NEWSLETTER

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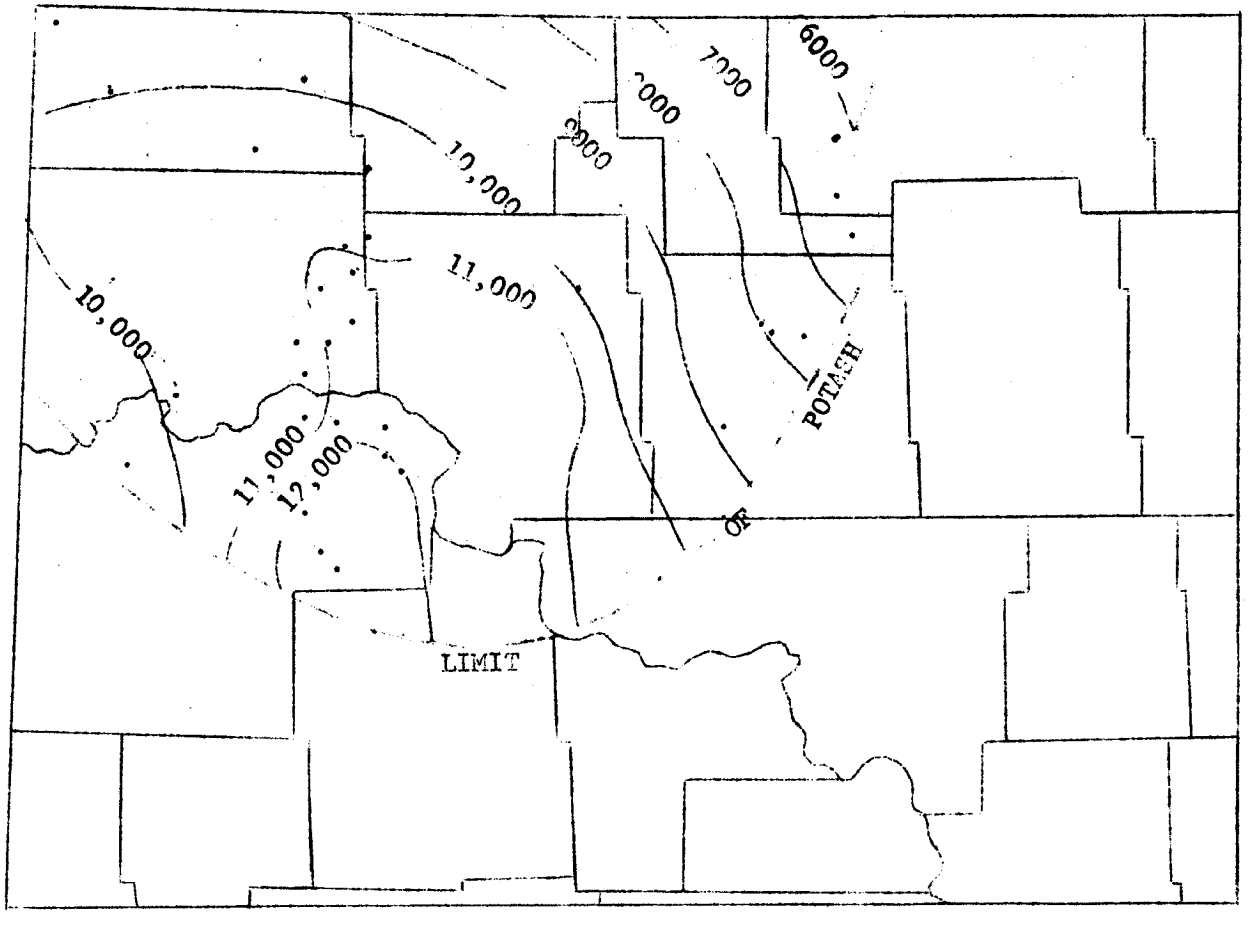
December, 1974

INTEREST MOUNTS IN NORTH DAKOTA POTASH--

North Dakota's potash deposits are attracting considerable interest on the part of both U.S. and Canadian companies and consultants. The term "potash" was derived from pot ashes, which were originally obtained by evaporating, in iron pots, solutions leached from wood ashes. The present worldwide meaning of potash is twofold. When used as a noun it means K_2O equivalent, and when used as an adjective it means potassium compounds or potassium-bearing materials. Potash in North Dakota is associated with the salt deposits of the Devonian Prairie Formation. It ranges from a depth of about 5,600 feet to over 12,500 feet. The map accompanying this article shows the depth to potash over the area it is found in North Dakota. Mining at these depths requires solution techniques because conventional shaft mining methods are impractical below 3,500 feet. Salt begins to flow below that depth.

