

STATEMENT OF
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BEFORE THE
COMMITTEE ON NATURAL RESOURCES
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Mr. Chairman and Members of the Committee, thank you for the opportunity to appear here today to discuss with you the U.S. Geological Survey's role in studying, understanding, and assessing continuous (unconventional) oil and gas resources in the Piceance Basin within the Uinta-Piceance Province of Colorado and Utah. My name is Walter Guidroz, and I am the Program Coordinator at the USGS' Energy Resources Program.

Introduction

Energy resources are an essential component of modern society. Adequate, reliable and affordable energy supplies obtained using environmentally sustainable practices underpin economic prosperity, environmental quality, human health and political stability. National and global demands for all forms of energy are forecast to increase significantly over the next several decades. Throughout its history, our Nation has faced important decisions regarding the competing uses of public lands, the supply of energy to sustain development and enable growth, and environmental stewardship.

Role of the U.S. Geological Survey and the Energy Resources Program

The U.S. Geological Survey (USGS) Energy Resources Program (ERP) provides information to address these challenges by conducting unbiased scientific investigations of energy resources, such as research on the geology, geochemistry and geophysics of oil, gas, coal, heavy oil and natural bitumen, oil shale, uranium and geothermal resources, emerging resources such as gas hydrates, and research on the effects associated with energy resource occurrence, production, and (or) utilization. Therefore, our goal is: (1) to understand the processes critical to the formation, accumulation, occurrence, and alteration of geologically based energy resources; and (2) to conduct scientifically robust assessments of those resources. The results from these geoscientific studies provide

impartial, robust scientific information about energy resources and support the mission of the Department of the Interior (DOI) to protect and responsibly manage the Nation's natural resources.

USGS National Resources Research and Assessment Activities

The overall goal of USGS domestic energy activities is to conduct research and provide quantitative assessments of all geologically based energy resources. This includes undiscovered, technically recoverable oil and natural gas resources in both conventional and unconventional accumulations throughout the United States (exclusive of the Federal outer continental shelf, which is assessed by the Bureau of Ocean Energy Management). These are resources that have yet to be found (i.e. drilled), but if found, could be recovered using currently available technology and industry practice. Economic factors are not always considered. The purpose of USGS assessments is to develop robust, geologically based, statistically sound, well-documented estimates of quantities of energy resources that have the potential, to be added to reserves. Thus, they could contribute to the overall energy supply, subject to economic and other factors. USGS resource assessment methodologies are thoroughly reviewed and externally vetted so as to maintain the transparency and robustness of the assessment results.

It is important to note the distinction between the terms “resource” and “reserves.” Resource is a concentration of naturally occurring solid, liquid, or gaseous hydrocarbons in or on the Earth's crust, some of which is, or potentially is, economically extractable. Reserves specifically refer to the estimated quantities of identified (i.e. discovered) petroleum resources that, as of a specified date, are expected to be commercially recovered from known accumulations under prevailing economic conditions, operating practices, and government regulations.

The estimate of undiscovered, technically recoverable resources changes over time. There are several reasons for this, including: (1) scientific and technological developments regarding petroleum resources in general and (2) improvements to the geologic understanding in numerous settings. These advances in geologic understanding, as well as changes in technology and industry practices, necessitate that resource assessments be periodically updated to take into account such advances.

Assessment of Continuous, Unconventional Oil and Gas Resources, Piceance Basin

Two USGS assessments of the Mancos Shale in the Piceance Basin were completed, the first in 2003 as part of a comprehensive assessment of the greater Uinta-Piceance Province and the most recent in 2016. The 2003 assessment pre-dated the modern expansion of hydraulic fracturing, making re-assessment necessary. The 2016 assessment of the Mancos Shale differed from the previous one in two ways: (1) it only assessed the Mancos Shale within the Piceance Basin and (2) the Mancos Shale strata were subdivided vertically into separate Assessment Units (AUs) that each differ in geological characteristics that control hydrocarbon accumulation type and extent, the type of drilling and completion techniques applied, and the distribution of estimated ultimate

recovery volumes of producing wells (Figure 1). In the time interval between the two assessments, more than 2,000 wells had been drilled and completed by industry in one or more intervals within the Mancos Shale of the Piceance Basin, the data from which was incorporated into geological studies conducted by the USGS that underpinned the assessment.

The USGS often collaborates with industry to obtain subsurface data that help inform and constrain our assessment results. These data, which are often proprietary, are held confidential by the USGS, but are aggregated when assessment results are released to the public in order to protect the proprietary nature of the data. In addition to the industry data utilized in this assessment, the USGS ERP drilled a research core of its own in the southern Piceance Basin that provided significant new geologic and geochemical data that were used to refine the 2003 assessment of undiscovered, technically recoverable oil and gas in the Mancos Shale.

