Memorandum

To: The Honorable H. Morgan Griffith and The Honorable Gene Green

From: Ken Ditzel

Date: May 14, 2014

cc:

Subject: Responses to Additional Questions for the Record

The Honorable H. Morgan Griffith and The Honorable Gene Green:

I appreciate the opportunity to elaborate on the testimony I submitted to the Subcommittee on Energy and Power on March 25, 2014. Below I have provided the complete text of the questions you have asked in bold and have provided responses to your questions in plain text. Please let me know if further clarification is required for any of my responses.

Sincerely,

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Responses to Questions submitted by The Honorable H. Morgan Griffith

I would like to be sure that I understand your point about LNG net back pricing and the influence of crude oil linked LNG prices; including the role of OPEC in this.

In the US, natural gas prices are determined by supply and demand. What I understand you are saying is that suppliers of crude oil, including OPEC countries have linked the price of LNG to it. So that if crude oil prices go up, so does the price of LNG.

Your net back argument implies that the price of US natural gas would have to rise to about $8 per mm Btu before it would reach parity with crude oil-linked LNG prices at $15-$16.

1. Is that right? Are most of the LNG prices linked to crude oil?

U.S. Henry Hub gas prices would need to rise to $10/MMBtu before reaching parity with *current*, crude oil-linked LNG prices of $15-$16/MMBtu *in Asia on a netback basis*. I arrive at a $10/MMBtu netback price by subtracting $5-$6/MMBtu for liquefaction and shipping from the $15-$16/MMBtu for LNG spot prices in Asia.

In my February 3, 2014 presentation entitled "Evaluation of the 2014 Annual Energy Outlook Early Release: Implications for U.S. LNG Exports and Natural Gas Prices", I show on page 16 that a high U.S. export scenario would increase annual Henry Hub gas prices to ~$8/MMBtu on average (not accounting for seasonal volatility) by 2020. This assumes the EIA's 2014 Annual Energy Outlook Early Release's forecast for Brent crude and an 80% linkage of Asian LNG prices to Brent.

To answer the second part of this question, 90% of LNG is tied up in contracts with at least four years remaining on the contract, and a vast majority of LNG *that is under contract* is linked to crude oil. The LNG that is not under contract is traded at spot prices, which are dictated by regional market conditions. It is worth noting that the LNG under contract can be sold at spot too if the buyer decides it is economically rational to do so.

2. Chemical manufacturing is very important to my district and natural gas is a vital feedstock to that industry. What will unlimited natural gas exports to do domestic gas prices?

With unlimited LNG exports, U.S. gas prices will no longer be based on the current North American supply and demand situation and instead will be based on the global market for gas. This means that unlimited natural gas exports will expose the U.S. to netback pricing. I define netback pricing as the market price representing the highest willingness to pay (Asian prices) less liquefaction and shipping costs. Again, using the EIA's forecast for Brent crude prices, Asian LNG will be ~$14/MMBtu in 2020 (in current dollars), which means netback price of ~$8/MMBtu at the Henry Hub on average in 2020 (in current collars).

a. How will that impact home heating and electricity prices?

If LNG demand growth were to surprisingly slow down and/or Asian countries were to quickly develop their gas resources in an economically competitive manner, unlimited exports could almost double Henry Hub gas prices from current levels by 2020. This in turn could double the fuel cost portion of home heating bills by 2020. Because home heating bills include both fixed (e.g., infrastructure costs) charges and variable charges (e.g., fuel), the final impact on the total bill would be less than a doubling.

b. How will it impact U.S. manufacturing?

If gas prices were to double, the U.S. manufacturing renaissance would end. The reason is that coal-based manufacturing in Asia and gas-based manufacturing in the Middle East (where prices are subsidized) would be more favorable relative to U.S. gas-intensive

manufacturing. This is what occurred in the 2000s when the U.S. faced high gas prices – the industrial flight to Asia and the Middle East ensued.

c. 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?

