The Marcellus Shale: Possibilities for furture North American natural gas production

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California Energy Commission
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Appalachian Fracture Systems, Inc.

PENNSTATE. 1855

Questions from CEC

- **Can future production of natural gas from shale formations meet expectations of the natural gas industry? 'Yes'**
- **Are the current shale reserve estimates reliable? 'No' How can they be improved?**
- **How does the current pricing environment affect drilling programs scheduled for natural gas shale formations?**
- ***How might potential environmental impacts affect future drilling and production of natural gas from shale formations?***
- **Can shale gas continue to gain demand-side market share?**
- **Is shale gas a viable long-term source of natural gas for the United States? 'Yes'**

Reserves Classification

- Proved Reserves:
  - (P90) - quantities actually recovered will equal or exceed this estimate.
- Unproven Reserves:
  - Probable Reserves: (P50) when probabilistic methods are used, there should be at least a 50% probability that quantities actually recovered will equal or exceed the sum of proved and probable.
  - Possible Reserves: (P10) there should be at least a 10% probability of realizing this number

Gas forcasts = Weather forcasts

- Proved Reserves: (short-term forcast)
  - (P90) - quantities actually recovered will equal or exceed this estimate.
- Unproven Reserves: (long-term forcast)
  - Probable Reserves: (P50) when probabilistic methods are used, there should be at least a 50% probability that quantities actually recovered will equal or exceed the sum of proved and probable.
  - Possible Reserves: (P10) there should be at least a 10% probability of realizing this number

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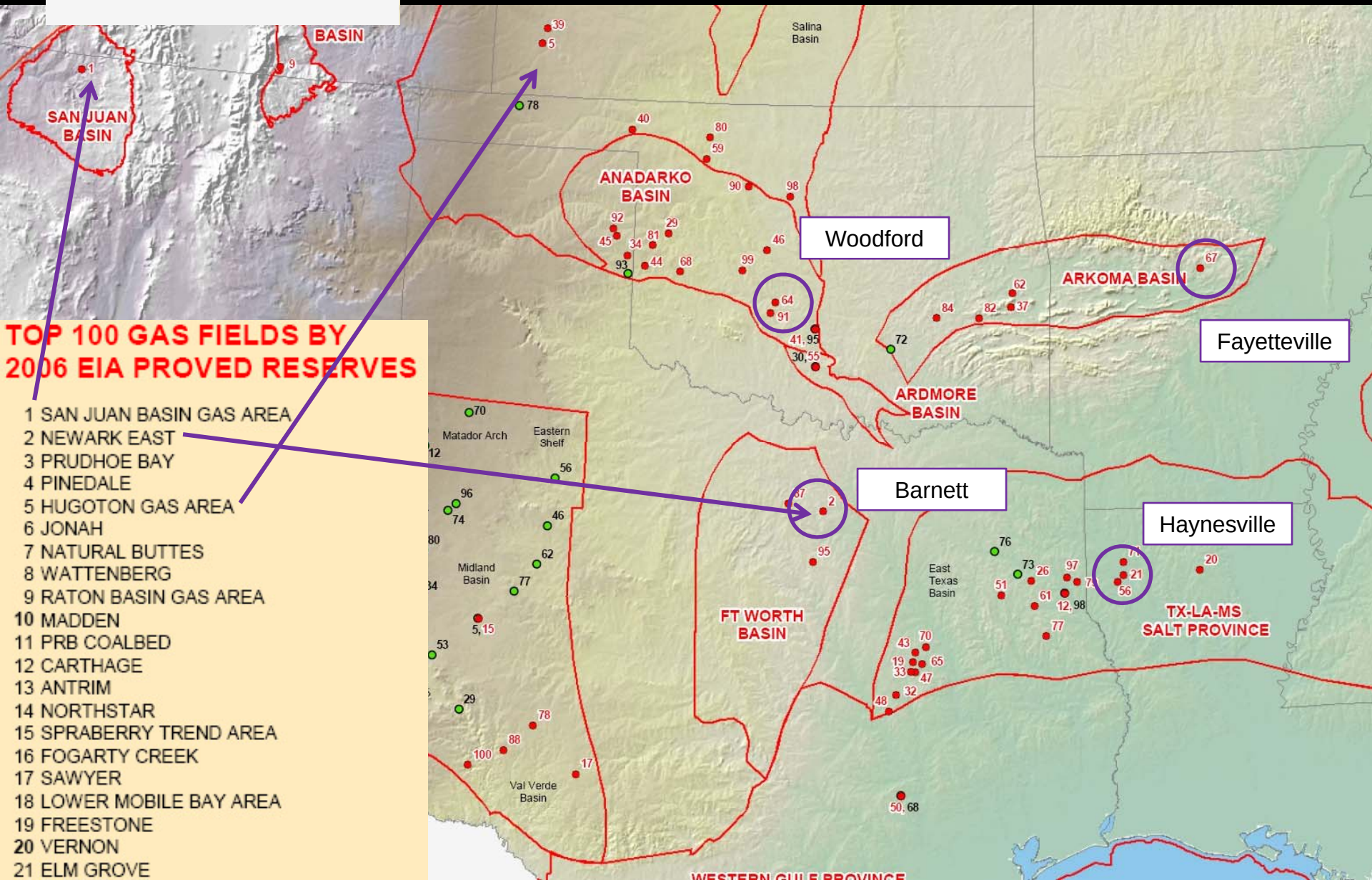
Short-term forecast