If potash mining becomes a reality in the State, North Dakota will, in a sense, be providing yet another type of energy in that, as a fertilizer, potash stimulates plant growth. The following quote is from Mineral Facts and Problems, a publication of the U.S. Bureau of Mines:

> "There is no substitute for potash in agriculture, and its importance as an essential plant food cannot be overemphasized. It is not only necessary for plant growth, but regulates the intake, by plants, of the other minerals and elements necessary for normal plant growth."



DRILLING ACTIVITY INCREASES--

There are, at the present time (Dec. 1, 1974), a total of seventeen drilling rigs operating in North Dakota. Last year at this time, seven rigs were operating. The increased drilling activity is reflected in the number of successful wells completed. So far this year, we have had six wildcat discoveries; there were only two discoveries in all of 1973. The six 1974 discoveries include one in the Tyler (Pennsylvanian), one in the Red River (Ordovician), and four in the Madison (Mississippian).

GAS PRODUCTION CORRECTED--

Jack Wilborn, Assistant Petroleum Engineer with the North Dakota Geological Survey, pointed out to me that the first item in the June NDGS Newsletter contained a misleading statement regarding North Dakota's natural gas production. The following statement is more accurate:

Petroleum production in North Dakota dates to 1951. Annual crude oil production in the State reached a peak of 27.1 million barrels in 1966. Since then production has declined each year, and by 1973, only 20.2 million barrels of crude oil were produced. As of December 1, 1974, North Dakota had 1,974 producing wells. The State ranks 11th in the United States in total known petroleum reserves.

Gas produced with crude oil and natural gas output in North Dakota has totaled over 30 billion cubic feet annually in recent years. In 1973 the three gas plants in the State received and processed over 29 billion cubic feet of gas produced with crude oil. Much of the dry natural gas produced by the plants is sold to local utility companies and is used to heat homes of North Dakotans. North Dakota also produces natural gas liquids such as butane, propane, and natural gasoline.

COST OF FUELS COMPARED--

The two tables that follow show how the cost of basic fuels has changed over the past five years in North Dakota. Table 1 shows how the cost for a bulk unit of fuel has changed (e.g., the price for a ton of lignite, a barrel of oil, or 1,000 cubic feet of natural gas). Table 2 shows the true cost of heat energy (Btu's) produced using the various fuels in North Dakota. This is a much more accurate way of comparing the cost of the fuels. Nearly all the information in these two tables was provided by John Ferguson of the North Dakota Geological Survey. James Dalglish of Northern States Power Company in Grand Forks provided information on the cost of Canadian gas.

The prices shown on Table 1 require some explanation. The cost per ton of lignite for 1974 is $2.24 at the mine mouth. This price applies only to lignite that is used on the spot as it is in North Dakota's major steam generating plants. The cost of lignite delivered elsewhere away from mine mouth would also include transportation costs and selling costs. Prices for North Dakota oil and gas are at the wellhead (the top of the well) and are proportionately higher elsewhere (pipeline or trucking charges are added, for example). Prices for Canadian oil and gas are at the U.S. border. Finally, to compute the cost of North Dakota oil at the wellhead, it is necessary to consider three categories of oil. "Old oil" is the amount of production per well that was produced during the 1972 base period. Any increase in an old well's production subsequent to the base period and all oil from new wells that have been drilled since the base period is "new oil." Wells that produce less than 10 barrels

of oil a day are designated as "stripper wells." The higher price allowed for stripper oil encourages the continued production of wells that might otherwise be salvaged and adds to the total oil recovered from a marginal oil pool.

A couple of added footnotes to the figures in the two tables: (1) Effective January 1, 1975, the price of Canadian gas at the border will rise to $1.00/1000 cu ft, and (2) The price of coal is highly dependent on transportation charges as it is a high-bulk commodity. Thus, the cost of coal to the customer who picks up his own lignite at a North Dakota mine might be about 7 or 8 dollars a ton (compare with $2.24 cost to large-scale, at-the-mine consumption of the lignite). I contacted several local fuel suppliers here in Grand Forks and verified that North Dakota lignite is not generally available. However, two dealers quoted prices of about $80.00 a ton for eastern coal (probably Pennsylvania or West Virginia). This coal has a much higher Btu content than North Dakota lignite, probably about 13 to 14 thousand Btu/lb, but even so, the cost/million Btu is about $3.00.