In the February 2013 CRA report[1], I pointed out that there was more than $90 billion of planned gas-intensive manufacturing that had resulted from the stable and affordable gas prices created by the shale boom. This investment level was a conservative estimate as others have commented that the number could be much larger. These investments represent new builds, expansions of existing facilities, bringing idled facilities back on-line, and physically re-locating facilities to the U.S. from other countries. In terms of a trend, the expected growth in manufacturing is a complete reversal from the 2000s when gas-intensive manufacturing output and jobs contracted.

It is important to note that for the same amount of gas consumed, manufacturing delivers twice the GDP impact and more than eight times the number of jobs than LNG exports. The reason is that much more of the value-added stays within the U.S. With unlimited exports, these manufacturing benefits are at risk because U.S. manufacturing cannot compete at $8/MMBtu gas (in current dollars), whereas LNG exports from the U.S. can compete at $8/MMBtu once the LNG export facilities are built.

[1] *US Manufacturing and LNG Exports: Economic Contributions to the US Economy and Impacts on US Natural Gas Prices.* Ditzel, K., Plewes, J., and Broxson, B., February 25, 2013.

Responses to Questions Submitted by The Honorable Gene Green

1. How is natural gas priced in different parts of the world?

Gas pricing in the three primary markets – North America, Europe, and Asia – varies considerably. The factors driving prices in these markets are threefold: 1) the marginal cost of supplying gas, 2) the varying degrees of gas-on-gas competition, and 3) the connection to the global gas market.

In the U.S. gas prices ($4-$5/MMBtu) are much lower than Europe (~$9/MMBtu) and Asia (~$16/MMBtu) because of favorable marginal gas well economics (due to shale), high gas-on-gas competition, and almost no connection to the world gas market with the except of some LNG imports into the Northeast.

In the European market, there is gas-on-gas competition much like the U.S.; however, marginal well economics are higher which explains why European spot gas prices are almost twice current Henry Hub price levels. Europe also has extensive pipeline connections to external regions, which fosters gas-on-gas competition. These pipeline resources are less expensive than LNG imports, which explains why Europe only uses a small percentage of its LNG import capacity.

In the Asian market, there is very little gas-on-gas competition. The largest global LNG consumers – Japan and Korea – have little to no gas production and have no pipeline access. The two largest LNG growth markets – China and India – have relatively small levels of gas production. China and India have potential to develop gas resources, but the resources currently are prohibitively expensive. Thus, refined oil products are the direct substitute for gas and drive the oil linkage.

2. When signing contracts, how many years constitute a "long-term" LNG contract?

Traditionally, LNG export contracts have been long-term and oil-indexed. Recently, major importers in Asia met to discuss a buyer's club. These countries are attempting to band together in an effort to increase negotiating power and lower prices. Also, there has been a 25% increase since 2000 in short-term, hub-priced contracts. Some economists expect more flexibility and negotiation to take place as new contracts come online and old contracts are renegotiated.

Many of the tolling agreements that have been negotiated for U.S. LNG exports have been for twenty years, which is a typical period for a "long-term" contract in the energy industry. Contract structures will vary depending on the market conditions. For example, many contracts for U.S. LNG exports have been linked to Henry Hub prices. This contracting mechanism is an attempt to stabilize prices for the LNG buyers, but it does not mean it will work once the U.S. gas market becomes interconnected with the global gas market. It is also worth noting that suppliers facing much higher investment costs than the U.S., such as Mozambique and Australia, likely will require an oil-linkage to ensure adequate return on investment as there is no liquid domestic trading hub by which to index. Therefore, the LNG oil linkage is not expected to go away any time soon.

3. **Does your analysis include any shift in contracting?**

U.S. producers have also entered into agreements by which they must meet certain criteria to ensure financing and future credit.

No, my analysis does not include any shift in contracting for U.S. gas producers. The CRA North American gas model will only add an additional well if full return on investment can be achieved. The model assumes balanced capital markets and does not account for how loose or rigid capital markets may be.

4. Does your research and analysis include any information on economic incentives or financial structures relating to U.S. natural gas producers?

Yes, my analysis does take into account tax advantages afforded to natural gas producers. These include accelerated depreciation and expensing of intangible drilling costs.