Introduction

Over the past fifteen years or so, mine closings at Larson, Velva, Dickinson, and Gascoyne have dominated much of the news about the lignite industry in North Dakota. Now, for the first time in almost 20 years, there is serious discussion of construction of a new mine and lignite-fired power plant.

Utilities and the coal industry have not expressed this much interest in the State’s lignite resources (total lignite) and reserves (mineable lignite) since the early 1980s. The reason is two-fold: 1) the North Dakota Industrial Commission’s Lignite Vision 21 Program, managed by the Lignite Energy Council and 2) the coalbed methane (cbm) potential of North Dakota lignites. The Vision 21 project provides monetary incentives for companies to study and construct new state-of-the-art coal-fired power plants in the State. The electrical supply problem in California last winter underscored a major problem with the availability and distribution of energy and increased interest in new power plant construction. For the past four years, the success of the large number of methane wells drilled in sub-bituminous coals in the Powder River Basin near Gillette, Wyoming, has been one of the biggest domestic news stories in the oil and gas industry.

Strippable Lignite Deposits

The North Dakota Geological Survey has its historic roots in lignite investigations. Survey geologists spent most of their time studying coal from 1895, the year the Survey was established, through the 1920s. In the 1970s, the Survey oversaw the drilling of thousands of test holes through a cooperative project with the United States Geological Survey. This program was undertaken to provide stratigraphic control in areas where few lignite exploration holes had previously been drilled. The Survey also completed several studies on coal stratigraphy and mined-land reclamation in the 1970s and early 1980s.

Since 1975, companies drilling exploratory test holes for coal outside of an active mine permit area have been required to obtain a permit from the North Dakota Geological Survey. To date, the 447 permits that have been issued under this program have resulted in almost 28,000 test holes (Figure 1). Companies are required to provide our office with copies of all data generated from these projects. This information automatically remains confidential for three years and the confidentiality period can be extended to a maximum of 10 years. In recent years, Survey personnel have entered over 18,000 data points (12,000 non-confidential coal test holes and information from 6,000 oil and gas logs, uranium holes, and water wells) into an electronic database with financial assistance from the U.S. Geological Survey under the National Coal Resource Database System and National Coal Assessment Programs.

Most of North Dakota’s coal exploration took place in the 1970s when dozens of out-of-state companies drilled test holes throughout the western part of the State (Figure 2). During this period, it was not unusual for four holes to be drilled, by four different coal companies, at one section corner. Since the early 1980s, most test drilling has been done by

Figure 1. Graph of the coal exploration permits issued and the coal exploration holes drilled in North Dakota over the past 26 years. The recent interest in coal has not yet led to a significant increase in permit applications. The lack of drilling is due, at least in part, to the ND Geological Survey’s coal database. Companies can now utilize this large database to identify areas of interest rather than resort to the often inefficient blanket drilling of the 1970s.
25 billion tons should be considered a conservative number. As a result, our final estimate of (as cover decreases, the chance that the lignite has lost Btus
stripping ratio of 10:1, and a minimum of 25 feet of overburden
individual bed thickness of 2.5 feet (it generally is not
 thickness of ten feet—typically occurring in two beds or one
deposits. These criteria include a minimum cumulative coal
conservative criteria to determine the economic viability of
been available for previous studies. Our study used fairly
completed study used at least 10 times more data than had
1980s, but a detailed assessment of the State's strippable
areas, such as the Knife River basin, in the 1970s and early
reserves. The NDGS published detailed studies on specific
areas in North Dakota contained 4.1 billion tons of strippable
1953, Brandt concluded that North Dakota's lignite resource
accounted to 351 billion tons. Others used Brandt's report to
conclude that North Dakota had strippable lignite reserves
of between 7 billion (Ball, 1966) and 50 billion tons (Averitt,
1958). In 1972, Pollard estimated that sixteen major coal
areas in North Dakota contained 4.1 billion tons of strippable
reserves. The NDGS published detailed studies on specific
areas, such as the Knife River basin, in the 1970s and early
1980s, but a detailed assessment of the State's strippable
reserves had never been undertaken. The Survey's recently
completed study used at least 10 times more data than had
been available for previous studies. Our study used fairly
conservative criteria to determine the economic viability of
deposits. These criteria include a minimum cumulative coal
thickness of ten feet—typically occurring in two beds or one
(the more beds the higher the mining costs), a minimum
individual bed thickness of 2.5 feet (it generally is not
economical to strip a bed less than 30 inches thick), a maximum
stripping ratio of 10:1, and a minimum of 25 feet of overburden
(as cover decreases, the chance that the lignite has lost Btus
due to weathering increases). As a result, our final estimate of
25 billion tons should be considered a conservative number.

