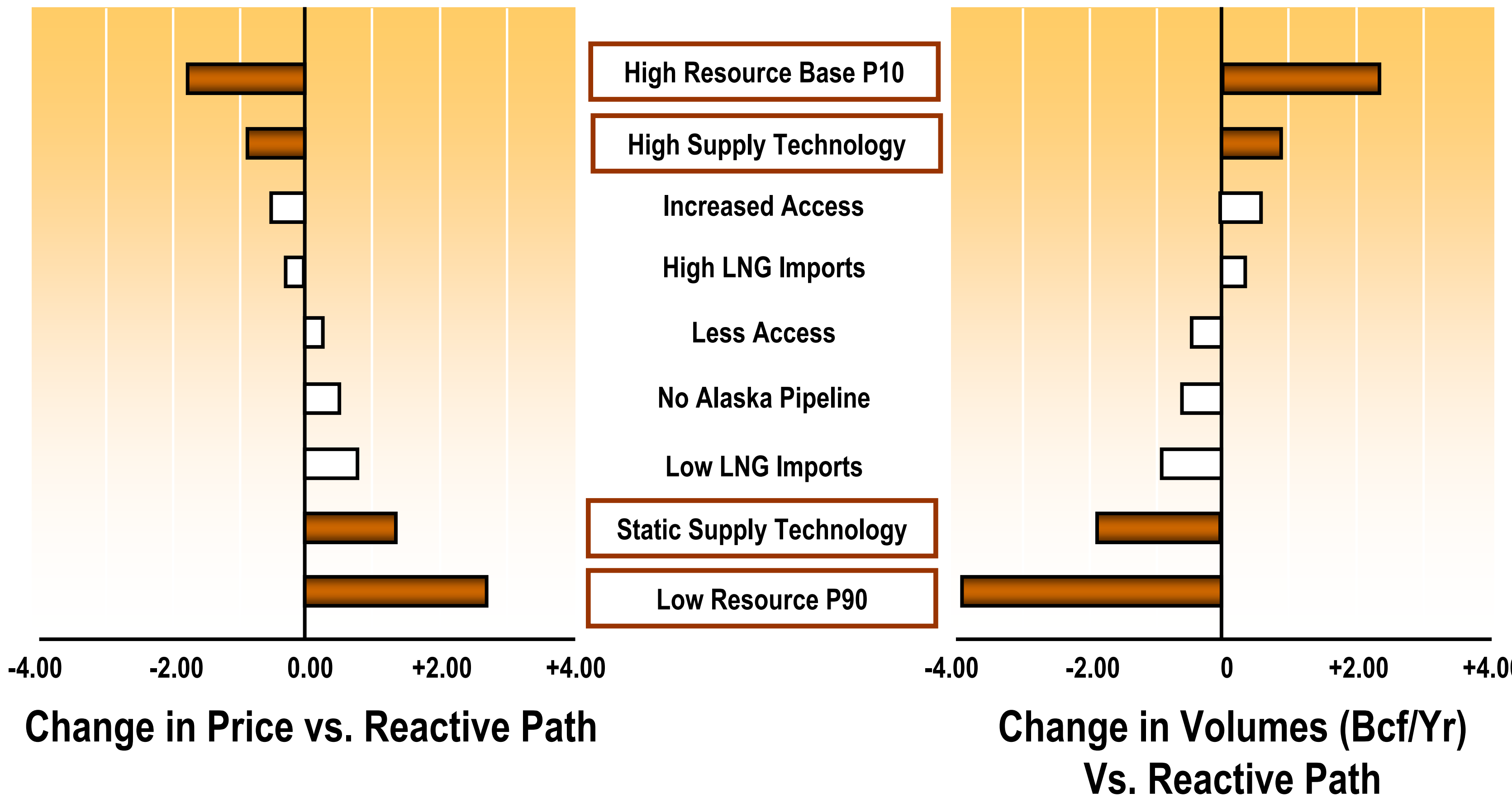
Source: Advanced Resources Int'l. (2002)

R&D AND PERFORMANCE BASED INCENTIVES LAUNCHED THE COALBED METHANE PLAY



Source: Advanced Resources Int'l (2004), EIA (2004)

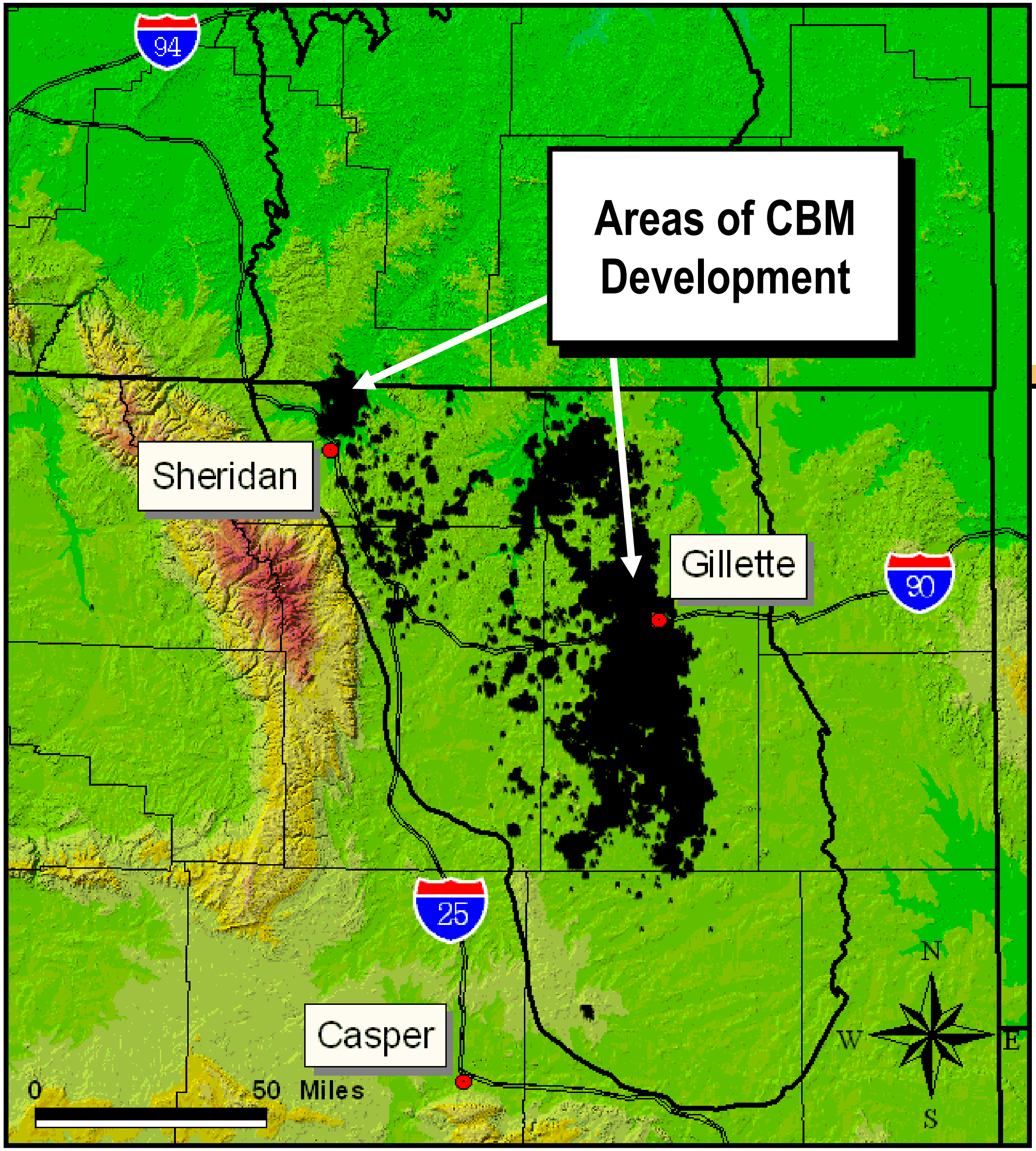
NPC STUDY SHOWS SIZE OF RESOURCE BASE AND PROGRESS IN TECHNOLOGY HAVE LARGEST IMPACTS



