(overview, data, & analysis)

# **Profile Analysis**

Last Updated: August 15, 2024

**Overview** 

North Dakota has substantial fossil fuel and renewable energy resources. 1,2,3 The state is the third-largest crude oil producer in the nation and has significant coal and natural gas reserves. 4,5,6,7 Located at the geographic center of North America, North Dakota has a climate characterized by large temperature differences, varied precipitation, plentiful sunshine, low humidity, and nearly continuous wind. North Dakota's rolling plains slope gently

upward to the west toward the Rocky Mountains. Two major river systems, the Missouri River and the Red River, flow through North Dakota, and a large federal dam on the Missouri River harnesses its hydropower. Winds move unobstructed across the state, providing a renewable resource that generates more than one-third of the state's electricity.<sup>8,9</sup> North Dakota's rich soils produce many crops, including corn used for ethanol production.<sup>10</sup> The state is among the top 10 ethanol and biodiesel producers in the nation. 11 North Dakota has the fourth-lowest population and is one of five states with less than 1 million people. 12 In part because of the state's small population, North Dakota's total energy consumption ranks among the lowest one-fourth of the states. However, North Dakota's energy consumption per capita and the amount of energy needed to produce each dollar of GDP rank among the top four states, in part because of its energy-intensive industrial sector, high

vehicle miles traveled per capita, and relatively cold climate. 13,14,15 The industrial sector accounts for almost three-fifths of the state's total energy consumption. 16 The energy-intensive oil and natural gas extraction industries, mining that includes coal production, and agriculture are major contributors to the state's economy. 17 The transportation sector accounts for one-fifth of total energy consumption in the state. The commercial sector accounts for less than one-eighth, and the residential sector makes up about one-tenth. 18 North Dakota's total energy production is about six times greater than its energy consumption. 19 A surge in energy production over the past decade except for a slowdown during the COVID-19 global pandemic—has come from the development of the state's oil reserves.<sup>20</sup> Crude oil accounts for slightly more than half of North Dakota's total primary energy production. Natural gas makes up about one-third of the state's energy production, coal is about one-

**Petroleum** North Dakota is the third-North Dakota ranks third in the nation, after Texas and New Mexico, in both crude oil reserves and production.<sup>22,23</sup> Oil exploration in North Dakota began in the early 20th century, but the state's first oil largest crude oil producer in discovery did not occur until 1951.<sup>24</sup> Production was modest until new drilling technologies—horizontal the nation.

## thousand square miles that includes parts of North Dakota, South Dakota, Montana, and the Canadian provinces of Manitoba and Saskatchewan.<sup>25</sup> The

drilling and hydraulic fracturing—were applied more than a decade ago to exploration of the Bakken Shale

formation in western North Dakota in the Williston Basin. The Williston Basin is an area of several hundred

twelfth, and renewable energy, including biofuels, accounts for the remaining 4%.<sup>21</sup>

U.S. Geological Survey estimates that up to 3.3 billion barrels of undiscovered, technically recoverable oil are in the Bakken formation and much of that oil is in North Dakota. 26 About 20 of the nation's 100 largest oil fields, as measured by proved reserves, are in North Dakota. 27 From 2012 to 2020, North Dakota was the nation's second-largest crude oil-producing state. After reaching record volume in 2019, the state's oil output declined each year from 2020 to 2022. New Mexico surpassed North Dakota in oil production in 2021. North Dakota's crude oil output decline was

mainly due to the drop in petroleum demand and drilling activity during the COVID-19 pandemic. However, the state's crude oil production in 2023 increased for the first time in four years and was the third-highest annual output ever at almost 1.2 million barrels per day. 28,29,30,31 North Dakota's one operating oil refinery can process about 71,000 barrels of crude oil per calendar day, which is less than one-tenth of the state's daily crude oil production. A smaller refinery, with an operating capacity of 19,000 barrels per calendar day, shut down in June 2020, and converted into a

calendar day, could accommodate Bakken crude oil production. 34,35 During the past decade, most of North Dakota's crude oil production was transported out of the state by rail. But new pipelines built in recent years resulted in more oil takeaway pipeline capacity than rail car capacity. 36,37,38 By mid-2024, about 8 out of 10 barrels of crude oil produced in the state was transported by pipeline. 39 North Dakota is also a U.S. entrance point for pipelines carrying crude oil from Canada. 40 Oil from Canada is transported via pipeline to Midwest refining centers and to the crude oil market hub at Cushing, Oklahoma, as well as to refineries on the Gulf Coast. 41

renewable diesel production plant. 32,33 A planned refinery, near Belfield in the west-central part of the state, with a capacity of nearly 50,000 barrels per

