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Presented by Katharine Lee Avary, West Virginia Geological and Economic Survey at the West Virginia Coal Bed Natural Gas Workshop on Oct. 29, 2003 at Stonewall Resort, Roanoke, WV. This meeting was a part of the Energy Roadmap Workshop Series commissioned by West Virginia Governor Bob Wise.

Recent Coal Bed Methane Activity in West Virginia

Katharine Lee Avary

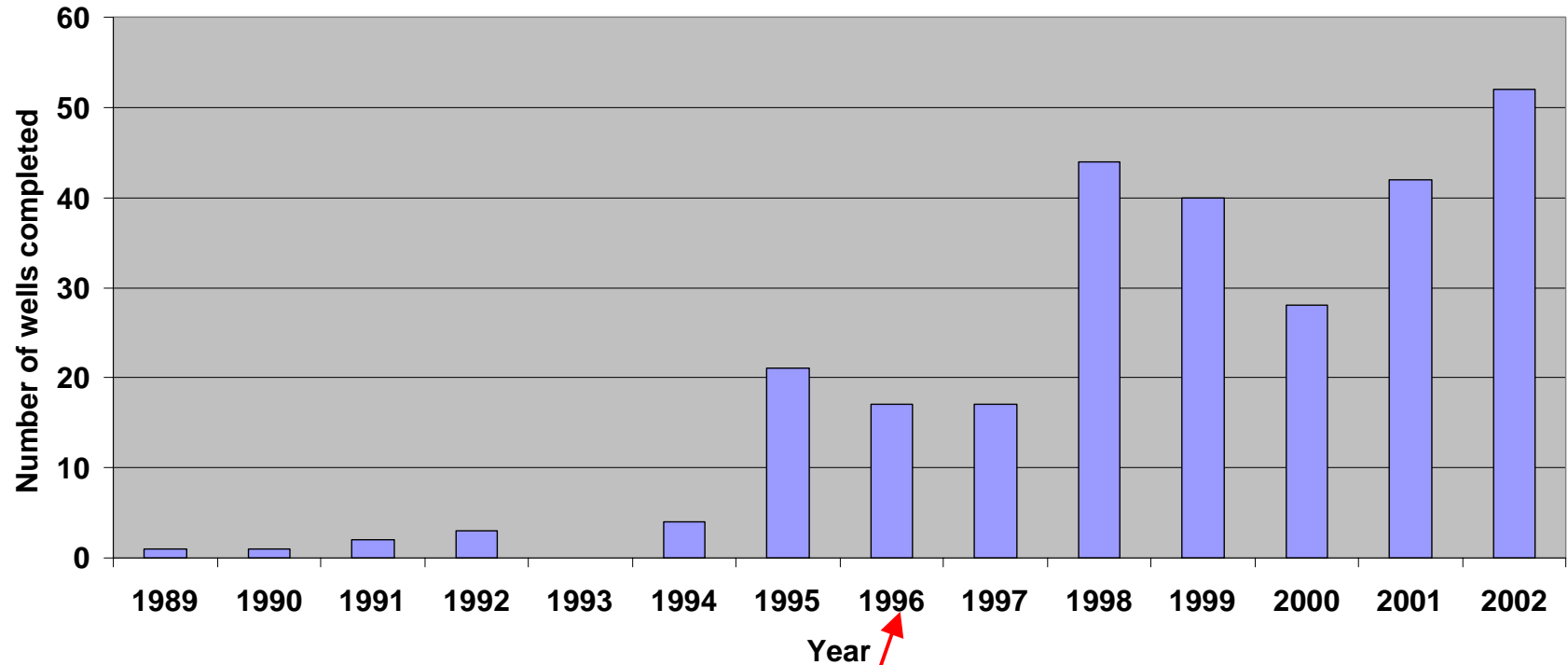
**West Virginia Geological and
Economic Survey**



In 1996, CBM regulations took effect.

- West Virginia code §22-21-3,4.
- CSR 35-03
- <http://129.71.220.230/csr/verify.asp?TitleSeries=35-03>
- Coal Bed Methane Review Board established.
- Records for about 300 CBM wells have been received.

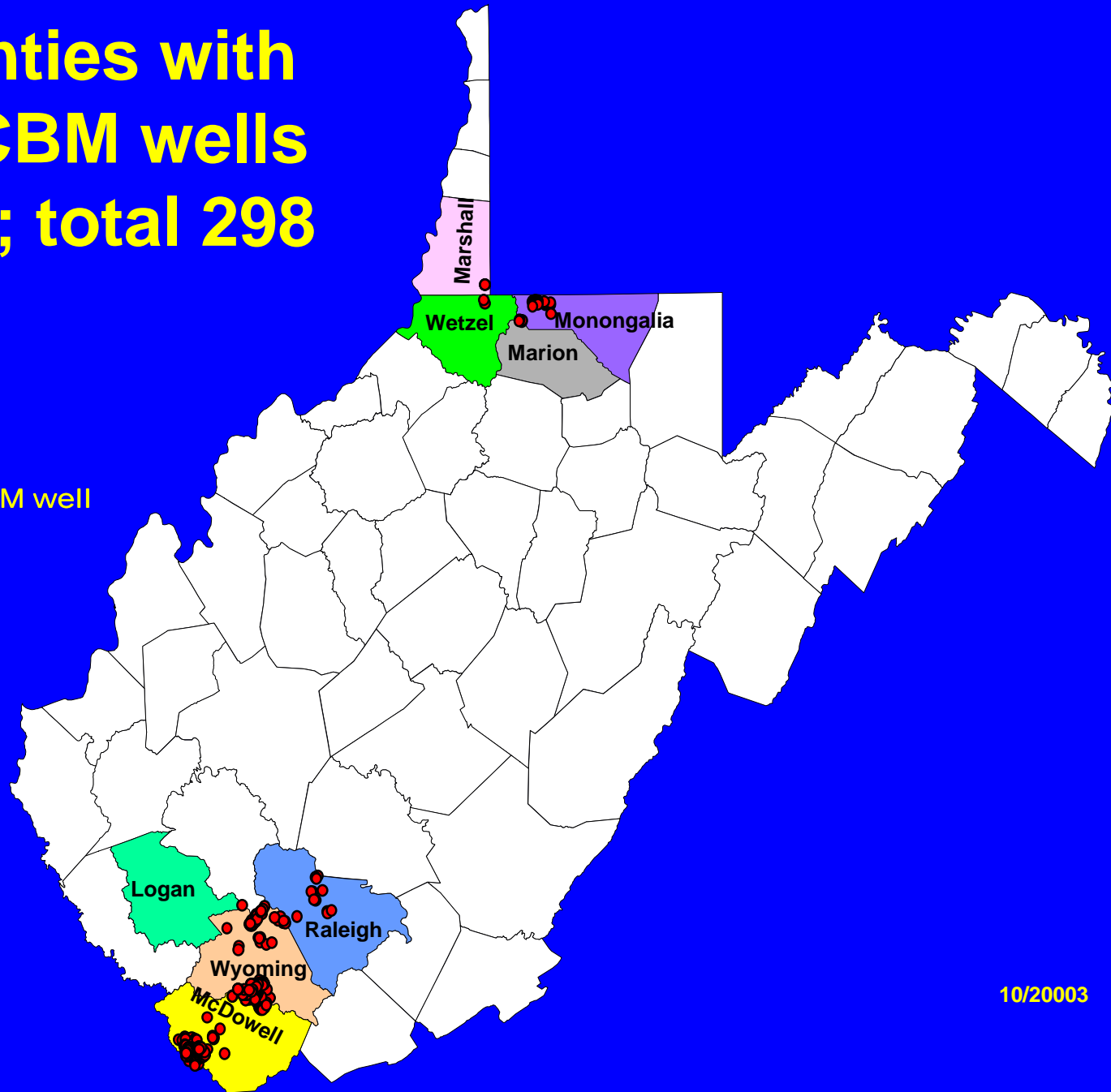
Number of CBM wells completed in West Virginia, 1989 - 2002