Using this geology-based assessment methodology, in 2016 the USGS estimated mean volumes of 66.3 trillion cubic feet of gas, 74 million barrels of oil, and 45 million barrels of natural gas liquids in the Mancos/Mowry Total Petroleum System. All of the undiscovered hydrocarbon resources quantitatively assessed were continuous, unconventional reservoirs. Continuous reservoirs are those where the oil or gas are dispersed throughout the geologic formation rather than in discrete, localized pockets. Because of this, continuous oil and gas often require special drilling and recovery methods. These two terms, “continuous” and “unconventional,” are sometimes used interchangeably. For our purposes what should be understood is that all of the resources in this assessment would be developed using unconventional techniques, such as the marriage of hydraulic fracturing and directional drilling.

The USGS employs a quantitative probabilistic methodology to its oil and gas resource assessments, meaning that estimated resources fall within a range of probability occurrence. Using this methodology, the USGS reports resource estimates as fractiles, which are fully risked estimates of technically recoverable resource. An F95 fractile denotes a 95% chance of at least the volume tabulated; an F5 fractile denotes a 5% chance of at least the volume tabulated; and an F50 fractile denotes a 50% chance of at least the volume tabulated. Applying this to the 2016 assessment of the Mancos Shale in the Piceance Basin, the range of natural gas resources assessed ranges from 34 trillion cubic feet of gas, which is the F95 fractile to 112 trillion cubic feet of gas, which is the F5 fractile. This means that there is a 95% chance that at least 34 trillion cubic feet of gas exists as undiscovered, technically recoverable continuous resource; equally there is a 5% chance that at least 112 trillion cubic feet of gas exists as undiscovered, technically recoverable resource. The mean of the resource estimate is 66 trillion cubic feet of gas, which is one of the largest estimates of natural gas that the USGS has ever assessed. The only natural gas assessments that eclipse the 2016 Mancos assessment are those of the Haynesville-Bossier Shale, with estimated mean resources of 304 trillion cubic feet of natural gas and 4.0 billion barrels of oil located in a trend that extends along the western and central U.S. Gulf Coast, and the Marcellus Shale, with estimated mean resources of

84 trillion cubic feet of natural gas and 3.4 billion barrels of oil located within the Appalachian Basin.

The USGS has also released an additional resource assessment in the Uinta-Piceance Basin, including an estimate of conventional and continuous (unconventional) oil and gas resources of the Uteland Butte member of the Green River Formation in eastern Utah. This assessment, released in 2015, estimates mean undiscovered resources of 214 million barrels of oil, 329 billion cubic feet of gas, and 14 million barrels of natural gas liquids. Earlier work completed by the USGS in the Uinta-Piceance Basin include a 2003 assessment of the Uinta-Piceance Basin Province and a 1995 review as part of the USGS National Oil and Gas Assessment. However, the results from these are superseded by those of more recent assessments because of (1) the advances in scientific and technological developments that have taken place since then, and (2) improvements in our geological understanding of the subsurface in the area.

Future USGS planned assessments in the region will include an assessment of the Mesaverde Formation in the Piceance and Uinta Basins of Colorado and Utah, respectively.

Conclusion

The USGS assessed undiscovered, technically recoverable continuous, unconventional oil and gas resources in the Mancos Shale of the Piceance Basin. The USGS estimated mean volumes of 66.3 trillion cubic feet of gas, 74 million barrels of oil, and 45 million barrels of natural gas liquids in the Mancos/Mowry Total Petroleum System. All of the undiscovered hydrocarbon resources quantitatively assessed are continuous, unconventional reservoirs.

Thank you for this opportunity to provide an overview of this USGS assessment of the undiscovered, technically recoverable continuous oil and gas resources of the Mancos Shale in the Piceance Basin. I would be happy to answer your questions.