Relatively little of the crude oil produced in North Dakota is used in the state. However, the state's petroleum consumption per capita is among the top five

in the nation. The transportation sector accounts for almost three-fifths of North Dakota's petroleum consumption and the industrial sector uses onethird. 42,43,44 Conventional motor gasoline without ethanol is allowed to be sold statewide, although most U.S. gasoline contains at least 10% ethanol. 45,46 There also are about 40 public fueling stations in the state that sell E85, a blend of 85% ethanol and 15% motor gasoline. 47 North Dakota has the thirdhighest per capita motor gasoline expenditures among the states. 48 About 6% of the petroleum used in North Dakota is consumed by the residential sector, where about one in seven households uses petroleum products—including propane, fuel oil, and kerosene—for home heating. North Dakota has the twelfth-highest share (15%) of petroleum use for home heating among the states. The commercial sector, which includes government buildings, hospitals, schools, and shopping centers, accounts for 4% of the state's petroleum use. 49,50,51

Natural gas North Dakota's natural gas North Dakota has about 2% of the nation's total natural gas reserves, and the state accounts for almost 3% of U.S. total natural gas gross withdrawals. 52,53 Natural gas was produced in North Dakota as early as gross withdrawals reached a 1892, but significant commercial production was not established until 1929, when development of a record high of nearly 1.2 Montana natural gas field extended into North Dakota. Sporadic development of the state's natural gas trillion cubic feet in 2023. resources continued between the mid-1940s and the early 1980s.<sup>54</sup> Production remained below 85 billion cubic feet per year until 2008, when output began to increase rapidly because of the associated gas produced from the development of Bakken shale oil resources. Gross withdrawals of natural gas in the state exceeded 1 trillion cubic feet for the first time in 2019, but dropped in 2020 due to lower U.S. natural gas demand resulting from a warmer winter in 2020 and the economic impacts of the COVID-19 pandemic. In each of the next three years North Dakota's total annual natural gas production surpassed 1 trillion cubic feet again and reached a record

high of nearly 1.2 trillion cubic feet in 2023. The state's natural gas production was on track in early 2024 to hit record output for the year. 55,56 North Dakota natural gas production exceeds the state's takeaway pipeline capacity. New natural gas processing plant capacity and pipelines are coming online to handle more of the state's natural gas output. 57,58,59,60,61 To reduce the state's emissions from natural gas that is burned off (flared), North Dakota's Industrial Commission set incremental targets over several years to increase the amount of natural gas that is captured. In mid-2024 about 95% of the state's natural gas production was captured, which exceeded the state's 91% target capture rate. 62,63,64 North Dakota has no underground natural gas storage fields.<sup>65</sup> In 2021, the state's legislature passed legislation that gives North Dakota's Industrial Commission the authority to issue permits for

North Dakota contains the world's largest known deposit of lignite, which has the lowest heating value of all

Dakota since the 1870s, but now only lignite is produced at five active surface mines in the west-central part

coal types and is mostly used to generate electricity. Coal has been mined at hundreds of sites in North

underground storage sites that can hold natural gas, natural gas liquids, or crude oil. 66,67

lignite in the world.

North Dakota has the highest

per capita electricity sales in

North Dakota has the sixth-

electricity generated from

wind energy among the

*largest share of total* 

states.

the nation.

the industrial sector. The electric power sector made up about one-fifth of North Dakota's natural gas end-use consumption in 2023, as natural gas use by power plants reached a record high. The commercial sector accounted for about one-sixth of the natural gas delivered in the state. North Dakota's residential sector accounted for about one-seventh of natural gas use, with 4 in 10 North Dakota households relying on natural gas for heating. 69,70 Coal *North Dakota contains the* North Dakota is the seventh-largest coal-producing state in the nation and accounts for about 4% of U.S. total coal output. 71 The state has about 3% of U.S. economically recoverable coal reserves. 72 Western largest known deposit of

Natural gas enters North Dakota primarily from Canada and Montana and most of it continues on to South Dakota and Minnesota. Slightly more than half

of the natural gas that enters the state leave it for other markets.<sup>68</sup> In recent years, more than half of the total natural gas consumed in North Dakota was

used in the production, processing, and distribution of natural gas. Of the natural gas delivered to the state's end users in 2023, just under half went to