TABLE 1. COST OF FUEL/BULK UNIT

Fuel	1974	1973	1972	1971	1970
ND Lignite	2.24/ton	2.00	1.89	1.86	1.81
ND Oil	5.94/barrel	3.90	3.28	3.27	3.05
ND Gas	0.28/1000 cu ft	0.22*	0.20*	0.18	0.18
Can. Oil	12.60/barrel	3.80*	3.18*	3.17*	2.95*
Ca. Gas	0.61/1000 cu ft	0.39*	0.39*	0.37*	0.37*

TABLE 2. COST/MILLION Btu

ND Lignite[1]	0.16	0.15	0.14	0.14	0.13
ND Oil[2]	1.02	0.67	0.57	0.56	0.53
ND Gas[3]	0.28	0.22*	0.20*	0.18	0.18
Can. Oil	2.17	0.65*	0.55*	0.55*	0.51*
Can. Gas	0.61	0.39*	0.39*	0.37*	0.37*

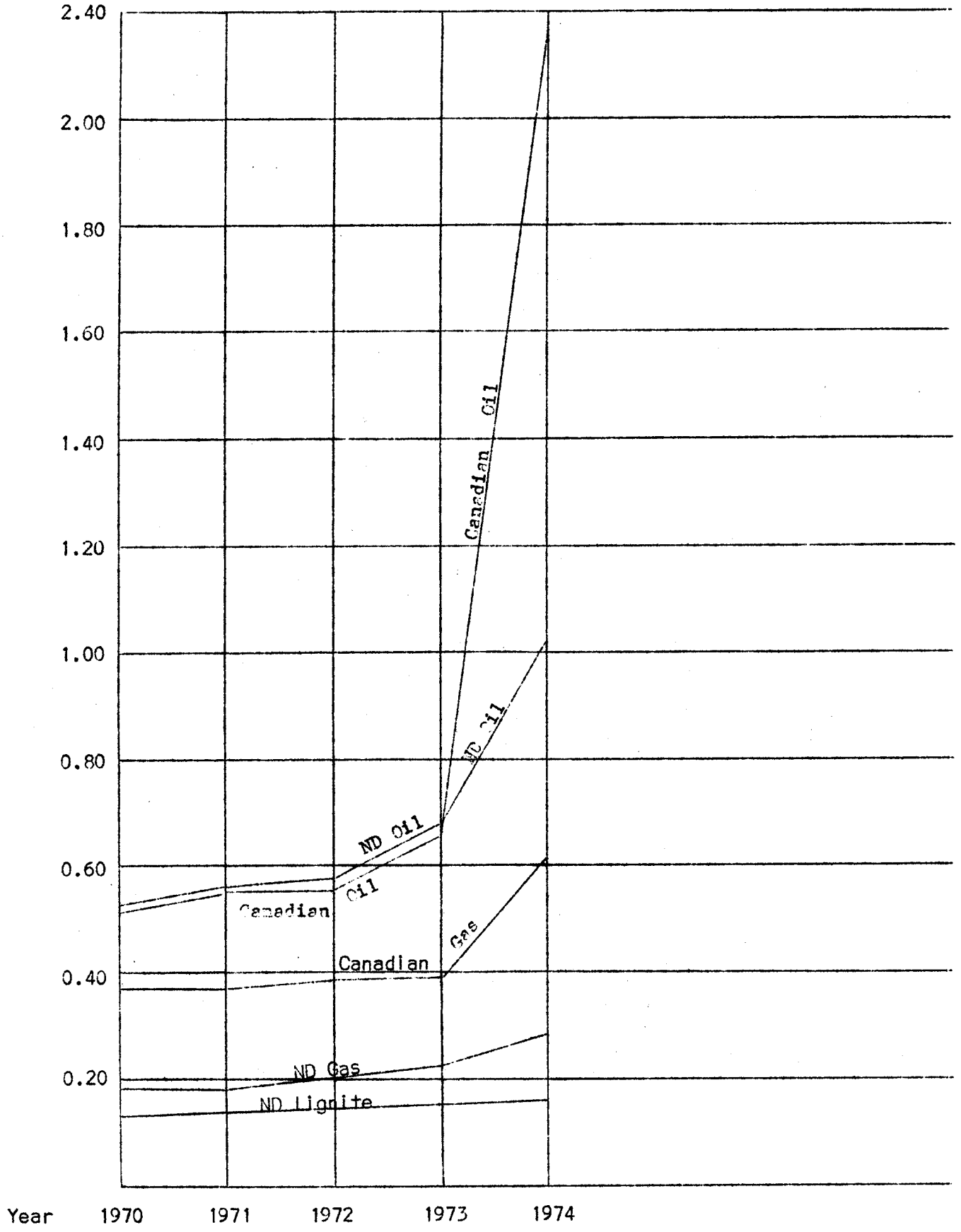
* Estimated Value
1 1 lb. of lignite - 6,800 Btu
2 1 barrel of oil - 5,800,000 Btu
3 1 cu ft of gas - 1,000 Btu