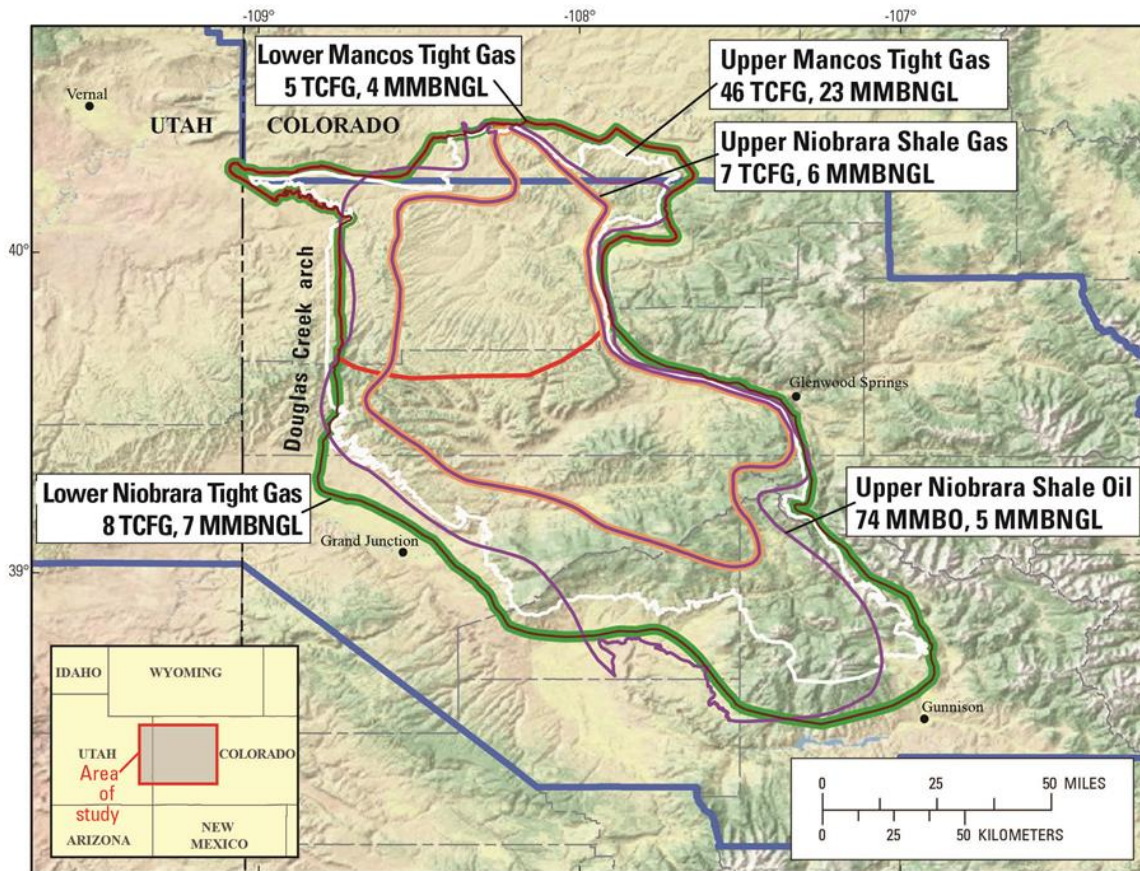


Figure 1. Assessment Units and current mean estimates from the USGS for undiscovered, technically recoverable resources of the Mancos Shale in the Piceance Basin of the Piceance-Uinta Province, Colorado and Utah.

| Total petroleum system (TPS) and assessment units (AUs) | AU probability | Accumulation type | Total undiscovered resources | | | | | | | | | | | |
|---|----------------|-------------------|------------------------------|-----------|------------|-----------|---------------|---------------|----------------|---------------|--------------|-----------|-----------|-----------|
| | | | Oil (MMBO) | | | | Gas (BCFG) | | | | NGL (MMBNGL) | | | |
| | | | F95 | F50 | F5 | Mean | F95 | F50 | F5 | Mean | F95 | F50 | F5 | Mean |
| Mancos/Mowry TPS | | | | | | | | | | | | | | |
| Lower Mancos Tight Gas AU | 1.0 | Gas | | | | | 1,266 | 4,343 | 10,297 | 4,875 | 1 | 3 | 10 | 4 |
| Lower Niobrara Tight Gas AU | 1.0 | Gas | | | | | 2,482 | 7,837 | 16,366 | 8,441 | 1 | 6 | 16 | 7 |
| Upper Niobrara Shale Gas AU | 1.0 | Gas | | | | | 1,875 | 6,360 | 15,659 | 7,268 | 1 | 5 | 15 | 6 |
| Upper Niobrara Shale Oil AU | 0.95 | Oil | 0 | 64 | 175 | 74 | 0 | 71 | 218 | 86 | 0 | 4 | 14 | 5 |
| Upper Mancos Tight Gas AU | 1.0 | Gas | | | | | 28,498 | 43,773 | 69,129 | 45,661 | 6 | 21 | 44 | 23 |
| Total undiscovered continuous resources | | | 0 | 64 | 175 | 74 | 34,121 | 62,384 | 111,669 | 66,331 | 9 | 39 | 99 | 45 |
| Distal Frontier Conventional AU | | | Not quantitatively assessed | | | | | | | | | | | |
| Total undiscovered continuous and conventional resources | | | 0 | 64 | 175 | 74 | 34,121 | 62,384 | 111,669 | 66,331 | 9 | 39 | 99 | 45 |

Figure 2. Assessment results for continuous and conventional oil and gas resources in the Mancos Shale, Piceance Basin of the Piceance-Uinta Province, Colorado and Utah.

Additional information from the USGS National Oil and Gas project is available from:

<http://energy.cr.usgs.gov/oilgas/noga/>.