# [PS]An Overview of the MRCSP Petroleum Fields 2019 Database Release*

**J. Eric Lewis[1], Kristin Carter[2], Phillip Dinterman[1], Thomas Sparks[3], William Harrison[4], Cristian Medina[5], Jessica Moore[1], Richard Ott[6], Brian Slater[7], and Michael Solis[8]**

Search and Discovery Article #80686 (2019)**
Posted July 1, 2019

*Adapted from poster presentation given at 2019 AAPG Annual Convention and Exhibition, San Antonio, Texas, May 19-22, 2019
 DOI:10.1306/80686Lewis2019

[1]West Virginia Geological and Economic Survey, Morgantown, West Virginia (elewis@geosrv.wvnet.edu)
[2]Pennsylvania Geological Survey, Middletown, Pennsylvania
[3]Western Michigan University, Kalamazoo, Michigan
[4]Indiana Geological and Water Survey, Bloomington, Indiana
[5]Maryland Geological Survey, Baltimore, Maryland
[6]New York State Museum, Albany, New York
[7]Ohio Department of Natural Resources, Columbus, Ohio
[8]Kentucky Geological Survey, Lexington, Kentucky

## Abstract

For nearly 20 years, the Midwest Regional Carbon Sequestration Partnership (MRCSP) has collected geologic reservoir data throughout the Appalachian and Michigan basins to analyze and optimize the potential for $CO_2$ storage. This process includes a new emphasis on EOR using $CO_2$, and the subsequent addition of attributes such as oil gravity and minimum miscibility pressure. To date, this massive compilation contains more than 4,000 petroleum fields that are described by 18,863 rows of reservoir characteristics. Multiple resources were used for data accumulation, quality control, and geospatial updates to fields across the region. These resources included the Tertiary Oil Recovery Information System (TORIS), historical oil and gas records, previously published information, and statistical analysis. The resulting work will enable stakeholders from various backgrounds to evaluate opportunities on a regional, and/or field-specific, basis.

# An Overview of the MRCSP Petroleum Fields 2019 Database

Authors: J. Eric Lewis[1], Kristin Carter[2], Philip Dinterman[1], William Harrison[3], Cristian Medina[4], Jessica Moore[1], Richard Ortt[5], Brian Slater[6], Michael Solis[7], Thomas Sparks[8]

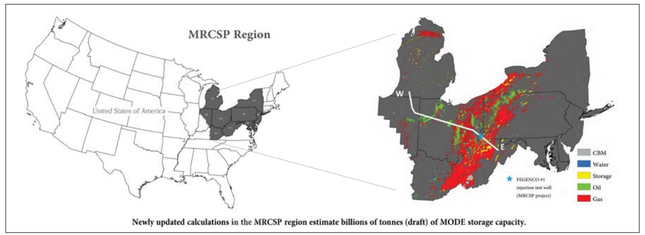
West Virginia Geological and Economic Survey[1], Pennsylvania Geological Survey[2], Western Michigan University[3], Indiana Geological and Water Survey[4], Maryland Geological Survey[5] New York State Museum[6], Ohio Department of Natural Resources[7], Kentucky Geological Survey[8]

DOE-NETL Cooperative Agreement DE-FC26-05NT42589

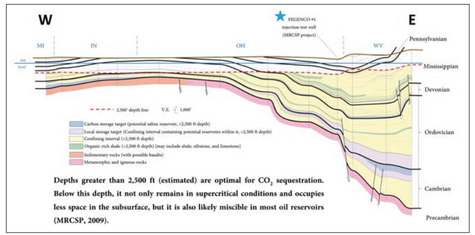
AAPG ACE 2019 ANNUAL CONVENTION & EXHIBITION — 19-22 May - San Antonio, Texas