Regulations in effect

WV Counties with Recent CBM wells reported; total 298 wells

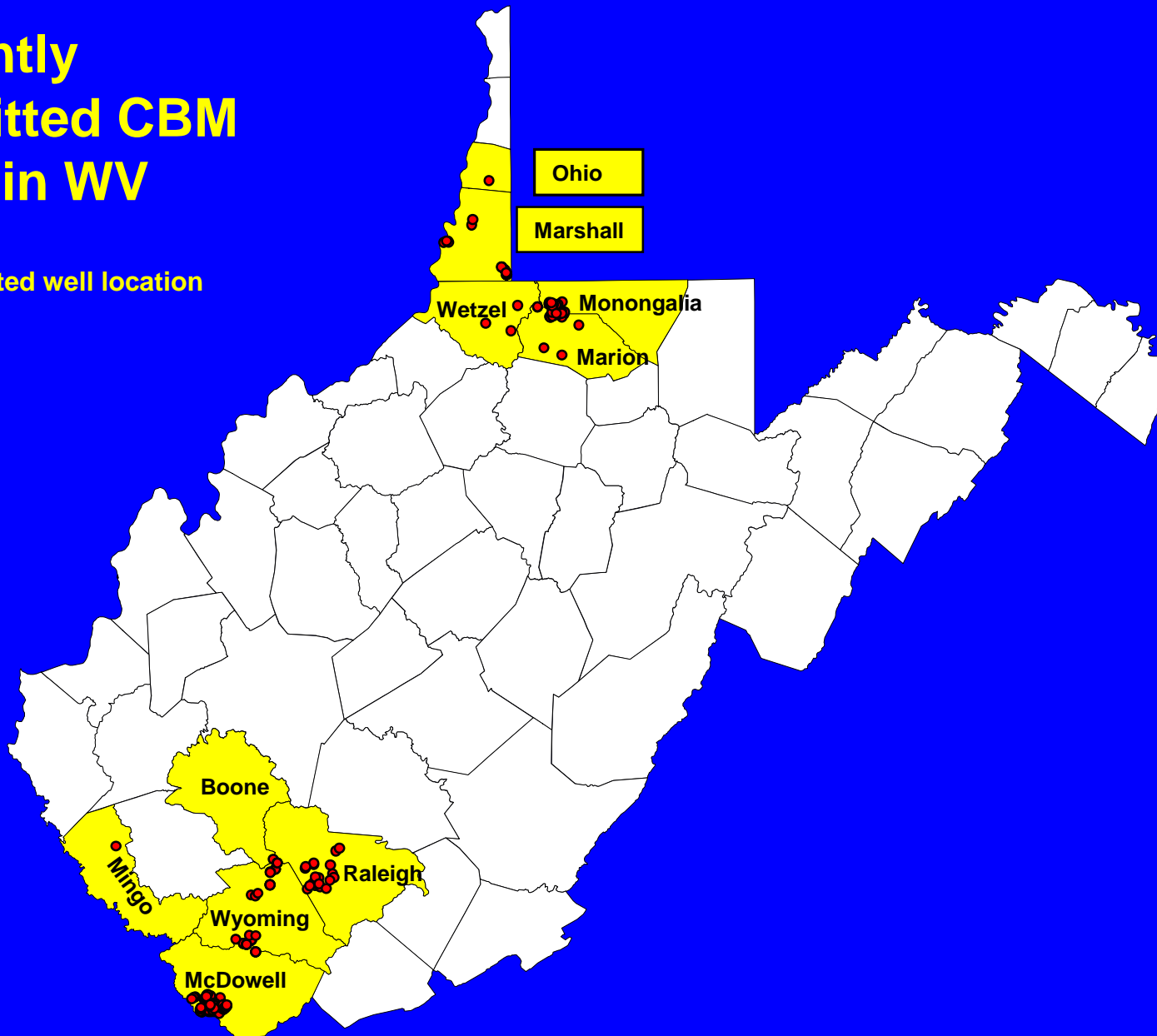
● Completed CBM well



10/2003

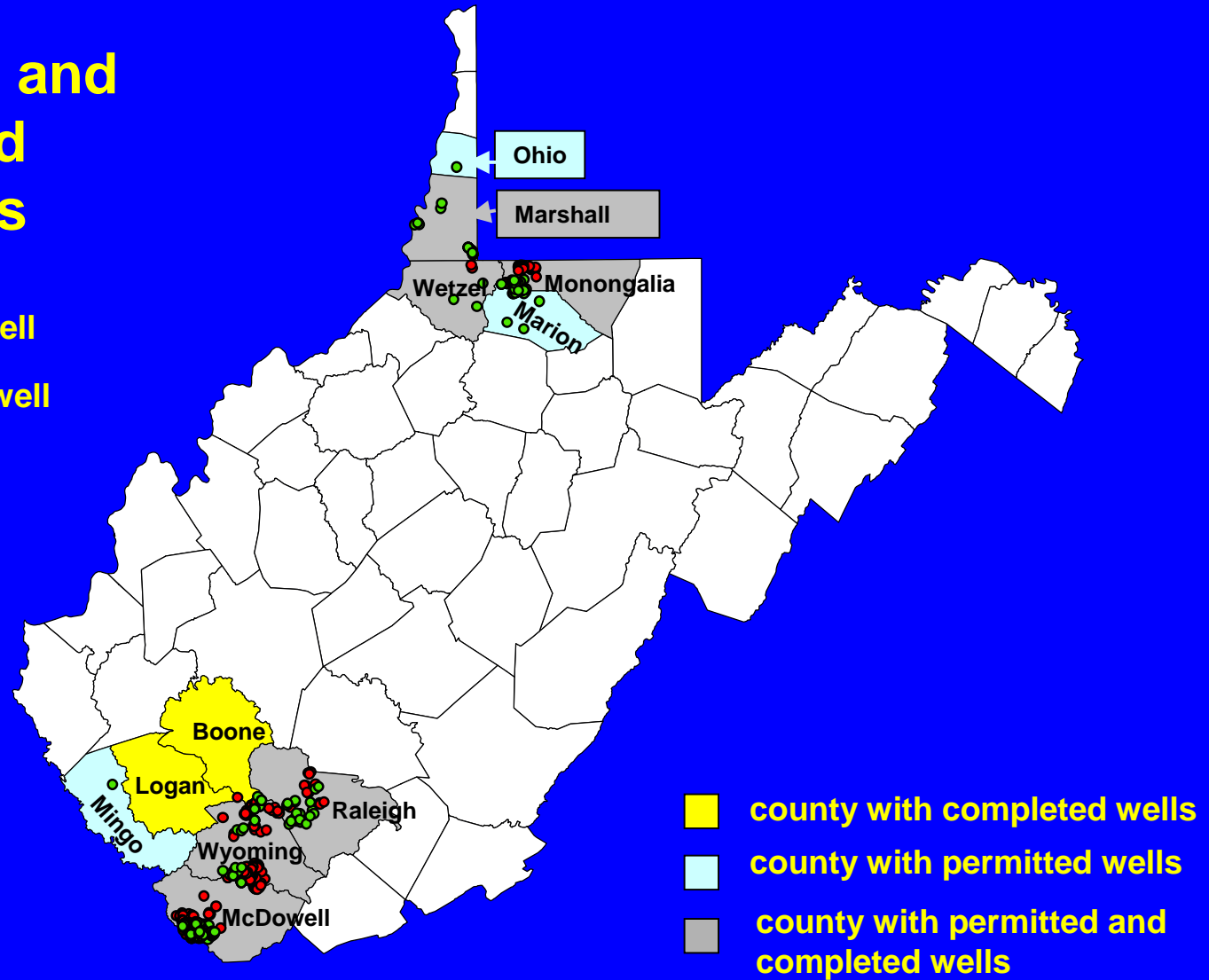
Recently Permitted CBM wells in WV

● Permitted well location



Recently permitted and completed CBM wells

- permitted well
- completed well



CBM Well Operators

- Amvest
- CDX/USX
- CNG/Dominion
- CNX/Consol Energy
- College of WV/Mountain State Univ
- Dynatec
- Energy Search
- Equitable/EREX
- Geomet
- Invitation Energy
- NW Fuel Development
- Penn Virginia
- Seneca Upshur

Operator with completed wells

Operator with permitted wells

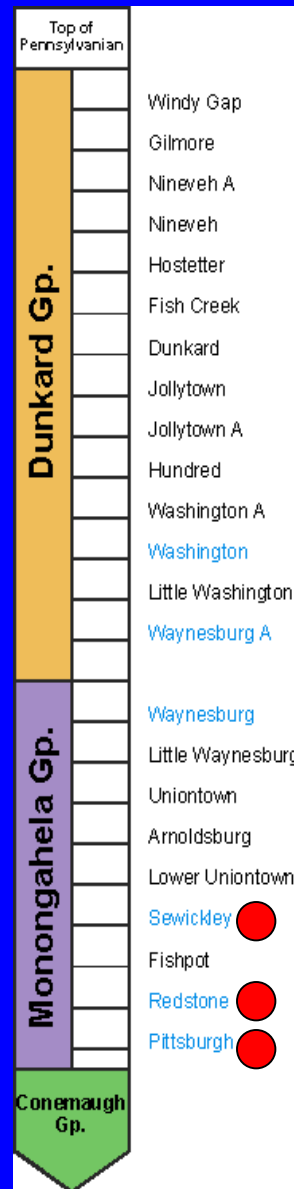
Different age coals are reservoirs in northern and southern WV

- In northern WV, Upper Pennsylvanian Monongahela Group coals are the source of most production.
- In southern WV, Lower Pennsylvanian New River and Pocahontas coals are productive.