Maps showing the strippable lignite reserves in 19 counties
are available for the NDGS at a cost of $5.00 per county (Murphy, 2001a-s). These maps will eventually be
posted on our website where they can be downloaded to a
print file for free. A 1:1,000,000-scale statewide map of
strippable lignite deposits (Murphy, 2001t) is available for
$3.00.

**Coalbed Methane**

The development of coalbed methane in the Powder
River Basin has been called one of the fastest growing gas
plays in the United States. The play began in 1987 and has
garnered much attention in the past five years. The coalbed
methane (cbm) in this play is associated with sub-bituminous
coals in the Fort Union Group. These Powder River coals are
equivalent to (the same age and occur in rocks that are
stratigraphically connected to) the coal-bearing Fort Union
strata in the North Dakota part of the Williston Basin. For
several years, the NDGS has been receiving inquiries on the
coalbed methane potential of North Dakota lignites. Since
1998, we have written a half dozen open-file reports to
address questions most frequently asked about North Dakota
lignites and the location and depths of the thick seams in
western North Dakota (Murphy, 1998; Murphy and Goven,
1998; Murphy and Goven, 1998a; Murphy and Goven, 1998b; Murphy and others, 1999; Murphy and others, 2000; Murphy and others, 2002; Murphy
and others, in prep.). To date, four companies have conducted
canister tests to determine the gas potential of North Dakota
lignites. Canister tests consist of placing the coal core in a
sealed tube (typically 3-inch diameter by 24-inch-long)
immediately after the core has been retrieved. The tube is
then placed in a water bath to maintain downhole temperature
and the gas pressure is periodically recorded by opening an
access valve at the end of the tube. The timed readings are
used to estimate the amount of recoverable gas in the coal.
The information generated under the NDGS permits is
currently confidential and will likely remain so for several
more years.

Unlike the area near Gillette, Wyoming, the mineable
deposits of lignite in North Dakota, i.e., those within about
170 feet of the surface, do not appear to have much cbm
potential. Near Gillette, methane problems had been reported
from water wells and homes in a subdivision near an active
strip mine for decades. Coal companies in North Dakota
have not encountered methane in their shallow observation
wells at the mines. There are only a few sketchy incidents of
methane being encountered in North Dakota underground
mines from the 1880s to the 1950s. An elderly underground
miner in northwest North Dakota recalled that when they
encountered water in the coal while mining they would mine
in a different direction. Water is an important component in

Figure 2. A truck-mounted rotary rig drilling for coal in western North Dakota.
the process of trapping methane because it helps to hold gas in place against the cleats or fractures in the coal. The absence of groundwater in dry mines might explain the lack of methane. Although I have been unable to confirm, deaths due to methane gas reportedly occurred in underground mines at both Wilton and near Stanley. In 1984, the Survey encountered gas while installing a monitoring well near the town of Lignite in Burke County (Figure 3).

For the past four years, the ND Geological Survey has suggested that companies target deeper lignites due to the relatively few known incidences of gas in the shallow coals in North Dakota. We know very little about the deeper coals in the Williston Basin because they were seldom targeted for water wells and were too deep to be of economic importance in mining. The deeper parts of the Williston Basin contain lignite at depths close to 2000 feet. It may be that these deeper lignites are closer in character to sub-bituminous coals due to the increased burial depths. Within the next year, we should get a much better idea of the cbm potential of North Dakota lignites with the information that companies are currently generating.

Interest in both mineable lignite and the coalbed methane that might occur in deep lignites, have combined to create an interest in North Dakota coals that has not been seen for 20 years. Many long-term coal leases in North Dakota, with the exception of the current mine areas, were allowed to expire during the 1990s. At that time, little or no hope was expressed that those areas would be leased anytime in the near future. But, within the last year, interest has once again been expressed in leasing areas that are not within existing mine plans. It should be noted that the methane ownership is held by the oil and gas mineral rights, not the coal rights. A few years ago, this premise was challenged in a lawsuit between the Southern Ute Indian Tribe and Amoco Production Company but was eventually upheld by the U.S. Supreme Court. Therefore, farmers and ranchers whose land is underlain by thick seams of lignite, near the surface and at depth, may have an opportunity to lease both the oil and gas and the coal mineral rights.

Selected References

Murphy, E.C., 2001a-s, Strippable coal deposits of [selected counties], NDGS Mineral Resource Maps 1-19.
Murphy, E.C., 2001t, Strippable lignite deposits of North Dakota: NDGS Miscellaneous Map no. 34, 1:1,000,000 scale.
Murphy, E.C., Vandal, Q., Kruger, N.W., Goven, G.E., in prep., Thick coals in Divide, Burke, Williams, and Mountrail Counties: NDGS Open-File Report No. 02-1.