Calculation of price of North Dakota oil:

New Oil:	170,500 bbl x	$10.50 =	$ 1,790,250
Stripper Oil:	71,500 bbl x	10.50 =	750,750
Old Oil:	1,682,000 bbl x	5.28 =	8,880,960
	1,924,000 bbl		$11,421,960

$11,421,960 ÷ 1,924,000 bbl = $5.94/bbl

THE CHANGING COST OF FUEL IN NORTH DAKOTA



SOME OIL AND GAS STATISTICS--

Most of the statistics that follow were compiled by Dr. Samuel P. Ellison, Jr., of the University of Texas.

The United States has 34.7 billion barrels of oil reserves. This amounts to 5.5% of the total world reserves. In 1973 we produced 9.225 million barrels of oil per day, which amounts to 16% of world production. We used about 16 million barrels of oil per day, that is, 29% of the world's daily production. The difference was imported. The United States, with 5.5% of the world's oil reserves, is using 29% of the daily world oil production. The United States has 247 trillion cubic feet of gas reserves, about 12% of the world total. (According to C. B. Folsom of the North Dakota Geological Survey, North Dakota has crude oil reserves of 664 million barrels. This represents about 2% of the U.S. total.)

If we assume that our oil production could be maintained and our usage not increased, the oil reserves in the United States would last 10.1 years and the gas reserves about 13 years.

The Middle East has 350 billion barrels of oil reserves, which is approximately 55.8% of the world's total. They have 413 trillion cubic feet of gas, about 20.3% of the world's reserves. The Middle East has just over 3,000 producing wells and an average of over 6,600 barrels of oil per well per day. The United States has 503,505 wells and an average production of 18 barrels per well per day. The average North Dakota oil well produces 43.3 barrels of oil per day. North America has produced about 120 billion barrels of oil in the past and the Middle East has produced 69 billion barrels.

Europe, with only 15.9 billion barrels of oil (2.5%) and 193 trillion cubic feet of gas (9.4%) is greatly deficient in oil and gas. However, recent drilling in the North Sea suggests that vast quantities of oil and gas there will add significantly to the world's reserves, but more drilling will be required to determine accurate reserve figures.

It seems clear that oil and gas are in short supply and limited. Coal, even though it is much more abundant, is also limited, but it must be counted on as a source of fossil fuel energy. Nuclear and breeder fission reactors are also sources of supply, but they are also limited. Fusion reactors and solar power may be the ultimate solution to most of our energy problems. These sources seem abundant and limitless. Hydropower, tidal power, wind power, geothermal power, hydrogen, and methanol will be small and also somewhat limited.

OVER 6,000 MILES OF HOLE DRILLED IN NORTH DAKOTA--

C. B. Folsom, Chief Petroleum Engineer with the North Dakota Geological Survey, has calculated that a total of 33,781,095 feet or 6,387 miles of hole have been drilled in North Dakota in search of oil. Of the 6,387 miles of hole that have been drilled, a total of 3,538 miles were productive and 2,859 miles were dry. This success ratio, about 55%, is somewhat misleading, however, because the total footage drilled includes development and offset oil wells, those drilled in areas of known oil production. In these areas, the success ratio can be expected to be high. If only wildcat wells are considered, the success ratio falls drastically.

