



# FARM FOUNDATION® FORUM

**GREENING THE FERTILIZER INDUSTRY**

MARCH 21, 2023



Today's webinar is made possible by a grant from  
Farm Credit

**#FarmFoundationForum**





MARTHA KING

Vice President, Programs and Projects  
Farm Foundation



# MEET FARM FOUNDATION

A 501(C)(3) NON-PROFIT AT THE INTERSECTION OF AGRICULTURE AND SOCIETY





Farm Foundation is an  
**ACCELERATOR**  
of practical solutions for agriculture.

We accelerate  
**PEOPLE AND IDEAS**  
into  
**ACTION.**





## OUR MISSION AND VISION GUIDE OUR WORK

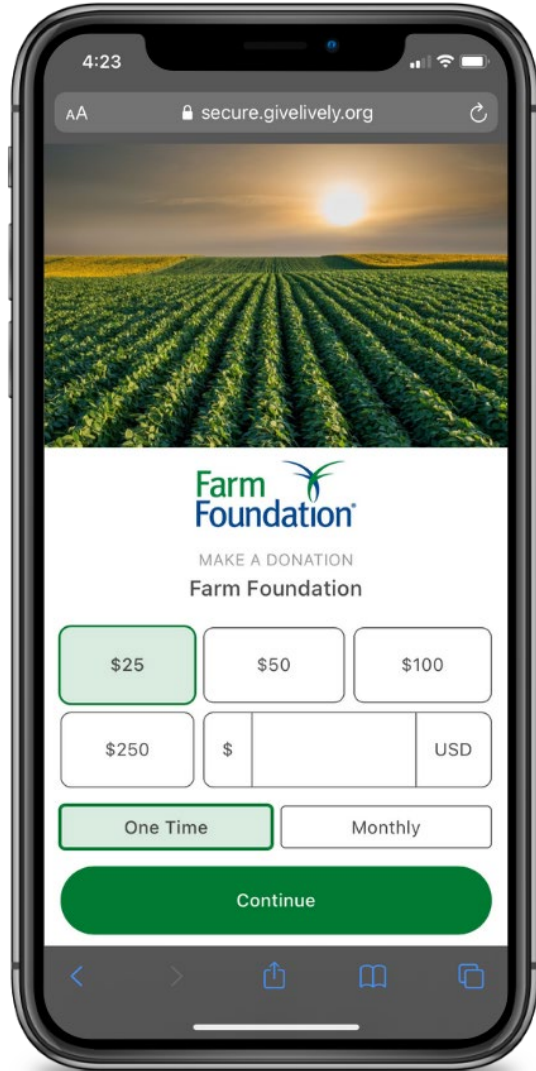
### **MISSION:**

To **build** trust and understanding at the intersections of agriculture and society.

### **VISION:**

To **build** a future for farmers, our communities, and our world.

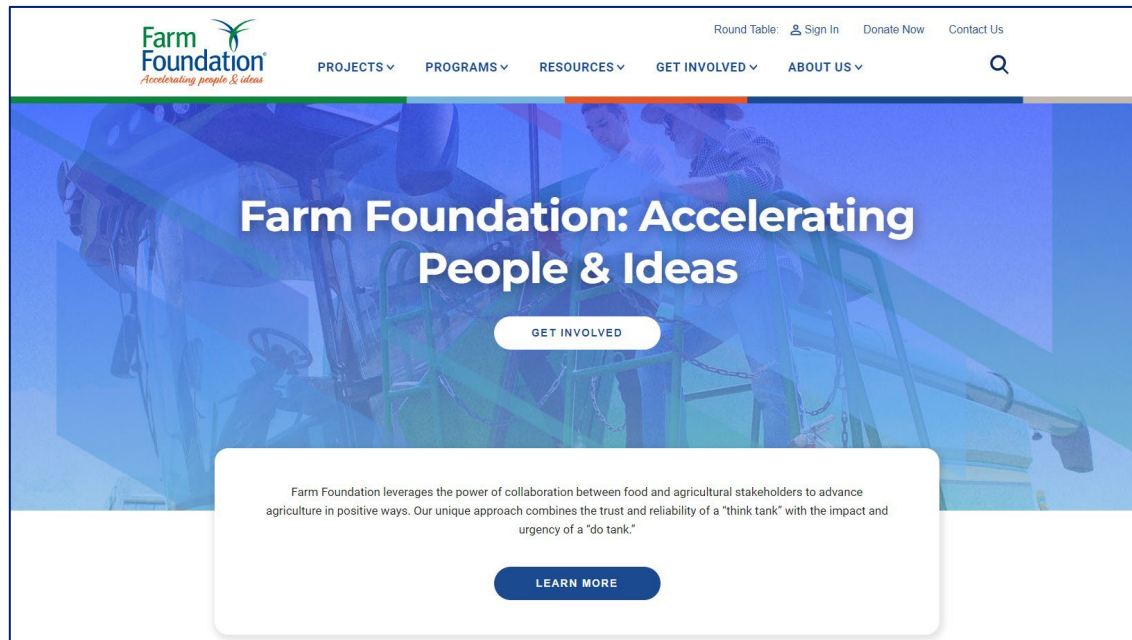
# BECOME A FRIEND OF FARM FOUNDATION



## See link in chat function

- Donate to Farm Foundation to support our mission
- Receive exclusive benefits and curated content
- Help us continue to provide valuable content like today's Forum

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# IMPORTANT NOTES

- Submit questions by clicking on the **Q&A Button** at the bottom of your screen.
- Please **include your name and company** so questions may be contextually understood.
- Due to **time limits**, we may not be able to ask all questions submitted.
- This Forum is being recorded and will be posted on our website at **farmfoundation.org** as well as the Farm Foundation **YouTube** channel.
- Please take the **short survey** at the conclusion of the Forum.



