Harvesting the Wind: Oklahoma's Strong Electricity Growth Has Few Agricultural Tradeoffs

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This edition of Oklahoma Economist examines where electricity is generated within the state, its effect on agricultural land, and what may lie ahead.

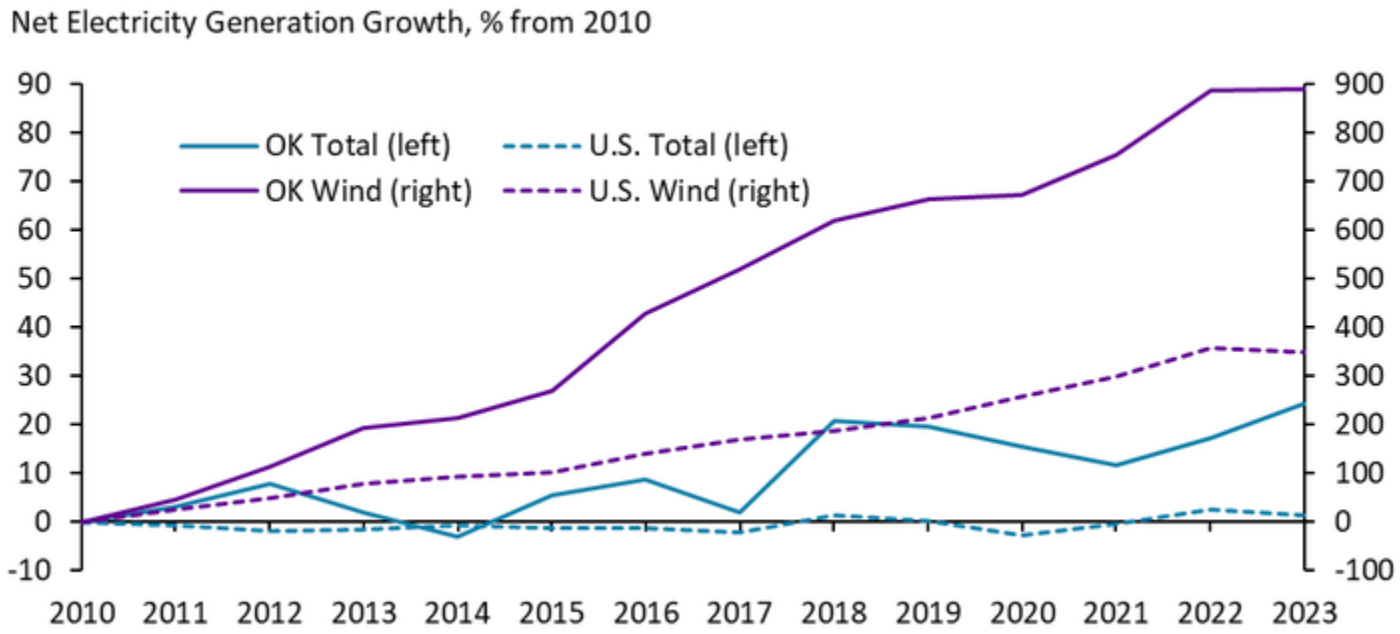
Oklahoma has long been known for its oil and gas production. But in recent decades, the state's electricity generation has increased principally from gains in wind energy. This edition of *Oklahoma Economist* examines where electricity is generated within the state, its effect on agricultural land, and what may lie ahead. It finds that, while the state has added substantial wind energy production, it has had a muted impact on land use. Moreover, wind capacity additions are slated at a slower pace in coming years, indicating that wind energy production is unlikely to spur future changes to the state's agricultural landscape.

Wind has driven Oklahoma's faster electricity generation growth than the nation

Historically, the United States has tapped numerous energy sources to meet rising energy demand, such as coal, natural gas, petroleum products, nuclear, and hydroelectric power. But in the past decade, renewable electricity sources—particularly wind and solar—have grown in function, productivity, and popularity as they produce electricity with lower carbon dioxide emissions.