## Abstract

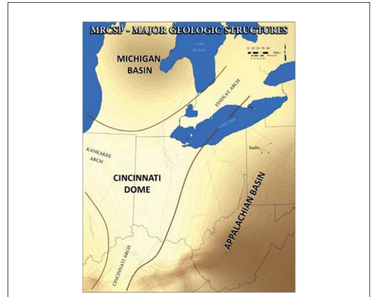
**For nearly 20 years, the Midwest Regional Carbon Sequestration Partnership (MRCSP) has collected geologic reservoir data throughout the Appalachian and Michigan basins to analyze and optimize the potential for carbon dioxide ($CO_2$) storage. This process includes a new emphasis on enhanced oil recovery (EOR) using $CO_2$, and the subsequent addition of attributes such as oil gravity and minimum miscibility pressure. To date, this massive compilation contains more than 4,000 petroleum fields. Multiple resources were used for data accumulation, quality control, and geospatial updates to fields across the region. These resources included the Tertiary Oil Recovery Information System (TORIS), historical oil and gas records, previously published information, and statistical analysis. The resulting work will enable stakeholders from various backgrounds to evaluate opportunities on a regional, and/or field-specific, basis.**



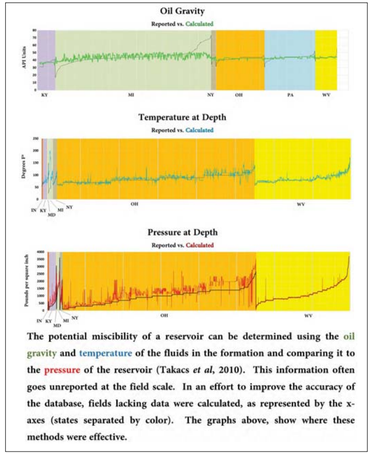

Newly updated calculations in the MRCSP region estimate billions of tonnes (draft) of MODE storage capacity.



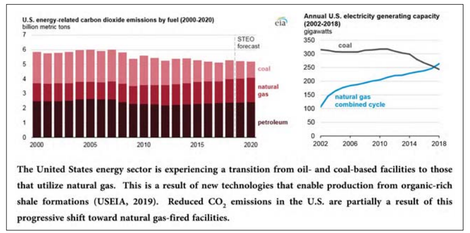

Depths greater than 2,500 ft (estimated) are optimal for $CO_2$ sequestration. Below this depth, it not only remains in supercritical conditions and occupies less space in the subsurface, but it is also likely miscible in most oil reservoirs (MRCSP, 2009).




The MRCSP region consists of two major basins separated by the Cincinnati Dome, which is centered along the border of Indiana and Ohio (MRCSP, 2005).



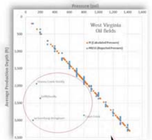

The potential miscibility of a reservoir can be determined using the oil gravity and temperature of the fluids in the formation and comparing it to the pressure of the reservoir (Takacs *et al*, 2010). This information often goes unreported at the field scale. In an effort to improve the accuracy of the database, fields lacking data were calculated, as represented by the x-axes (states separated by color). The graphs above, show where these methods were effective.

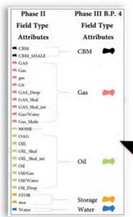



The United States energy sector is experiencing a transition from oil- and coal-based facilities to those that utilize natural gas. This is a result of new technologies that enable production from organic-rich shale formations (USEIA, 2019). Reduced $CO_2$ emissions in the U.S. are partially a result of this progressive shift toward natural gas-fired facilities.

## Highlights

The MRCSP Petroleum Fields dataset will consist of a geodatabase and an accompanying Excel ™ file which will be available at https://www.mrcsp.org/.



