Fertilizer and Climate Change

Safeguarding the Future of our Food and our Planet

Fertilizer Means Food Security

50%

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.

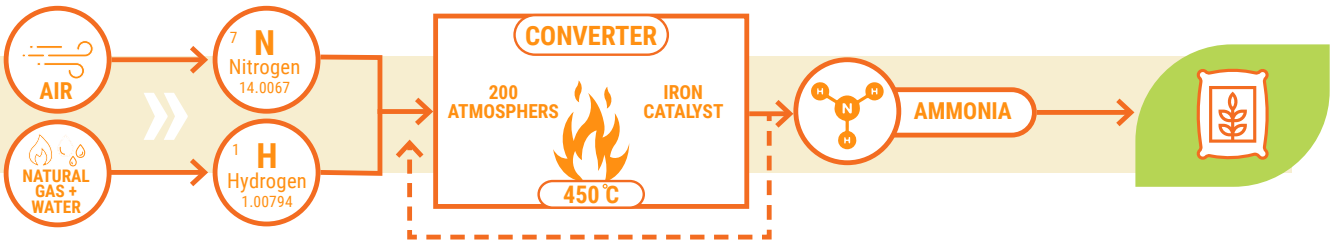
7 N Nitrogen 14.0067 » 15 P Phosphorous 30.9738 » 19 K Potassium 39.0983

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

41%

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** **$1.5 BILLION** on natural gas purchased as feedstock = **1.5 MILLION** households' natural gas bills for a year

We Are Energy-Efficient

10%

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

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Reduce, Reuse, Recycle

Nitrogen fertilizer manufacturing produces 2 types of CO_2 emissions:

1. **PROCESS EMISSIONS** — Produces pure and recyclable CO_2
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_2

Equivalent to taking **1.7 MILLION** CARS OFF THE ROAD **FOR A YEAR**

CAPTURED/RECYCLED CO_2 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_2 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

4Rs

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 needs 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 **1.67 lbs.** **in 1970** **TO** **0.77 lbs.** **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_2

$813 MILLION TAX
Climate Leadership Council Proposal
$40 per ton of CO_2

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.**

70%

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_2 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

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