Mr. Folsom also pointed out that wells drilled this year have tended to be considerably deeper than prior to 1974.

A SHORT HISTORY OF COAL MINING IN NORTH DAKOTA--

Most of the information in this article was taken from the text of a speech delivered in 1954 by W. B. Rowe of Truax-Traer Coal Company (now Consolidation Coal Company).

The first lignite mined in the United States or Canada was probably dug from outcrops in creek beds and hillsides by the American Indians where firewood was scarce. Lewis and Clark, in their journals, mention using lignite during the winter of 1803-1804 while they were camped along the Missouri River at Fort Mandan. While some of the early mining may have been from short drifts into the outcrops, the bulk of the operations consisted of removing shallow overburden and loading out the lignite as is done in modern strip mining.

Production records for North Dakota start in 1884 when the state produced 35,000 tons. By 1900, output had increased to more than 100,000 tons. In 1922, one million tons were mined; in 1937, 2 million tons; in 1950, 3 million tons; in 1970, 5 million tons; and in 1975 nearly 12 million tons will be mined.

Prior to 1902, about half of the output of North Dakota was from small strip pits along outcrops, where overburden was light. At that time, before power stripping equipment was developed, overburden of about 10 feet in depth was considered the practical maximum for a six-foot seam. Between 1902 and 1919, underground mining on a larger scale developed and for a time took the lead away from the strippers.

The operations which led to the development of the modern lignite stripping industry began just prior to 1919 when the Whittier Coal Company and Traux Brothers began stripping lignite in Kincaid, in Burke County, with horse-drawn elevating graders and horse-drawn dump wagons. The wagons were used both to dispose of overburden and haul lignite to the tipple.

The first power equipment used to strip lignite in North Dakota was put into service by the Truax Brothers in 1919. This was a 1½ cu. yd. steam shovel which replaced the elevating grader for loading overburden into dump wagons. The same shovel was also used to load lignite into narrow-gauge pit cars which were hauled to the tipple by steam locomotives.

By 1950, over 90% of North Dakota's coal was taken from surface mines. In 1970, only 12 tons of lignite was produced by the underground mining method and the mine that produced that, the Square Deal Coal Mine in Williams County, closed shortly thereafter.

SELECTED REFERENCES DEALING WITH COAL GASIFICATION--

John Ferguson, coal geologist with the North Dakota Geological Survey, has compiled the following list of selected references relating to coal gasification.

1971

-Coal gasification circulates molten salt: Oil and Gas Journal, v. 69, Sept. 27, page 103.

1972

- Koppers unveils versatile coal-to-gas process: Oil and Gas Journal, v. 70, June 19, page 26.
-SNG-Where will it come from and how much will it cost?: Oil and Gas Journal, v. 70, July 17, p. 83-88.
-Coal-to-gas pilot plant: The Mines Magazine, Oct. 1970, p. 4-10.
-AGA funds molten-iron SNG process development work: Oil and Gas Journal, v. 70, Dec. 4, p. 45.

(Selected References Continued)

1973

-The Lurgi process route makes SNG from coal: Oil and Gas Journal, v. 71, Jan. 22, p. 90-92.
-Coal-gasification costs may lower: Oil and Gas Journal, v. 71, Feb. 12, p. 87-94.
-How coal-gasification common base costs compare: Oil and Gas Journal, v. 71, Feb. 5, p. 68-71.
-SNG uses molten-iron coal gasifier: Oil and Gas Journal, v. 71, March 26, page 97.
-Corrosion still big problem in coal gasification: Oil and Gas Journal, v. 71, May 28, p. 55.
-SNG from coal involves big projects: Oil and Gas Journal, v. 71, June 25, p. 131-134.
-Work begins on coal-gasification unit: Oil and Gas Journal, v. 71, Aug. 6, p. 62.
-IGT's Hygas plant achieves large-scale coal gasification: Oil and Gas Journal, v. 71, July 23, p. 27.
-IGT, Parsons to build coal gasifier: Oil and Gas Journal, v. 71, July 30, p. 87.
-Exxon discloses advances in coal utilization: Oil and Gas Journal, v. 71, Sept. 17, p. 131.