Northern WV coal seams

- Coal completed for gas production

Seam with coverages on WVGES website, www.wvgs.wvnet.edu



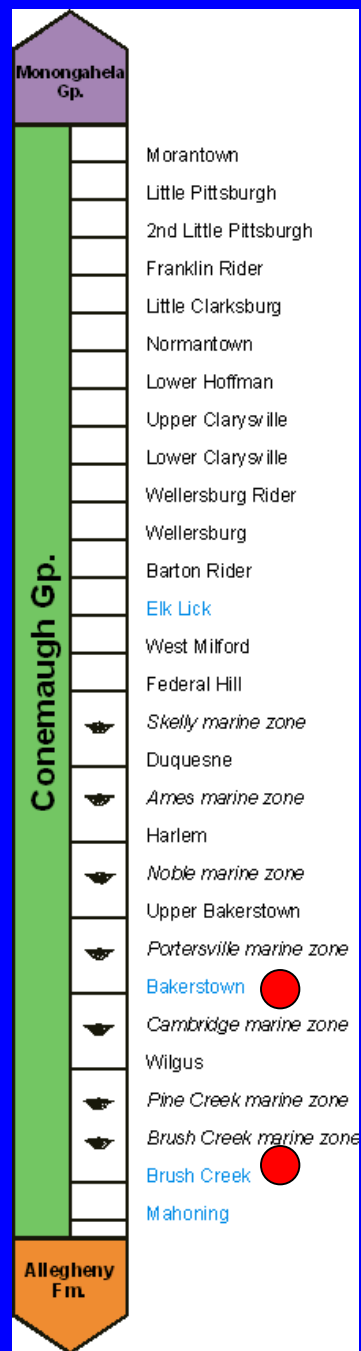
Many Pittsburgh coal gob wells

Sewickly
Redstone
Pittsburgh

Northern WV coal seams

- Coal completed for gas production

Seam with coverages on WVGES website, www.wvgs.wvnet.edu



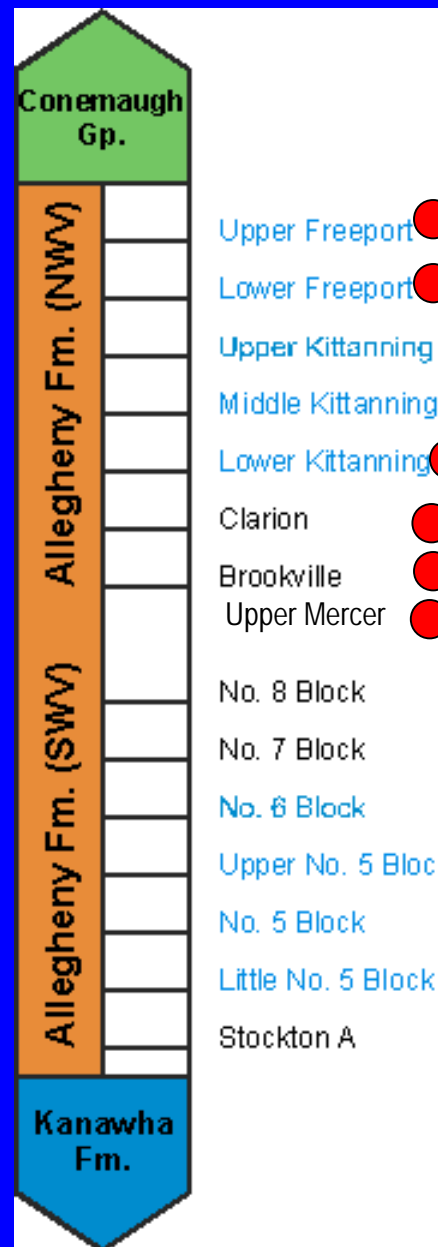
Bakerstown

Brush Creek

Northern WV coal seams

- Coal completed for gas production

Seam with coverages on WVGES website, www.wvgs.wvnet.edu






Upper Freeport

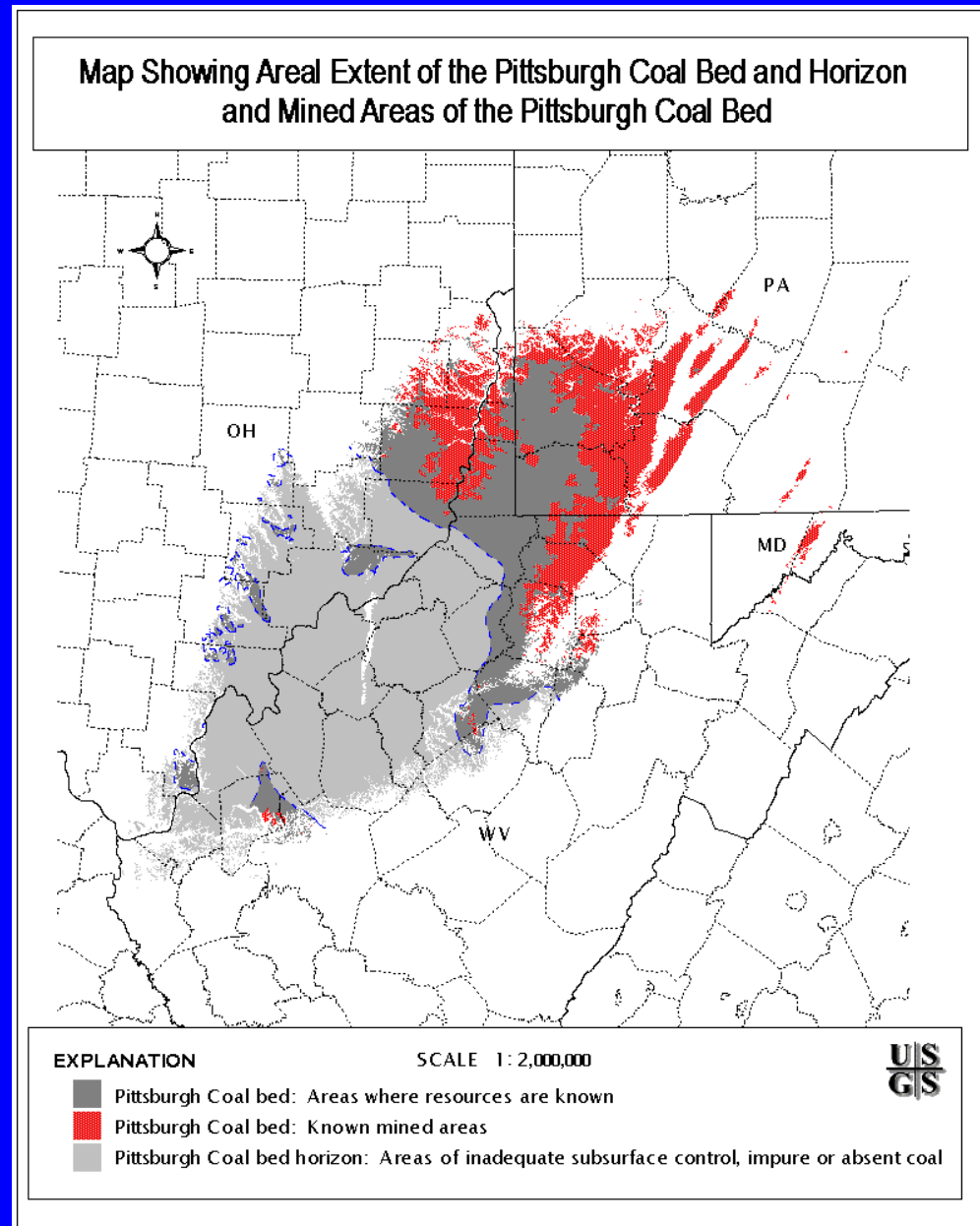
Lower Freeport

Lower Kittanning
Clarion

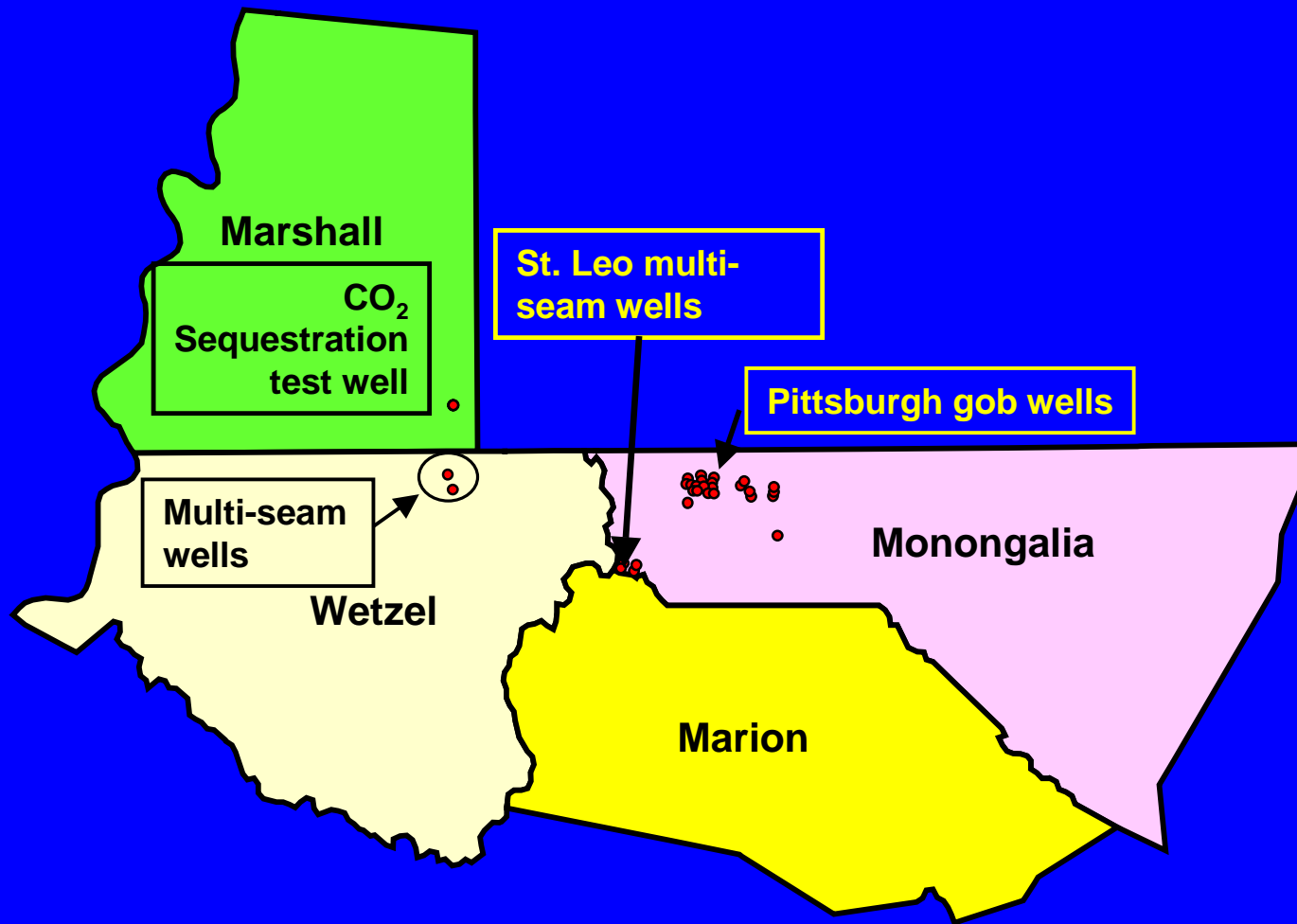
Brookville
Upper Mercer

Extent of Mining, Pittsburgh coal, USGS

-  Mined area
-  Known resource area
-  Inadequate data, impure coal or absent coal



<http://energy.er.usgs.gov/products/openfile/of96-280/pittcoal.gif>



Recent CBM wells in northern WV

CBM wells and relationship to mining

- CBM well
- Permitted CBM well

Lateral Pittsburgh wells

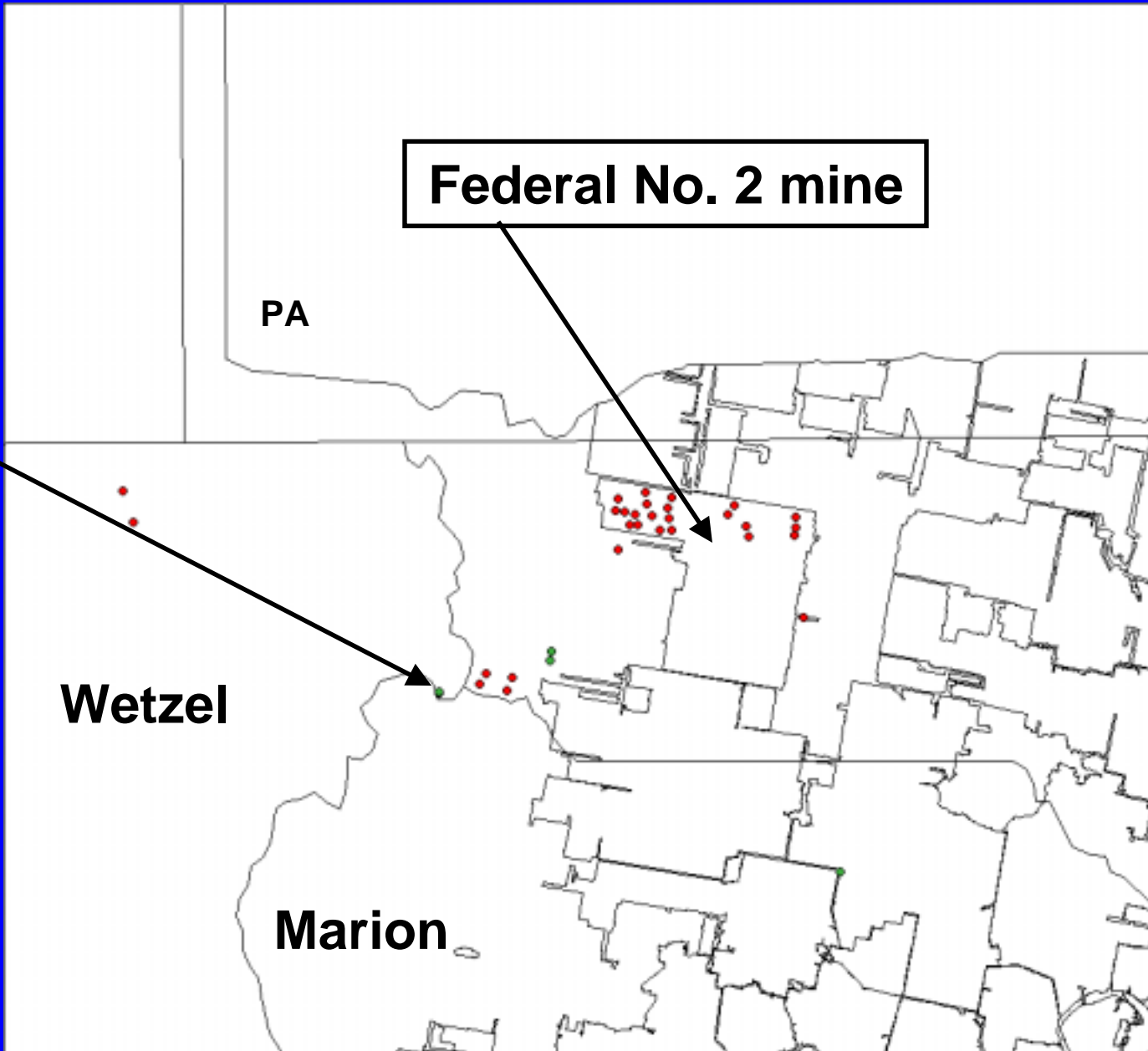
Federal No. 2 mine

PA

Wetzel

Marion

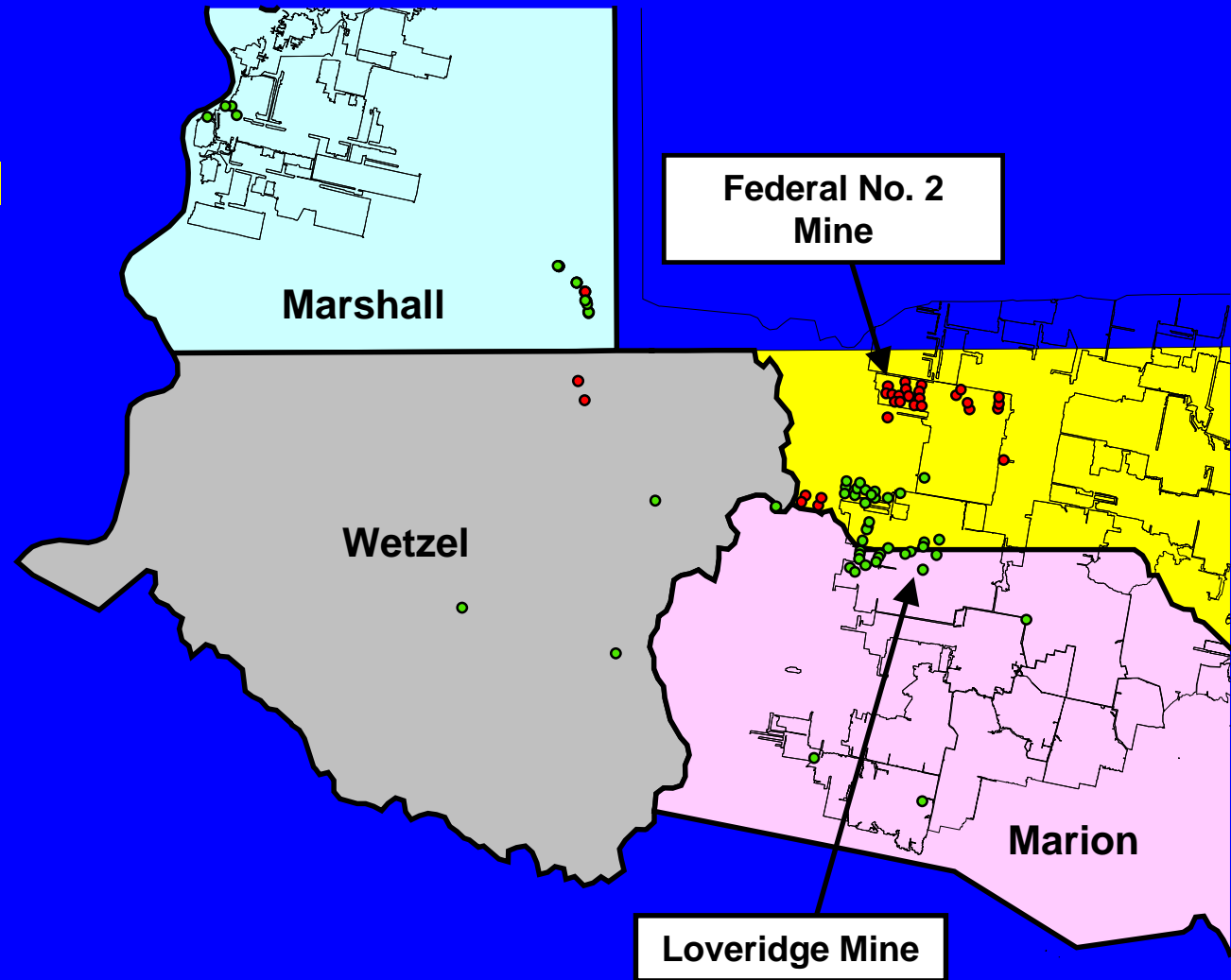
Mining data from WVGES Coal Bed Mapping Project