Values shown are averages for the 2011 to 2025 period

Source: NPC, 2003

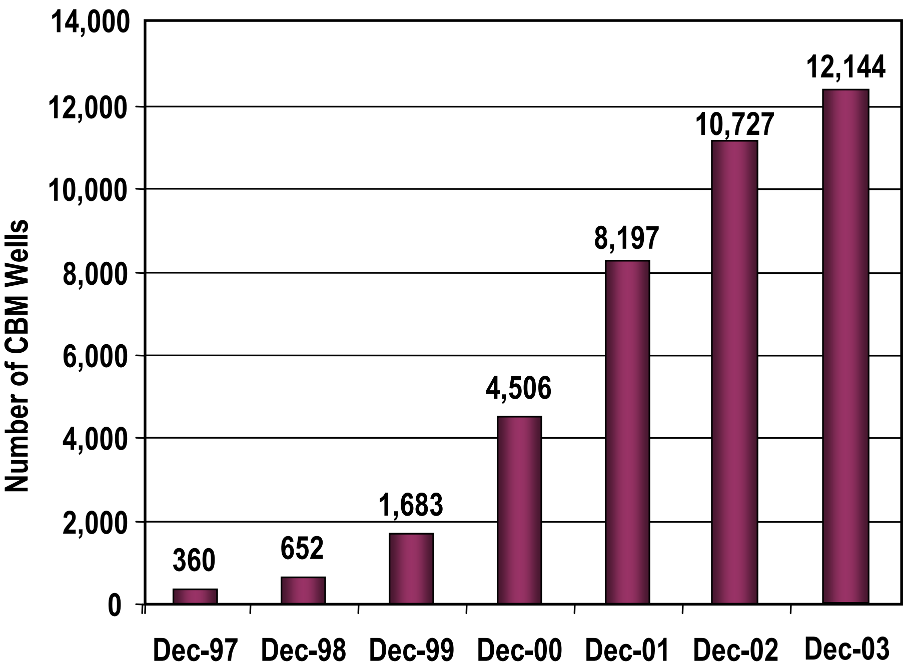
2. A LOOK AT KEY PLAYS



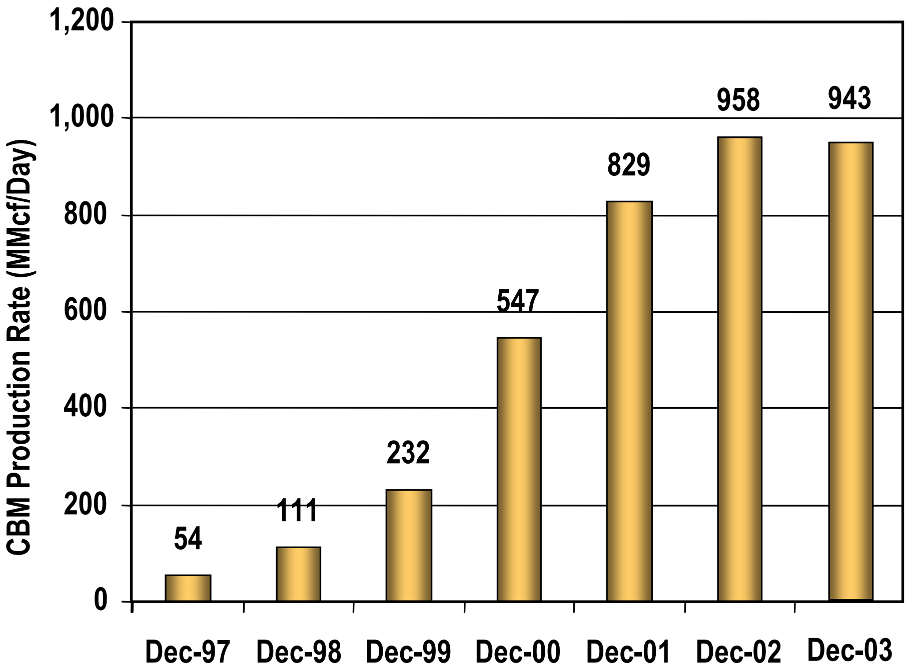
COALBED METHANE DEVELOPMENT, POWDER RIVER BASIN

- Currently producing at 0.9 Bcfd, up 20 fold from five years ago.
- Over 12,000 producing CBM wells.
- Play expanding to deeper area of basin.
- Multi-seam technology essential for future development.

END-OF-YEAR CBM PRODUCTION AND PRODUCING WELLS FOR POWDER RIVER BASIN *

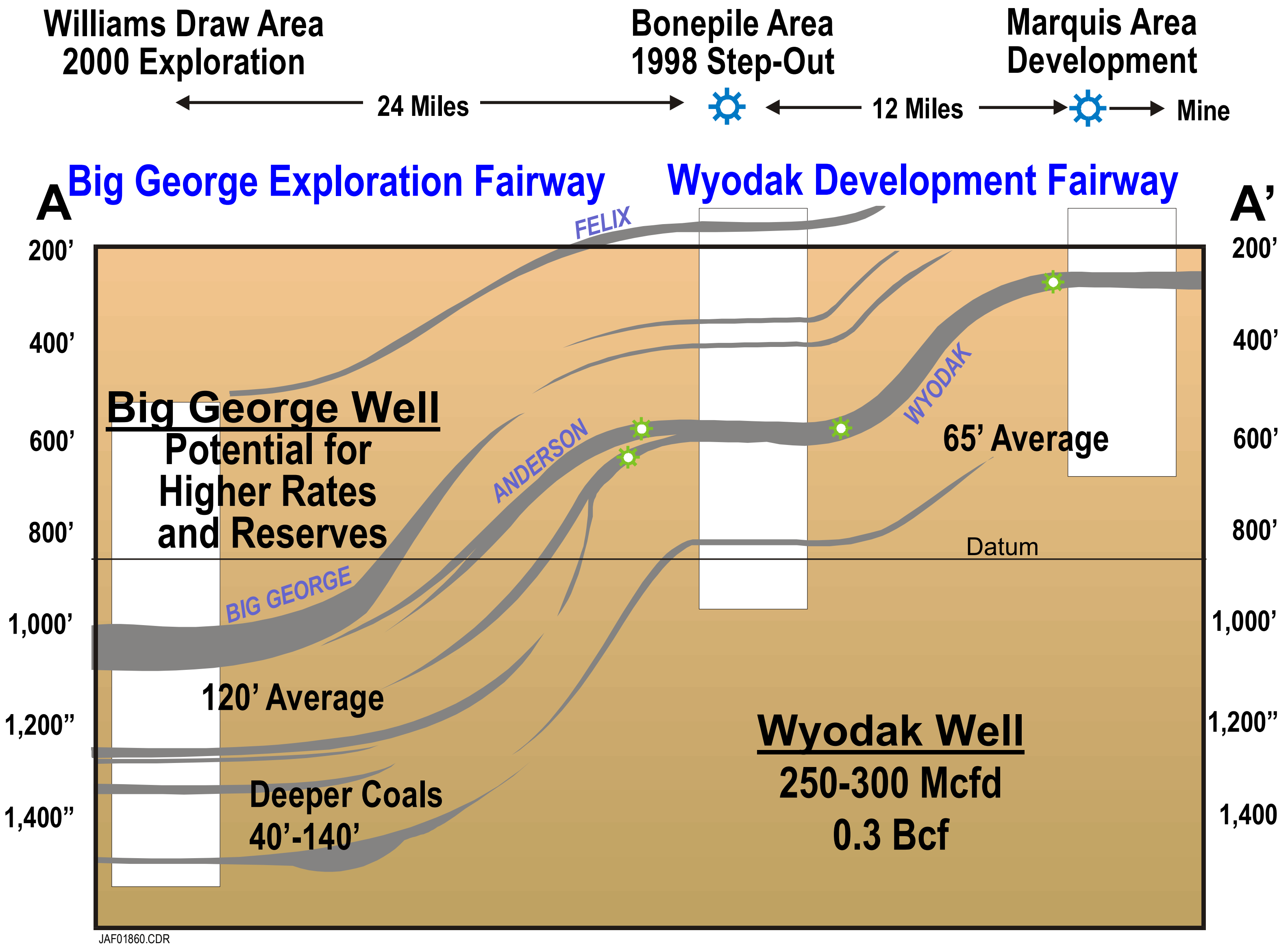


Source: Wyoming Oil and Gas Commission (WOGCC) May, 2003.