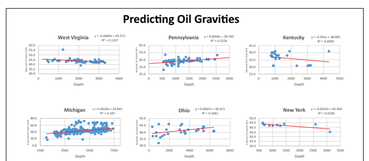



- Newly updated storage capacities have been calculated to represent three scenarios, including a minimum, most likely, and maximum value, represented by storeMIN, storeMODE, and storeMAX, respectively (Goodman *et al*, 2011).
- More than 18,000 rows of data with 44 columns of attributes.
- Hundreds of millions of tonnes (draft) of MODE storage capacity in 2,595 oil fields.
- Billions of tonnes (draft) of MODE storage capacity in all petroleum fields deeper than 2,500 ft (the depth at which $CO_2$ remains supercritical).
- Quality control measures
- Streamlining of data
- Newly introduced attributes include:
  - oil volumetrics (OOIP, ROIP, etc.)
  - oil gravity
  - Fluid saturation
  - Pressure data (including minimum miscibility pressure)
  - permeability
  - salinity
- Newly defined fields in WV, including Majorsville (storage) and 14 coalbed methane fields
- PA has introduced field analysis at the "pool" level, in addition to updating oil field data
- Formulaic and statistical analysis to increase data density
- Consolidation of oil fields (previous editions of the database featured 1 row of data, for each polygon, except for WV. The 2019 database follows WV model, focusing on merging oil polygons with identical attributes. This helps with quality control / mapping efficiency.)

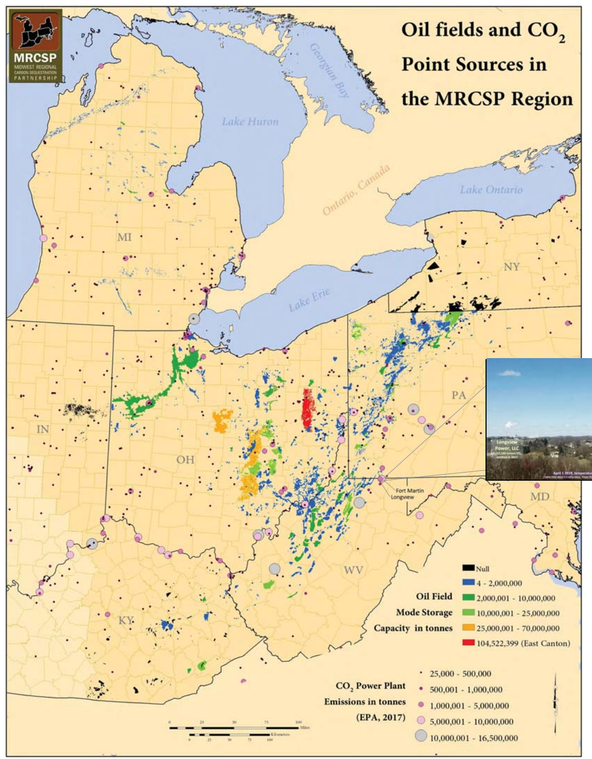
**Storage Capacity = A x h x Φ x (1-Sw) x ρ x Ef/2200**

Where: A = field area (ft²), h = field thickness (ft), Φ = field porosity, Sw = connate water saturation, ρ = CO2 density (lb/ft³), 2200 = conversion factor, Ef = storage efficiency factor

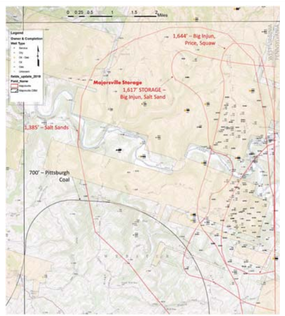
| Region | State | EOR Efficiency Factor (Ef) | | |
|---|---|---|---|---|
| | | Min. | Mode | Max. |
| Appalachian Basin | OH, IL, KY, PA, WV, NY | 0.177 | 0.296 | 0.539 |
| Michigan/Illinois Basin | MI, IN, WI, KY | 0.372 | 0.557 | 0.68 |



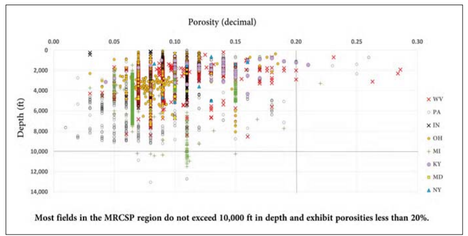

Reported oil gravity values were analyzed as a function of depth. Lighter values may imply migration to shallower depths (Hohn, 2017, personal communication). The lack of recorded data is responsible for the low coefficients of determination ($R^2$); therefore, calculated data should be scrutinized.




The MRCSP Petroleum Fields 2019 Database is designed to be a quick, user-friendly, tool used to examine cost-saving opportunities for energy producers in the eastern U.S.




