Is Abundant Natural Gas a Bridge to a Low-carbon Future or a Dead-end?

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Executive summary

In recent decades, there has been a dramatic boom in natural gas production in the United States, spurred by the hydraulic fracturing ("fracking") technological innovation. Fuel switching away from coal (and to a lesser extent oil) to natural gas can reduce emissions from electricity generation due to the lower carbon content of natural gas, raising the possibility of natural gas as a "bridge" to a lower-carbon future. However, many have argued that while a large-scale transition to natural gas may reduce emissions in the short-run, it may increase emissions in the long-run by leading to lock-in of a low-cost emitting technology. This paper uses a large-scale energy-economic model of the United States—the National Energy Modeling System (Yale-NEMS or NEMS on a Yale server)—to assess the extent to which abundant natural gas affects greenhouse gas emissions, local air pollution, and welfare, and the effectiveness in reducing emissions relative to climate policy.

We first develop an economic theory model that illustrates how adding natural gas could either increase or decrease emissions and elucidates the theoretical links between the outcomes from the computational model. The theory framework clearly lays out the welfare effects, identifying the economic forces of driving welfare. Second, we use the modeling platform Yale-NEMS to tackle our research question from both economic and environmental perspectives. Yale-NEMS is an ideal tool for our analysis because of its granularity and comprehensiveness. Third, we calculate the welfare effects of abundant natural gas both with and without a carbon policy, including monetized CO_2 and other air pollutants impacts. Finally, we examine the winners and losers of an abundant natural gas scenario, accounting for both direct welfare and environmental effects from greenhouse gas and air pollution emissions based on recent air quality modeling work.

We find that our abundant natural gas does significantly reduce local air pollutant but not greenhouse gas emissions, while at the same time providing a large welfare benefit. However, the reduction in emissions is modest relative to what a carbon price (e.g., from a carbon tax) could achieve. Furthermore, as we approach 2050, emissions under the abundant natural gas scenario are even slightly higher than the reference case due largely to less deployment in renewables. We examine heterogeneous welfare effects across regions, illustrating that while all regions see welfare gains from abundant natural gas (regardless of whether there is a carbon policy), there is substantial heterogeneity in the welfare effects across regions. Our welfare estimates are subject to the caveat that we cannot quantify all of the potential local impacts of natural gas production and distribution, but illustrative calculations suggest that even if these are included, the welfare benefits would remain large. Our bottom-line finding is that abundant natural gas should not be seen as a "bridge" to a low-carbon future, but rather as a source of welfare improvements.

Keywords welfare; natural gas revolution; distributional impacts; carbon pricing.

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