Worried About High N Prices?

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Nitrogen - A Simplified Flow Diagram

Natural Gas

33.5 MMBtu/ton

Anhydrous Ammonia (NH₃)

Nitric Acid (NA)

Nitrate (AN)

Liquid Ammonium Nitrate (AN)

Nitric Acid (NA)

Liquid Urea (UR)

Carbon Dioxide (CO₂)

33.5 MMBtu/ton

0.29 t/t

0.22 t/t

0.58 t/t

0.78 t/t

0.80 t/t

0.45 t/t

0.35 t/t

1.01 t/t

Prill Tower or Granulator

UAN Solution 28-32% N (UAN)

Prill Tower or Granulator

Solid Urea

Ammonia

Nitric Acid

Ammonium Nitrate

UAN Solution

Solid Urea

Fertilizers & Industrial Sales

Industrial Sales

Fertilizers & Explosives

Fertilizers

Fertilizers, Feeds & Industrial Sales

Source: PotashCorp
NYMEX Natural Gas Prices

Source: Monthly Closing gas prices
Natural Gas Prices

January 2002 - December 2005

$ Per MMBtu

Henry Hub Price

Actual

PIRA Forecast

January 2002 - December 2005
NYMEX US Natural Gas Futures Prices
October 16, 2003

Source: NYMEX
<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>Per Cent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Res/Commercial</td>
<td>22.04</td>
<td>22.85</td>
<td>+3.7</td>
</tr>
<tr>
<td>Electric Generation</td>
<td>15.11</td>
<td>13.75</td>
<td>-9.0</td>
</tr>
<tr>
<td>Industrial</td>
<td>20.11</td>
<td>18.89</td>
<td>-6.1</td>
</tr>
<tr>
<td>Ammonia</td>
<td>1.14</td>
<td>0.90</td>
<td>-21.1</td>
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<tr>
<td>Misc.</td>
<td>5.17</td>
<td>5.17</td>
<td>0.0</td>
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<tr>
<td>Total</td>
<td>62.42</td>
<td>60.67</td>
<td>-2.8</td>
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</table>
1997-2003 Nitrogen Market
Driving Factors

- High U.S. natural gas prices
- Record increase in world nitrogen capacity
- China’s ban on urea imports
- Collapse of the Russian ruble (i.e. natural gas prices)
US Ammonia Production is About 25% Curtailed

- PotashCorp Geismar and Memphis still down
- Koch’s Sterlington plants are still down
- Terra’s Blytheville ammonia/urea brought back to 80% (was shut down on July 1)
- Miss Chem’s Donaldsonville Ampro plant is still down
- Miss Chem’s Donaldsonville Triad facility and Yazoo City 3 are up (Yazoo City 4 is still down).
- Dakota Gas’ Beulah, ND plant down for $3.5 million of repairs

Source: Industry Publications
U.S. Annual Nitrogen Production Capacity

Million Tons

Estimate

Actual
New Ammonia Capacity vs Demand
Cumulative Growth

Million Tonnes Product

Source: Fertecon

Several Projects uncertain
Longer-Term Outlook

U.S. natural gas prices are expected to moderate but remain above historical averages. This will likely result in:

- Increased reliance on imports
- Further consolidation of U.S. industry
  - Industrial ammonia suppliers along Gulf coast likely to close and rely on imports
  - Some urea capacity likely to close due to increased offshore competition

Tightening world balance and access to large domestic market, however, will allow the bulk of the industry to remain competitive.
Y2K + 4 outlook

- Low commodity prices?
- Some inflation
- Large fertilizer price increases?

Possible strategies
- Cut inputs?
- Continue past practices?
- Evaluate and allocate for best returns
Corn grain yield response at Arlington 1990’s

Yield (bu/a)

N rate (lb/a)
Economic Optimum N Rate (EONR)

\[
\text{Cost of last increment of N added} \quad = \quad \text{Value of yield increase produced}
\]
## Calculation of economic optimum N rate for 1990’s Arlington corn data

<table>
<thead>
<tr>
<th>N rate</th>
<th>Actual Yield</th>
<th>Yield Increase</th>
<th>Increased Corn Value</th>
<th>Increased Fertilizer Cost</th>
<th>Increased Return</th>
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<tbody>
<tr>
<td>60</td>
<td>161.4</td>
<td>9.8</td>
<td>24.50</td>
<td>4.00</td>
<td>20.50</td>
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<td>80</td>
<td>169.2</td>
<td>7.8</td>
<td>19.50</td>
<td>4.00</td>
<td>15.50</td>
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<tr>
<td>100</td>
<td>175.0</td>
<td>6.8</td>
<td>17.00</td>
<td>4.00</td>
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<td>120</td>
<td>178.8</td>
<td>3.8</td>
<td>9.50</td>
<td>4.00</td>
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<tr>
<td>140</td>
<td>180.6</td>
<td>1.8</td>
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<td>4.00</td>
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<tr>
<td>160</td>
<td>180.8</td>
<td>0.2</td>
<td>0.50</td>
<td>4.00</td>
<td>(3.50)</td>
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<tr>
<td>180</td>
<td>180.5</td>
<td>-0.3</td>
<td>(0.75)</td>
<td>4.00</td>
<td>(4.75)</td>
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Calculated at corn to N fertilizer price ratio of 12.5:1.
Check yield 126 bu/a
EONR only changes slightly with N cost or corn value changes

- Steep response curve
- Broad top plateau
- EONR not related to yield
- Needed 0.78 lb N/bu
Optimum N rates for northern Illinois sites 1999-2002

<table>
<thead>
<tr>
<th>location</th>
<th>corn - corn</th>
<th>soybean - corn</th>
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<tbody>
<tr>
<td></td>
<td>optimum N rate</td>
<td>yield N/bu</td>
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<tr>
<td></td>
<td>lb/a</td>
<td>bu/a</td>
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<tr>
<td>Perry</td>
<td>127</td>
<td>132</td>
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<tr>
<td>Urbana</td>
<td>187</td>
<td>161</td>
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<tr>
<td>Monmouth</td>
<td>173</td>
<td>174</td>
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<tr>
<td>DeKalb</td>
<td>206</td>
<td>159</td>
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</table>

*40 lb “soybean” credit added to calculate this ratio for corn following soybean. Adapted from Nafzigen et al, 2003.
Principles of N fertilizer economies

1. EONR generally insensitive to value/price changes

2. EONR is best rate if supply and capital are unlimited = largest total return

3. “Other” N reduces EONR

4. First units applied provide biggest per unit returns

5. Management value increases in tough times
Beating Y2K + 4

- Use the EONR or slightly less
- Credit all N sources
- Guard against N losses
- Treat each management unit individually
- Grow the best possible crop