ENERGY AND NUTRIENT SUPPLIES

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Abstract

A study by the Potash and Phosphate Institute on 2.5 million North American soil samples has determined that soil nutrients have been withdrawn without adequate replacement for several years. Soil fertility levels have dropped below optimum. At the same time, energy prices have skyrocketed, increasing fertilizer production costs. The presentation explains natural gas supply/demand, and how it affects both the price for natural gas and the production costs for fertilizers. The impact of this price hike on nitrogen production and markets is looked at in depth, along with strategies for dealing with the increase. The presentation concludes with a look at how the energy provided by members of the fertilizer industry has improved the world.

Slide 1: PotashCorp P: Good morning, and my thanks to the North-Central Extension Industry Soil Fertility Conference for the privilege of speaking to you today.

Slide 2: Title Slide: My subject is "Energy and Nutrient Supplies." An overview of this important area is very timely, as soil fertility has fallen below optimal levels at the same time that energy prices have increased and appear to be stabilizing at substantially higher prices than in the recent past.

Slide 3: Presentation Overview: We'll begin by exploring energy's impact on agriculture. Then we'll examine its importance to the three major nutrients, potash, phosphate and nitrogen. With potash, we'll review the part energy plays in low- and high-energy production processes and the effect higher prices would have on each. Moving on to phosphate nutrients, we'll determine energy's share of DAP production costs and how those costs are affected when energy prices rise. Finally, we'll focus on nitrogen by examining the changes in natural gas markets that have pushed gas prices up substantially, and how these changes have affected both US nitrogen markets and international trade in nitrogen nutrients.

We'll conclude the presentation with a brief look at how we can improve the public perception of an industry that should require no work on its image – since it helps feed the world's 6 billion people. We call this "Fertile Minds."

Slide 4: Agriculture: Let's start with agriculture, where the energy used in planting and harvesting and in producing and applying fertilizers is a vital component in the process of turning seed into productive crops for the world's tables.

Slide 5: Soil Fertility: To achieve stable, high yields, crops must have access to the complete range of nutrients at a rate that supports such high production. Each harvest removes nutrients from the soil so commercial fertilizers are applied annually to restore and maintain soil fertility. At least that's the theory.

Slide 6: Low Potassium Nutrient Levels: In practice, some farmers are treating soil nutrient reserves like a bank. When crop prices are down, they draw funds from these reserves by postponing fertilizer application. This provides ready cash but puts off the necessary replenishment of soil nutrients, bringing the soil bank account closer to the "insufficient funds" line. Crops may not receive enough balanced nutrients to achieve optimum yields. After some years of this "mining" the soil, yields could plunge just as prices rebound.

The Fertilizer Institute, TFI, did a major study in 2001 to determine how current North American soil nutrient levels of potassium and phosphate compare to optimum levels. It consolidated analytical results from 2.5 million soil samples collected in Canada and the US.

This map indicates how the soils measured up in potassium nutrient. The yellow areas represent states and provinces where 40% or more of the soil samples had medium to low potassium content. Adding potassium to the soils in these areas would provide a yield response. For several years, more nutrients have been removed from North American soils than were replaced, so 43% of the soil samples analyzed medium to low.

Slide 7: Low Phosphate Nutrient Levels: Mining soils of their phosphate nutrient has been going on even longer. This map shows that very few areas have soils with good levels of phosphate. Overall, 47% of the soil samples were in the medium to low range where additional phosphate would provide a yield response.

Recent practices have reduced the level of both nutrients and the energy stored in the soil nutrient bank.

Slide 8: Conservation Tillage: Conservation tillage saves energy in several ways. First, it reduces fuel costs. Switching from mold board plowing to conservation tillage saves 2 gallons of diesel fuel per acre. The trash cover left on the soil reduces moisture loss, saving irrigation costs and providing crops with higher moisture levels that improve production. Conservation tillage also reduces soil erosion, conserving soil fertility and reducing the amount of energy required to maintain optimum fertility levels.

Slide 9: Ethanol: The clean-burning energy source ethanol has an important role in our future. The ethanol manufacturing plant in this photo is located in Minnesota, where it converts locally grown corn into around 30 million gallons of ethanol each year. It also processes the spent corn to produce a high-quality cattle feed.

The corn used as a feedstock for ethanol production has taken in energy from the sun and from fertilizer and used it to convert air, water and nutrients into starches that store considerable energy. They are perfect raw materials for producing ethanol.

As a clean-burning source of energy, ethanol will replace environmentally-damaging petroleum-based products and help reduce our dependency on foreign energy sources.

Slide 10: Ethanol Replacing MTBE: MTBE, a gasoline additive produced from petroleum, is blended with gasoline to provide a source of oxygen. This allows the gasoline to burn more cleanly.

minimizing pollutants. However, MTBE is itself a pollutant that contaminates groundwater. Ethanol can replace it as a source of oxygen in gasoline, without being potentially harmful to the environment.

California has passed laws requiring the elimination of MTBE by the end of 2003, and other states are looking at following its lead.

The switch from MTBE to ethanol as an oxygenate in gasoline will require a great deal of corn for ethanol production. Converting just the state of California to ethanol will require another 1.8 million acres of corn, on top of the 80 million acres the US currently plants. If ethanol replaced MTBE in all the gasoline consumed in the US, a total of 6.3 million additional acres would have to be planted to corn.

Slide 11: US Ethanol Capacity: With the explosion in US ethanol capacity as 14 new plants are added to the existing 62, demand has increased for the energy contributed by corn to the production of ethanol. Industry consultants project that Washington will, in the next few years, mandate the use of 5% ethanol content in all US gasoline to protect the environment and reduce our dependency on foreign oil imports. This could triple the demand for ethanol over the next 10 years.