CBM wells and relationship to Pittsburgh coal mining

- CBM well
- Permitted CBM well

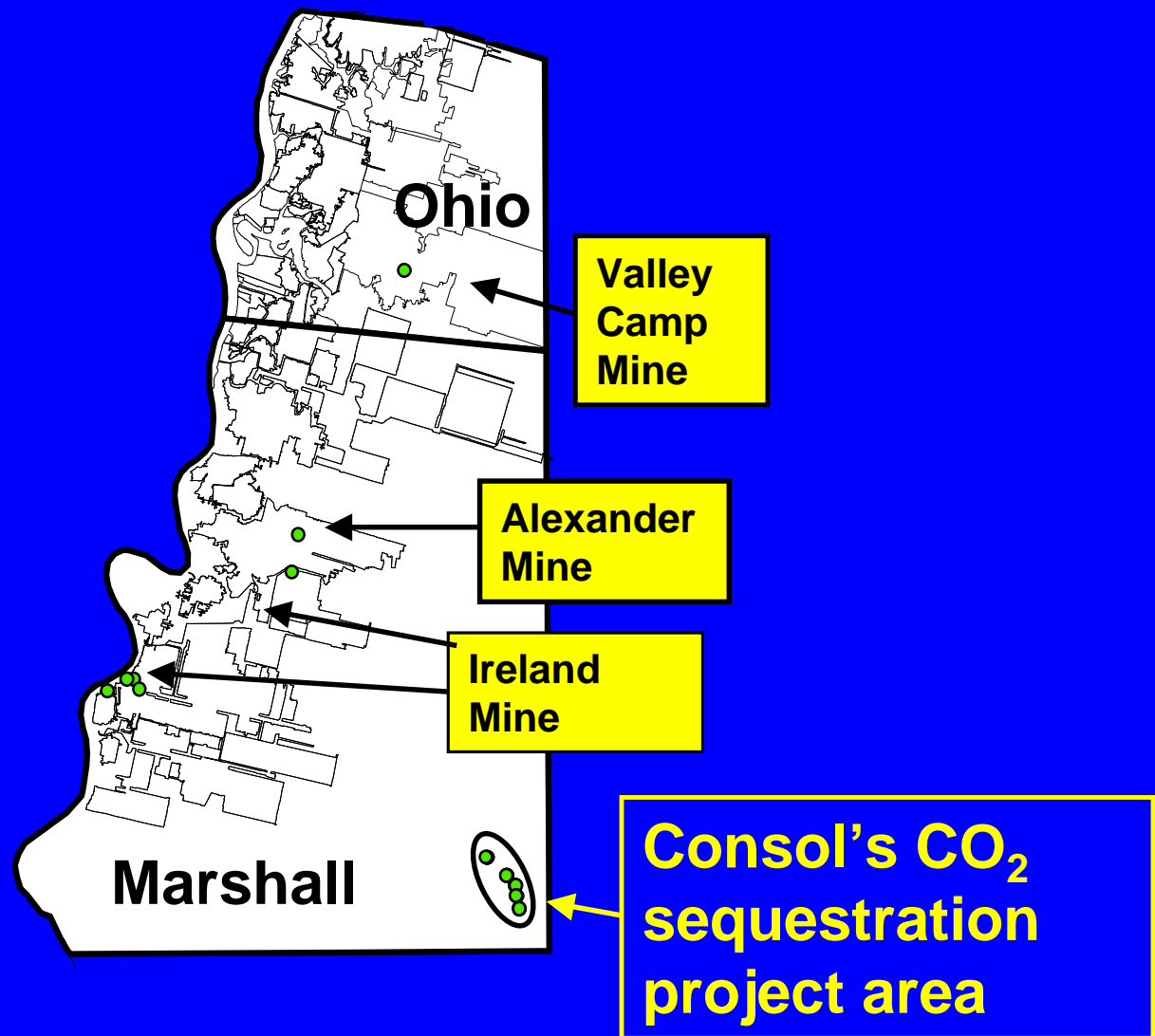
Mining data from WVGES Coal Bed Mapping Project



Recently Permitted CBM Wells in the northern panhandle

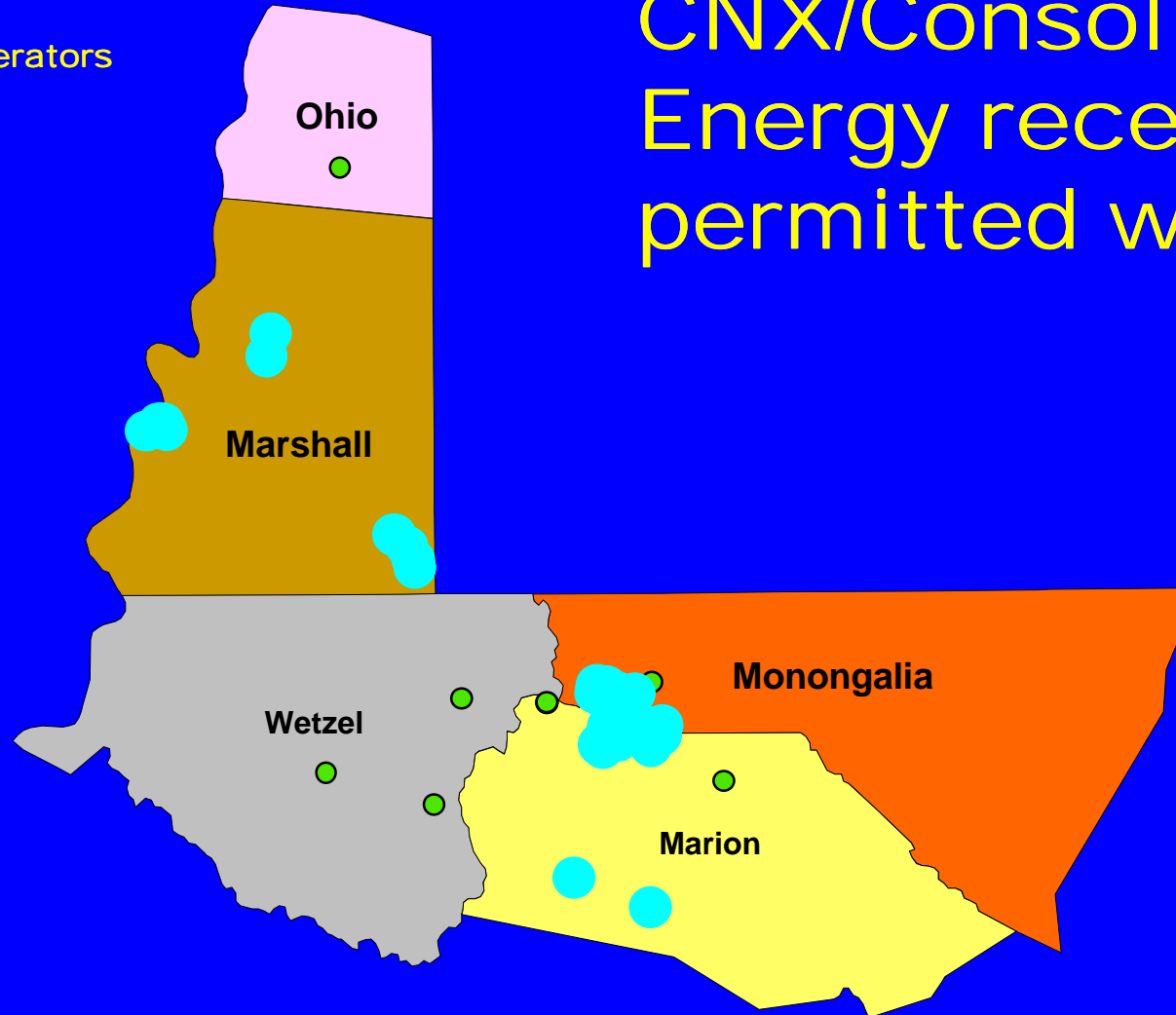
● Permitted CBM well

Pittsburgh coal
mining data from
WVGES Coal Bed
Mapping Program

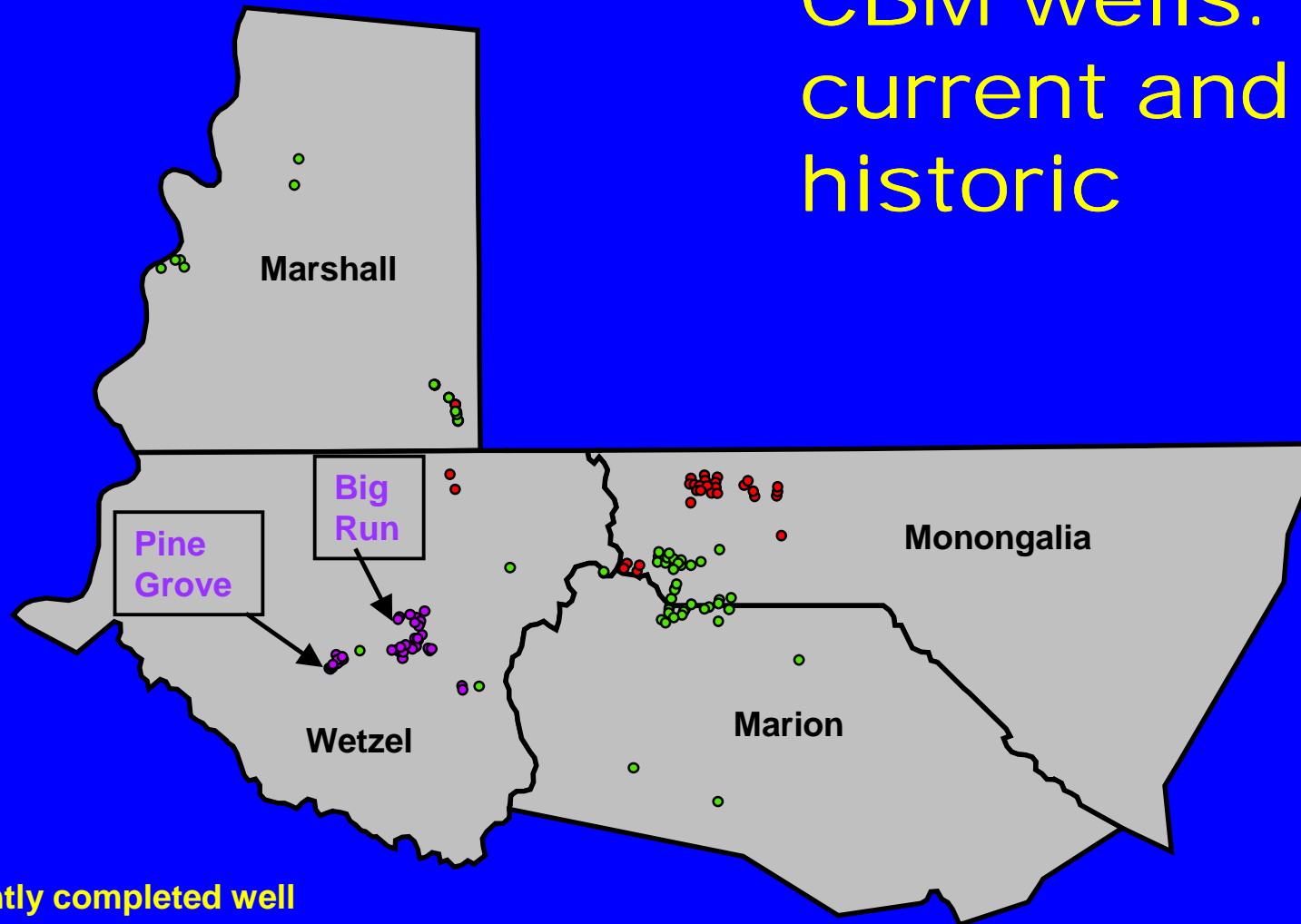


- CNX/Consol Energy well
- Well of other operators

CNX/Consol Energy recently permitted wells



Northern WV CBM wells: current and historic

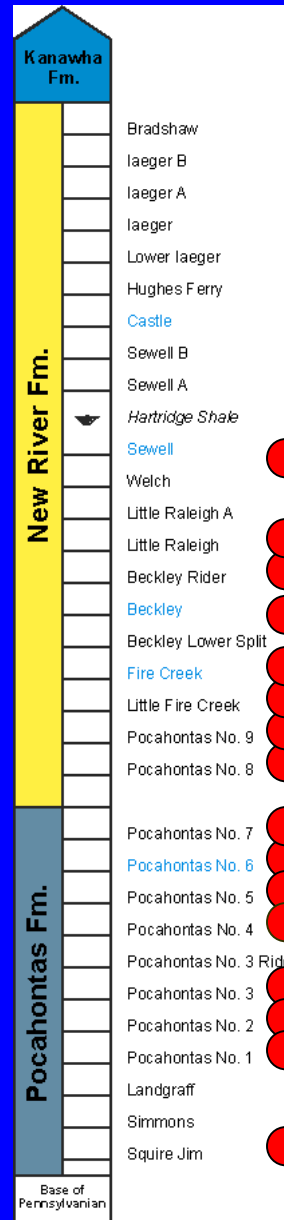


- recently completed well
- recently permitted well
- historic well; Pittsburgh coal