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-Hygas pilot yields operating data: Oil and Gas Journal, v. 72, Feb. 11, p. 75.
-The gasification of coal: Scientific American, v. 230, no. 3, p. 19.
-Oil coal-conversion methods seen attractive: Oil and Gas Journal, v. 72, April 29, p. 36.
-Coal conversion technology: Chemical Engineering, July 22, 1974, p. 88-102.
-Clean fuels from coal: Oil and Gas Journal, v. 72, Aug. 26, p. 73.
-SNG plans shift to coal: Oil and Gas Journal, v. 72, Aug. 26, p. 93.
-U.S. coal-to-gas process is ready: Oil and Gas Journal, v. 72, Sept. 9, p. 86.
-Rising prices and new technologies stimulate synthetic gas production: Oil Week, v. 25, Sept. 23, p. 18.

THE MINERAL INDUSTRY IN NORTH DAKOTA IN 1973*--

The total value of mineral production in North Dakota in 1973 was $101.6 million, an increase of 3.6% over the $98.1 million reported in 1972, according to the Bureau of Mines, United States Department of the Interior. Mineral fuels accounted for approximately 87.9% of the total value. The remaining 12.1% of the value was the result of production of sand and gravel, clays, stone, salt, and small amounts of other mineral commodities.

Production of petroleum (crude), the State's most valuable mineral commodity, decreased 3.5% while its value increased 2.1% because of a price increase to $3.47 per barrel, up 19 cents from the previous year. Marketed natural gas decreased from 32.0 billion cubic feet to 31.6 billion cubic feet in 1973, while its average value at the wellhead increased to 19 cents per thousand cubic feet. Natural gas ranked third in value and accounted for 5.9% of the State's total mineral value.

Lignite, the State's second largest mineral commodity in terms of value, accounted for 14.0% of the total mineral production. Compared with 1972, production was up 6.0% and the average value per short ton increased 8.9% to $2.20 per short ton.

The value of sand and gravel, the highest valued nonfuel commodity, increased 4.0% above 1972, while its unit value per ton was lower at 85 cents per ton. Lime production increased 55.6%, its average value up 16.8% per ton. Production of clays decreased by 7.3%, while salt production increased 23.8%.

Table 1. Mineral production in North Dakota *

Mineral	1972 Quantity	1972 Value (thousands)	1973 Quantity	1973 Value (thousands)
Coal--thousand short tons	6,632	$13,416	6,453	$14,200
Gem stones	NA	2	NA	2
Natural gas--million cubic feet	32,472	5,455	31,575	5,999
Petroleum (crude)--thousand 42-gallon barrels	20,624	67,647	19,910	69,088
Sand and gravel--thousand short tons	6,681	5,757	6,948	5,905
Value of items that cannot be disclosed: Clays, lime, natural gas liquids, pumice, salt, and stone	--	5,809	--	6,407
Total	--	98,086	--	101,601

NA Not available

The production figures on this table are as measured by mine shipments, sales, or marketable production (including consumption by producers).

This article is based on information supplied by the Division of Fossil Fuels-Mineral Supply, U.S. Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of North Dakota.

MONTHLY OIL PRODUCTION REPORTS AVAILABLE--

Monthly oil production reports are available from the North Dakota Geological Survey for a fee of $5.00 a year. The reports include final figures on all oil and gas wells completed to date, arranged by counties, for the previous month, and preliminary figures for the current month. It includes oil and water production for all wells operating in North Dakota and the amount of oil sold from the lease. A list of new permits issued each month is included. The report also includes abstracts of cases to be considered at upcoming hearings before the State Industrial Commission.

GEOLOGY DEPARTMENT NEWS--

Even though recruiting for geology graduates has been intense, particularly by oil companies, the number of students majoring in geology at the University of North Dakota remains about the same as last year. Roberta Zick, UND geology department secretary, reports that there are currently 50 undergraduate geology majors and 31 graduate students. The total number of students enrolled in geology 101, the introductory geology course, is 230.

For at least the next few years, the number of majors is expected to remain high or to increase. Graduate students interested in reclamation or in geology of coal areas are expected to find that financial support is available through the variety of projects in which both the Department and Survey will be involved. A number of such students are already employed on these reclamation-oriented projects.