Slide 12: Ethanol Production Cost vs Corn Cost: We are all happy to see crop prices finally beginning to move up, providing farmers with a better return for their energy expenditure and brightening the future for the fertilizer business. However, higher corn prices will push up the cost of ethanol production, for corn is by far the major input. One bushel produces just over 2.5 gallons of ethanol. The long-term price for ethanol is projected to be about $1.25 per gallon, which will cover production costs with corn at $2.00 per bushel. The byproduct cattle feed produced adds a credit of about 45 cents per gallon of ethanol production, which will cover production costs up to a corn price of $3.00 per bushel. When government incentives to use ethanol are added to the equation, it appears that there is room for corn prices to move up to more desirable levels and also for increased ethanol production.

(Aside: We have probably all wondered whether the farming and production inputs required to produce a gallon of ethanol will result in a deficit. Does ethanol production consume more energy than is contained in the ethanol? A USDA study concluded that recent improvements in crop yields and in ethanol production technology result in ethanol providing 34% more energy than it consumes. If this doesn't seem like a wide enough margin, we need to look at gasoline. The expense involved in finding and developing oil reserves and refining the crude to produce gasoline means that gasoline contains 26% less energy than it consumes.)

Ethanol converts the energy stored by corn into a product that helps conserve our environment and reduce our dependency on foreign oil imports. The demands it will place on our corn production will require increased energy in the form of fertilizer to maintain soil fertility. Our need for energy stored in the form of ethanol will also stabilize corn prices, providing farmers with a higher return for their efforts.

Slide 13: Potash Fertilizer and Energy: Now let's look at energy's impact on the three nutrients. We'll start with potash, where production processes require differing levels of energy consumption, and compare the effect of an energy price increase on low- and high-energy production processes.

Slide 14: Low--Energy Process two photos, borer and flotation: The low-energy process consists of conventional underground mining of the potash ore with boring machines. and conventional concentration of the ore on surface using flotation.

Slide 15: High-Energy Process Solution Mining Schematic and Crystallization: The high-energy process consists of solution mining of the ore, pumping the hot solution from wells to the mill, and recovering potash using crystallizers.

Slide 16: Impact of Energy Price Increase: This slide compares the effect of higher energy costs on the two processes. The electricity price rises from 3.8 to 6 cents per kilowatt hour and the price of natural gas from $3 to $4 per MMBtu.

Energy is approximately 25% of total costs for the low-energy process. including operations, depreciation and taxes. Higher energy prices push that share up to 31%.

With the high-energy process, energy is now 45% of total costs. Higher prices would raise that to 53%.

Slide 17: Phosphate Fertilizer: We'll move now to phosphates and determine the impact of energy on DAP costs.

Slide 18: Energy Cost Increase Impact on DAP Cost: Energy is consumed in DAP production to mine phosphate rock, to convert the rock to phosphoric acid, to produce ammonia, and to combine the phosphoric acid and the ammonia to produce DAP. In the low-energy cost case, electricity is 4 cents per KWH and natural gas is $3.50/MMBTu, while in the higher cost case, electricity is 6 cents and gas is $4.50/MMBTu. Higher energy prices pushes energy from 25% of operating costs to 36%.

Slide 19: Nitrogen: Now we'll look at the last of the three nutrients, nitrogen. We'll examine in some depth the changes in the markets for natural gas, and how they have affected nitrogen production economics and international trade.

Slide 20: Nitrogen Flow Sheet: Natural gas is a major input into the production of ammonia, which is then used to make the downstream products urea, nitric acid, ammonium nitrate and UAN solutions. The energy in natural gas is transformed into the energy in the nitrogen nutrients used by crops.

Slide 21: Natural Gas and Ammonia Costs: The price of natural gas has a major impact on the cost of producing nitrogen fertilizers. At $2/MMBtu, gas makes up 75% of the $100 per short ton cash cost of producing ammonia. If gas goes to $4/MMBtu, the cost of ammonia production jumps to $166 and gas makes up 82% of the cash cost.

Slide 22: Natural Gas: As natural gas plays such a vital role in the cost of nitrogen nutrients, we'll look at the gas markets more closely to understand the recent changes and see where we may be headed.

Slide 23: World Gas Reserves: While natural gas is found all over the world, it is not evenly distributed. Eastern Europe, the FSU and the Middle East together have close to three-quarters of known gas reserves, while North America has only 4%.

Slide 24: World Gas Consumers: The picture is reversed when it comes to consumption. The US, with only a small percentage of known reserves, is the world's largest consumer of gas.

Slide 25: Reserve Life: What do low reserves and high consumption mean? Canada, which exports 60% of its gas production to the US, currently has about nine years of reserves. The US has about seven years. This doesn't mean we'll be out of gas in that time, but it does mean our reserves are being used quickly and an ongoing program of drilling for new gas is required. What's more, all the low-hanging fruit has already been picked, meaning that our exploration costs are going to be higher.

Slide 26 US Drilling Rig Count: Industry analysts advise that at present, a gas price of $3-$3.50 is required to cover exploration costs and provide a profit covering the risks. The chart shows the impact of the recent gas price spike on the number of natural gas drilling rigs in operation, and shows how changes in the number of rigs lags behind gas price changes. A gas price reduction to between $2 and $3 led to a sharp drop in the rig count, and when prices subsequently increased, the rig count also picked up again, to over 700 rigs.