TOP 100 GAS FIELDS BY 2006 EIA PROVED RESERVES

1 SAN JUAN BASIN GAS AREA
2 NEWARK EAST
3 PRUDHOE BAY
4 PINEDALE
5 HUGOTON GAS AREA
6 JONAH
7 NATURAL BUTTES
8 WATTENBERG
9 RATON BASIN GAS AREA
10 MADDEN
11 PRB COALBED
12 CARTHAGE
13 ANTRIM
14 NORTHSTAR
15 SPRABERRY TREND AREA
16 FOGARTY CREEK
17 SAWYER
18 LOWER MOBILE BAY AREA
19 FREESTONE
20 VERNON
21 ELM GROVE

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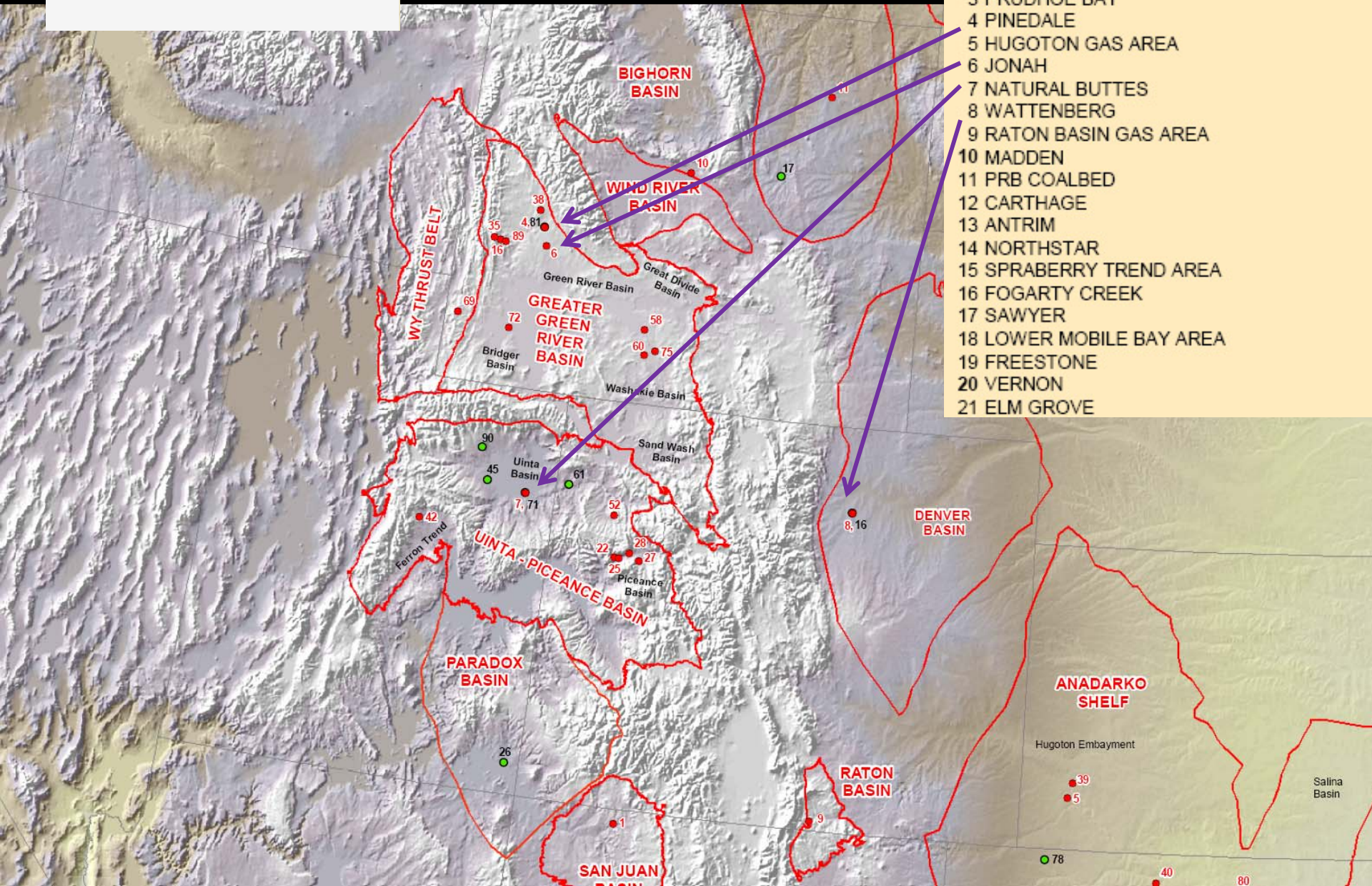