Oklahoma's net generation of electricity increased by 25% from 2010 to 2023, while total U.S. net generation has stayed flat (Chart 1). Almost all of Oklahoma's net generation growth during this time was from wind energy, which was nearly ten times larger in 2023 than in 2010, while the U.S. in total only generated about 4.5 times more electricity from wind. In 2023, Oklahoma generated 89,900 megawatthours of electricity on net, 37,700 of which was from wind, making the state the third-largest wind electricity producer after only Texas and Iowa (Energy Information Administration, 2024).

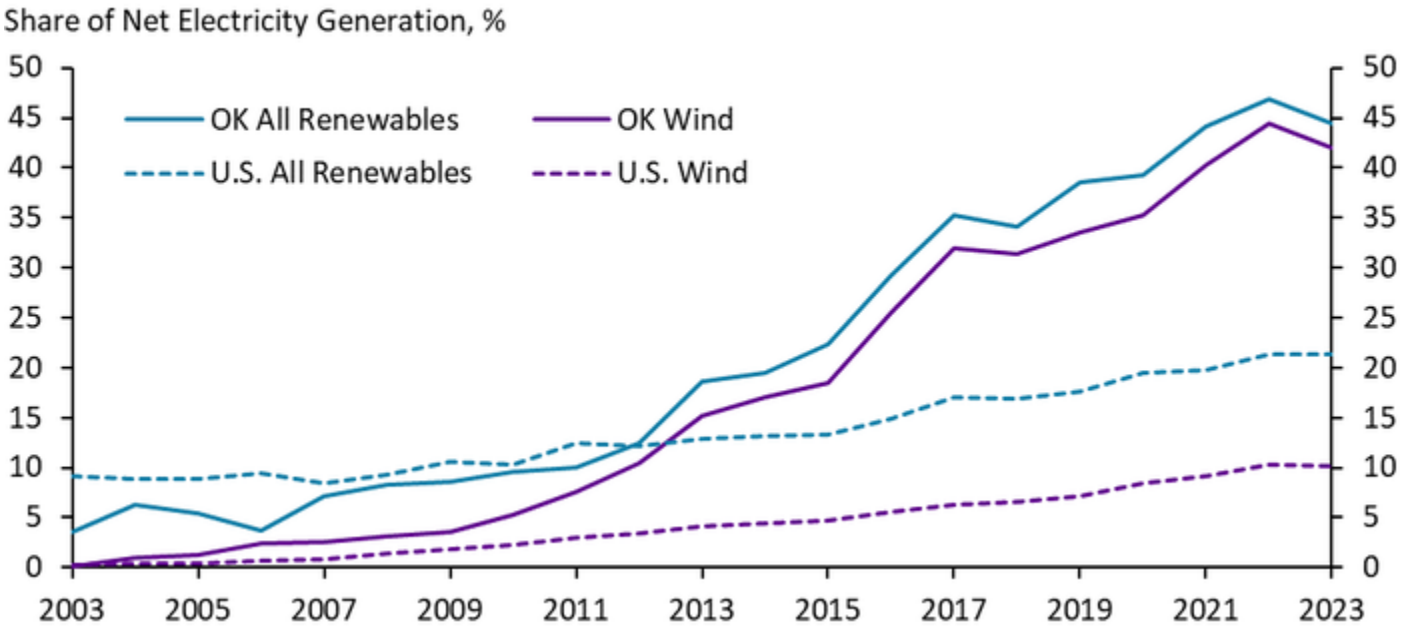
Chart 1: Net electricity generation has grown more in Oklahoma than the U.S. since 2010, driven by wind generation



Source: EIA

The proliferation of wind generation across the state also caused Oklahoma's renewable share of total electricity generation to overtake the national average. The state's renewable energy share was less than half the country's in 2003, at about 4% (Chart 2). In 2012, Oklahoma's share exceeded the nation's for the first time, and by 2023, it reached 44% while the national average was 21%. Wind energy accounts for nearly all of this increase in Oklahoma, as it made up 95% of all renewable electricity generation in 2023. The U.S. arsenal of renewable energy sources is much more diverse, with wind making up only 48% of all renewable electricity.

