

# Fertilizer and Climate Change

## Safeguarding the Future of our Food and our Planet

### Fertilizer Means Food Security



Fertilizers account for **50%** of global food production. With the world population expected to reach **10 billion people by 2050**, fertilizer will become increasingly critical.

### Economic Impact



Each year, the U.S. fertilizer industry generates more than

**\$155  
BILLION**

in economic benefit, creating

**89,000  
DIRECT JOBS**

AND

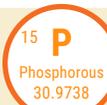
**406,000  
INDIRECT JOBS**



### About the Industry



Nitrogen, Phosphorous and Potash are the building blocks of all fertilizers.



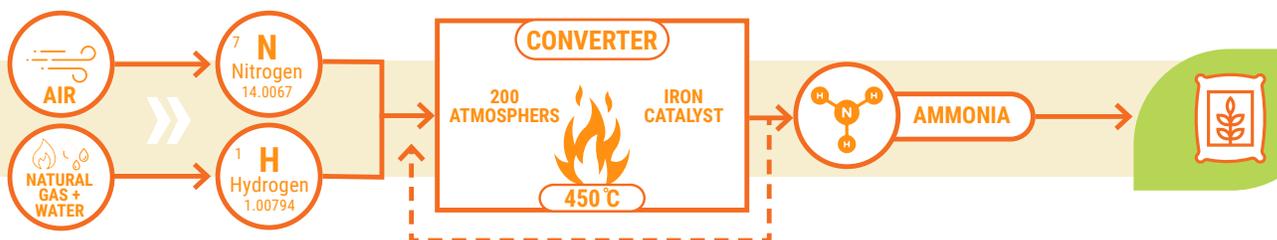
Phosphate and Potash are mined minerals, Nitrogen is extracted from air via a complex chemical reaction

### Greenhouse Gas Emissions (GHG)

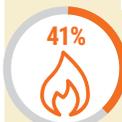


In fertilizer manufacturing, GHG emissions come from ammonia, phosphoric acid, and nitric acid production. In 2018, industry spent \$3.8 billion dollars in capital improvements and new facilities.

### Nitrogen Fertilizer Manufacturing: Haber-Bosch Process



### We Are Energy-Intensive



U.S. nitrogen fertilizer manufacturing consumes 41% of natural gas purchased as feedstock in the U.S. **In 2018, the nitrogen fertilizer manufacturing industry spent**



on natural gas purchased as feedstock

=



households' natural gas bills for a year

### We Are Energy-Efficient



From 1983-2003, there was a **10% increase in efficiency to produce 1 ton of ammonia** (today, this takes 33 MMbtu).

*"It's a magical innovation that's responsible for saving millions of lives from hunger and lifting millions more out of poverty by boosting agricultural productivity."*

—Bill Gates on Fertilizer



## Reduce, Reuse, Recycle



Nitrogen fertilizer manufacturing produces 2 types of CO<sub>2</sub> emissions:

**1 PROCESS EMISSIONS**  
Produces pure and recyclable CO<sub>2</sub>

**2 COMBUSTION EMISSIONS**  
Cannot be separated for recovery



The laws of chemistry prevent fixed process emissions from being reduced.



In 2016, the industry captured 8 MMT of CO<sub>2</sub>

Equivalent to taking



**1.7 MILLION CARS OFF THE ROAD FOR A YEAR**



**CAPTURED/RECYCLED CO<sub>2</sub> BYPRODUCTS**

Urea used to abate nitrogen oxide emissions from coal-fired power plants and diesel engines

+DEF  
+Pharmaceutical  
+Beverage  
+Enhanced Oil Recovery



Since 1990, CO<sub>2</sub> emissions from ammonia production have decreased by 6%. In 2016, ammonia and nitric acid production were 0.2% each of U.S. GHG emissions. Phosphoric acid emissions were negligible.

## Fertilizer on the Farm



**1 RIGHT SOURCE**  
Matches fertilizer type to crop needs.



**2 RIGHT RATE**  
Matches amount of fertilizer type crop needs.



**3 RIGHT TIME**  
Makes nutrients available when crops need them.



**4 RIGHT PLACE**  
Keep nutrients where crops can use them.

The Fourth National Climate Assessment identifies the 4Rs as an effective tool to adapt to climate change.

## Fertilizer Use Efficiency



Nitrogen use per bushel of corn has declined from



1.67lbs.

in 1970



TO

0.77lbs.

in 2016

A reduction of **64%**

## Reduced Deforestation



If corn yields had remained constant from 1964-2016, the U.S. would have needed **175 million more acres** to grow corn

= The size of Texas



## Impacts of Cap & Trade or a Carbon Tax



Analyses of potential cap & trade programs or carbon taxes consider the nitrogen fertilizer manufacturing industry among the most vulnerable, due to increased feedstock prices, carbon leakage, energy intensiveness, and trade exposure.

**\$488 MILLION TAX**  
MARKET Choice Act

\$24 per ton of CO<sub>2</sub>

**\$813 MILLION TAX**  
Climate Leadership Council Proposal

\$40 per ton of CO<sub>2</sub>

## Decreased Global Competitiveness = Reduced Domestic Investments.



With higher production costs, fewer companies will invest in U.S.-based facilities.

→ Growers and consumers will ultimately shoulder these costs, making the US less competitive in global food production.



Every \$2 increase in price of natural gas means **\$1 billion in production costs.**



Shifting production to less efficient producers leads to more emissions. For Example: 70% of Chinese ammonia production is coal-based, which emits



**2.4 X**

**MORE CO<sub>2</sub> THAN U.S. NATURAL GAS-BASED PLANTS**

*"This is a basic problem, to feed 6.6 billion people. Without fertilizer, forget it. The game is over."*

—Dr. Norman Borlaug, father of the Green Revolution