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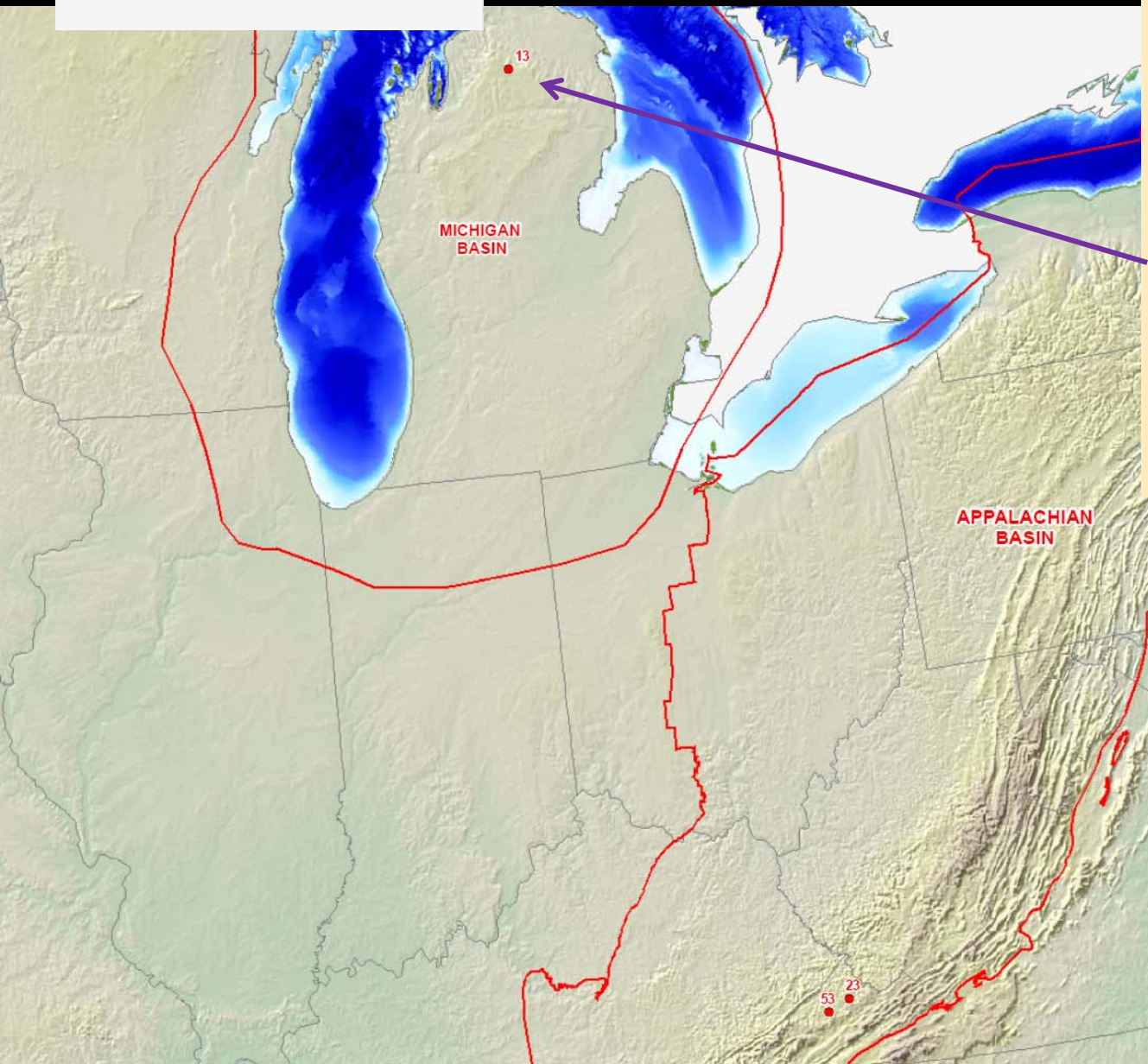