**Wyoming portion of the PRB only.*
Source: Wyoming Oil and Gas Commission (WOGCC) May, 2003.

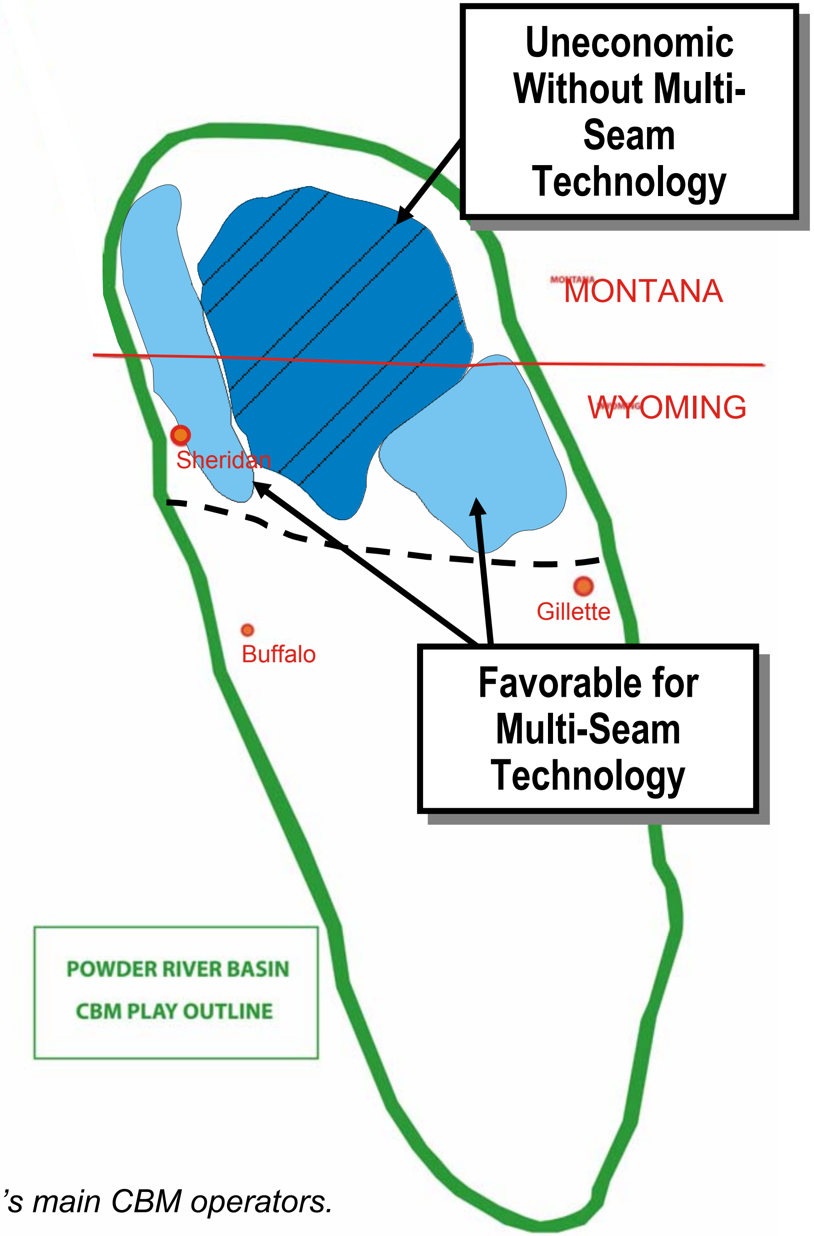
PRB COALBED METHANE FAIRWAYS



SINGLE- SEAM WELL COMPLETIONS ARE INADEQUATE

Northern portion of PRB CBM play marginally economic with current technology.

Illustrates critical need for multi-seam well completion technology for expanding the Powder River Basin CBM play.

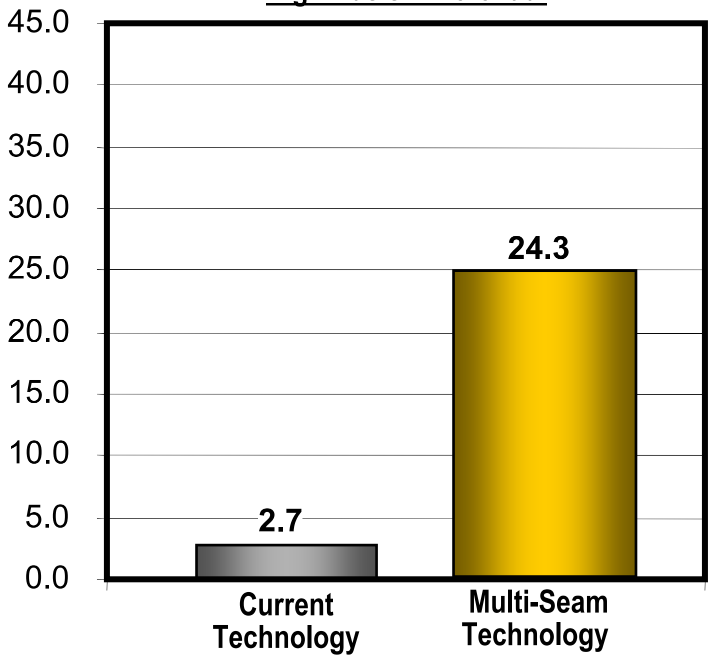


Source: Submitted to State of Wyoming by one of the basin's main CBM operators.

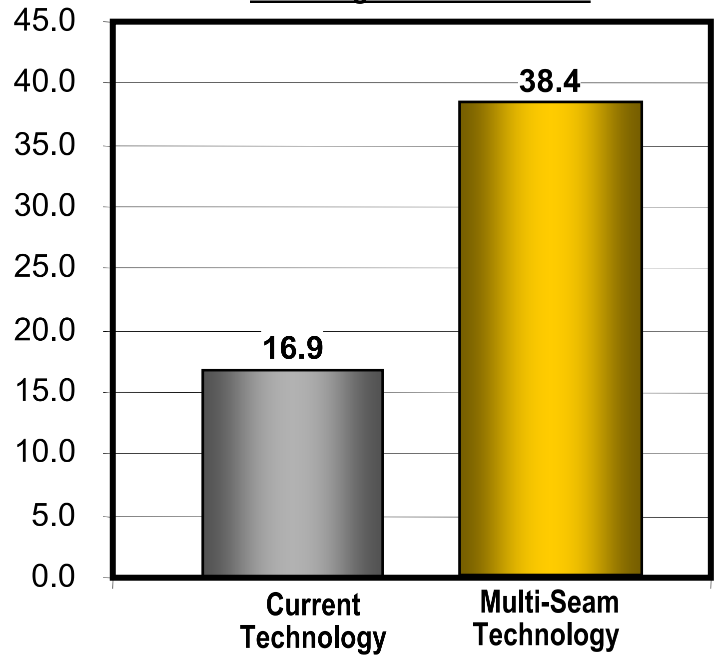
BENEFITS OF OPTIMUM MSC TECHNOLOGY FOR THE POWDER RIVER BASIN CBM PLAY

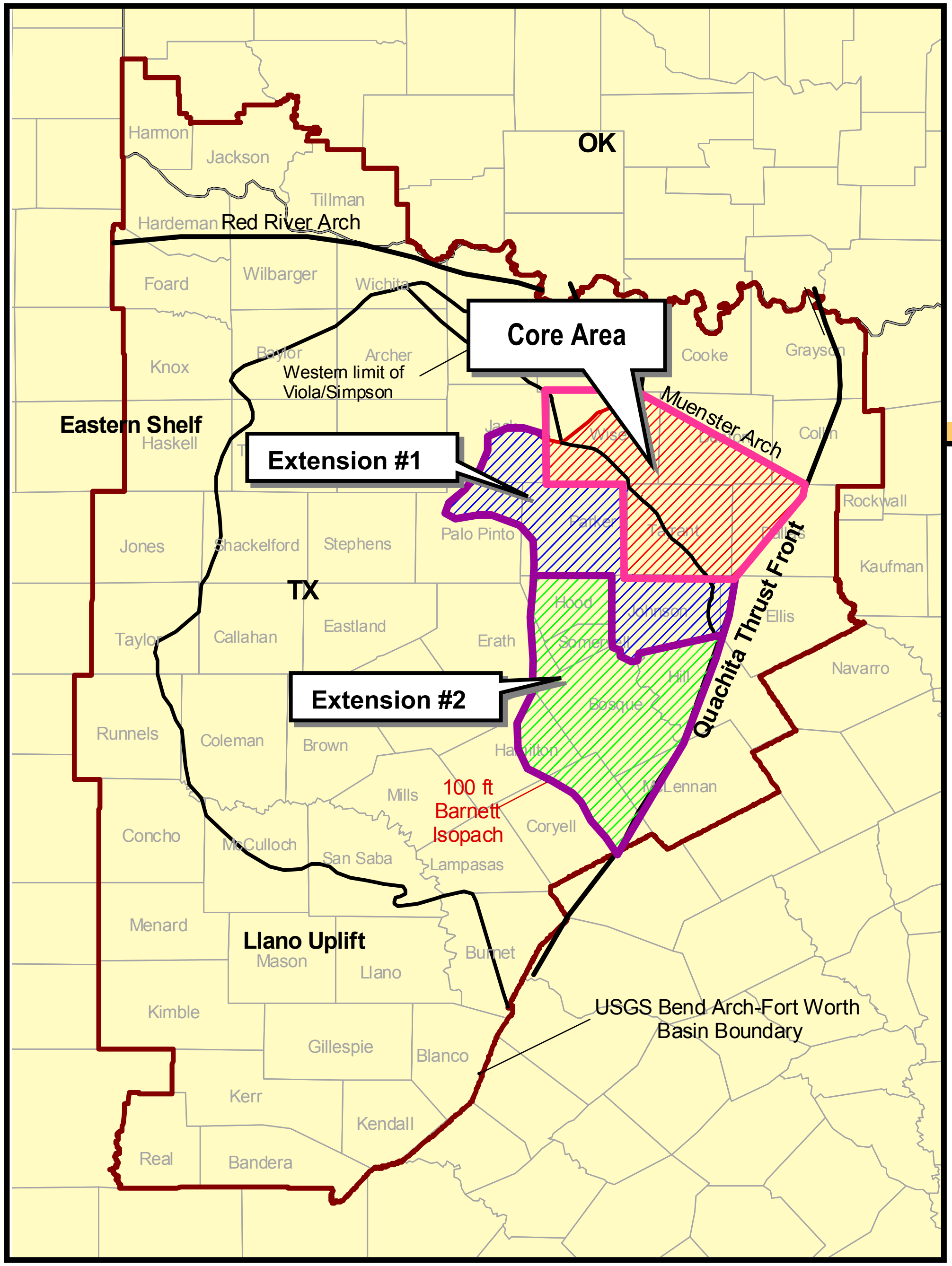
The Volume of Economically Recoverable CBM from the Powder River Basin Depends Greatly on the Realized Wellhead Price and Progress in Technology