Slide 27: US Gas Storage: The orange line indicates the current level of natural gas in the storage caverns. We presently have a comfortable margin over the low yellow line that led to the gas spike in 2000. However, industrial gas consumption declined as the economy slowed, and as the economy returns to normal growth we can expect consumption to pick up, putting more pressure on natural gas production and on prices.

Slide 28: Natural Gas vs Ammonia Price: As we saw earlier, the natural gas price has a big impact on the ammonia price. This graph shows their historical relationship and confirms our expectations, with the green ammonia price line closely tracking the yellow natural gas price line.

Slide 29: Natural Gas Price vs US Ammonia Operation: Several US nitrogen producers purchase their gas from the spot market, and have limited price hedging programs. For them, the high gas prices shown by the yellow line mean red ink and, as the green line indicates, production curtailments. Last year, when gas prices peaked at $10/MMBtu, 50% of US ammonia producers curtailed production.

Slide 30: Nitrogen Imports: The US is by far the world's largest importer of both ammonia and urea, and also imports ammonium nitrate and UAN solutions.

Slide 31: World Gas Prices: The high demand in the US for the energy in natural gas for both agricultural and industrial consumption has given it the world's highest gas prices. The projected average 2002 cost to nitrogen producers of $3.20 is approached only by gas prices in Western Europe, where reserves are also low and demand high. Low prices in locations such as Trinidad, Russia and the Middle East allow nitrogen producers there to convert the energy in their natural gas into nitrogen products and export them to the US.

Slide 32: Delivered Cash Cost of Ammonia to the US: The bottom three bars show the cost of ammonia in the US Gulf region with gas at $2, $3 and $3.50. With $2 gas, US producers compete well with the rest of the world. When gas rises to $3 or $3.50, Gulf Coast producers face stiff competition from offshore producers.

Slide 33: Vulnerable US Nitrogen Plants: The increase in US gas prices has changed the playing field for American nitrogen producers. Plants that may be facing red ink, and as a result may be vulnerable, are indicated on the map. Operations in blue are smaller producers with a capacity below 400,000 short tons per year; economies of scale contribute to their vulnerability. Operations in yellow are located close to the Gulf Coast or on the Lower Mississippi, where low-priced imports make them vulnerable.

Slide 34: Offshore Capacity: My company, PotashCorp, has adopted energy-related strategies to counter the impact of high US gas prices. The first strategy is ownership of low-cost offshore ammonia capacity. The yellow portion of the bars represents offshore capacity. Close to half PotashCorp's ammonia capacity is located in Trinidad, taking advantage of its low gas costs. But what about the half located in the US?

Slide 35: PotashCorp Hedging Program: PotashCorp follows a gas hedging program. We purchase gas on the futures market to stabilize the cost paid. This avoids exposure to short-term swings in gas prices, and provides a cost savings in a rising market.

Slide 36: PotashCorp Industrial Customers: We also partner with industrial customers located adjacent to our production plants, and supply them by pipeline, saving energy and transportation costs. This lets us enjoy the stability of the nitrogen industrial market and minimizes our exposure to the fluctuations of the nitrogen fertilizer market.

Slide 37: The Future of Natural Gas: Let's turn now to the future of natural gas and the fertilizer industry.

Slide 38: New Capacity: New Western Hemisphere projects have come on stream in Argentina, Venezuela and Trinidad. More projects are in the works, taking advantage of the energy cost differential between offshore and US natural gas prices. These projects will put additional pressure on US nitrogen producers.

Slide 39: US Natural Gas Consumers: In the near term, when some US nitrogen producers are forced to permanently shut down, will the resulting reduction in gas demand cause gas prices to drop? The pie chart indicates that the entire US fertilizer industry consumes only 3% of US gas. Even if a significant number of plants shut down permanently, the effect on US gas consumption will be minimal.

Slide 40: US Gas Price Forecasts: This slide compares several independent forecasts of US gas prices to the NYMEX index. All forecasts project high gas prices, generally in the $3.40 to $4.50 range.

Slide 41: Import Costs – Russia: One other big adjustment will take place in the international nitrogen trade market. Russia was given market economy status by the US a few months ago, although there were strings attached. Russia's energy charges to its domestic nitrogen producers are below cost, subsidized by high-priced gas exports. The strings were that Russia must rectify this situation over the next couple of years by increasing the gas price charged nitrogen producers to export market levels. As it does so, Russia's nitrogen exports will become less competitive or non-competitive in the US Gulf market. Some Russian producers have not been paying for their gas, and with the change, will be unable to compete in the export market with suppliers such as Trinidad and will be forced to cease production.

Slide 42: US Nitrogen Imports: US nitrogen imports have followed the price of natural gas. We can expect they will continue at a high level, and the US will continue to be the world's largest importer of both ammonia and urea.