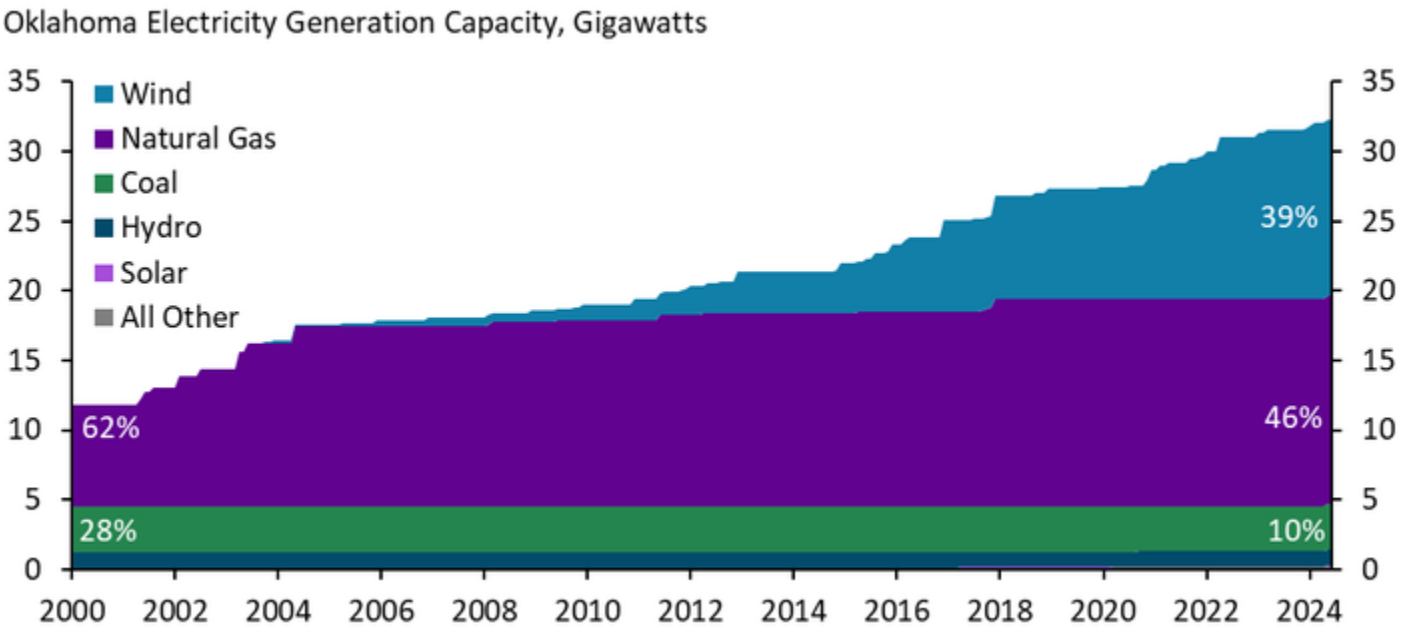
Chart 2: Oklahoma's renewable share of net electricity generation is now double the national average



Source: EIA

Despite wind's massive growth in the past two decades, natural gas—an abundant resource in Oklahoma—remains the state's most prevalent source of electricity generation. Wind energy accounted for 12.6 gigawatts of the state's total 20.4 gigawatt increase in electricity generation capacity from 2000 to June 2024, now bringing the total capacity to 32.2 gigawatts (Chart 3)[1]. In that time, wind's share of Oklahoma's total electricity generation capacity—the maximum output the state could possibly produce—increased from 0% to 39%. Natural gas accounted for nearly all the remaining 7.8 gigawatt gain in capacity, but its increases mostly stopped after 2004. In fact, natural gas's share of total capacity has declined from 62% in 2000 to 46% in 2024 due to wind's growth. Similarly, generation capacity from coal has not changed at all, but its share diminished from 28% in 2000 to just 10%.