SCENARIO #1
Economically Recoverable Resource,
High Basis Differential



SCENARIO #2
Economically Recoverable Resource,
Declining Basis Differential





BARNETT SHALE RESOURCE AND PLAY AREAS

Total Barnett Shale gas production area covers over 6,000 mi² with three plays:

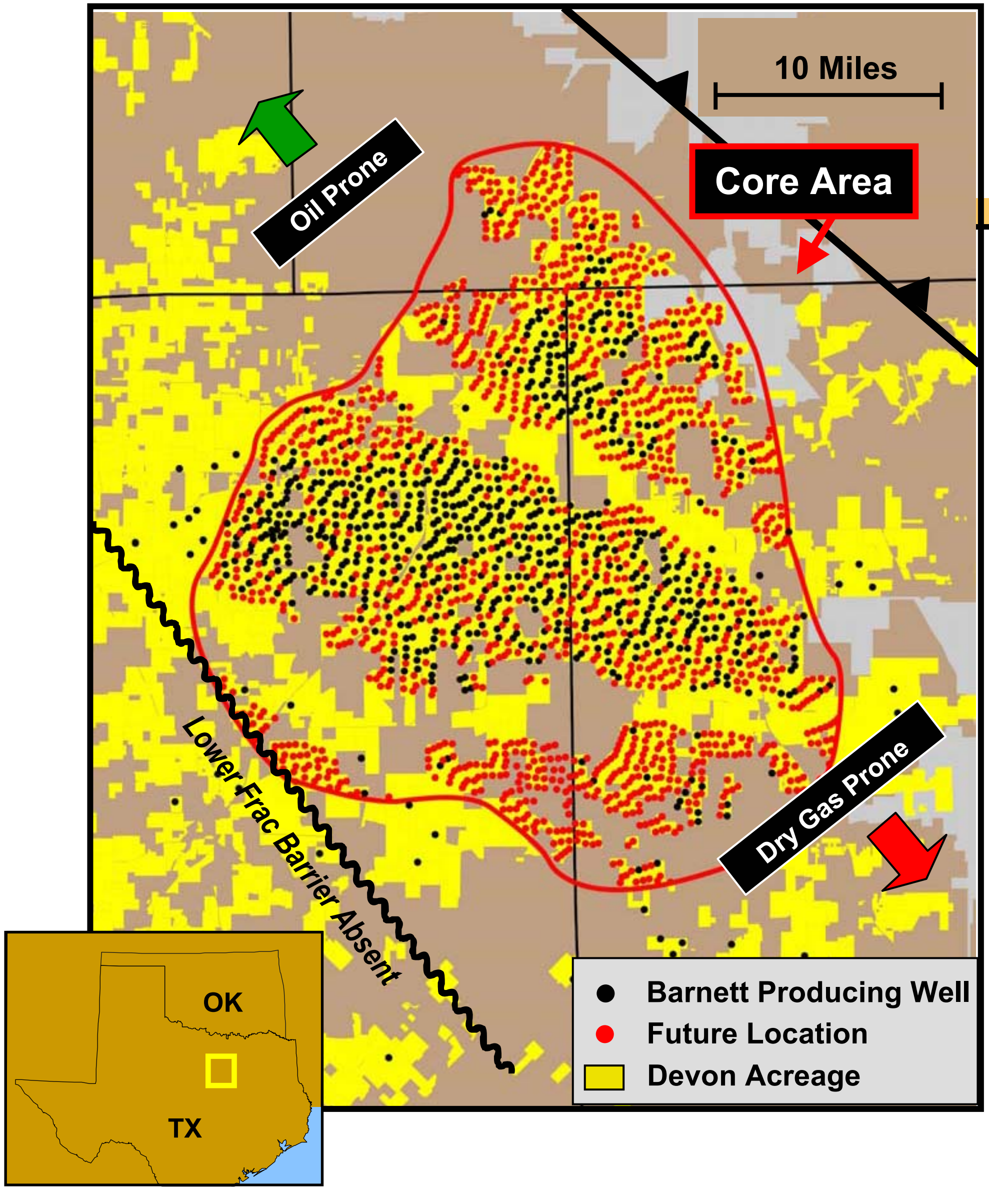
- **<u>Core Area</u>. Area of existing drilling and production.**
- **<u>Extension Area #1</u>. Area of emerging drilling and production.**
- **<u>Extension Area #2</u>. Production not established.**

FORT WORTH BASIN – BARNETT SHALE GEOLOGY/STRATIGRAPHY

- **Maximum 1,000 ft thick near SW fault boundary of S. OK aulocagen. Thins to the SW as it crops out along the flanks of Llano uplift.**
- **Average shale thickness is 500 ft in current producing trend. Lower 200-300 ft section originally completed, with upper 100-200 ft added in recent wells.**
- **Production limit set at 100 foot shale thickness contour and 1.1% Ro contour.**

SUMMARY: FORT WORTH BASIN-BARNETT SHALE

- **The Barnett Shale emerged as an interesting new gas shale play in the mid-1980s.**
- **Based on published data, as of the end of 2003, the Barnett Shale:**
  - **Producing at nearly 1 Bcfd;**
  - **Has provided 1 Tcf cumulative recovery;**
  - **Nearly 3 Tcf of proved reserves;**
  - **About 2,500 producing wells.**

