

Additional Questions for the Record

The Honorable H. Morgan Griffith

1. Chemical manufacturing is very important to my district and natural gas is a vital feedstock to that industry. What will unlimited natural gas exports do to domestic gas prices?
 - a. How will that impact home heating and electricity prices?
 - b. How will it impact U.S. manufacturing?

Answer: In the Reference cases analyzed in the recent NERA report on the Macroeconomic Impacts of LNG Exports we found that if DOE put no limits on exports, price increases would average something less than 25 cents per million BTU, or about a 4% increase over Reference Case wellhead prices of about \$6 per million BTU. Delivered prices of natural gas for home heating are around \$10 per million BTU in much of the country, so that the average homeowner would experience at most a 2% increase in natural gas bills. Given the inherent variability in natural gas prices from one month to the next due to weather or other factors, this would be difficult to separate out from other movements in natural gas prices.

The effect of natural gas price increases on electricity prices will vary across the country, depending on whether customers are served by utilities under traditional cost of service regulation or by so-called competitive markets in which the price of electricity moves with the price of natural gas whenever natural gas is the marginal source of generation. The effect of natural gas price increases on electricity prices in these regions will depend on their generation mix and their ratio of peak to off-peak consumption. We did not model impacts on electricity prices, but a reasonable estimate can be made by comparing the increase in natural gas prices between EIA's Reference Case and High Oil and Gas Resource Case in AEO2014 to the difference in residential electricity prices between the two scenarios. A \$2 per million BTU difference in natural gas prices led to an increase of about 10% in electricity prices. Applying the same proportion to the estimated \$0.25 per million BTU increase in natural gas prices attributable to unlimited exports provides an estimate of the impact of unlimited exports on electricity prices. The result is that if DOE put no limit on exports of LNG, residential electricity prices might be expected to increase by about 1.25%, again a change difficult to differentiate from normal weather related variation in bills.

In our study, price increases of this magnitude or even larger have an almost undetectable effect on the rate of growth in U.S. manufacturing. Growth in all manufacturing sectors remains robust with or without natural gas exports, and changes in the growth rates are in the undetectable range of hundredths of a percentage point.

2. I understand that stable and affordable gas prices are allowing energy intensive manufacturers to expand and invest in the U.S., and that the foreign companies are relocating advanced manufacturing facilities to the United States. Can you discuss this trend and the impact that unlimited exports would have?

Answer: The relative advantage that U.S. chemical and other manufacturers have gained over rivals in other countries that must import natural gas had clearly driven expansion of the chemicals industry and investment in chemical and related facilities. As I discussed in my testimony, U.S. manufacturing has moved from being the world's high cost producer of bulk chemicals like ethylene to being one of the lowest cost. According to the American Chemicals Council, the U.S. chemicals industry has about a 60 cent per pound advantage in the cost of producing ethylene over its next closest large rival, China. The price increases attributable to LNG

exports in our reference case would close this gap by just over a penny. Even the largest natural gas price increases we found in highly unlikely scenarios would take away only 5 out of the 60 cent advantage.

And these calculations assume that the price of the natural gas byproduct that is actually used to produce ethylene and related chemicals would move penny for penny with natural gas prices. This byproduct is a natural gas liquid called ethane, and as shale gas production has increased, the supply of ethane has increased faster than the capacity to use it. As a result, the price of ethane has fallen relative to the price of natural gas, and this contributes greatly to the attractiveness of the U.S. as a location for chemical manufacturing. Exports of LNG, by increasing production of both natural gas and ethane, would likely drive the price of ethane down further. Thus increased exports served by increased production, as we find they would be, will actually benefit U.S. chemicals producers. Canadian chemical producers recognized this years ago, and as a result have been enthusiastic supporters of Canadian LNG exports.

The competitive position of other, advanced manufacturing concerns in the U.S. is a much more complex question. The increase in output of manufacturing industries other than chemicals has coincided with the shale gas revolution and the decline in natural gas prices from their peaks, but at the same time the U.S. is recovering from the recession and an increase in manufacturing investment would be expected in a period of recovery. The share of natural gas in the cost of most U.S. manufacturing industries is relatively small—5% or less—and less in relative importance than labor costs or impacts of regulations. A change in industrial natural gas prices of 5% -- which is more than we think likely due to even unlimited exports—would increase manufacturing costs by less than $\frac{1}{4}$ of 1%, and would not have a noticeable effect on the competitive position of manufacturing in general.

Additional Questions for the Record

The Honorable Cory Gardner

1. If the federal government were to restrict in any manner or eliminate hydraulic fracturing nationwide, what would this scenario do to liquefied natural gas exports?

Answer: The Low Oil and Gas Resource case that we considered in NERA's study of the Macroeconomic Impacts of LNG Exports illustrated how restrictions on hydraulic fracturing could reduce LNG exports even if DOE automatically approves all applications. In this case, production of shale gas would be reduced by 4 tcf from the reference case with no such restrictions, and LNG exports would fall from a maximum of 1.6 tcf in the reference case in 2028 to 0.7 tcf.

We did not include a scenario in which shale gas production is reduced to zero in our study, but it is a question of great interest. We recently did a new model run to examine what would happen in the reference case if shale gas production were eliminated from 2018 onward. We found that a ban on fracking would drive LNG exports from the lower 48 states to zero. Even with no exports, the price of natural gas to consumers would be driven up by from 50% to 100% by a ban on fracking, with the more severe impacts likely if new coal-fired generation is prohibited. A ban on fracking would also have impacts on energy-intensive manufacturing sectors, in which natural gas use would fall by about 30% compared to the reference case in which fracking is allowed.