Chart 3: Wind has accounted for almost all increases in total generation capacity in the past two decades, but natural gas remains the state's largest electricity source

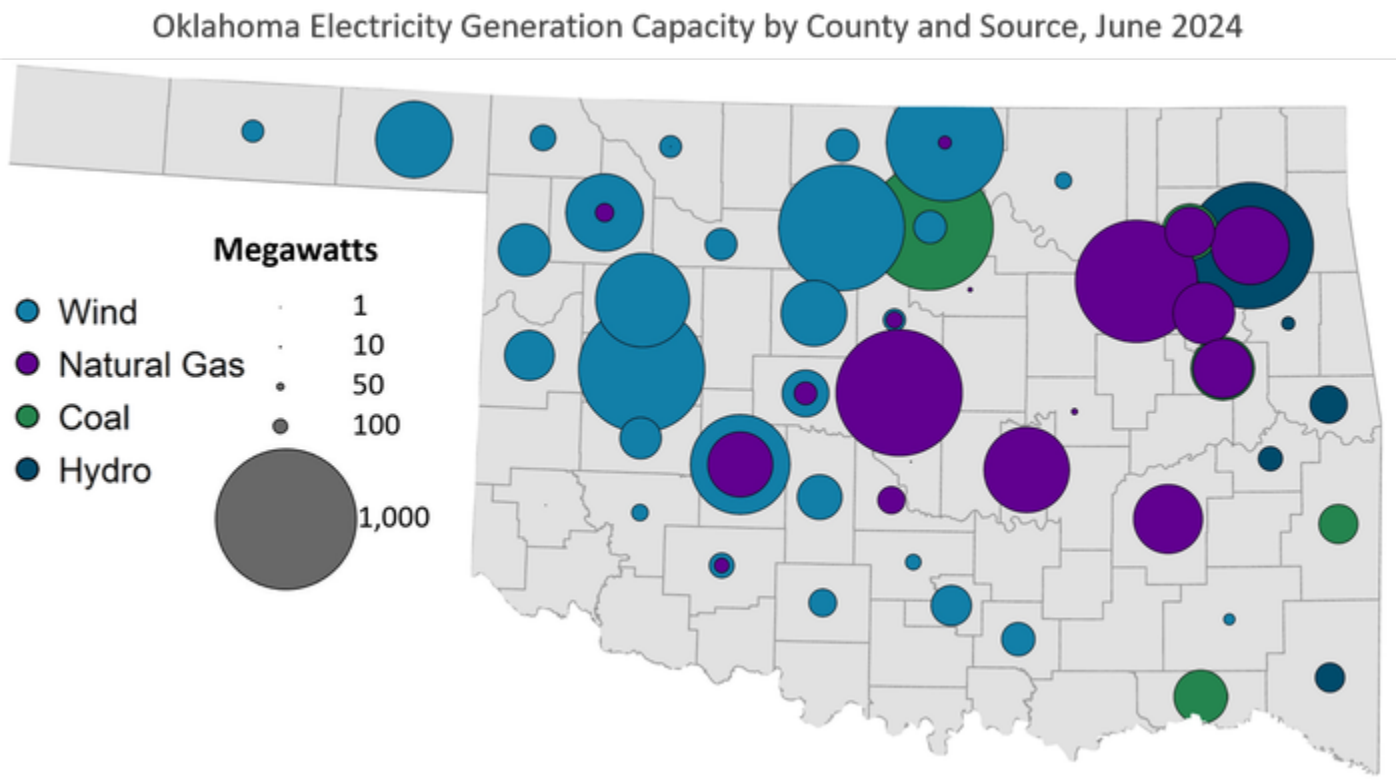


Note: Sum of net summer capacity is shown. Percentages on the left side represent the sources' share of total generation capacity in January 2000. Percentages on the right side represent the same for June 2024.
Source: EIA

