

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

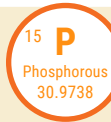
**406,000
INDIRECT JOBS**



About the Industry



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



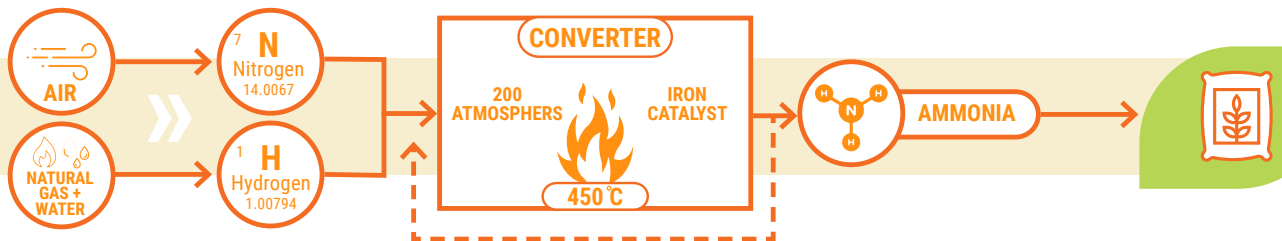
Phosphate and Potash are mined minerals, Nitrogen is extracted from air via a complex chemical reaction

Greenhouse Gas Emissions (GHG)

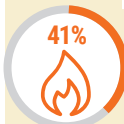


In fertilizer manufacturing, GHG emissions come from ammonia, phosphoric acid, and nitric acid production. In 2018, industry spent \$3.8 billion dollars in capital improvements and new facilities.

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

= **1.5 MILLION**

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 CO₂ emissions:

1 PROCESS EMISSIONS
Produces pure and recyclable CO₂

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 CO₂

Equivalent to taking



1.7 MILLION CARS OFF THE ROAD FOR A YEAR



CAPTURED/RECYCLED CO₂ BYPRODUCTS

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

+DEF
+Pharmaceutical
+Beverage
+Enhanced Oil Recovery



Since 1990, CO₂ 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 CO₂

\$813 MILLION TAX
Climate Leadership Council Proposal

\$40 per ton of CO₂

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 CO₂ 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