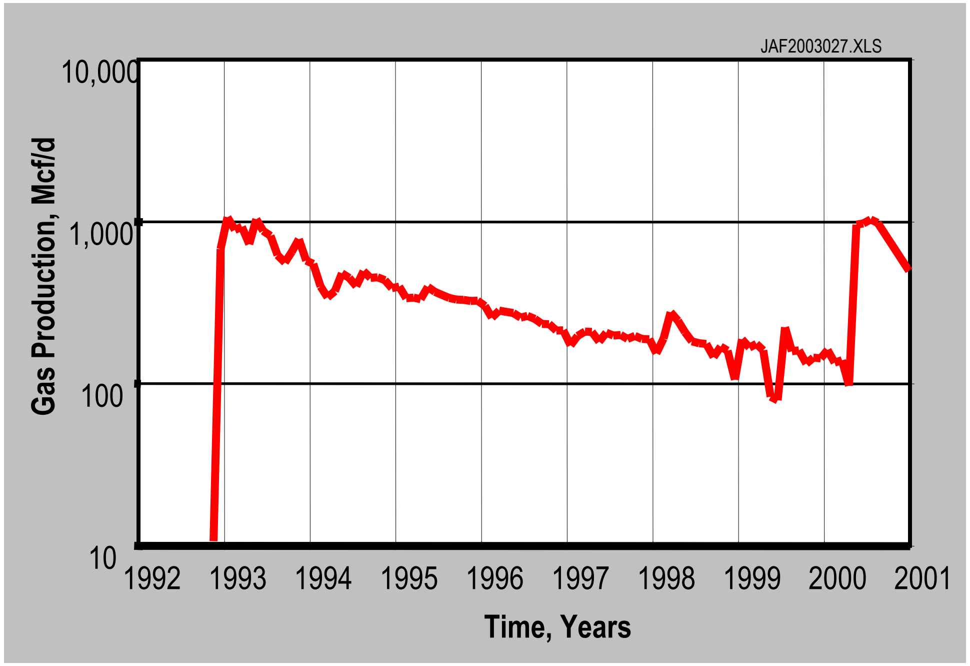


BARNETT SHALE

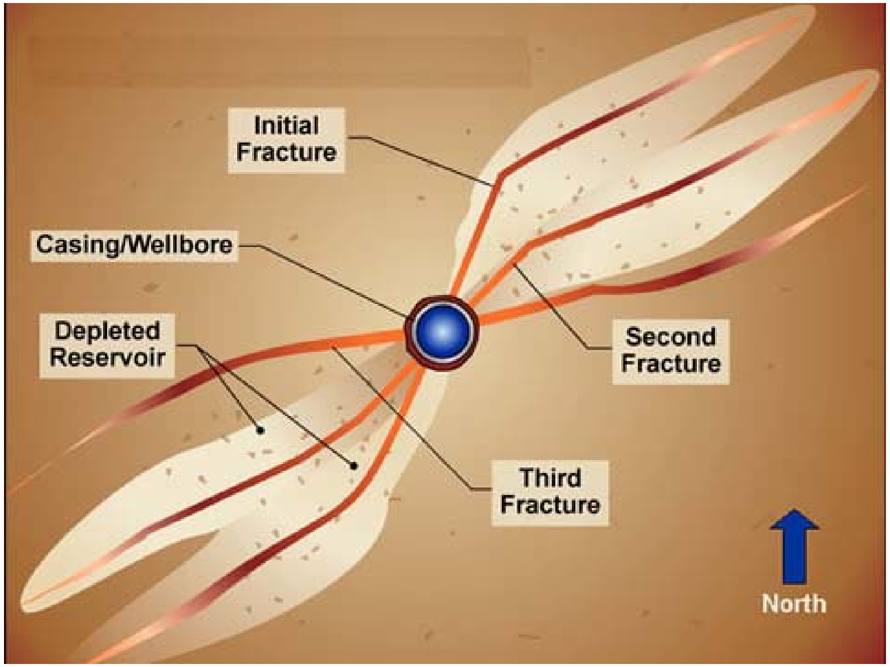
- Assessments of technically recoverable resources have grown steadily:
  - 1.4 Tcf (USGS, 1990)
  - 10 Tcf (ARI/USGS, 1998)
  - 20 Tcf (Devon, 2003)
  - 26 Tcf (USGS, 2004)
- Reserves per well in core area have steadily improved with refracs
- Horizontal drilling used in expansion areas.

BARNETT SHALE/NEWARK EAST FIELD

Devon Denton Creek Trading Co. No. 1



Fracture Reorientation



PERFORMANCE OF REFRACED WELLS

The Denton Creek Trading #1 well is the "poster child" for the refrac program:

- **Drilled in late 1992, deliverability testing indicated a BHP of 3,840 psig and a CAOF of 16,000 Mcfd;**
- **Completed from 7,738' to 8,007' and stimulated with a large frac containing 789,000 gal water and 1,548,000 lb sand;**
- **From late 1992 through early 2000 (6 years), well recovered 770 MMcf, was producing 140 mcfd, and had an EUR of 1.02 Bcf;**
- **In 2000, well was refractured, restoring gas rate to 1,000 Mcfd; since the refracs, well has produced an additional 1 Bcf and has an EUR of 2.20 Bcf.**

PERFORMANCE OF REFRACTURED BARNETT SHALE WELLS*

(1999-2000 PROGRAM)

	Well Name	Date	Original Stimulation (Bcf)		After Refracture (Bcf)		Increased Recovery (Bcf)
			Cum Recovery**	EUR	Cum Recovery***	EUR	
1	Denton Creek #1	1992	0.77	1.02	1.69	2.20	1.18
2	Talley #1	1993	0.36	0.52	1.67	2.00	1.48
3	Logan #2	1991	0.39	0.64	1.03	1.85	1.21
4	Ted Morris #1	1992	0.57	0.76	1.45	2.14	1.38
5	Joleson #3	1984	0.71	0.78	1.72	2.40	1.62
6	Young #2	1984	0.27	0.39	0.92	0.92	0.53
7	Johnson #2	1984	0.29	0.42	1.42	1.93	1.51
	Average			**0.65**		**1.92**	**1.27**

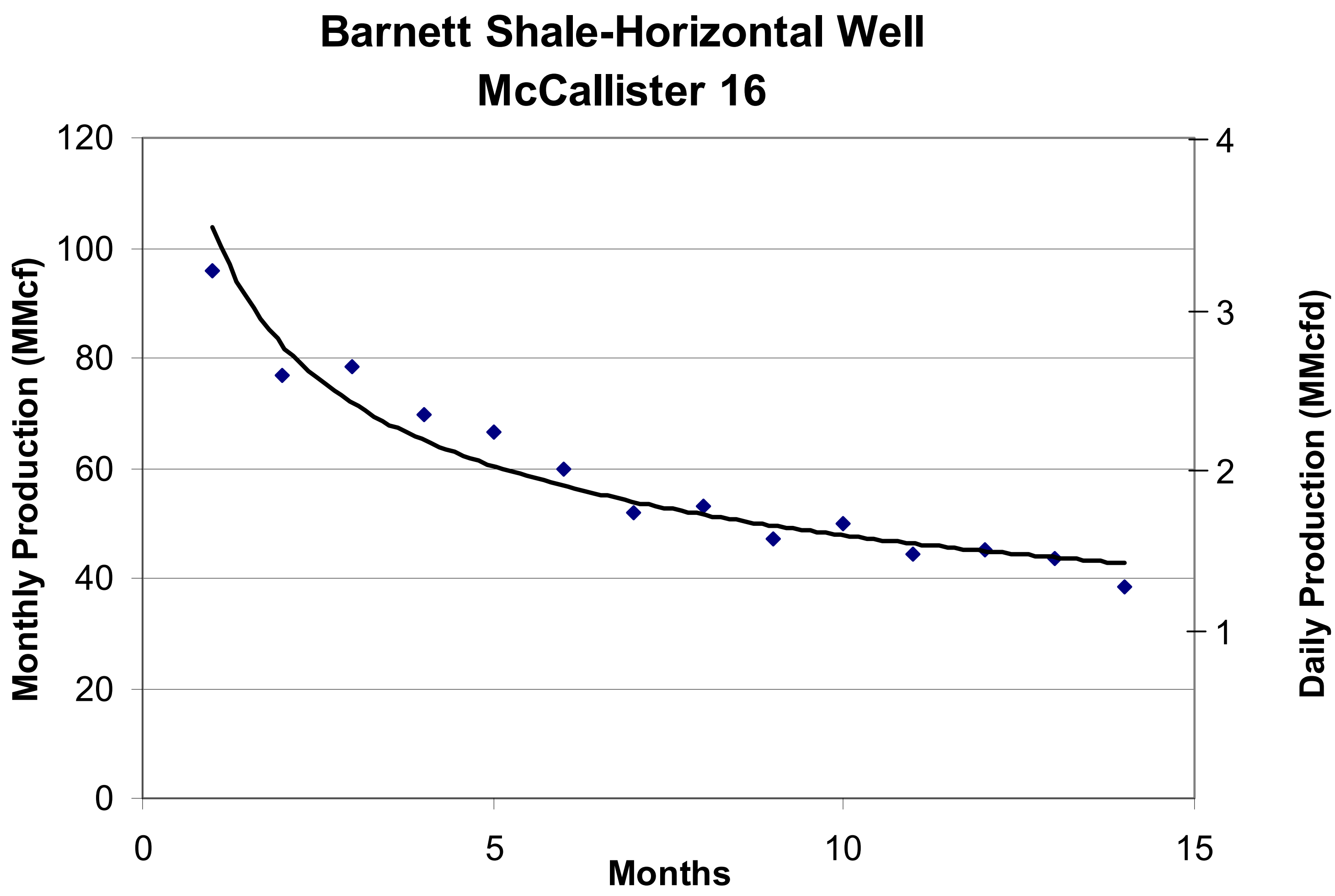
**Based on analysis by Advanced Resources.*
***Cumulative gas recovery at date of refrac.*
****Cumulative gas recovery as of February 2004*