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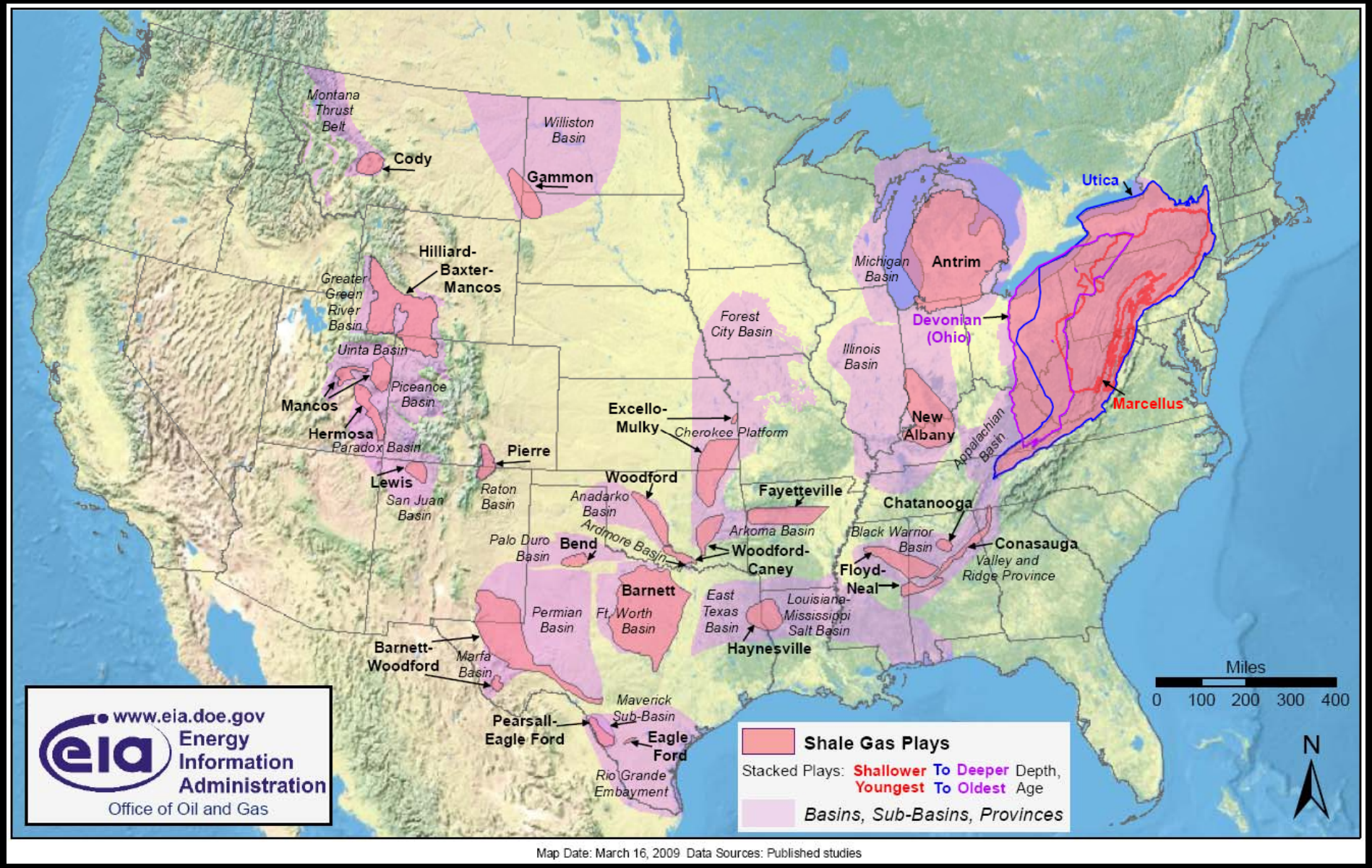
TOP 100 OIL FI
2006 EIA PROV

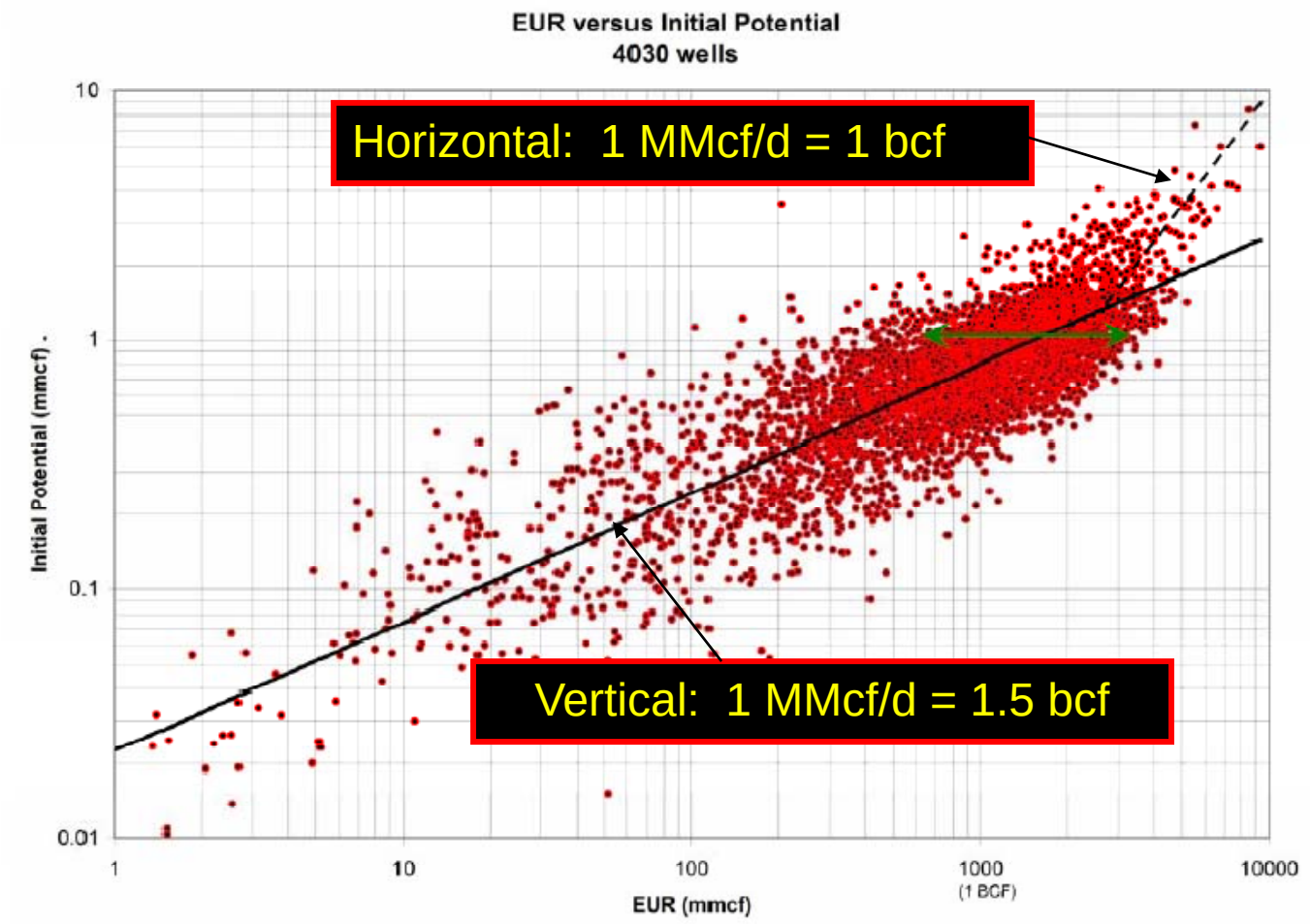
1 PRUDHOE BAY
2 WASSON
3 BELRIDGE SOUTH
4 MISSISSIPPI CANYON
5 SPRABERRY TREND
6 KUPARUK RIVER