NDGS HELPS TO DETERMINE RECLAMATION POTENTIAL--

The Survey has become actively involved in the State's overall concern with reclamation of surface-mined land during the past few months. Dr. Noble was appointed by Governor Link to the Mined Land Planning Group last winter. This group of scientists has been working with Dr. Ed Englerth of the Public Service Commission to develop the technical information base necessary to assure that mined land is returned to its pre-mining productivity. The Mined Land Planning Group is conducting a program of research funded by the Old West Regional Commission. The NDGS participation in this research project involves the determination of detailed stratigraphy of overburden before mining and the initial monitoring of groundwater conditions. Studies have begun at the Indian Head Mine and the proposed Underwood Mine of the North American Coal Corporation. The data from these studies will provide the framework for determining the physical and chemical characteristics of potential spoil material. The ultimate goal of these studies is to develop the data needed to permit, before mining begins, the design of the optimum landscape, hydrology and soils of the mined areas. In this way we hope to make possible reclamation that produces beneficial modification of landscape, hydrology, and soils rather than just reclamation that minimizes deleterious effects.

Survey geologists working on this project include Kelly Carlson, Steve Moran, Mike Arndt, and Gerry Groenewold, who has joined us this summer from the Ohio Geological Survey. Dr. Alan Ashworth at NDSU, James Ulmer, a Master graduate of UND, and UND students Michael Camara, LeRoy Hemish, and Curtis Anderson have all been involved in this project.

Our geologists have been greatly aided in their work by the cooperation and assistance of personnel of the North American Coal Corporation. At Underwood, geologist John Jedlicka and mining engineers Doug Huber and Jim Germundson were helpful and interested in our work. The entire staff at the Indian Head Mine have leaned over backward to assist us. Reclamation engineers Terry Dudley and Jerry Becker have been actively involved with our work at Indian Head.

STRATIGRAPHIC INFORMATION OBTAINED IN GRAND FORKS COUNTY--

This fall, Survey geologists work with researchers from the Agricultural Research Service (ARS) on a stratigraphic and hydrologic test-drilling program in Grand Forks County. Steve Moran, Mike Arndt, and Gerry Groenewold all were involved in the location, sampling, logging, and coring of 18 testholes. They were assisted by Jim Ulmer and UND geology grad students Howard Hobbs, Ken Harris, and LeRoy Hemish.

The results of this drilling will greatly advance the ARS study of the saline soil problems in the Red River Valley. The drilling and coring give the Survey geologists a real boost in their ongoing study of glacial stratigraphy in the Red River Valley.

PRE-MESOZOIC PALEOGEOLOGIC MAP READY--

The NDGS has just published a new pre-Mesozoic paleogeologic map of North Dakota. The map, by Sid Anderson of the Survey, is available in color at a scale of 1:1,000,000. Included with the map are four representative electric and gamma ray logs of the various lithologic units. The map itself locates 24 different lithologic units. Well control points are shown on the map along with the major oil fields.

Miscellaneous map 17 is available from the NDGS for $1.00. It should be a valuable tool for oil and gas explorationists.

THREE NEW MAPS IN PRESS--

Three new maps that went to the printer should be available soon. All three maps are approximately 6 x 10 inches in size and all will have wide appeal to students and the interested public. Miscellaneous map 14, by Karol-lyn Knudson, is a relief map of North Dakota. In addition to presenting a graphic artist's concept of the North Dakota landscape, the relief map will include a small index map showing the various physiographic areas in North Dakota. Miscellaneous map 15 shows the surface geology of North Dakota. It deals primarily with features that were deposited by glaciers, landforms that occur throughout the State. The map, which is in color, is by Steve Moran. Miscellaneous map 16, by C. G. Carlson, shows the generalized bedrock geology of North Dakota. Also in color, this map shows the geologic surface that occurs beneath the cover of glacial deposits.

SLIDE-TAPE SHOWS AVAILABLE--

The North Dakota Geological Survey has several slide-tape shows available to schools, service clubs, and other groups. They include the following titles:

Geology Can Be Beautiful
Colorado Rockies
Volcanic Features in Oregon
A Trip to the Moon
Early Man in the Southwest
North Dakota Landforms
Reclamation of Mined Lands
The Story of Energy

The only cost to the borrower will be return postage and insurance.

DRILLING PERMITS ISSUED BY THE NORTH DAKOTA GEOLOGICAL SURVEY--

From the last printing of the newsletter to December 1, 1974, there have been 101 permits to drill issued by the Oil and Gas Section of the Survey. Permits issued each month are listed in the Monthly Oil Production Report. Anyone desiring this information should subscribe to that publication.