HORIZONTAL WELL PERFORMANCE

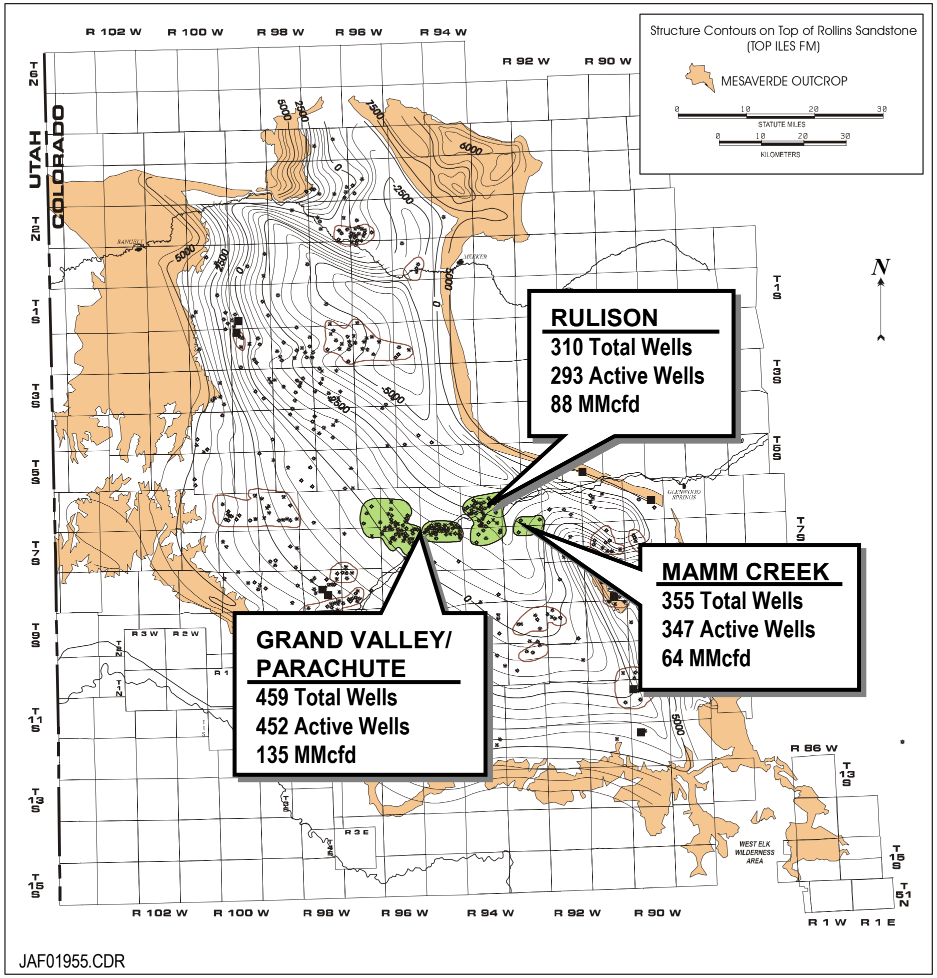
First horizontal well, Thomas Sims #1, drilled in 1992. Two additional wells drilled in 1998, Wilson #1 and Wilson #2.

- **The initial gas flow rate for Sims #1 of 400 to 500 Mcfd, lower than vertical wells, was discouraging.**
- **Subsequent recompletion raised the EUR for the Sims #1 well to 2.8 Bcf, giving more promise to this option; the two Wilson wells are lower performers.**
- **Three additional horizontal wells were drilled in 2002 and early 2003 provide the longest sustained gas production for assessing performance.**

HORIZONTAL WELL PRODUCTION PROFILE



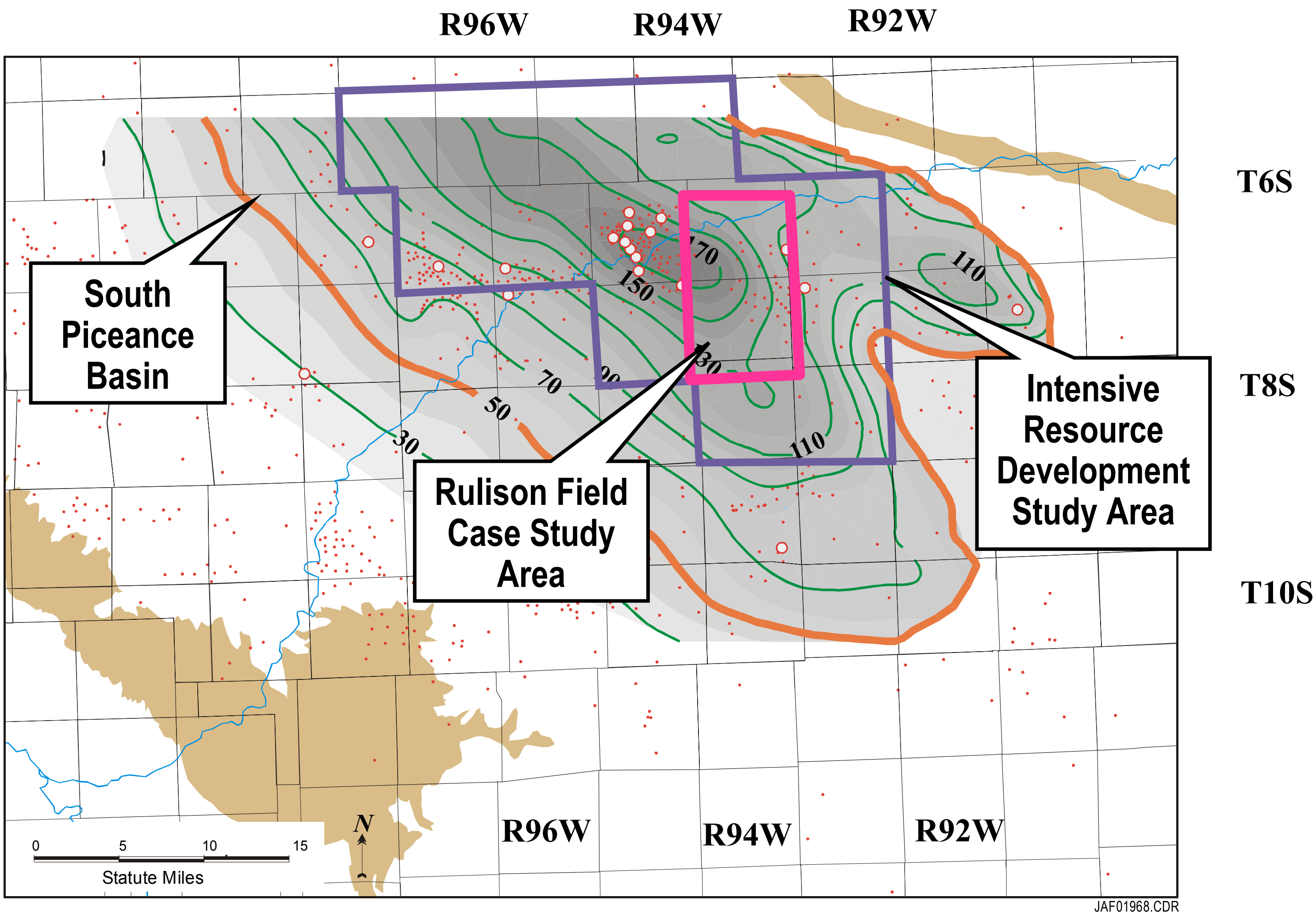
PICEANCE BASIN/MESAVERDE (WILLIAMS FORK) TIGHT GAS PLAY



- ♦ Piceance Basin/Williams Fork is a "rediscovered" tight gas play with 1,400 wells, 800 Bcf of past production, and 1,700 Bcf of proved reserves.
- ♦ Reserves per well are on increase:
  - 0.6 Bcf (pre-1995)
  - 1.1 Bcf (1999-2001)
  - 1.5 to 2.0 Bcf (Recent)
- ♦ Undiscovered recoverable resources:
  - 3.1 Tcf (USGS, 2002)
  - 29.7 Tcf (ARI, 2004)
- ♦ Future resources and technology:
  - Intensive resource development: 20 acres/well; full completion of stacked sands
  - Improved D&C technology

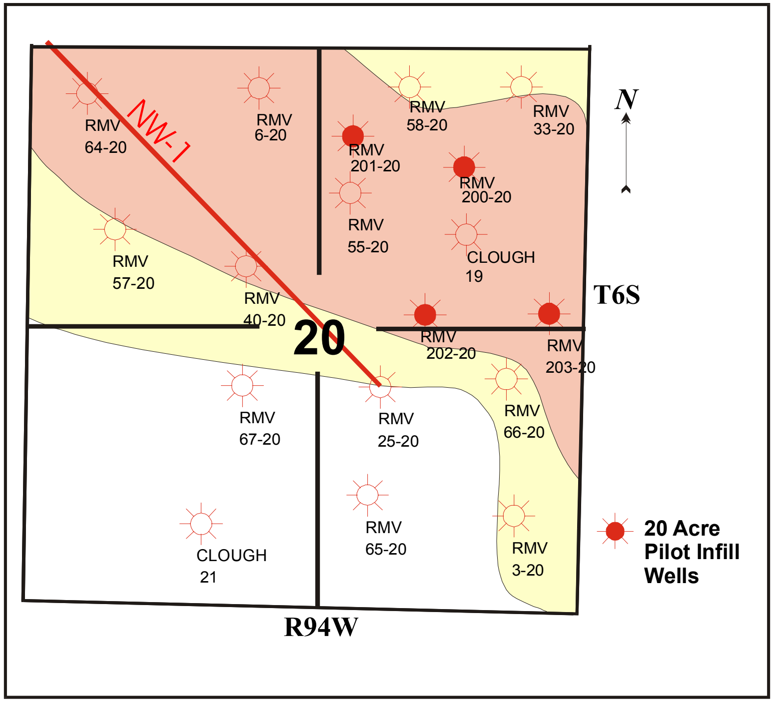
UNCONVENTIONAL GAS RESOURCE

Gas In-Place (Bcf per Section), Williams Fork/Mesaverde, S. Piceance Basin.