Long-term forecast: Volume matters!



Map Date: March 16, 2009 Data Sources: Published studies

The Barnett experience: Relationship between PIP and EUR

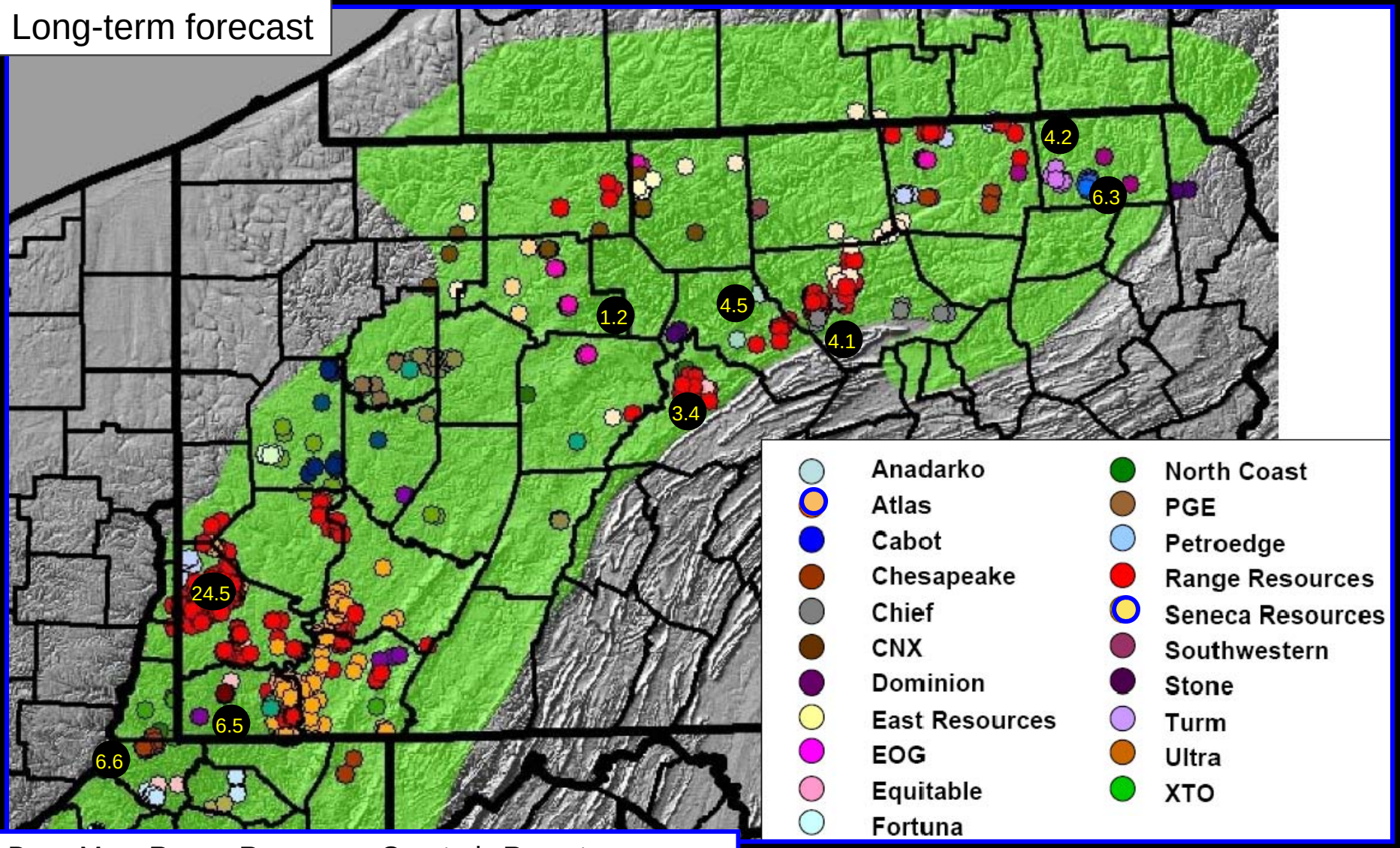


Steve Drake (Marsh Operating Company) (12-6-07)
http://spemc.org/resources/presentation_120607.pdf