Wind energy production has had a muted impact on agricultural land use

Perhaps unsurprisingly, Oklahoma's electricity generation is concentrated in areas with the requisite natural resources. Almost all the wind generation capacity lies in the windy, western half of the state (Map 1). The Weatherford, Enid, and Ponca City areas are the top three places for wind generation, each with around 1,100 megawatts of capacity. In contrast, natural gas electricity generation is primarily in the eastern half of the state, concentrated around the Oklahoma City and Tulsa metro areas. Oklahoma and Tulsa Counties are the state's largest natural gas electricity producers, each with approximately 2,200 megawatts of capacity. Coal and hydroelectric electricity generation are also located in eastern Oklahoma. Noble County in north central Oklahoma generates the most coal electricity, but the remainder of the coal and hydroelectric capacity is centered around the Tulsa metro area and the southeastern corner of the state.

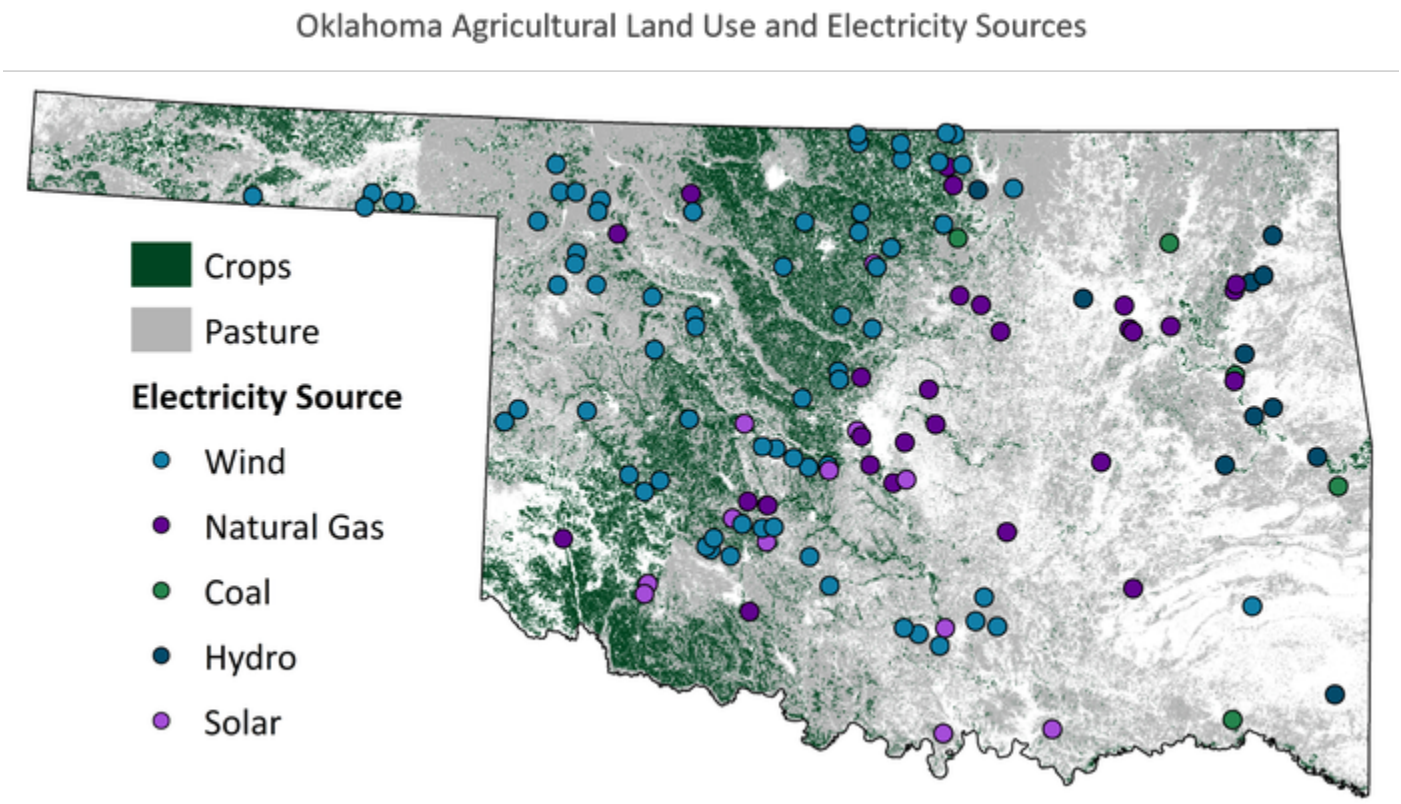
Map 1: Wind generation is concentrated in the windy western half of the state, while natural gas remains centered around Oklahoma City and Tulsa