Southern WV coal seams

- Coal completed for gas production

Seam with coverages on WVGES website, www.wvgs.wvnet.edu



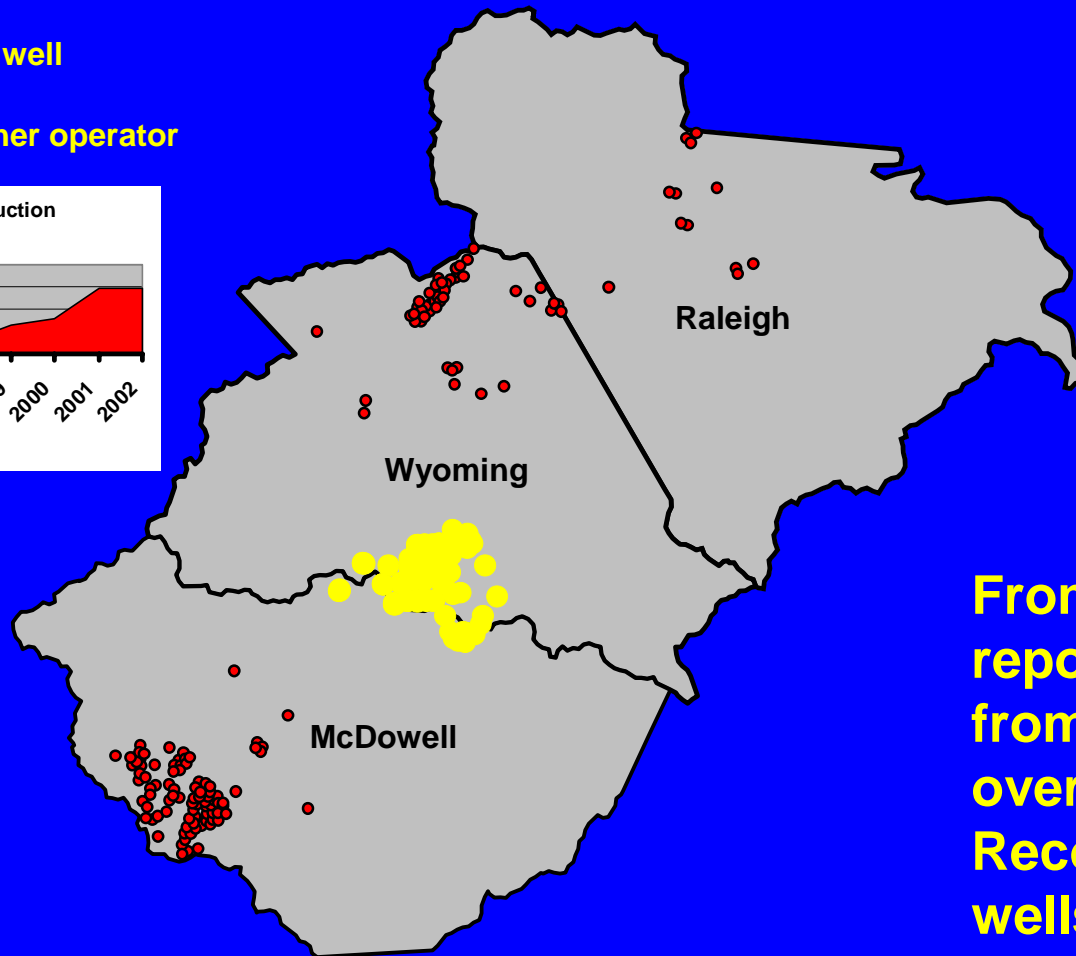
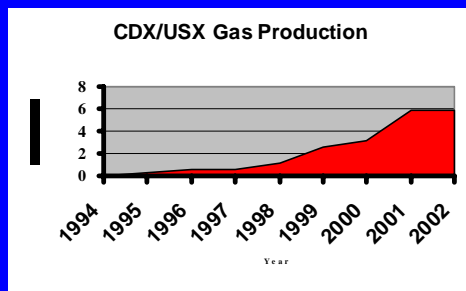
- Sewell
- Little Raleigh
- Beckley Rider
- Beckley
- Fire Creek
- Little Fire Creek
- Poca 9
- Poca 8
- Poca 7
- Poca 6
- Poca 5
- Poca 4
- Poca 3
- Poca 2
- Poca 1
- Squire Jim

← Poca 3- most wells

Multiple seams in New River and Pocahontas completed; interbedded sandstones also sometimes completed

CDX/USX Wells-Pocahontas 3 coal Pinnacle Mine Project

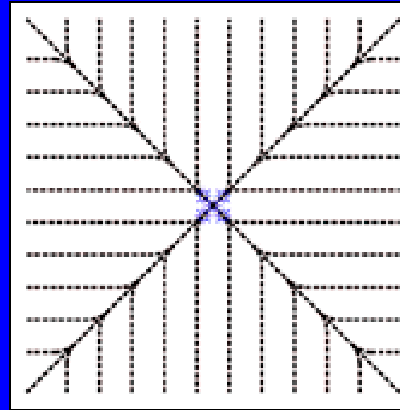
- CDX/USX well
- well of other operator



From 1994 to 2002, reported production from this project is over 20 Bcf of gas. Records for 119 wells have been received.

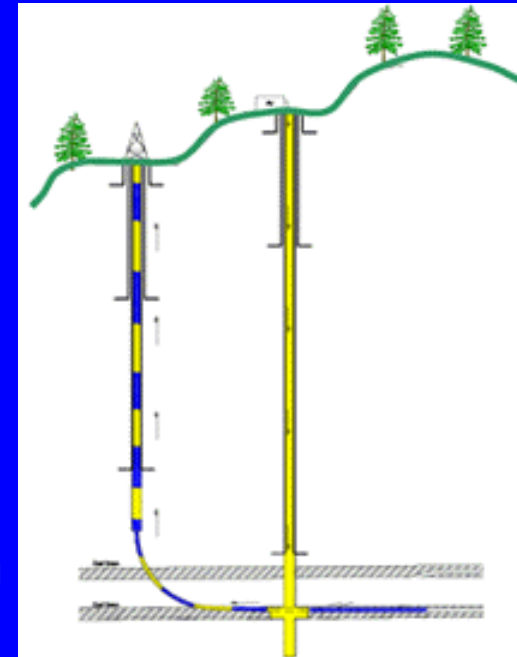
CDX Z-Pinnate™ Horizontal Drilling and Completion System.

Plan View



Pinnate Pattern

Cross-sectional View



CDX's Dual Well System

3-D View

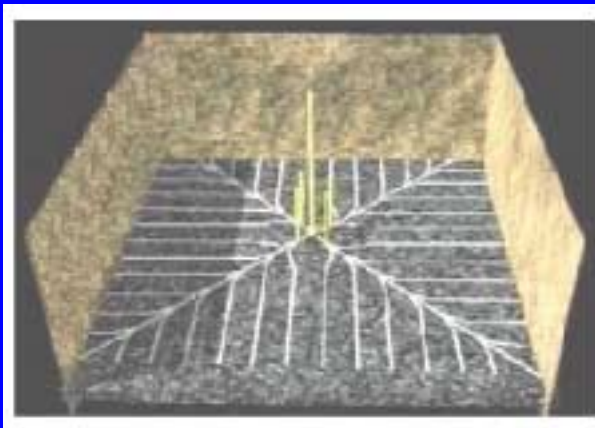
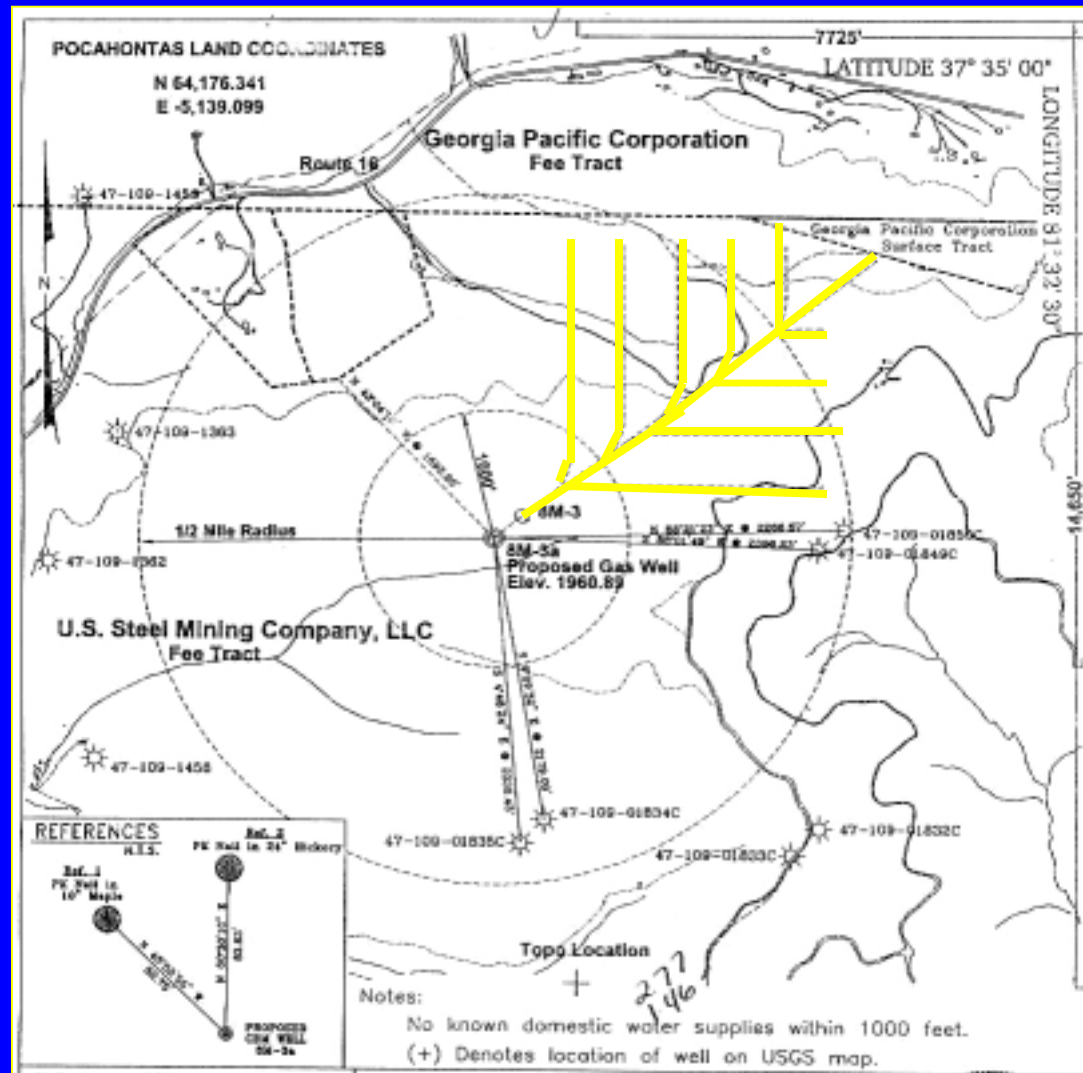