Marcellus Permits (2008)

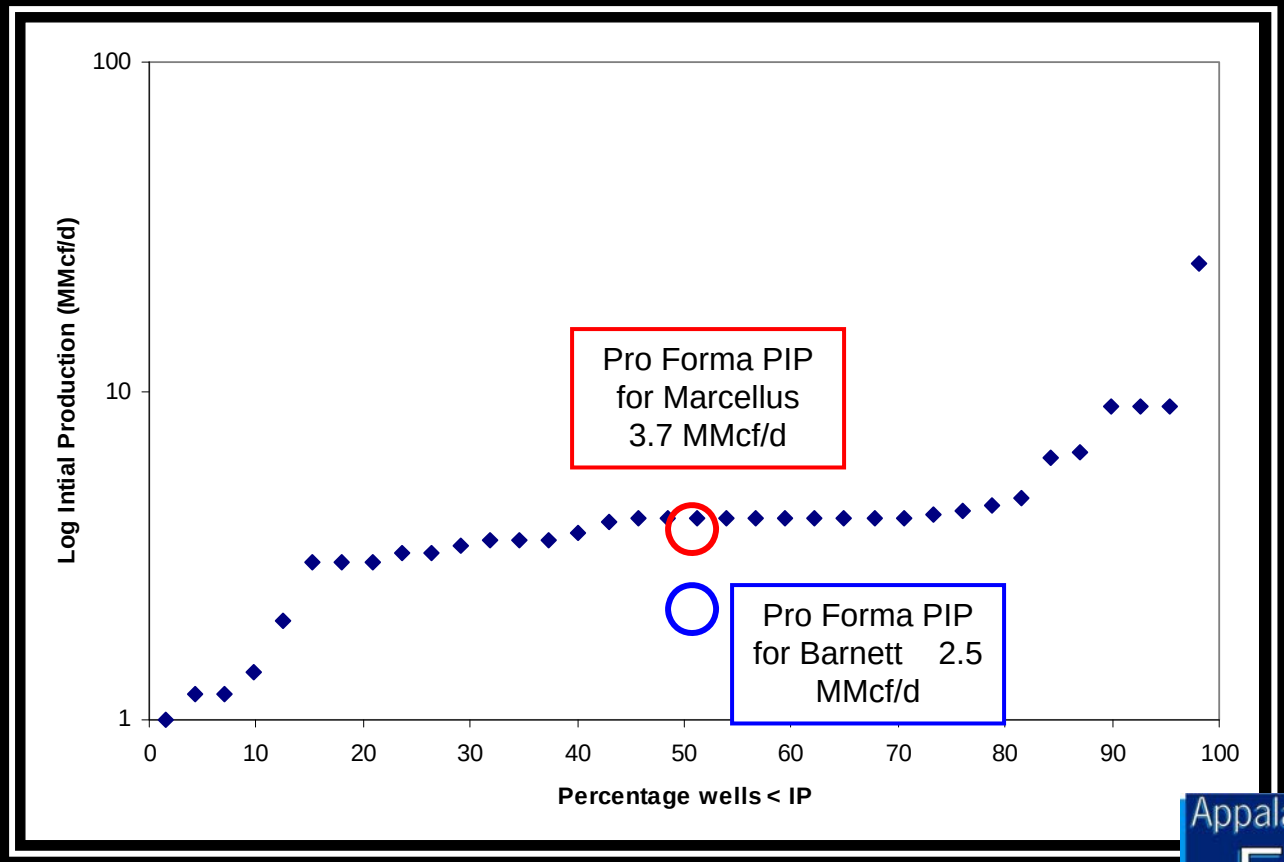
(6.3) IP (bcf/d)– Quarterly calls

Long-term forecast



Base Map: Range Resources Quarterly Report

Marcellus Horizontal wells
24-hour flow tests (n = 36)
All known data through February 2009