All of North Dakota's mined lignite is used within the state by electricity generating plants and industrial users. <sup>76</sup> The state's five largest power plants by generation are coal-fired and are clustered near the coal mines in the center of the state, north of Bismarck. 77,78 Industrial facilities and commercial users in the state also receive small amounts of coal by rail and truck from Montana and Wyoming.<sup>79</sup> In addition, North Dakota uses coal to produce synthetic natural gas (SNG). The only commercial-scale coal-to-SNG facility in the nation is the Great Plains Synfuels Plant in Beulah, North Dakota, where about 18,000 tons of lignite can be converted into an average 170 million cubic feet of pipeline-quality natural gas each day.<sup>80</sup> **Electricity** 

Coal-fired power plants accounted for 55% of North Dakota's electricity generation in 2023, and the state's four largest power plants by generating

North Dakota's electricity generation from utility-scale facilities (1 megawatt or larger capacity), and all of it is wind power.<sup>84</sup>

are also several electric transmission line crossings at North Dakota's border with Canada. 86

making up nearly half of the power sales in the state, followed by the commercial sector, which accounted

North Dakota has substantial and nearly continuous wind energy resources. Wind power generation more

than doubled in the state from 2015 to 2023. In 2023, wind was the second-largest electricity generating

source in North Dakota and provided nearly two-fifths of the state's net generation. The state ranked sixth in

the nation in the share of its electricity generated from wind energy. 94,95 At the beginning of 2024, North

Dakota had about 4,000 megawatts of installed wind power generating capacity. Four of the state's top 10

power plants by generation are wind powered. The state's largest wind farm, located near Williston, has

about 300 megawatts of generating capacity and came online in early 2021. 96,97

capacity and five largest by the amount of electricity produced annually are coal-fired. 81,82 The rest of the state's electricity generation came primarily from

renewable resources, including wind energy, which supplied 36% of generation, and hydroelectric power, which provided about 4%. Natural gas fueled

5% of the state's electricity generation. The state does not have any nuclear power plants.<sup>83</sup> Independent power producers account for about one-fourth of

North Dakota generates more electricity than it consumes, and about half of the power generated in the state is sent to other states and Canada via the

regional electric grid.<sup>85</sup> Several high-voltage electric transmission lines connect North Dakota to Minnesota, Montana, South Dakota, and beyond. There

of the state. Oxidized lignite (leonardite), which is used in soil stabilization and as a drilling fluid additive, is also mined in North Dakota. 73,74,75

#### North Dakota ranks among the 10 states with the lowest total electricity sales. However, because of its small population and heavy electricity use in its energy-intensive industrial sector, the state has the highest per capita electricity sales.<sup>87</sup> In 2023, the industrial sector was North Dakota's leading electricity consumer,

Renewable energy

to provide back-up power. 103

for one-third. The residential sector, where about 4 out of every 10 households heat with electricity, accounted for almost one-fifth of the state's electricity sales. 88,89 In mid-2024, North Dakota had almost 100 public electric vehicle charging locations, the second-lowest number among the states after Alaska. Most of these charging locations are located in North Dakota's major cities of Fargo, Bismarck, and Grand Forks. 90,91 The state plans to use \$26 million in federal funds over five years through 2026 to help pay for charging locations spaced no more than 50 miles apart and within one mile of the exits along North Dakota's Alternative Fuel Corridors, which are the state's two interstates, I-94 and I-29. 92,93

North Dakota has undeveloped renewable energy resources, including geothermal and solar energy. 104 The state has moderate solar energy resources, but there is only a small amount of customer-sited, small-scale (less than 1 megawatt in capacity) electricity generation from solar photovoltaic (PV) energy systems, most of which comes from rooftop solar panels. North Dakota is one of two states, along with West Virginia, that has no utility-scale solar power generating facilities. 105,106,107 The western half of North Dakota has moderately favorable conditions for geothermal development, but the state has no utility-scale electricity generation from geothermal energy. 108,109 North Dakota's geothermal resources are used for direct applications, such as heating and cooling homes, schools, and other public buildings. 110

North Dakota is one of the top 10 fuel ethanol-producing states, and it manufactures about 3.5% of the nation's total ethanol. The state's five ethanol

production plants use mainly corn as feedstock and together can produce 532 million gallons of ethanol per year. 111,112,113 The state also has one