Slide 43: Conclusion:

To recap:

- Low soil nutrient levels will require an energy investment in fertilizer application
- Demand for ethanol as an energy source will require more corn acres
- Energy costs make up a substantial share of potash
- Energy costs make up a substantial share of phosphate
- Nitrogen prices are heavily dependent on natural gas prices
- High gas prices will lead to additional US nitrogen curtailments
- US nitrogen imports will remain the world's highest
- As Russia attains market economy status, its gas is expected to rise to market prices and its nitrogen exports will become less competitive or non-competitive

Slide 44: Fertile Minds Program and Website Address: I'll complete our look at energy and nutrients with a few words about our personal energy. Our fertilizer industry devotes a great deal of human energy to soil nutrition. Without our efforts, one of three people alive today would starve. At one time, we felt confident that these efforts would not only be recognized but appreciated and applauded, and that blowing our own horn was neither necessary nor appropriate. Yet many people have lost sight of the connection between the tremendous efforts of fertilizer producers and distributors, farmers and others in the industry and the nutritious food they take for granted on the shelves of their local supermarket. Activist groups have blindsided us. As we quietly went about the business of helping feed the world, they have turned many well-meaning but ill-informed people against us. Last year, PotashCorp became concerned about public opinion of the fertilizer industry. We commissioned surveys to check people's understanding of the role fertilizer nutrients play in the food supply. What we found made us realize that our industry has much work to do in educating consumers. Legislators, too, have almost no understanding of the world's need for fertilizer nutrients. It is essential that as an industry we unite to bridge this knowledge gap before we have lost too much ground.

Slide 45: Key Fertile Minds Points:

The key points in delivering this message are:

1) Fertilizers are drawn from nature – they are not man-made
2) Fertilizers replace the nutrients that are "mined" from the soil at each harvest
3) The world has no choice but to use fertilizers. Without them 2 billion people would starve.
4) Fertilizers conserve land, making recreational areas and natural habitat possible
5) There is no better-qualified environmentalist than the North American farmer

If all of us invest just a small amount of our personal energy, we will succeed in delivering the message that the fertilizer industry and its nutrients are vital to our future.

Slide 46: PotashCorp P: Thank you for your attention. I would be pleased to answer your questions.

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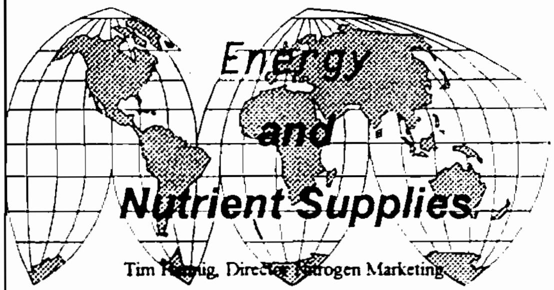

Energy and Nutrient Supplies

Tim [illegible]ig, Director Nitrogen Marketing

Soil Fertility Conference

Des Moines, Iowa

November 20, 2002

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Energy & Nutrient Supplies Overview

- Energy & Its Impact Upon
  - Agriculture
  - Potash
  - Phosphate
  - Nitrogen
- Fertile Minds and Industry Image

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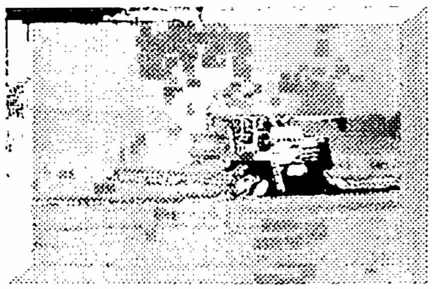
Agriculture



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Soil Fertility

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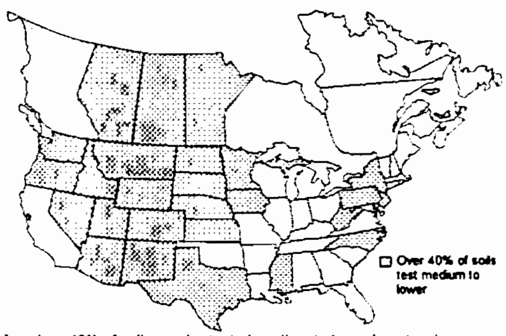
Low Potassium Nutrient Levels



North America - 43% of soil samples tested medium to lower in potassium

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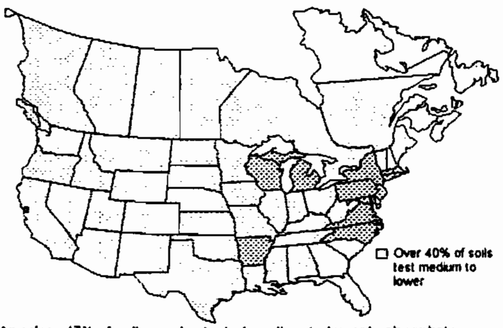
Low Phosphate Nutrient Levels



North America - 47% of soil samples tested medium to lower in phosphate

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Conservation Tillage

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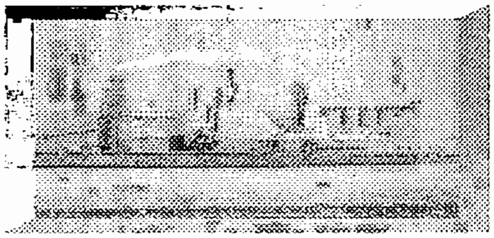
Ethanol Production, Economics and Use



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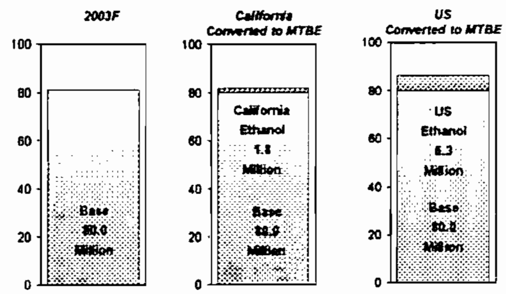
Impact of Ethanol Replacing MTBE in Gas