INTENSIVE DEVELOPMENT OF MASSIVE SAND PACKAGE ENABLES SMALL AREAS TO PROVIDE LARGE RESERVES

Intensive Field Development Pilot, Sec. 20, Rulison Field*



*For wells drilled through 1997.

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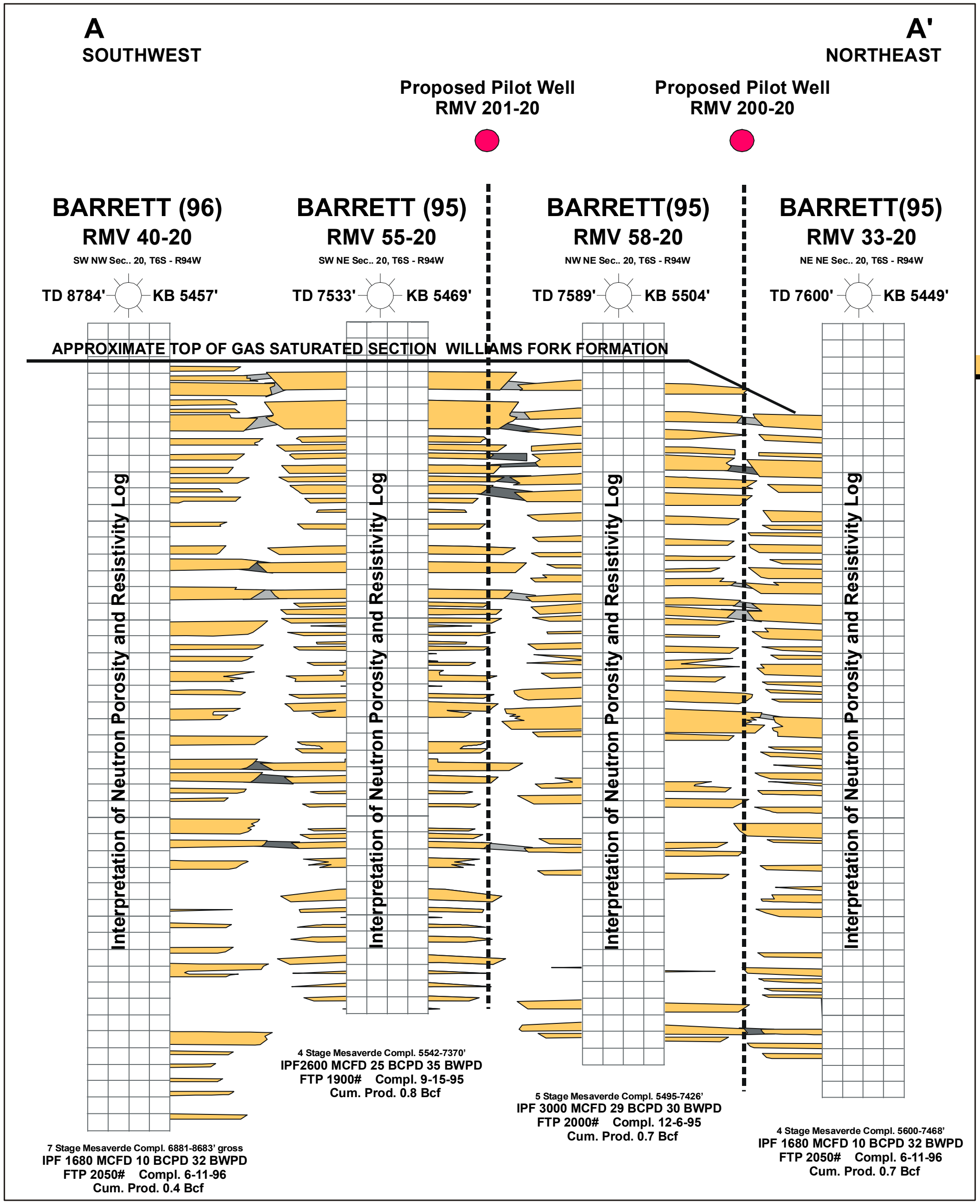
Expected Results from Intensive Field Development (Sec. 20, Rulison)

Date	Wells and Spacing	Reserves/ Well[1] (Bcf)	Reserves/ Section (Bcf)
Initial	2 wells @ 320 A/W	2.1	4
1994	2 wells @ 160 A/W	2.2	4
1995	4 wells @ 80 A/W	1.9	8
1996-1997	6 Wells @ 40 A/W	1.7	10
1997-2000	16 wells @ 20 A/W	1.7	28
Latest	8 Wells @ <20 A/W	2.5	20
TOTAL (38 Wells)		1.95	74

[1] *Estimated Based on ARI-Tight Type Curve Model.*

UNCONVENTIONAL GAS RESOURCE
(Cont'd)

Sand Continuity in Closely Spaced Wells, Section 20, Rulison Field.

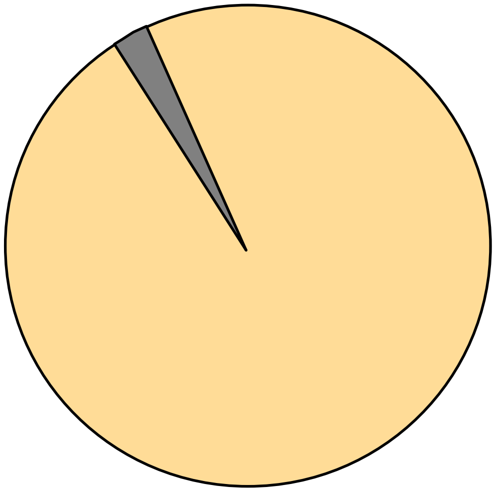


DEVELOPING UNCONVENTIONAL GAS RESOURCES

Intensive Resource Development,
Rulison Field Case Study Piceance Basin, Colorado

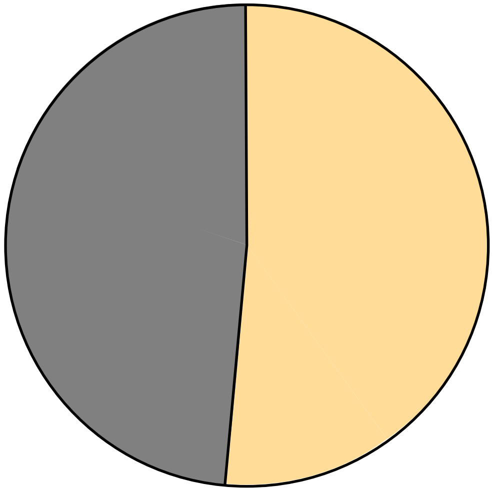
Traditional

160-Acre Development
4 Wells/Section w/o Old Technology
3 Bcf, 2.5% Recovery of GIP



Intensive

20-Acre Development
32 Wells/Section w/ New Technology
48 Bcf, 40 % Recovery of GIP