In 2007, North Dakota adopted a voluntary renewable energy goal. By 2015, electricity providers were to obtain 10% of the power they sold in the state

from renewably sourced generation or by recovering energy that is normally lost and using it to generate electricity. 117 The 10% goal was met several years

sources. 118 In 1991, North Dakota was one of the first states with a net metering program to allow households and businesses with small renewable energy

biodiesel production plant that uses canola oil as its primary feedstock and has a production capacity of 85 million gallons per year. 114,115,116

early and has been exceeded several times over. In 2023, about 40% of the electricity generated in North Dakota came from renewable energy

Hydropower contributed about 4% of North Dakota's in-state electricity generation in 2023. 98 The state's sixth-largest power plant based on generation is at

the Garrison Dam located on the Missouri River northwest of Bismarck. Construction of the Garrison Dam in the 1950s significantly reduced the extent of

amount of electricity can also be generated from the state's one utility-scale biomass-fueled facility, a 10-megawatt industrial unit that is typically on standby

serious flooding in the state. 99,100,101 The 510-megawatt Garrison generating facility is North Dakota's only utility-scale hydroelectric plant. 102 A small

systems and combined heat-and-power systems with up to 100 kilowatts in capacity to sell their excess electricity generated to investor-owned utilities. 119 **Energy on tribal lands** North Dakota is home to five federally recognized Native American tribes and one Indian community. 120 Two of the five reservations—Standing Rock and Fort Berthold—are among the nation's largest reservations at about 1.2 million acres each. 121 There are about 30,000 Native Americans living in North Dakota, making up about 5% of the state's population, and about 2% of the state's land area is tribal lands. 122,123

The Native American tribes of North Dakota have shared in the state's increased crude oil production. In 2023, crude oil production from all tribal lands

accounted for about 6 out of 100 barrels produced on federal leases and tribal lands combined, and much of that production came from wells on North

Dakota tribal lands. The Fort Berthold Reservation, home to the Mandan, Hidatsa, and Arikara nations—known as the Three Affiliated Tribes—is in the

center of the prolific oil-producing Williston Basin in the western part of North Dakota. 124,125 The wells on the Fort Berthold Reservation, which is the

largest reservation in the state, typically produce about 15% of the state's monthly oil output. 126,127,128 The Affiliated Tribes drilled the first tribe-owned

wells on the reservation in 2015. 129 In June 2023, the tribes purchased a 31-mile pipeline that is connected to a major nearby interstate crude oil pipeline,

which will transport 15,000 barrels per day of the tribe's crude oil produced on the Fort Berthold Reservation to U.S. markets. 130,131 The Affiliated Tribes

uses the captured natural gas from oil wells on the reservation for heat and electricity generation at new greenhouses constructed to grow almost 2 million

North Dakota's reservations have significant renewable resources. A 2020 report from Sandia National Laboratories found that the Turtle Mountain Band of

Chippewa Indians' reservation, located in north-central North Dakota near the Canadian border, had sufficient wind energy resources to provide electricity

to the tribe's casino and resort hotel. 134 The Standing Rock Sioux Reservation is rated among the top 10 tribal lands in the nation with the best wind and

solar resources for potential electricity generation. 135 The Standing Rock Sioux Tribe plans to build a 235-megawatt wind farm. The tribe received a

### \$725,000 grant from the U.S. Department of Commerce to pay for the evaluation and design of the proposed wind farm. 136,137,138 The tribe received a separate federal grant in 2021 to install public charging stations on the reservation for electric vehicles. 139 The Spirit Lake Tribe on the Fort Totten Reservation received a U.S. Department of Energy grant in August 2018 to help pay for a 1.5-megawatt wind turbine to provide most of the electricity used

**Endnotes** 

by 12 tribal facilities and 350 residential consumers. 140,141

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<sup>37</sup> North Dakota Pipeline Authority, Monthly Update, July 2024 Production & Transportation, p. 2-3.

<sup>38</sup> North Dakota Pipeline Authority, North Dakota Crude Oil Pipelines, accessed July 17, 2024.

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<sup>49</sup> U.S. EIA, State Energy Data System, Table F16, Total Petroleum Consumption Estimates, 2022.

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Coal

Nuclear

**Electricity** 

Consumption

**Total Energy** 

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pounds of vegetables a year. 132,133

The design of the school includes solar PV panels; ground-source geothermal heating and cooling; high-efficiency heat pumps; an energy recovery system; occupancy sensors; and LED and solar tube lighting, among other features. 142

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Energy efficiency projects have been undertaken on tribal lands in North Dakota as well. The Fort Totten School on the Spirit Lake Indian Reservation was

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