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North Dakota

State Profile and Energy Estimates

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HELP

Profile Analysis

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 (overview, data, & analysis)

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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.^{8,9} North Dakota's rich soils produce many crops, including corn used for ethanol production.¹⁰ 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.²⁰ 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-twelfth, and renewable energy, including biofuels, accounts for the remaining 4%.²¹

Petroleum

North Dakota ranks third in the nation, after Texas and New Mexico, in both crude oil reserves and production.^{22,23} Oil exploration in North Dakota began in the early 20th century, but the state's first oil discovery did not occur until 1951.²⁴ Production was modest until new drilling technologies—horizontal 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 thousand square miles that includes parts of North Dakota, South Dakota, Montana, and the Canadian provinces of Manitoba and Saskatchewan.²⁵ The 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

North Dakota is the third-largest crude oil producer in the nation.

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.^{28,29} Natural gas was produced in North Dakota as early as 1892, but significant commercial production was not established until 1929, when development of a Montana natural gas field extended into North Dakota. Sporadic development of the state's natural gas resources continued between the mid-1940s and the early 1980s.³⁰ 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.^{31,32}

North Dakota's new 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 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 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

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 one-third.^{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 third-highest 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}

North Dakota's natural gas gross withdrawals reached a record high of nearly 1.2 trillion cubic feet in 2023.

Coal

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 North Dakota contains the world's largest known deposit of lignite, which has the lowest heating value of all coal types and is mostly used to generate electricity. Coal has been mined at hundreds of sites in North Dakota since the 1870s, but now only lignite is produced at five active surface mines in the west-central part 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 contains the largest known deposit of lignite in the world.

All of North Dakota's mined lignite is used within the state by electricity generating plants and industrial users.⁷⁶ 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.⁷⁹ In addition, North Dakota uses coal to produce synthetic natural gas (SNG). The only commercial-scale coals-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.⁸⁰



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 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.⁸³ Independent power producers account for about one-fourth of North Dakota's electricity generation from utility-scale facilities (1 megawatt or larger capacity), and all of it is wind power.⁸⁴

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.⁸⁵ Several high-voltage electric transmission lines connect North Dakota to Minnesota, Montana, South Dakota, and beyond. There are also several electric transmission line crossings at North Dakota's border with Canada.⁸⁶

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.⁸⁷ In 2023, the industrial sector was North Dakota's leading electricity consumer, making up nearly half of the power sales in the state, followed by the commercial sector, which accounted 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 the highest per capita electricity sales in the nation.

Renewable energy

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}

Hydropower contributed about 4% of North Dakota's in-state electricity generation in 2023.¹⁰ 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 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 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 to provide backup power.¹⁰³

North Dakota has the sixth-largest share of total electricity generated from wind energy among the states.

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