Illustration from EPA Coalbed
Methane Extra, July 2003

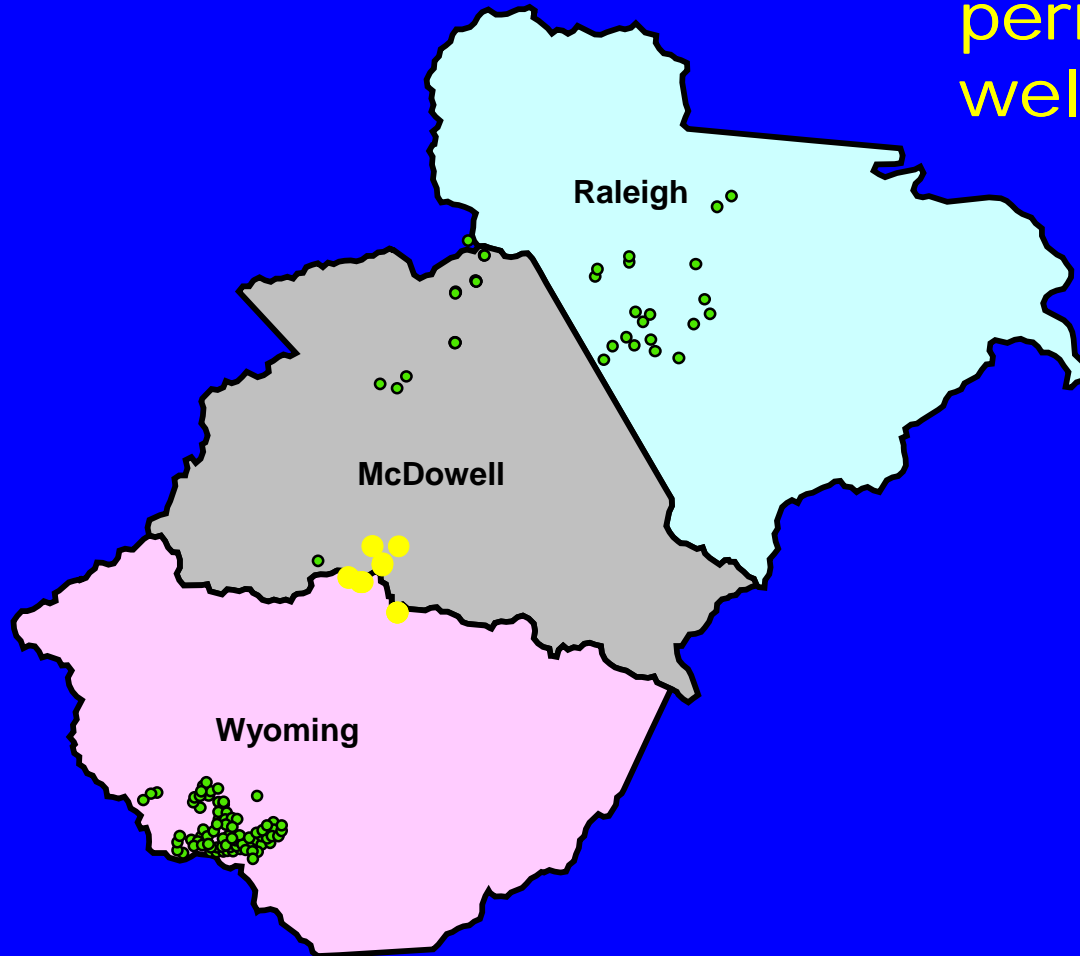
Illustrations From:
<http://www.cdxgas.com/solution.html>

CDX Gas, LLC Multi-Lateral Well



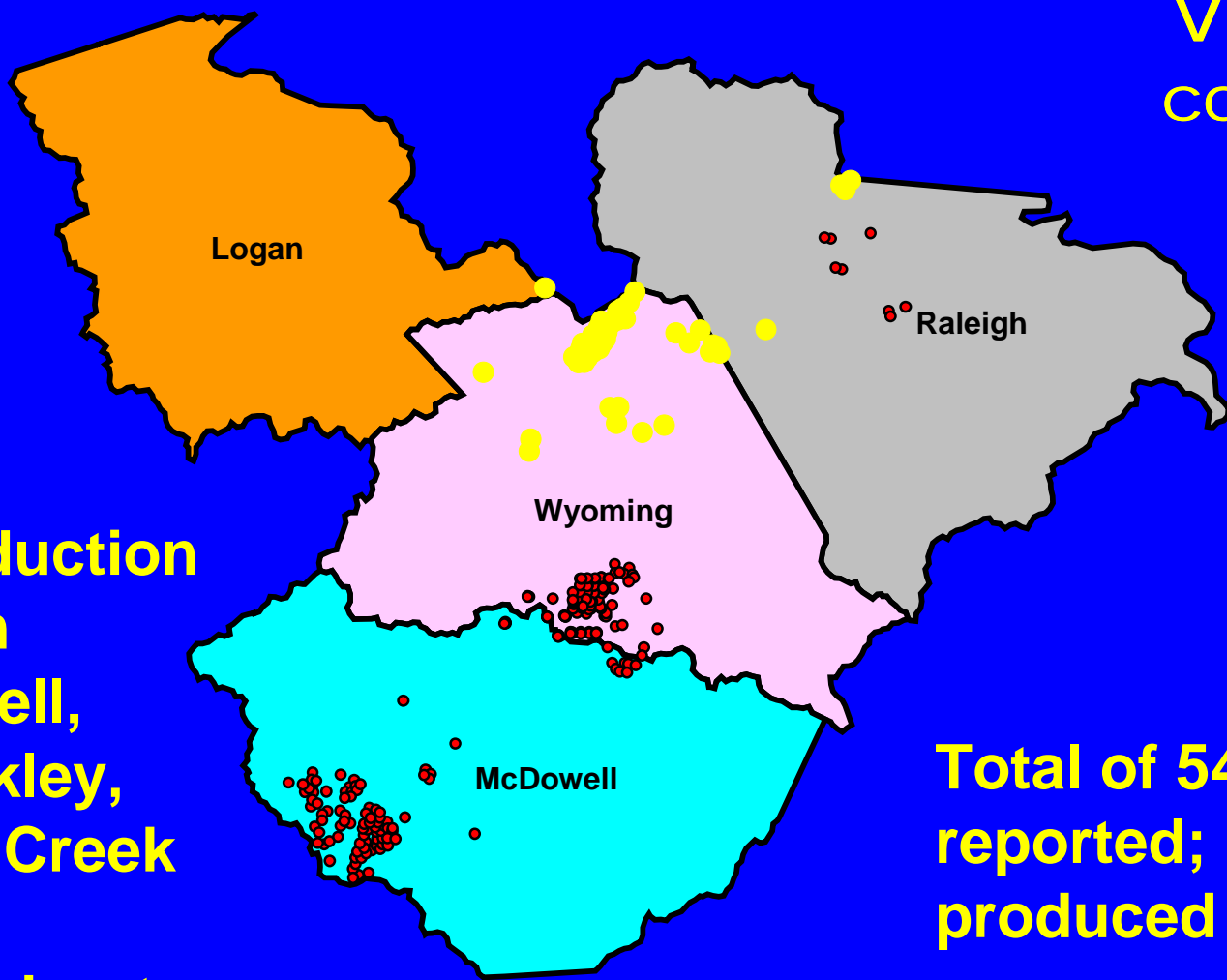
CDX Gas recently permitted wells

- CDX well
- Well of other operators



- Penn Virginia well
- well of other operators

Penn Virginia completed wells

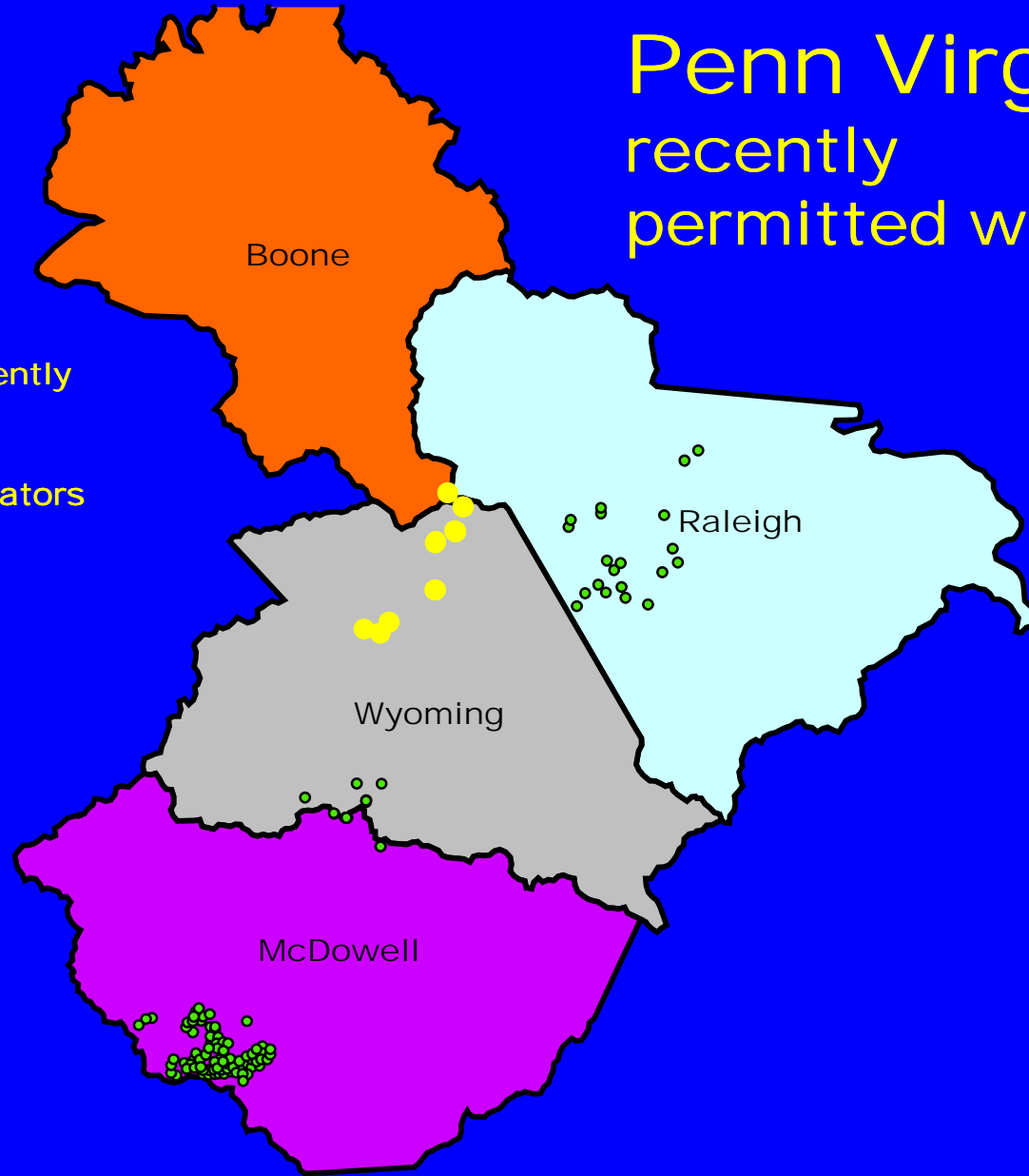


Production from Sewell, Beckley, Fire Creek and Pocahontas coals

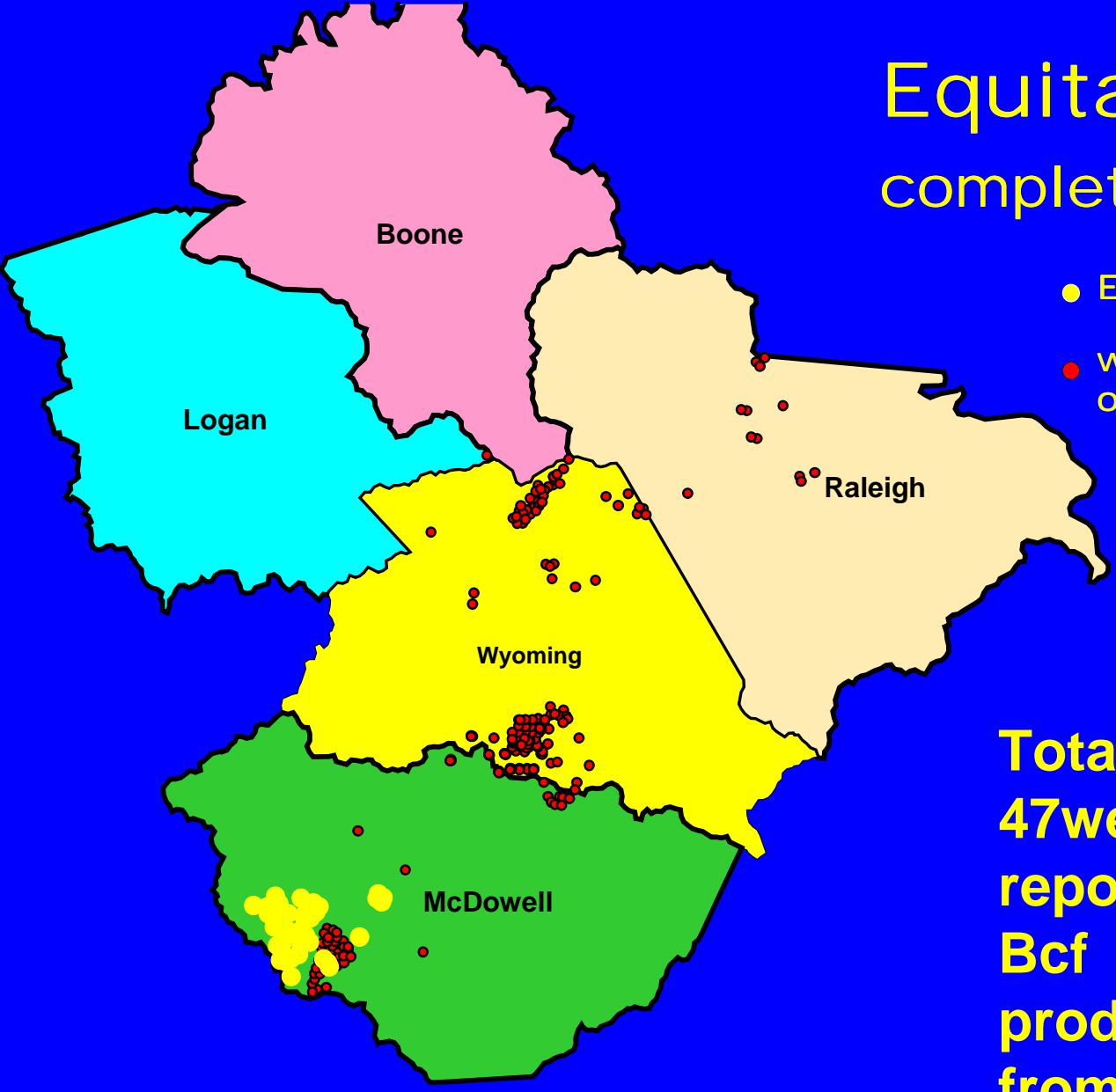
Total of 54 wells reported; 1.9 Bcf gas produced 1997-2002.

