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Natural Gas Saves Water and Reduces Drought Vulnerability, Even When Factoring in Water Lost to Hydraulic Fracturing

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AUSTIN, Texas — A new study finds that in Texas, the U.S. state that annually generates the most electricity, the transition from coal to natural gas for electricity generation is saving water and making the state less vulnerable to drought.

Even though exploration for natural gas through hydraulic fracturing requires significant water consumption in Texas, the new consumption is easily offset by the overall water efficiencies of shifting electricity generation from coal to natural gas. The researchers estimate that water saved by shifting a power plant from coal to natural gas is 25 to 50 times as great as the amount of water used in hydraulic fracturing to extract the natural gas. Natural gas also enhances drought resilience by providing so-called peaking plants to complement increasing wind generation, which doesn't consume water.

Water Savings from Fuel Shift

For every gallon of water used to produce natural gas through hydraulic fracturing



Texas saved 33 gallons of water by generating electricity with that natural gas instead of coal (in 2011)

Illustration: Univ. of Texas at Austin

The results of The University of Texas at Austin study are published this week in the journal *Environmental Research Letters*.

The researchers estimate that in 2011 alone, Texas would have consumed an additional 32 billion gallons of water — enough to supply 870,000 average residents — if all its natural gas-fired power plants were instead coal-fired plants, even after factoring in the additional consumption of water for hydraulic fracturing to extract the natural gas.

Hydraulic fracturing is a process in which water, sand and chemicals are pumped at high pressure into a well to fracture surrounding rocks and allow oil or gas to more easily flow. Hydraulic fracturing and horizontal drilling are the main drivers behind the current boom in U.S. natural gas production.

Environmentalists and others have raised concerns about the amount of water that is consumed. In Texas, concerns are heightened because the use of hydraulic fracturing is expanding rapidly while water supplies are dwindling as the third year of a devastating drought grinds on. Because most electric power plants rely on water for cooling, the electric power supply might be particularly vulnerable to drought.

"The bottom line is that hydraulic fracturing, by boosting natural gas production and moving the state from water-intensive coal technologies, makes our electric power system more drought resilient," says Bridget Scanlon, senior research scientist at the university's Bureau of Economic Geology, who led the study.

To study the drought resilience of Texas power plants, Scanlon and her colleagues collected water use data for all 423 of the state's power plants from the Energy Information Administration and from state agencies including the Texas Commission on Environmental Quality and the Texas Water Development Board, as well as other data.

Since the 1990s, the primary type of power plant built in Texas has been the natural gas combined cycle (NGCC) plant with cooling towers, which uses fuel and cooling water more efficiently than older steam turbine technologies. About a third of Texas power plants are NGCC. NGCC plants consume about a third as much water as coal steam turbine (CST) plants.

The other major type of natural gas plant in the state is a natural gas combustion turbine (NGCT) plant. NGCT plants can also help reduce the state's water consumption for electricity generation by providing "peaking power" to support expansion of wind energy. Wind turbines don't require water for cooling; yet wind doesn't always blow when you need electricity. NGCT generators can be brought online in a matter of seconds to smooth out swings in electricity demand. By combining NGCT generation with wind generation, total water use can be lowered even further compared with coal-fired power generation.

The study focused exclusively on Texas, but the authors believe the results should be applicable to other regions of the U.S., where water consumption rates for the key technologies evaluated — hydraulic fracturing, NGCC plants with cooling towers and traditional coal steam turbine plants — are generally the same.

The Electric Reliability Council of Texas, manager of the state's electricity grid, projects that if current market conditions continue through 2029, 65 percent of new power generation in the state will come from NGCC plants and 35 percent from natural gas combustion turbine plants, which use no water for cooling, but are less energy efficient than NGCC plants.

"Statewide, we're on track to continue reducing our water intensity of electricity generation," says Scanlon.

Hydraulic fracturing accounts for less than 1 percent of the water consumed in Texas. But in some areas where its use is heavily concentrated, it strains local water supplies, as documented in a 2011 study by Jean-Philippe Nicot of the Bureau of Economic Geology. Because natural gas is often used far from where it is originally produced, water savings from shifting to natural gas for electricity generation might not benefit the areas that use more water for hydraulic fracturing.

Scanlon's co-authors at the Bureau of Economic Geology are Ian Duncan, research scientist, and Robert Reedy, research scientist associate. The bureau is a research unit in the Jackson School of Geosciences at The University of Texas at Austin.

The Jackson School helped fund the research along with the State of Texas Advanced Resource Recovery (STARR) program, a state-funded program managed by the Bureau of Economic Geology.

The University of Texas at Austin is committed to full transparency and disclosure. Bridget Scanlon has received research funding in the past from various governmental, nonprofit and private organizations such as the Texas Commission on Environmental Quality, NASA, the National Science Foundation and Shell International Exploration and Production Inc. Ian Duncan has received research funding in the past from various governmental, nonprofit and private organizations such as the U.S. Department of Energy, the Sloan Foundation and Shell International Exploration and Production Inc. Robert Reedy has received research funding in the past from various governmental, nonprofit and private organizations such as the Texas Commission on Environmental Quality and Shell International Exploration and Production Inc."

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