

## A one-two punch: Joint effects of natural gas abundance and renewables on coal-fired power plants

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SINCE 2007, coal-fired electricity generation in the U.S. has declined by a stunning 25%. At the same time, natural gas-fired generation and wind generation have dramatically increased due to technological advances and policy interventions. The increased utilization of natural gas-fired generation is likely due to the decrease of natural gas prices, resulting from increased supply from hydraulic fracturing extraction techniques. The increase in renewable generation is likely driven by state-level renewable portfolio standards, federal production and investment tax credits, and technological advances. The authors analyze the joint impact of natural gas prices and wind generation on coal generation to better understand the effectiveness of overlapping energy and environmental policies.

The authors develop a statistical model to estimate the operations of generators across four transmission regions within the U.S. In contrast to previous studies, the analysis is conducted across several regions and gives a much more comprehensive view of generator responses. Specifically, this analysis focuses on how gas prices and renewables interact to affect daily operating decisions (the “operating margin”). Based on the daily availability of wind power on the system and the relative prices of natural gas and coal, Independent Systems Operators (ISO) will utilize generation from specific fuel sources. For example, low natural gas prices may lead to more coal on the “margin, meaning coal generation would be offset by increased wind generation. Alternatively, since natural gas turbines are well suited for

ramping in response to intermittent wind resources, more natural gas generation may be dispatched to handle the volatility associated with higher levels of wind generation.

The authors find that low natural gas prices and increased wind generation have both led to reductions in coal-fired generation. Additionally, the authors find evidence of an interaction effect where the combination of natural gas prices and wind generation led to a greater reduction in coal-fired generation than would be explained by either factor alone. These results suggest that multiple policies (such as carbon pricing combined with policies that increase wind generation) would be complementary and have an increased impact on coal-fired generation.