The MRCSP fields file has already been used to efficiently respond to several inquiries at the regional level. This custom map was used to help identify petroleum wells in WV that intersect mining paths of the Pennsylvanian-aged Pittsburgh coal seam (wells and coal seams are separate file source – WVGES, 2019). The fields help to simplify the complex well dataset from WVGES and give an effective overview of what formations are targeted in the area of concern. Updated MRCSP fields data on this map include the Majorsville storage field and a portion of one of the newly added CBM fields in WV.




Most fields in the MRCSP region do not exceed 10,000 ft in depth and exhibit porosities less than 20%.

## Discussion

One of the objectives of the MRCSP Petroleum Fields 2019 Database is to focus attention on $CO_2$ sequestration and utilization potential in the region. Much effort has been taken to make this an efficient and effective tool for quickly analyzing a small region's subsurface with respect to its future energy contributions around the globe.

Utilization of $CO_2$ floods for EOR is a developing technology in the eastern U.S. While it may still be too early to predict its contribution to America's future energy balance, many opportunities for implementation exist within the region. A comprehensive assemblage and evaluation of petroleum data by the MRCSP Geo-Teams will enable stakeholders from diverse backgrounds to evaluate these opportunities on a regional, and/or field-specific basis.

A renewed focus on $CO_2$-EOR also helps to identify information severely lacking in the MRCSP region, such as permeability and oil gravity. Where possible, steps have been taken to increase data density and enable reservoir characterization.

## References


- Goodman, A., A. Hakala, G. Bromhal, D. Deel, T. Rodosta, S. Frailey, M. Small, D. Allen,V. Romanov, J. Fazio, N. Huerta, D. McIntyre, B. Kutchko, and G. Guthrie. 2011. U.S. DOE methodology for the development of geologic storage potential for carbon dioxide at the national and regional-scale. Int. J. Greenh. Gas Con., vol. 5, pp. 952–965.
- Environmental Protection Agency (EPA), 2017, Summary data collected by the Greenhouse Gas Reporting Program for 2017. https://www.epa.gov/ghgreporting/ghg-reporting-program-data-sets This data was reported to EPA by facilities as of 08/19/2018. All emissions data is presented in units of metric tons of carbon dioxide equivalent using GWP's from IPCC's AR4, website accessed 5/14/2019.
- Midwest Regional Carbon Sequestration Partnership (MRCSP), 2005, Characterization of Geologic Sequestration Opportunities in the MRCSP Region – Phase I Task Report, Open-File Report prepared by Ohio Division of Geological Survey under subcontract to Battelle Memorial Institute, DOE Cooperative Agreement No. DE-PS26-05NT42235, 152 p.
- Midwest Regional Carbon Sequestration Partnership (MRCSP), 2009, Evaluation of CO2-Enhanced Oil Recovery and Sequestration Opportunities in Oil and Gas Fields in the MRCSP Region, Phase II Task Report, DOE Cooperative Agreement No. DE-FC26-05NT42589, OCDO Grant Agreement No. DC-05-13, 177 p.
- Petroleum Technology Transfer Council (PTTC), 2005, Tertiary Oil Recovery Information System (TORIS) database for the Appalachian Region.
- Takacs, K.G., Nuttall, B.C., Parris, T.M., 2010, Assessment of Kentucky fields for CO2-Enhance Oil Recovery, Chapter 2 "Evaluation of Geologic CO2 Sequestration Potential and CO2 Enhance Oil Recovery in Kentucky", Report of Investigations 21, Series XXII, p. 15-36.
- United States Energy Information Administration (USEIA), 2019, U.S. natural gas-fired combined-cycle capacity surpasses coal-fired capacity, https://www.eia.gov/todayinenergy/detail.php?id=39912&tm=email, accessed April 12, 2019.
- West Virginia Geological and Economic Survey (WVGES), 2019, West Virginia Mine Information Database System (MIDS), http://www.wvgs.wvnet.edu/www/coal/MIDS_Index.htm, accessed March, 10, 2019.
- West Virginia Geological and Economic Survey (WVGES), 2019, WVGES Oil and Gas Well Data for West Virginia, Digital Data Series 5, accessed March 10, 2019.