Natural Gas and the U.S. Fertilizer Industry

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Outline of Presentation

• Brief Intro on Fertilizer
• Focus on N Production
  – Anhydrous Ammonia
• Impact of Increased U.S. Natural Gas Prices
• Climate Change Legislation
• Concluding Remarks
Contributions of the Domestic Fertilizer Industry

- Fertilizer nutrients account for 40-60% of total crop production!
  => Enable the U.S. to feed the world; without it, the U.S. (and world) would have to plant 2X as many acres, which is impossible, or have significantly less agricultural output which would result in higher food prices and significantly more world hunger!

- Agriculture is one sector in the U.S. budget accounts where we have a POSITIVE trade surplus. Fertilizer is one of the primary inputs which makes our highly productive agriculture possible!

- In addition to it’s SIG contribution to AG, domestic fertilizer Prod:
  - Creates a total of 245 thousand U.S. jobs!
  - Provides a total U.S. economic contribution of over $ 58 Billion!
NPK

**NITROGEN (N)**

is a primary building block for all organisms. It is essential to making proteins, helps keep plants green and is a critical component of soil structure.

**COMES FROM THE AIR**

**PHOSPHORUS (P)**

is found in every living cell. Phosphorus is a component of DNA and it also plays vital roles in capturing light during photosynthesis, helping with seed germination, and helping plants use water efficiently. Plants also use phosphorus to help fight external stress and prevent disease.

**COMES FROM ANCIENT SEA LIFE**

**POTASSIUM (K)**

is essential to the workings of every living cell. It plays an important role in plant’s water utilization and also helps regulate the rate of photosynthesis. Other aspects of plant health influenced by potassium include the growth of strong stalks, protection from extreme temperatures, and the ability to fight stress and pests such as weeds and insects.

**COMES FROM EVAPORATED OCEANS**
Share of World Crop and Fertilizer Products Traded, 2008

- Rice: 6%
- Corn: 11%
- Wheat: 21%
- Cotton: 28%
- Soybeans: 36%
- AN: 20%
- Urea: 23%
- Nit. Sol. Phosphate: 30%
- Amm. Sulf.: 33%
- TSP: 48%
- Potash: 77%

Fertilizer materials are commodities!

Source: USDA, IFA.
Anhydrous ammonia production

- Source of the nitrogen in fertilizer
- Haber-Bosch process (Fritz Haber/Carl Bosch)
- Combines N (atmosphere) with H (natural gas)
- 32.5 MMBtu’s natural gas per ton ammonia
Natural Gas Required to Produce a Ton of Anhydrous Ammonia

1983 to 2006 => 11 % increase in efficiency

Source: TFI.
Natural Gas as a Share of Total Anhydrous Ammonia Production Cost

2004-08: $5.64 - $8.84 MMBtu
What Happened the Last Time U.S. Natural Gas Prices Increased?

Source: Spot-delivered-to-pipeline price, Natural Gas Week.
Cumulative U.S. Ammonia Plant Closures vs. Natural Gas Prices

Source: Blue, Johnson and Associates, IFDC, Natural Gas Week and The Fertilizer Institute.
U.S. Nitrogen Sources - Ammonia Production and N Imports

Source: U.S. Department of Commerce and The Fertilizer Institute.
Most imports from countries with no climate change legislation!
U.S. Retail Fertilizer Prices Reach Record

Increase of 356 percent

Source: National Agricultural Statistics Service, USDA.
Spot delivered-to-pipeline Natural Gas Prices

Average Gas Price:

1985-1999: $1.97/MMBtu
2000-2008: $6.03/MMBtu

Source: Monthly Average, Natural Gas Week.
Potential Impact of Climate Change Legislation on:

1. The Domestic Fertilizer Manufacturing Industry:
   - Direct Impacts – cost of CO2 emissions allowances
   - Indirect: Higher domestic energy (natural gas, electricity) prices

2. U.S. Agricultural Production Costs:
   - Doane Study
   - USDA Estimates
   - Increased Energy and other Input Prices

   - Crops
   - Livestock
Energy Use

Nitrogenous Fertilizer Manufacturing

- Natural Gas (Fuel), 38.0%
- Natural Gas (Feedstock), 59.4%
- Electricity, 2.4%
- Other, 0.2%

About 97% of energy use is in the form of natural gas which is purchased largely from producers.