Penn Virginia recently permitted wells

- Penn Virginia recently permitted well
- Well of other operators



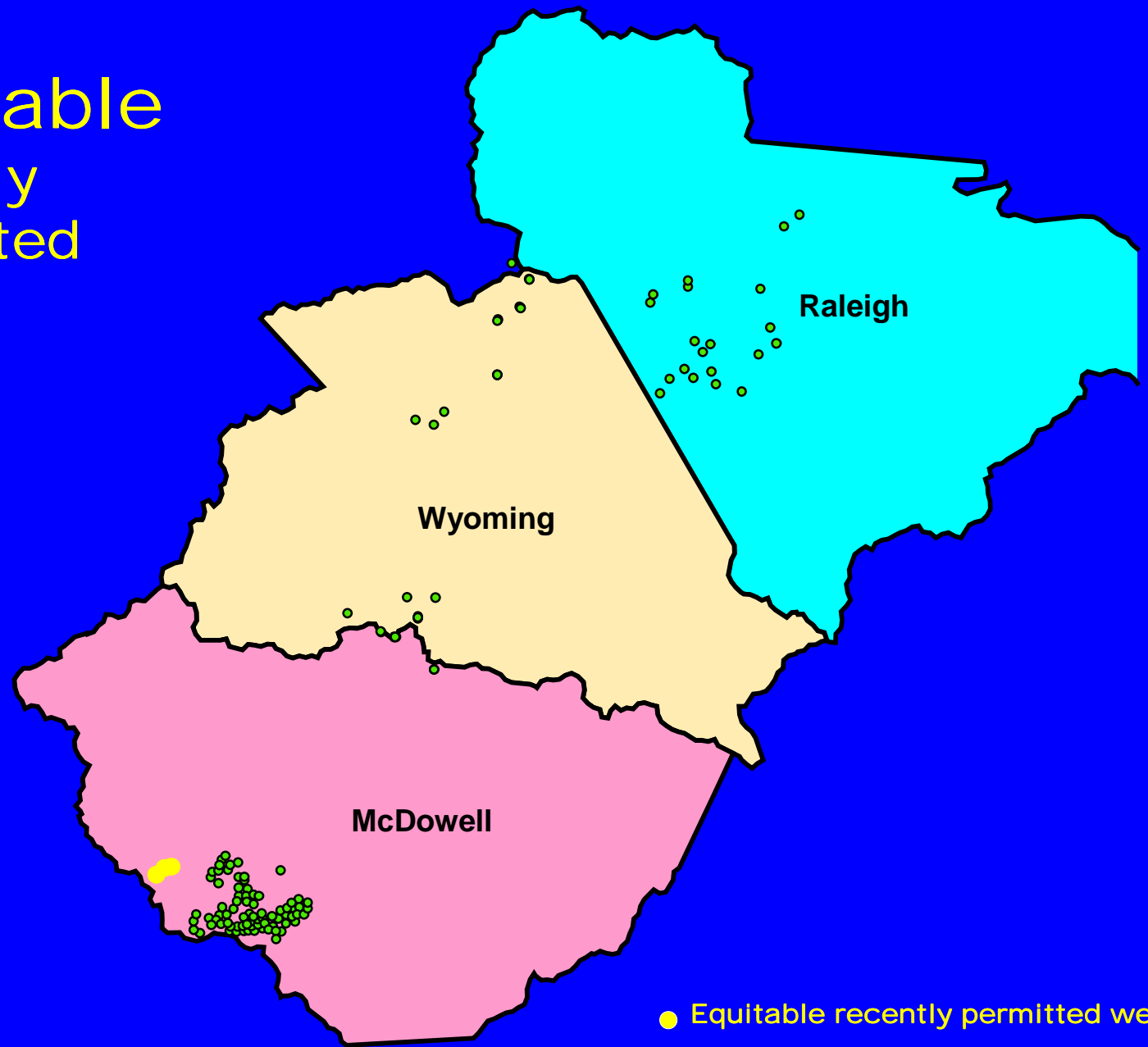
Equitable completed wells



- Equitable well
- well of other operators

**Total of
47wells
reported; 2.3
Bcf gas
produced
from 1997 –
2002.**

Equitable recently permitted wells

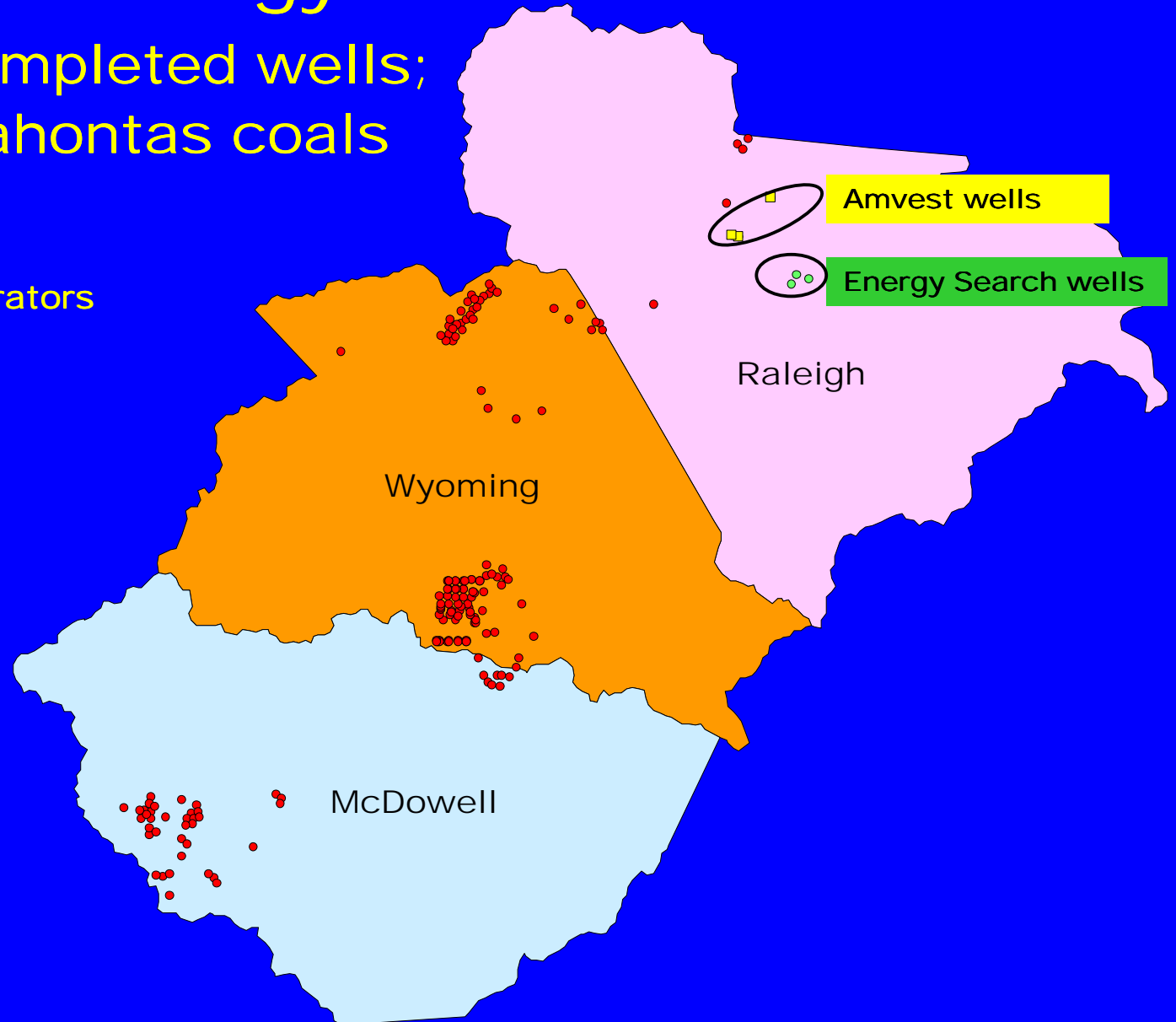


● Equitable recently permitted well

● Well of other operators

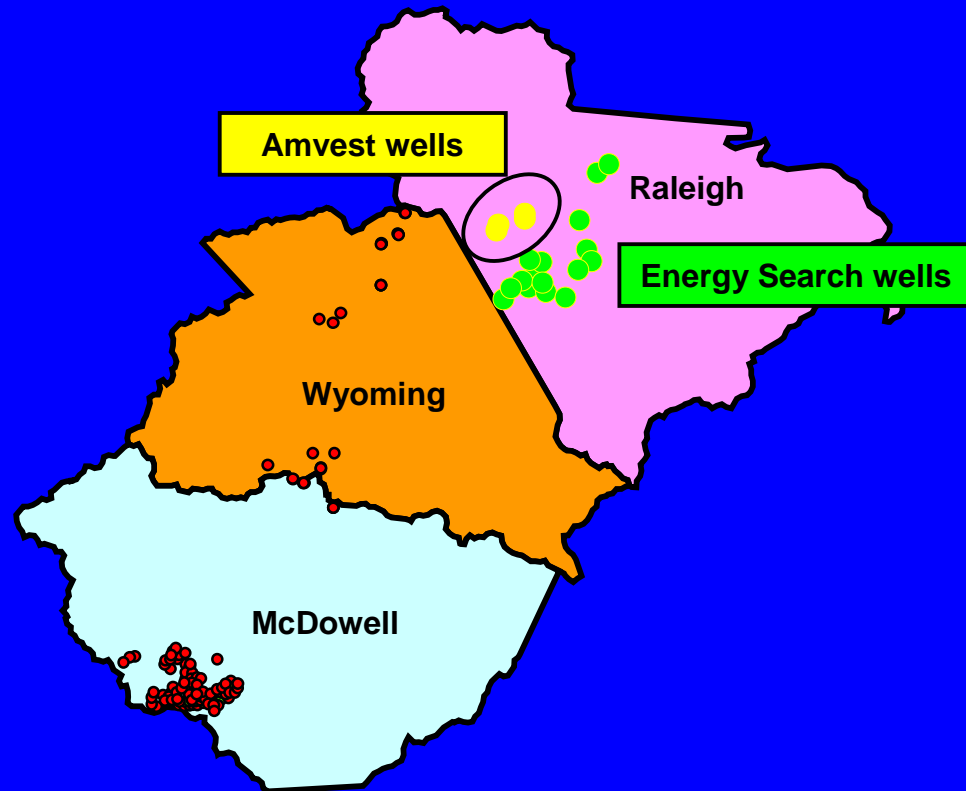
Amvest and Energy Search completed wells; 3 each; Pocahontas coals