PIP – First month average

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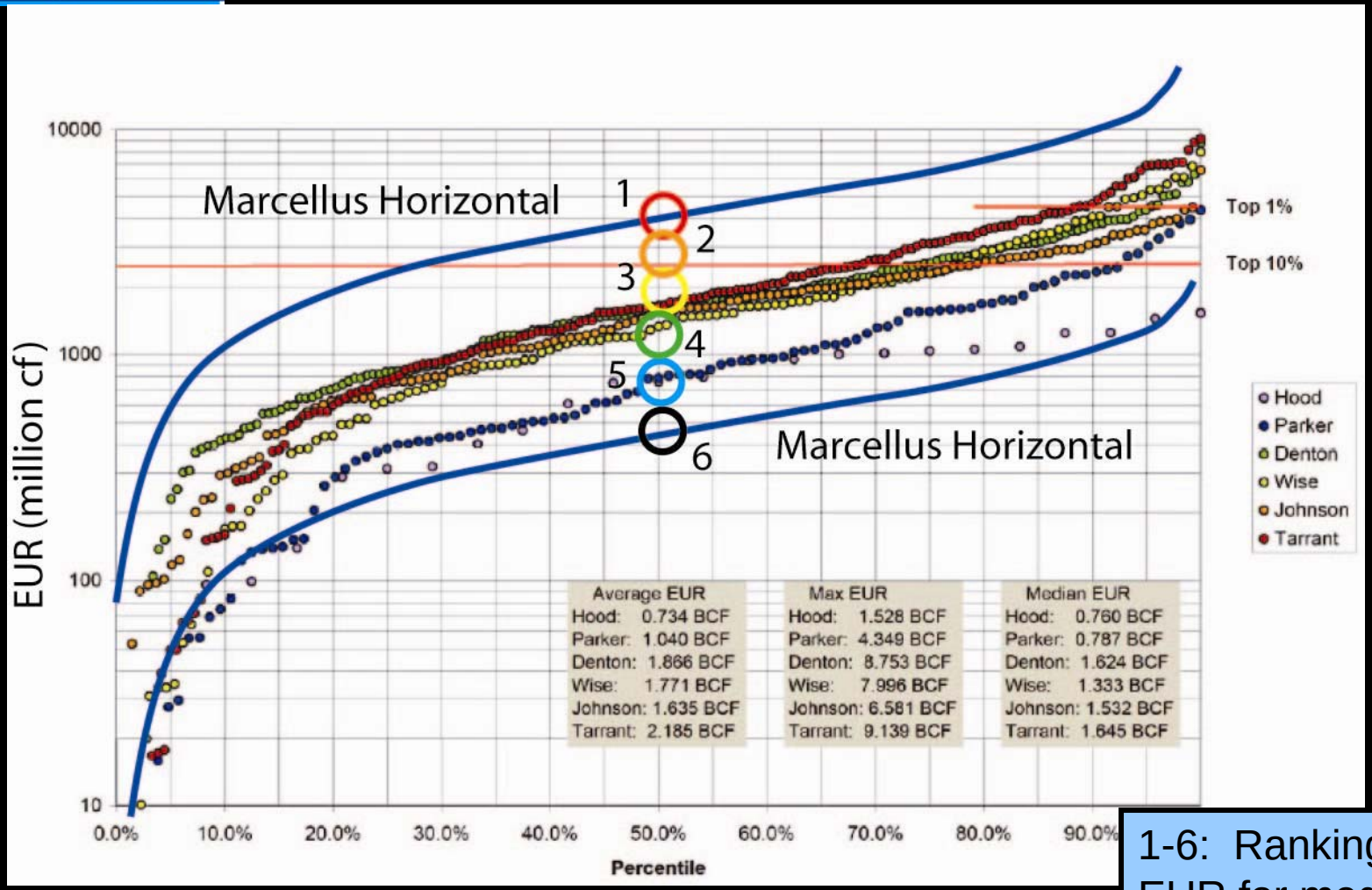
Marcellus v. Barnett



1-6: Ranking of EUR for medium Marcellus well sorted by county

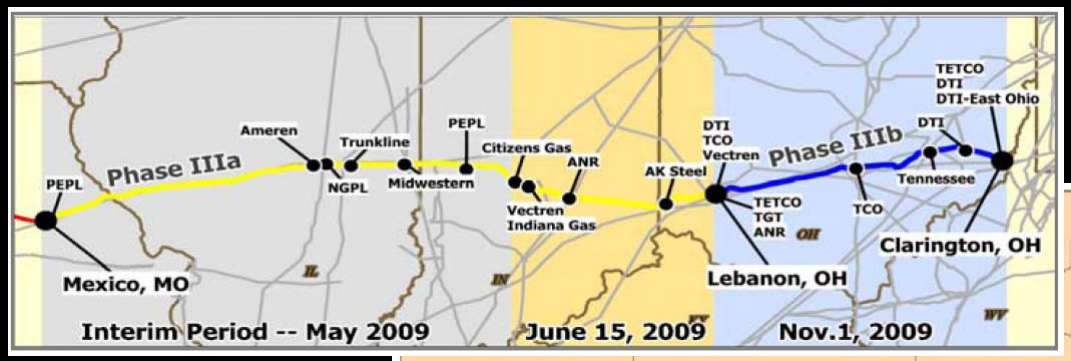
Steve Drake (Marsh Operating Company) (12-6-07)
http://spemc.org/resources/presentation_120607.pdf

Risked Potential of the Marcellus (Bcf)