Source: EIA Manufacturers Energy Consumption Survey - 2002
Where do we get our electricity?

Nitrogenous Fertilizer Manufacturing

Local Utility* 97.4%

Other** 2.4%

*‘Local Utility’ is an entity that produces and/or delivers a particular energy source

**‘Other’ includes independent producers, brokers, marketers, and marketing subsidiaries of utilities; for the case of electricity sources, also include small power producers and cogenerators not located at the establishment site.

Source: EIA Manufacturers Energy Consumption Survey - 2002
Where do we get our natural gas?
(fuel and feedstock)

Nitrogenous Fertilizer Manufacturing

Local Utility*
0.2%

Other**
99.8%

*‘Local Utility’ is an entity that produces and/or delivers a particular energy source
**‘Other’ includes independent producers, brokers, marketers, and marketing subsidiaries of utilities; for the case of electricity sources, also include small power producers and cogenerators not located at the establishment site.
Source: EIA Manufacturers Energy Consumption Survey - 2002
Costs of Potential Climate Change Legislation to U.S. Fertilizer Manufacturers

Nitrogen Fertilizer production would be impacted in four major ways:

1. Through the direct cost of allowances the industry would need to purchase to offset emissions – estimated cost of $1.02 - 1.43 billion, before free allowances*

2. Through the indirect increase in electricity costs (through suppliers’ purchases of emission allowances and through cogeneration of electricity) - potentially covered under current proposed bill

3. The unknown impact of fuel switching which will inevitably raise the price of natural gas – estimated cost of hundreds of millions of dollars

Nothing in the bill to cover this => A competitiveness (survival) issue!

4. 1. – 3. above place the domestic industry at a competitive disadvantage relative to foreign producers from countries with no climate change laws because most foreign producers do not have to deal with these cost increases!

* Computed using 2008 nitrogen production data and a CO₂ cost of $25-$35/ton.
Costs to U.S. Fertilizer Manufacturers - continued

Phosphorous and Potash Producers Will Also Be Impacted:

Phosphorous:
- Through the direct cost of allowances the industry would need to purchase to offset emissions from the production of phosphoric acid;

Potash:
- Through the unknown impact of fuel switching which will inevitably raise the price of natural gas, which is used in the drying process.

Nothing in current proposed bills to cover ANY of these costs!
Purchased Natural Gas (fuel and non-fuel use) as a percent of industry's value of shipments - Top 10

Source: EIA Manufacturers Energy Consumption Survey - 2002

Formula used: \(((\text{natural gas fuel use} + \text{natural gas non-fuel use}) \times \text{Price}) / \text{Value of Shipments}\)

Data years used:
- Prices - 2002 (latest data available)
- Total fuel use - 2002 (used to make fair comparison)
- Value of Shipments - 2002 (used to make fair comparison)

Note: Green bars represent industries that are not listed in EPA’s list of presumptively eligible sectors.
Purchased nonfuel (feedstock) Natural Gas - 2006

Nitrogenous Fertilizers 43.8%

Other Basic Organic Chemicals 18.5%

Industrial Gases 12.1%

Other Basic Inorganic Chemicals 7.9%

Phosphatic Fertilizers 2.1%

Carbon Black 2.6%

Plastics Materials and Resins 2.8%

Iron and Steel Mills 2.6%

Ethyl Alcohol 0.5%

All Other 5.4%

Noncellulosic Organic Fibers 1.8%

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Source: EIA - 2006 Manufacturing Energy Consumption Survey (MECS) (latest available data)

Note 1: "All Other" includes: all other industries that are estimated to use less than 0.5TBtu natural gas

Note 2: Industry ranked using 6-digit NAICS code level
Climate Change: Issues for the Fertilizer Industry

- **Fuel Switching** – The Natural Gas Industry is advocating for government subsidies to close old coal fired plants. Natural gas to pick up excess capacity.

- Increased natural gas demand puts upward price pressure on critical feedstock for fertilizer production.