Increased Corn Acres Planted



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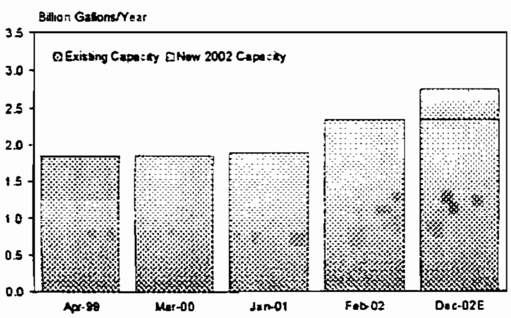
US Ethanol Capacity



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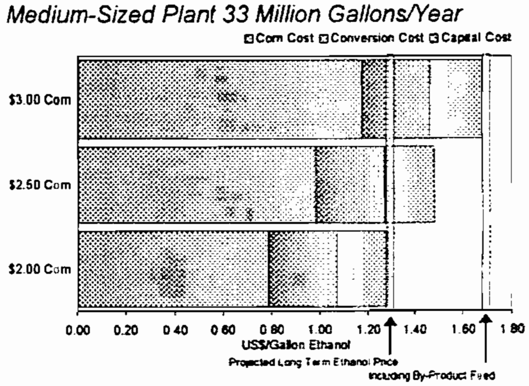
Ethanol Production Cost vs Corn Cost

Medium-Sized Plant 33 Million Gallons/Year



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Potash Fertilizer and Energy

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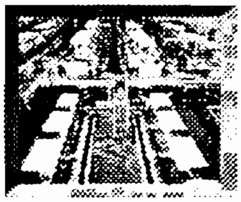
Low Energy Potash Production



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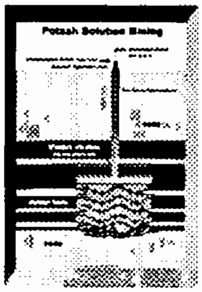
High Energy Potash Production



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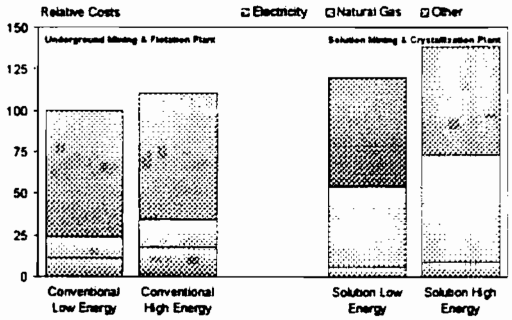
Effect of Energy Cost Increase on Potash



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Phosphate Fertilizer and Energy

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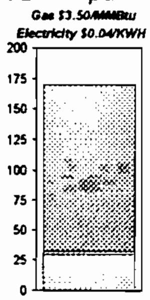
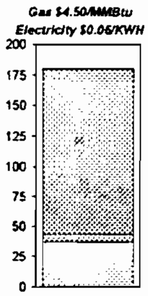
Energy Cost Increase Impact on DAP Cost

DAP FOB Tampa





Direct Production Costs increase $10.00/s ton
Indirect Production Costs also affected

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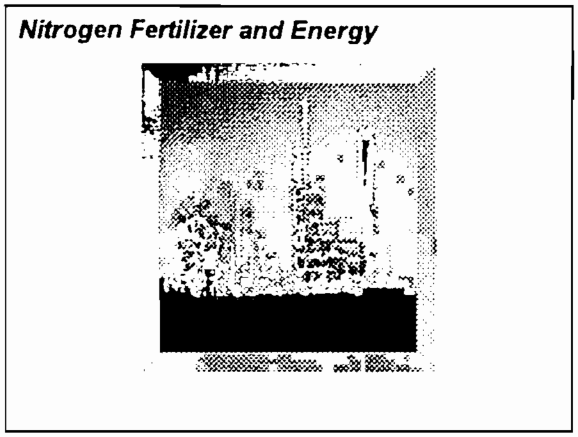

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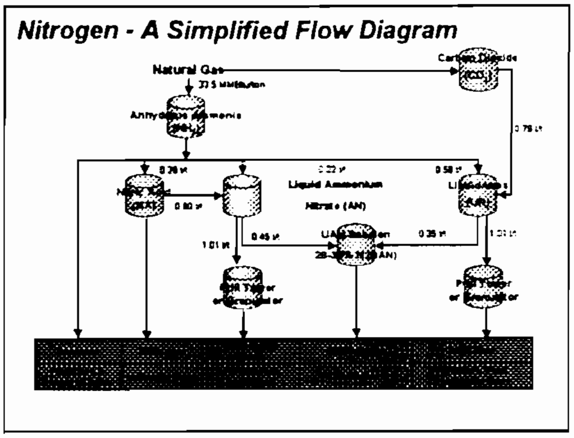

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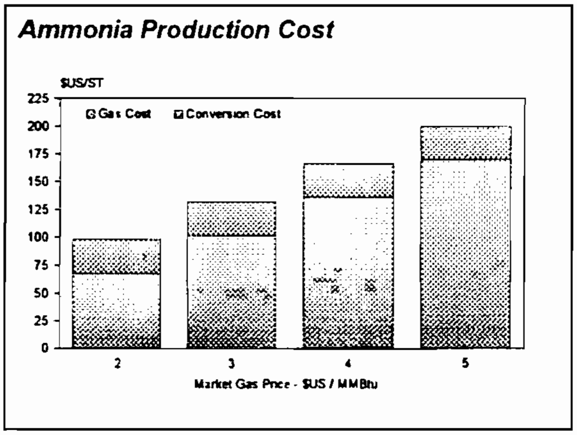