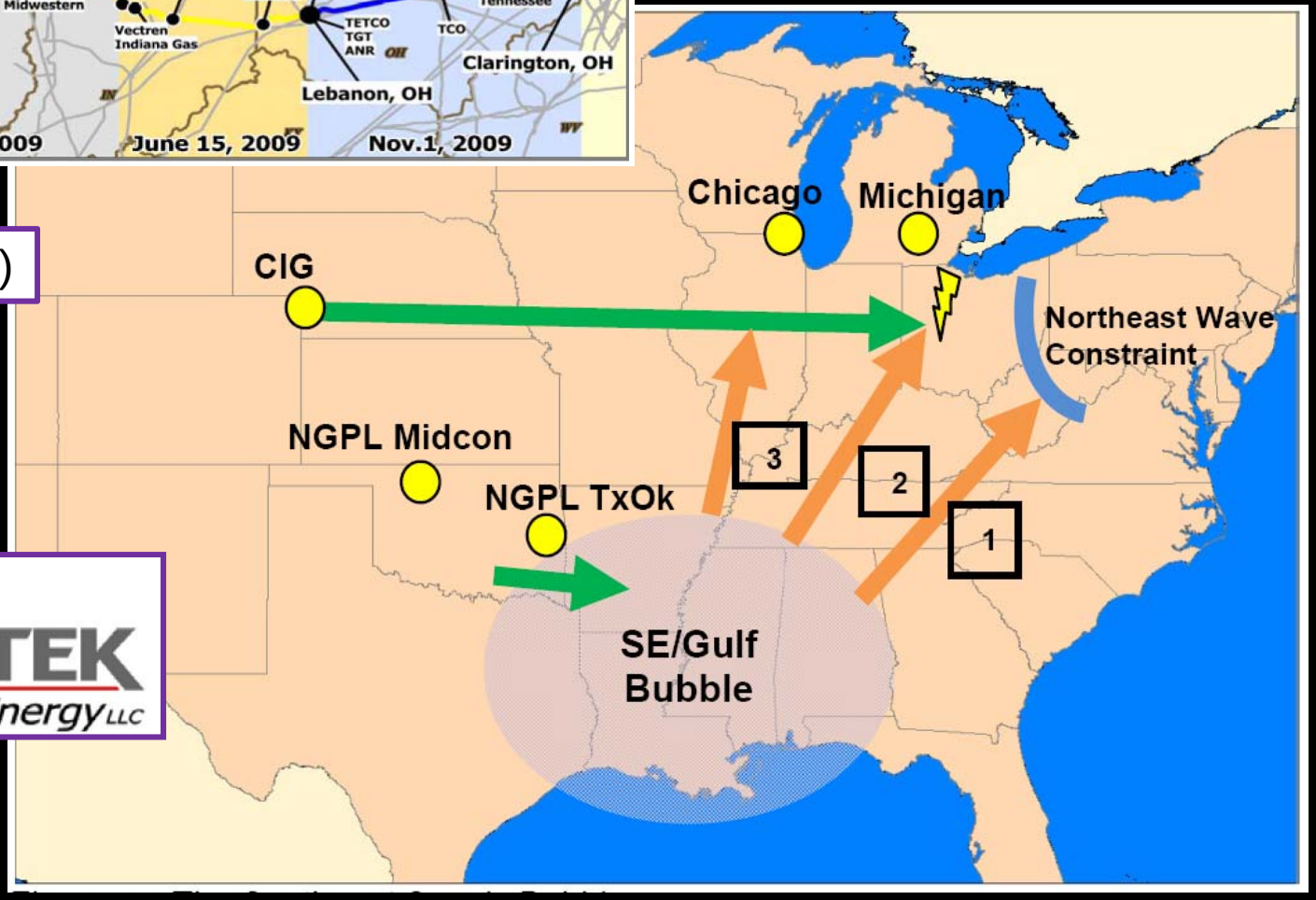
80 acre spacing & 70% accessible

	P90 Total Risked Potential	P50 Total Risked Potential	P10 Total Risked Potential
Maryland	1,102	4,408	10,286
New York	18,196	71,859	178,484
Pennsylvania	70,318	264,602	666,820
Ohio	10,367	41,166	100,966
West Virginia	19,531	77,588	193,860
	119,513	459,623	1,150,416

Unrisked Tristone Capital = 1,200,000 Bcf



REX (Phase III)



BENTEK Energy LLC

When REX gas enters the Northeast, shippers from the Southeast/Gulf region will be forced to reevaluate prices in order to compete with gas from lower priced locations in the west. Due to constraints past Lebanon and Clarington there is limited takeaway capacity to absorb delivered gas from both REX and Southeast/Gulf pipelines. Lebanon will be the stage for the first major battle between Rockies producers and Southeast/Gulf producers.

Source: BENTEK_Energy_Mayhem_in_Midcon_090507_963.pdf

List of Natural Gas Fields (P50)

(Wikipedia* ---- March 24, 2009)

1. South Pars (Qatar): 377 Tcf - 565 Tcf
2. Urengoy (Russia): 384 Tcf
3. Marcellus (United States): 167 Tcf - 515 Tcf
4. Haynesville (United States): 227 Tcf
5. Iolotan: (Turkmenistan): 263 Tcf
6. Yamburg (Russia): 198 Tcf
7. Bovanenkovskoe (Russia): 151 Tcf
8. Rusanovskoye (Russia): 151 Tcf

USA consumes about 23 Tcf/yr

* Of limited accuracy


AAPG
March 2008
EXPLORER
Appalachian Spring
A new shale play
emerges in the East
Questions?