● well of other operators

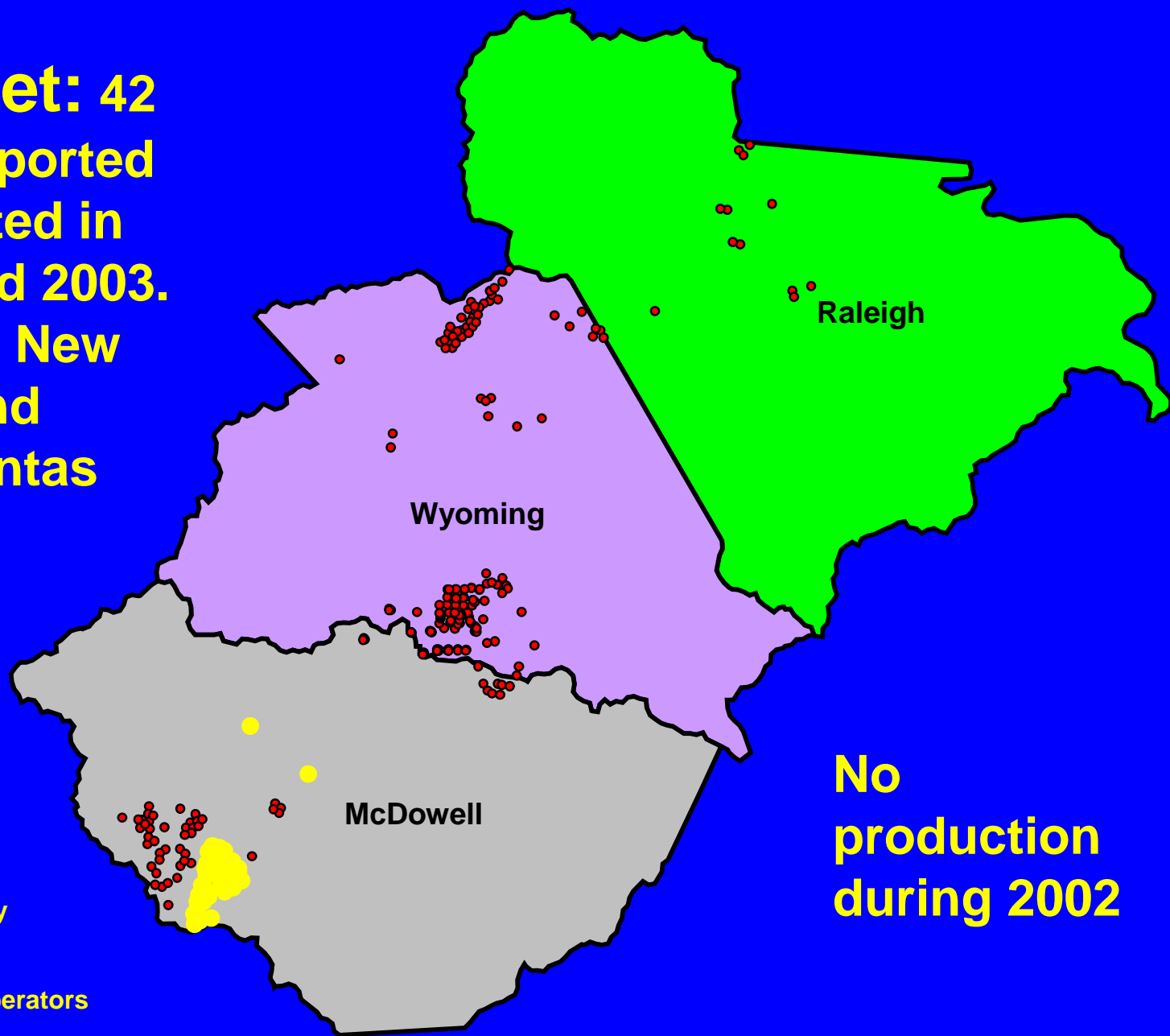


Amvest and Energy Search recently permitted wells

● Well of other operator



Geomet: 42 wells reported completed in 2002 and 2003. Multiple New River and Pocahontas seams

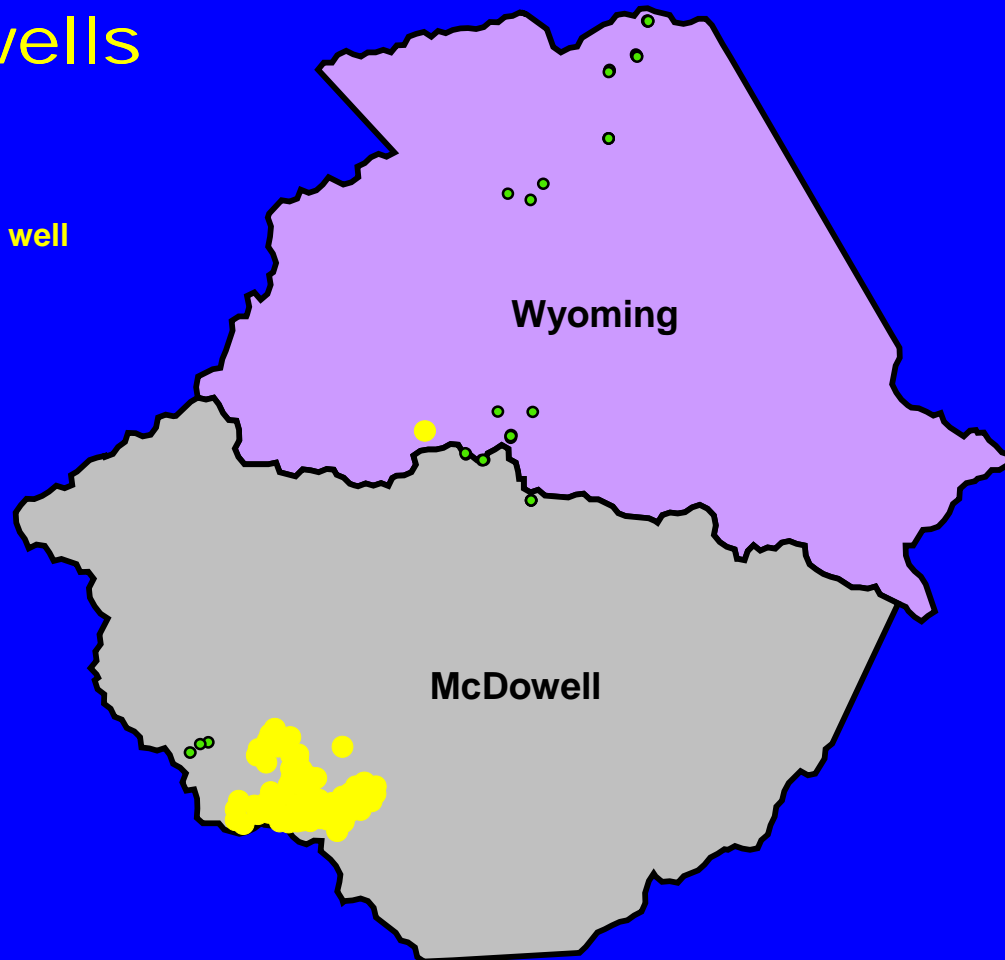


No production during 2002

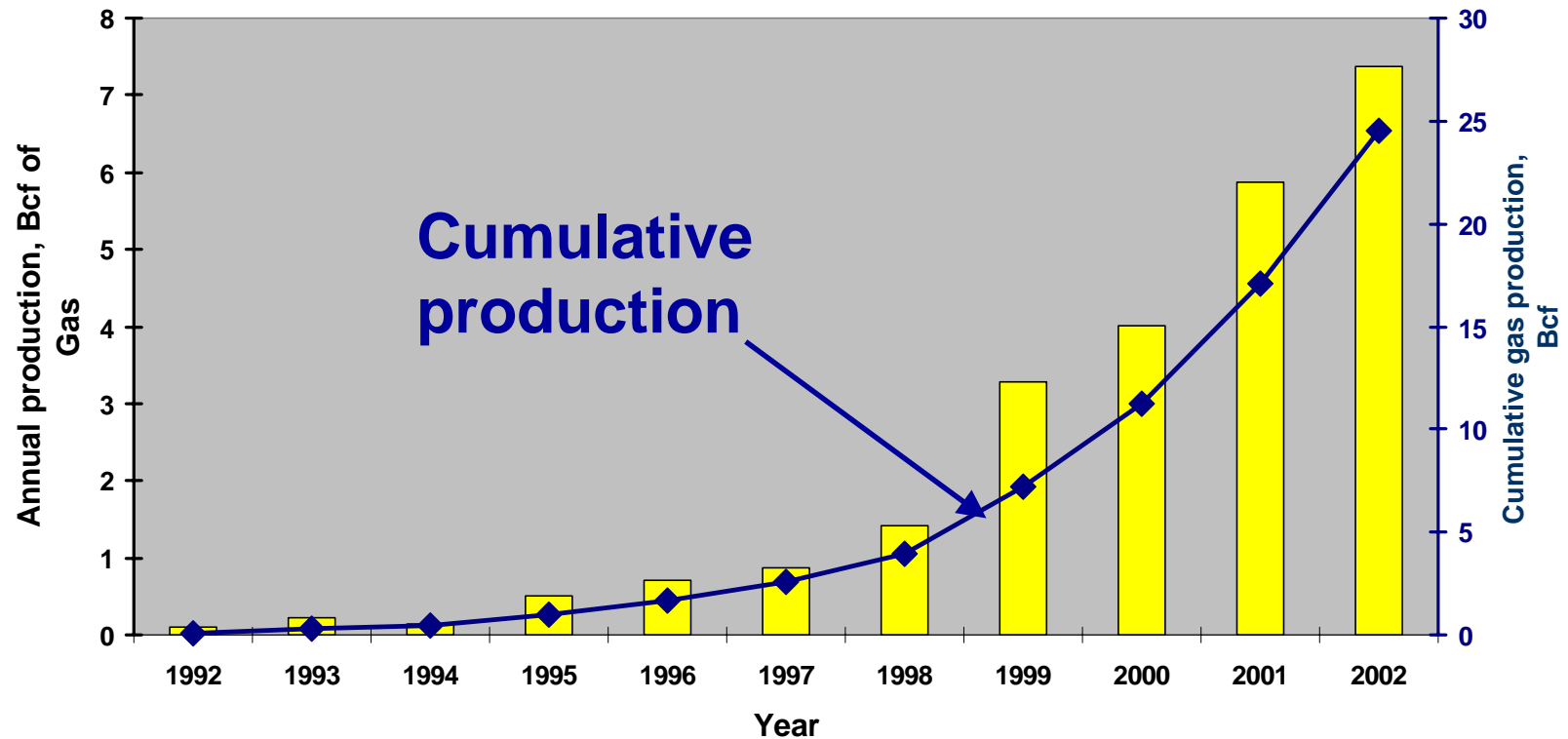
- Geomet recently completed well
- Well of other operators

Geomet recently permitted wells

- Geomet recently permitted well
- Well of other operator



West Virginia CBM Gas Production



Annual and Cumulative CBM production for WV; total 24.5 Bcf of gas

The Future

- Coals may have potential for carbon dioxide sequestration
- Consol, Inc. recently received a US DOE award to demonstrate a coal bed methane production technology known as "slant-hole" drilling to drain natural gas from unmineable coal seams, then use the gas production holes for sequestering CO₂.
- See <http://www.netl.doe.gov/> for more information.

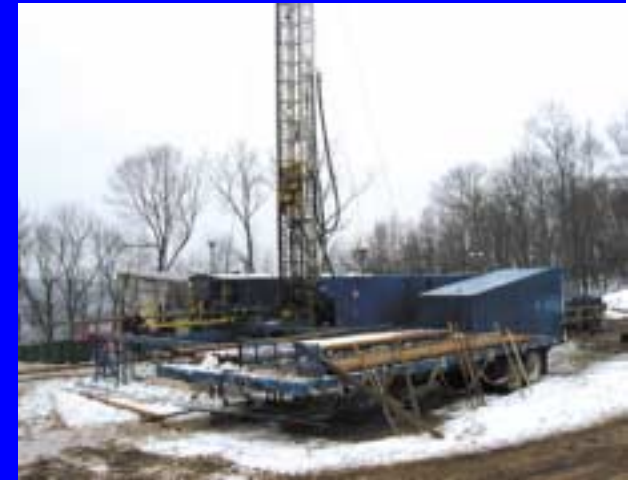


Photo from *Geotimes*, March, 2003, p. 24

The Future, other issues

- Pipeline capacity especially in southern WV and other transportation issues
- Production issues including water disposal
- Legal issues

CBM well data for WV

- <http://www.wvgs.wvnet.edu/www/datastat/datastat.htm>
- Downloadable data files in Excel and ASCII text format
- Downloadable .shp file for use with ESRI products