Source: EIA

Wind electricity generation and crop production both require open and flat land, which provides both windy conditions and ideal ground for cultivation. Thus, wind and crops are typically harvested in the same areas in Oklahoma (Map 2). However, wind turbines do not substantially infringe on agricultural land area, as farm production uses much more space. Agriculture is the largest land use in Oklahoma, accounting for more than 70 percent of the state's 45 million acres. Roughly one-third of the state's farmland is dedicated to crops, with the remaining two-thirds designated as pastureland for livestock. Further, according to Maguire et al. (2024), the estimated footprint of wind farms covers only about 0.04 percent of all farmland in the United States.

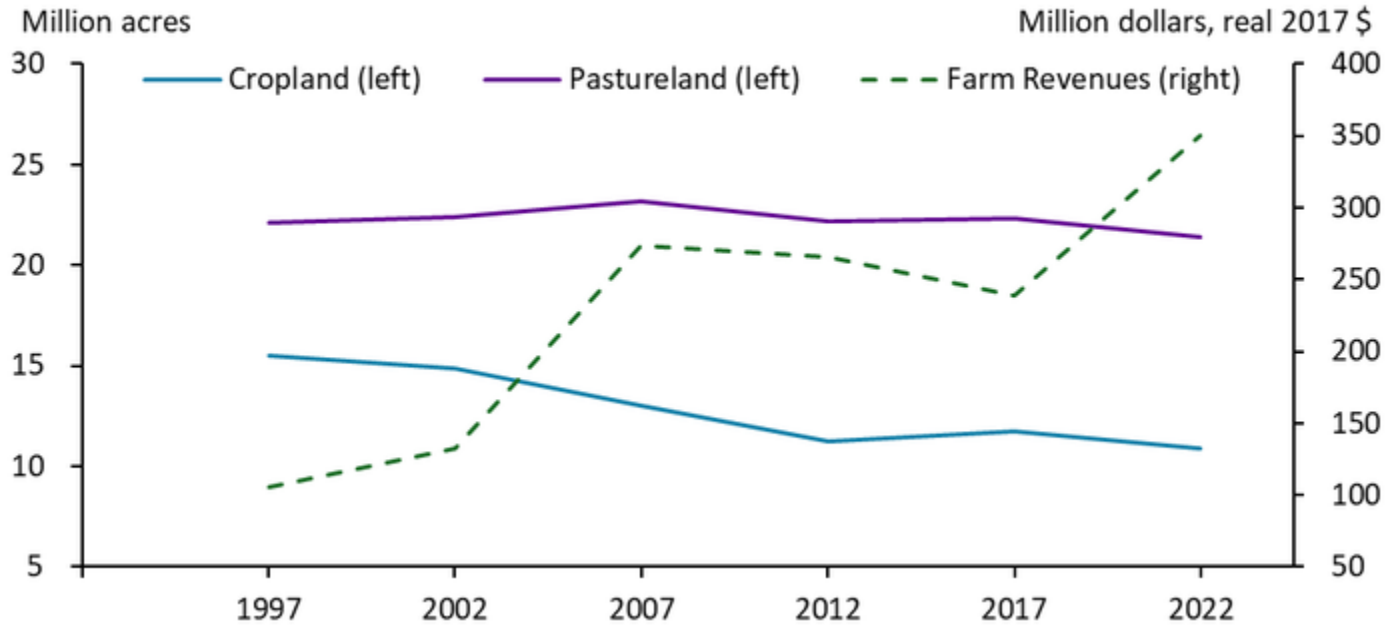
Map 2: Although wind and crops are typically harvested in the same areas in Oklahoma, wind turbines have had limited effects on agricultural production