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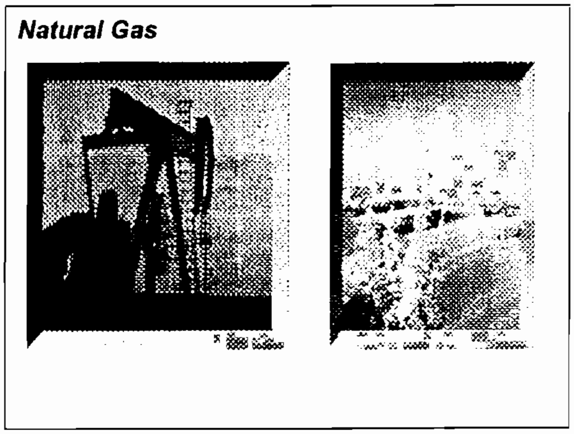

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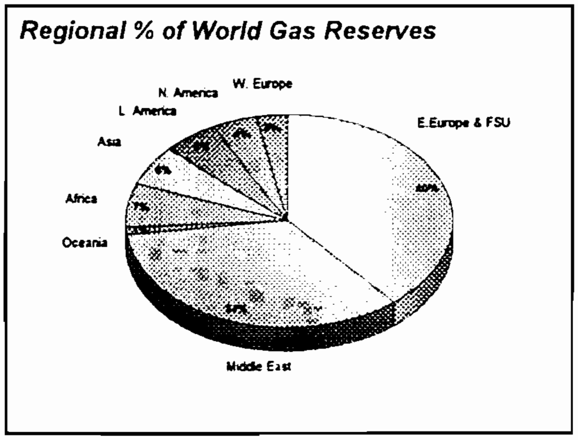

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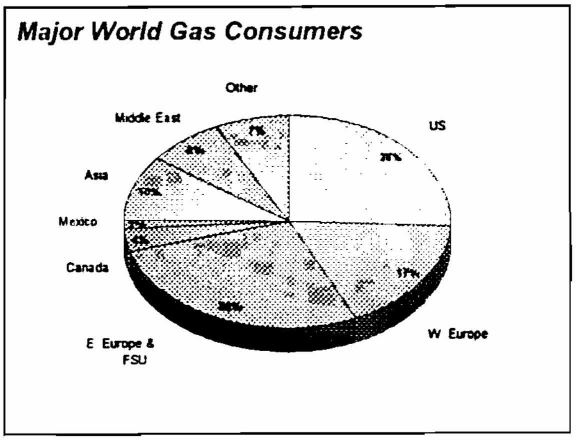

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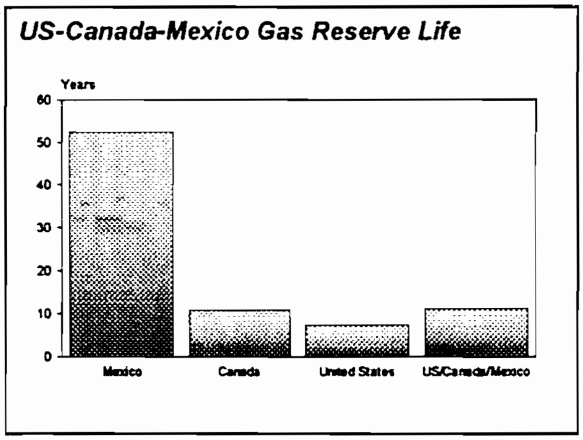

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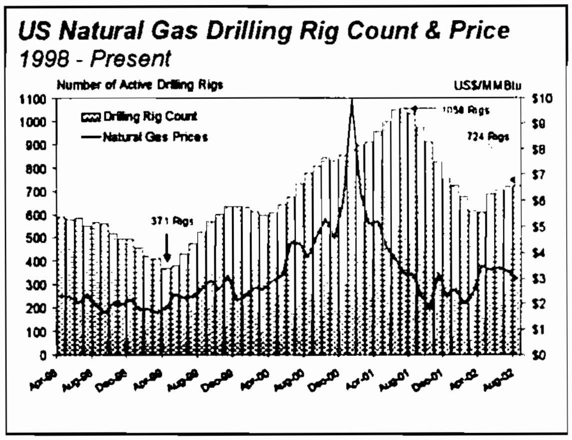

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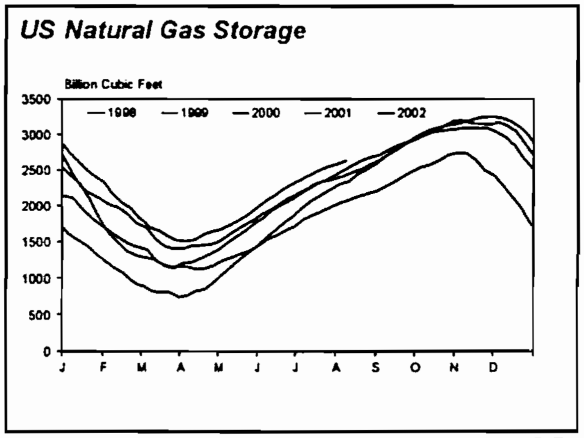

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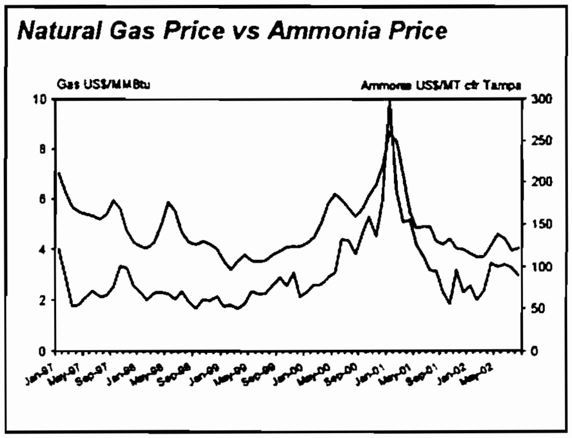