- Higher U.S. natural gas prices increase vulnerability to international nitrogen and phosphate fertilizer competition.
Coal: 48.5%
Natural Gas: 21.6%
Nuclear: 19.4%
Hydroelectric Conventional: 6.0%
Other Renewables: 2.5%
Petroleum Liquids: 1.2%
Petroleum Coke: 0.4%
Other Gases: 0.3%
Other: 0.1%
Petroleum Liquids: 1.2%
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Net Generation of Electricity by Energy Source - 2008

Source: EIA
### U.S. Natural Gas Consumption by End Use

<table>
<thead>
<tr>
<th>Category</th>
<th>2008</th>
</tr>
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<tbody>
<tr>
<td>Lease and Plant Fuel</td>
<td>1.28</td>
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<tr>
<td>Lease Fuel</td>
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<tr>
<td>Plant Fuel</td>
<td>-</td>
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<td>Pipeline &amp; Distribution Use</td>
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<td>Volumes Delivered to Consumers</td>
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<tr>
<td>Residential</td>
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<tr>
<td>Commercial</td>
<td>3.12</td>
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<tr>
<td>Industrial</td>
<td>6.62</td>
</tr>
<tr>
<td>Vehicle Fuel</td>
<td>0.03</td>
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<tr>
<td><strong>Electric Power</strong></td>
<td><strong>6.66</strong></td>
</tr>
<tr>
<td><strong>Total Consumption</strong></td>
<td><strong>23.21</strong></td>
</tr>
</tbody>
</table>

Source: EIA Data
Electricity Generator Nameplate Capacity – 2007

- **Natural Gas**: 41.3%
- **Coal**: 30.9%
- **Nuclear**: 9.7%
- **Hydroelectric Conventional**: 7.1%
- **Petroleum**: 5.7%
- **Pumped Storage**: 1.9%
- **Wind**: 1.5%
- **Other**: 1.8%
- **Petroleum Conventional**: 5.7%
- **Other**: 1.8%

Source: EIA
U.S. Electricity Generation Capacity from Natural Gas

Capacity - 2008

Number of Generators: 5,439
Generator nameplate: 449,389 Megawatts
Net Summer: 392,876 Megawatts
Net Winter: 422,184 Megawatts

Ave. Summer/Winter: 407,530 Megawatts

Total capacity: 3,423,252 thousand Megawatt hours

= 407,530 Megawatts * 24 hrs./day * 350 days/yr.

Source: EIA.
U.S. capacity to generate electricity from natural gas
2008 Ave. Net Summer/Winter

Total electricity generation capacity from natural gas: 3,423.3 thousand MWh

Available Capacity 74.4%

2008 Actual Consumption (876.9 thousand MWh) 25.6%

Source: EIA

Required 6.66TCF – 29% of total U.S. – Natural Gas Demand!
There is ample capacity to produce more electricity from natural gas and significant electricity production currently from coal which natural gas can displace for natural gas demand in electricity production to rise significantly!
Snippets from EIA’s Annual Energy Outlook 2009 with projections to 2030

• “In addition to ongoing uncertainty with respect to future demand growth and the costs of fuel, labor, and new plant construction, it appears that capacity planning decisions for new generating plants already are being affected by the potential impacts of policy changes that could be made to limit or reduce GHG emissions.”

• “Instead of relying heavily on the construction of new coal-fired plants, the power industry constructs more new natural-gas-fired plants, which account for the largest share of new power plant additions, followed by smaller amounts of renewable, coal, and nuclear capacity.”

Stage is already being set for an increase in natural gas demand!
CONCLUSIONS

- Domestic Fertilizer Production Makes a Significant Contribution to U.S. Agriculture and the U.S. economy:
  - Accounts for 40-60 percent of crop production – feed world + Ag. trade surplus;
  - Creates a total of 245 thousand U.S. jobs!
  - Provides a total U.S. economic contribution of over $58 Billion!

- Climate Change Legislation Will Significantly Raise Production Costs of the U.S. Fertilizer Industry, Particularly for the Nitrogen Sector:
  - Increases the Uncertainty of running the business - number of free allowances?;
  - What will be the cost of the allowances: $25/ton CO2?, $30?, $35?, $40?
  - Increased energy costs – electricity and especially natural gas, where the rise in price will add hundreds of millions of dollars to production costs!
  - Higher costs will significantly impact the international competitiveness of industry!
  - Will place thousands of productive jobs in rural America at risk!

- The Increase in Fertilizer Production Costs, Energy Prices, and other Farm Input Costs which rise with Energy Prices Will Lead To:
  - Significantly Higher Domestic Crop Production Costs;
  - Significantly Higher Livestock Production Costs;
  - And Significantly Lower Farm Income!
Thank you! Any questions?