Notes: The circles denote operational (257) and planned (9) electricity generation sources as of June 2024. Cropland and pastureland areas are from the USDA 2023 Cropland Data Layer, available at https://croplandcros.scinet.usda.gov/. Crops (dark green) include alfalfa, canola, cotton, corn, hay, millet, rye, sorghum, soybeans, winter wheat, and double-crop acres.
Sources: EIA and USDA

The sharp increase in wind electricity generation has had a limited effect on agricultural production in the state. Cropland area in Oklahoma has declined slightly over the past two decades, while pastureland area has remained relatively more constant (Chart 4). However, the largest declines in cropland occurred from 2002 to 2012, prior to the largest expansions of wind energy production. In addition, despite slight declines in cropland, farm revenues in Oklahoma have continued to trend upward. Farm revenues in 2022 were four times larger than in 1997.

Chart 4: Cropland area in Oklahoma has declined slightly over the past two decades, while pastureland area has remained relatively more constant



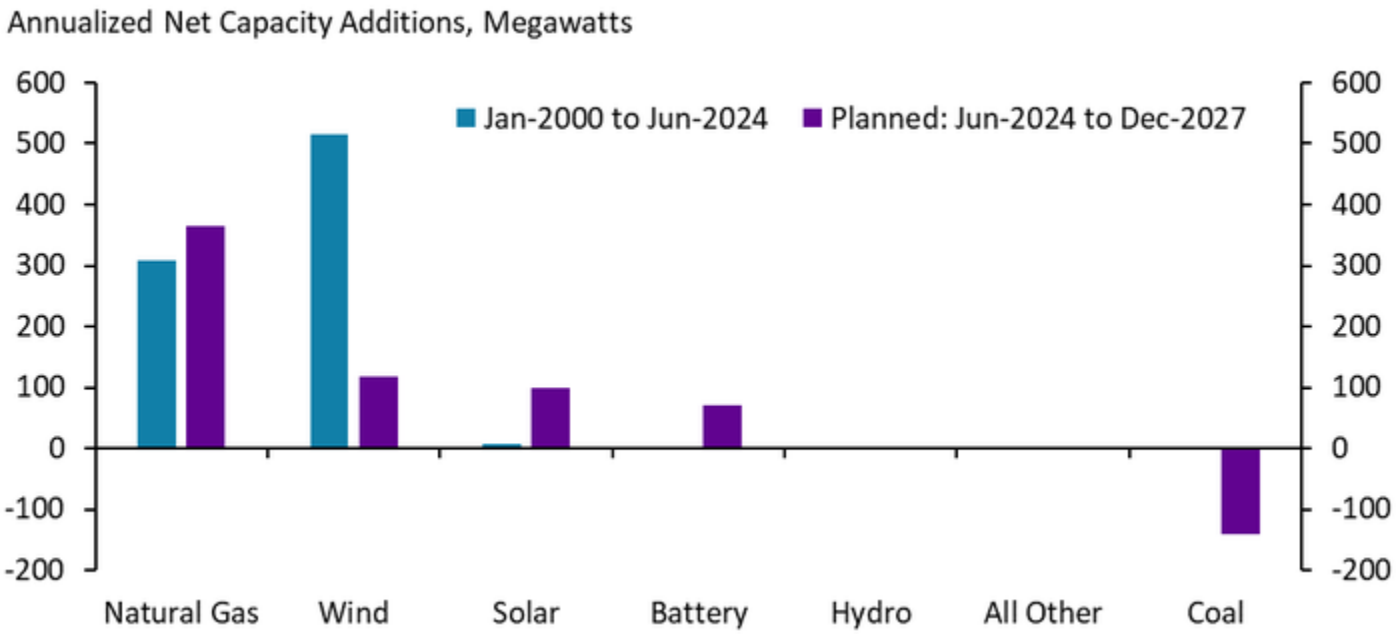
Source: USDA

Aside from energy development, other factors that may have affected agricultural land use in the state include an economic recession in the early 2000s, urban development, farm retirements, and historic drought in 2011 and 2012. Moreover, solar electricity generation has been shown to create more competition for agricultural land than wind. In fact, approximately 15 percent of land surrounding solar farms is typically shifted out of agricultural production (Maguire et al. 2024). However, solar still makes up a smaller footprint, overall, than wind nationwide and a much smaller share of electricity generation in the state. Also, of the solar farms that are planned or operational in Oklahoma, only half are located on or around cropland.

Looking ahead

Despite major expansions of wind electricity generation over the past decade, natural gas remains Oklahoma's top source of electricity generation, and this is not expected to change in coming years. Increases in the state's wind electricity generation capacity are planned at a much slower pace through 2027, while other sources anticipate faster growth. Oklahoma added 516 megawatts of wind electricity capacity each year since 2000 on average but is only expected to add 119 megawatts annually through 2027 (Chart 5). By contrast, natural gas is set to add 364 megawatts of capacity a year through 2027, an acceleration from recent years. Additionally, the state is slated to add 100 megawatts of solar capacity a year and 72 megawatts of battery capacity annually. No further coal capacity additions are currently planned, and overall capacity is set to decline by around 141 megawatts due to the retirement of one coal plant.