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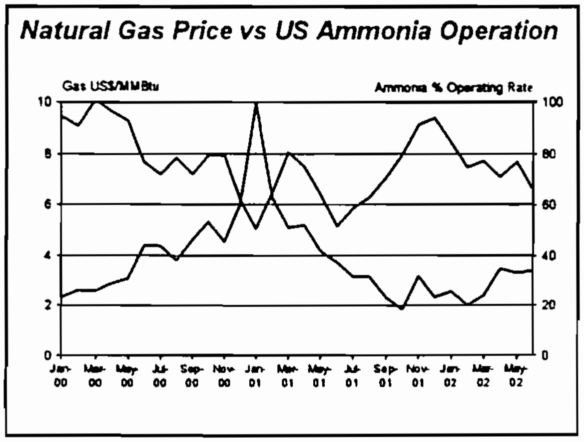

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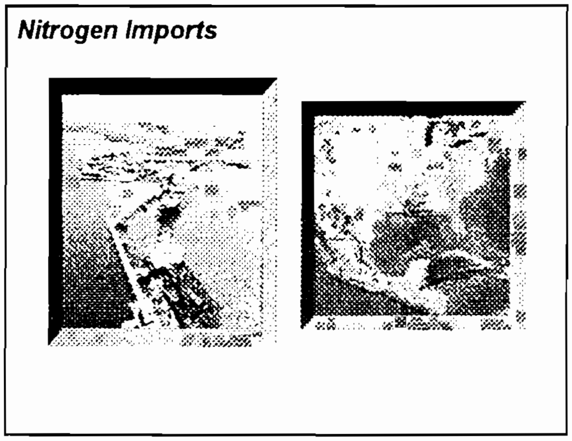

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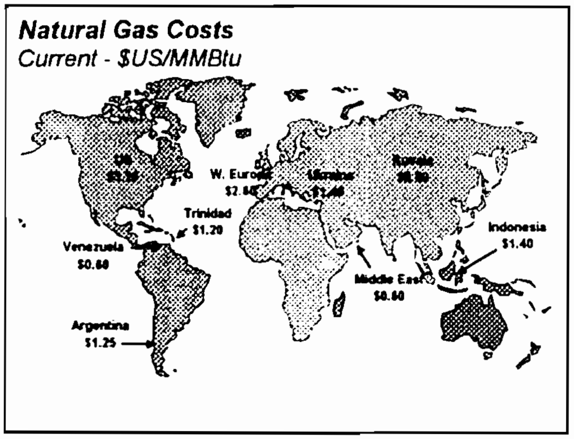

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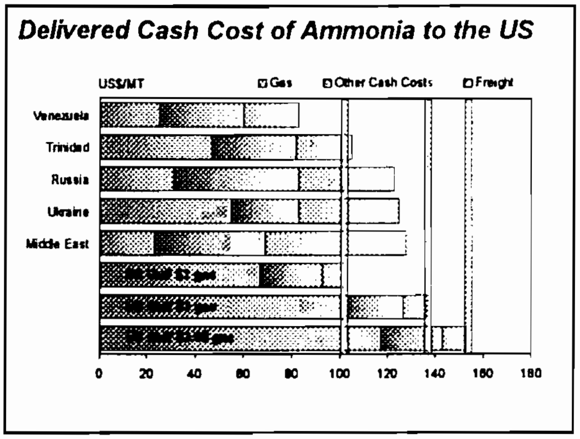

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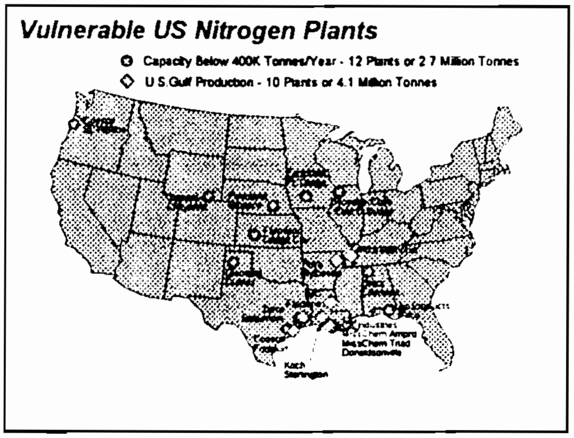

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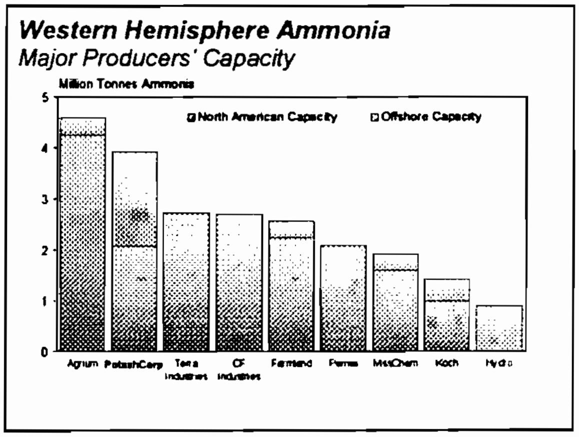