Source: Modified from Williams, 2003

DEVELOPING UNCONVENTIONAL GAS RESOURCES

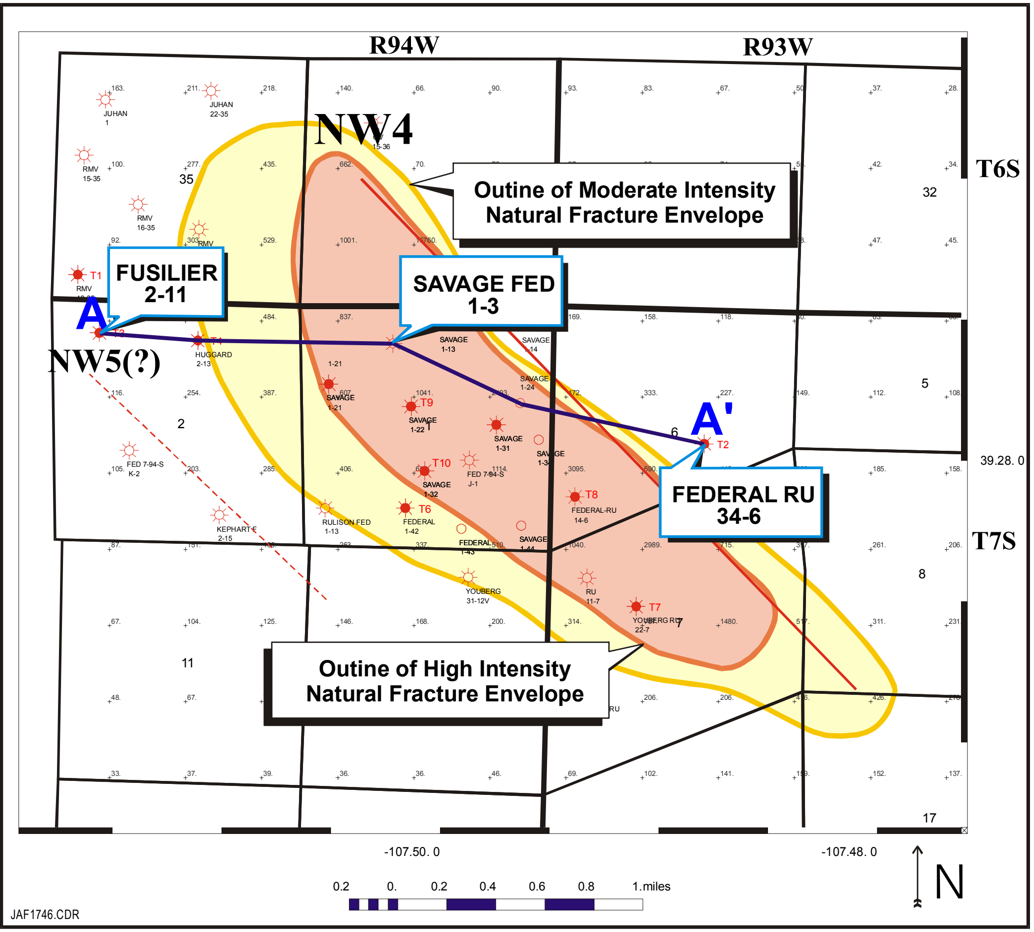
Increasing Prospect Size with Intensive Resource Development and Advanced E&P Technology: Rulison Field Case Study.

Field Development Options	Well Spacing (A/W)	No. of Well Locations	Success Rate	No. of Completions Per Well	Reserves/ Well (Bcf)	Reserves/ Section (Bcf)	Reserves/ Prospect (Bcf)
Traditional Practices	160	288	85%	1 to 2	0.9	3	200
Future Strategy	20	2,300	~100%	4 to 6	1.5	48	3,400

**For two townships (72 square miles or sections); based on Sec. 20; T6S-R94W results.*

INTEGRATION OF GEOMECHANICS AND 3-D SEISMIC OFFERS PROMISE FOR DEFINING "SWEET SPOTS"

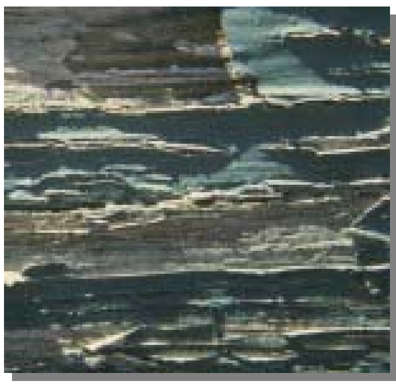
(Tight Gas, Rulison Field, Piceance Basin)



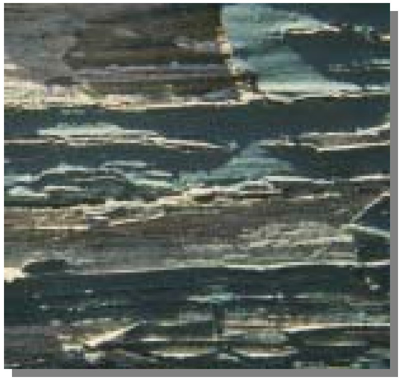
Source: Advanced Resources Int'l (2001)

Results of Geomechanics/3-D Seismic Technology Test

Natural Fracture Cluster Area	Cum. Recovery	Est. Ult. Recovery
<u>Inside Envelope (12 wells)</u>		<u>2.5 Bcf/Well</u>
• Savage Fed . 1-3	2.0 Bcf	2.8 Bcf
<u>Outside Envelope (23 wells)</u>		<u>1.2 Bcf/Well</u>
• Fed. RU 34-6	0.2 Bcf	0.3 Bcf
• Fusiler 2-11	0.8 Bcf	1.5 Bcf



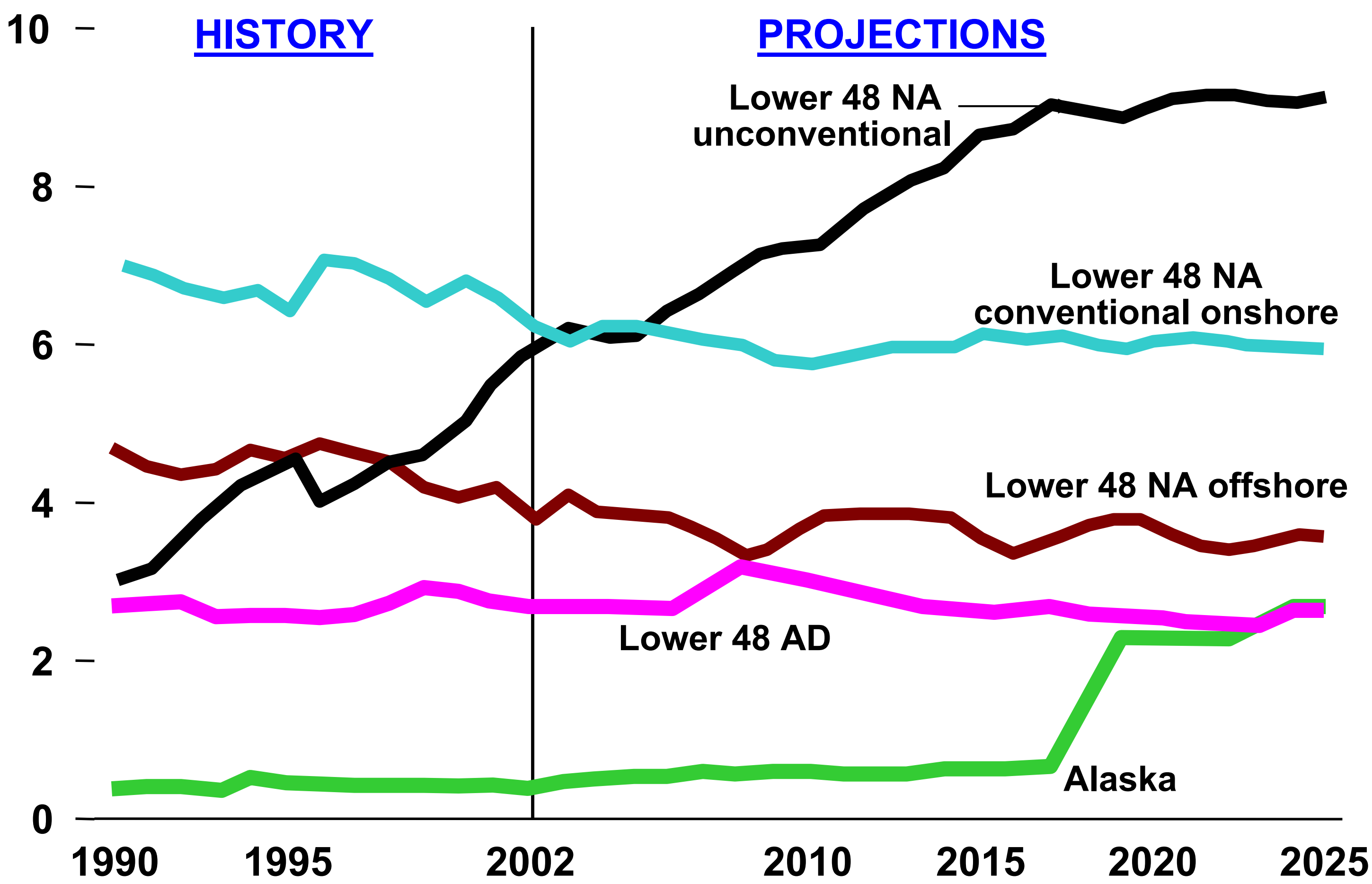
3. Concluding Remarks



CONCLUDING REMARKS

- **“The future is not what it used to be” - - it’s unconventional.**
- **There is not a shortage of resources, but a shortage of ideas and technology.**
- **The wildcatter of the future will be exploring for the “sweet spots” in unconventional gas prospects.**
- **Each unconventional gas play has unique challenges, requiring its own base of data and knowledge.**
- **The successful unconventional gas producers will be those that invest in or rapidly adopt “best technology”.**

U.S. NATURAL GAS PRODUCTION, BY SOURCE 1990-2025 (Tcf)



Source: Based on data from Energy Information Agency (2004).

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