Chart 5: Further additions in wind capacity are planned to slow, while picking up slightly for natural gas



Note: Annualized net capacity additions are calculated as net additions and retirements in net summer capacity.
Source: EIA

Oklahoma's energy landscape has evolved considerably over the past two decades, but that has not necessarily caused similar evolutions in its agricultural landscape. Wind electricity generation has increased tenfold since 2010, now making up close to two-fifths of the state's total generation capacity. However, the direct impacts of wind electricity generation on agricultural land seem to be muted, with both cropland and pastureland declining only 3% from 2012 to 2022. Further, wind electricity capacity is set to increase at a far slower pace in the next three years, and thus will most likely not have a large effect on agricultural production in the future.

Further reading

Agricultural Economic Summit Highlights Growing Connection Between Agriculture and Energy

Endnotes

[1] 1 gigawatt = 1,000 megawatts.

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Cortney Cowley serves as Oklahoma City Branch Executive and Assistant Vice President for the Federal Reserve Bank of Kansas City. Cowley joined the Bank in 2015 as an economist and was promoted to senior economist in 2021. In 2025, Cowley began her role as Branch Executive.As Oklahoma City Branch Executive, Cowley is the Bank's lead officer and economist in Oklahoma. She recruits and works closely with the Oklahoma City Branch Board of Directors and is responsible for briefing Kansas City Fed President Jeff Schmid, a member of the Federal Open Market Committee, on economic trends in the state. She also serves as a special advisor on agriculture to Vice Chair for Supervision Miki Bowman at the Federal Reserve Board of Governors. Cowley's team conducts research and surveys on key regional issues such as energy, manufacturing and migration.Cowley holds a Ph.D. in Agricultural Economics from Oklahoma State University, as well as a master's degree in Civil Engineering from Colorado State University and a bachelor's degree in Biosystems Engineering from Oklahoma State University, where she was named a Harry S. Truman Scholar. She is a member of the Economic Club of Oklahoma, Downtown Club of Oklahoma City, the Agricultural and Applied Economics Association and serves as an economic advisor on the campaign cabinet of the United Way of Central Oklahoma. Cowley, along with her husband and eight-year-old twins, lives on a small farm northwest of Oklahoma City.

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