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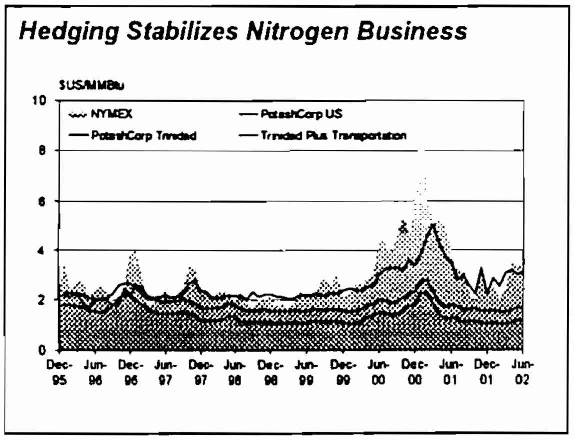

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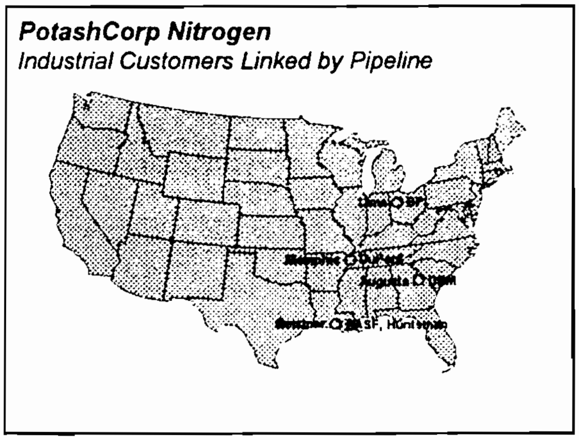

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Natural Gas and Nutrients – The Future

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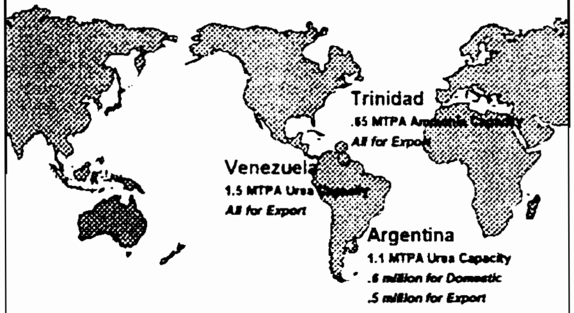
Major New Nitrogen Capacity



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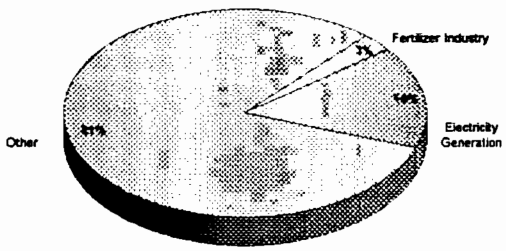
US Natural Gas Consumers



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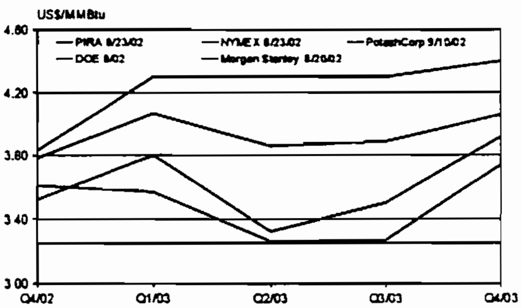
US Gas Cost Projections 2002 - 2003



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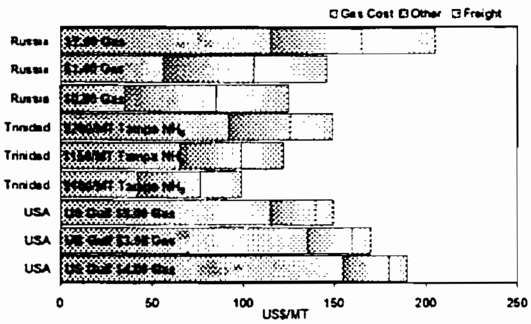
Delivered Cash Cost of Ammonia to US Gulf



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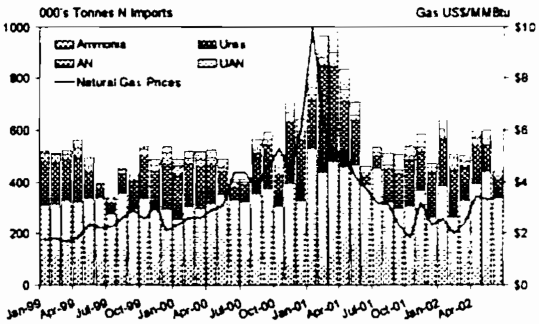
US Monthly Nitrogen Imports



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Conclusion

- Low soil nutrient levels will require an energy investment
- Ethanol demand will require increased corn acres
- Energy costs make up a substantial share of potash
- Nitrogen prices are dependent on natural gas
- High gas prices will lead to US nitrogen curtailments
- US nitrogen imports will remain the world's highest
- As Russia attains market economy status, its gas prices are expected to rise to market prices & its nitrogen exports to be less competitive

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Fertile Minds Key Points

- Fertilizers are drawn from nature – they are not man made
- Fertilizers replace the nutrients that are "mined" from the soil at each harvest
- The world has no choice but to use fertilizers. Without them, 2 billion people would starve
- Fertilizers conserve land, making recreational land and natural habitats possible
- There is no better qualified environmentalist than the North American farmer

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PROCEEDINGS OF THE

THIRTY-SECOND NORTH CENTRAL EXTENSION-INDUSTRY SOIL FERTILITY CONFERENCE

Volume 18

November 20-21, 2002
Holiday Inn University Park
Des Moines, IA

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