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**JAY VROOM**  
Moderator/Speaker  
Chief Innovation Officer,  
Vroom Leigh Agriculture







## CHERI DE JONG

Principal Owner, Natural Prairie Dairy

Owner and CFO, AgriVision Farm Management



**SEDRON**<sup>®</sup>  
TECHNOLOGIES

# THE VARCOR

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Farm Foundation Forum – Greening the Fertilizer Industry  
March 21, 2023





## Meet the De Jong's

---

Donald and Cheri started with 800 cows in the High Plains of Texas, dedicating 15 years to building the organization from the ground up. Now, NPD has over 18,000 certified organic cows and 250 team members in multiple states all dedicated to producing an exceptional product.





What We Do

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Natural Prairie Dairy produces **best-in-class, highest quality certified organic milk** from **family-run, sustainable** farms in Texas and Indiana.



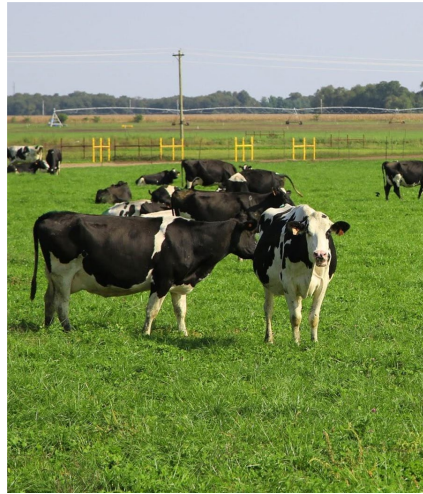
# Best-in-class cow care

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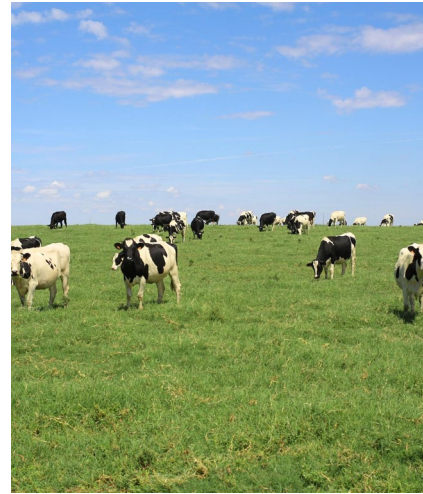
Our cows receive the best care—because happy, healthy cows raised on clean land make great tasting milk. Our cows enjoy...



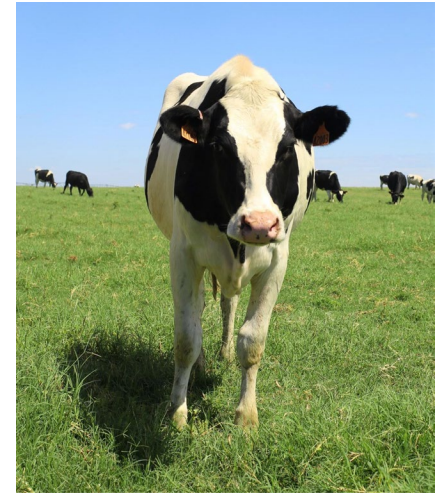
**Organic Pastures**  
Our land is certified organic by the Texas Department of Agriculture and Oregon Tilth.



**Natural Resources**  
Our land is fertilized by the nutrients our cows produce, replenishing essential nutrients.



**Open Grazing**  
During grazing season, our cows get the nutrients they need by grazing on beautiful pastures.



**Organic Feed**  
We grow our own feed to be used in a unique formula approved by a dairy nutritionist.



# Give back to the land

---

We believe organic farming requires the utmost respect for the land. To ensure the quality we're known for, we...



## **Work in sustainable harmony**

Because of our scale, we are able to create a farm ecosystem that supports and relies upon the cows, the land and the people who produce it.



## **Prove that technology and farming go hand-in-hand**

We run a 21st century farm, with state-of-the-art equipment and technology that makes our farm cleaner and more sustainable.



## **VARCOR Waste Management**

We've improved our Indiana farm's sustainable footprint with the groundbreaking VARCOR system, which processes manure into useful materials.





What if we could eliminate manure ponds?



# VARCOR

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The Varcor will ***change animal agriculture for the better, transforming dairy farms for the better, forever.***

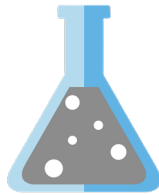
The VARCOR system can efficiently distill cow manure into:



**Clean  
water cows  
can drink.**



**Portable  
dry,  
odorless  
NPK**



**Aqueous  
ammonia**





# VARCOR...a brief history

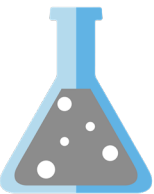
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**SEDRON**<sup>®</sup>  
TECHNOLOGIES



# The origin of the Varcor technology: Bill Gates and Peter Janecki



Innovate

## Bill Gates' poop water machine gets a test run

by David Goldman @DavidGoldmanCNN

August 13, 2015: 11:54 AM ET



Why Bill Gates drank wastewater

Earlier this year, Bill Gates [posted a video](#) of himself drinking water that was made from human feces. (It went viral, unsurprisingly.)

The water was processed by a machine that collects human waste and converts it into safe, reusable byproducts -- water, electricity and ash. This week, Gates said in a [blog post](#) that the "Omni Processor" machine is getting its first test run in Dakar, Senegal, with the aim of reducing disease and saving lives in the city.

Dakar is a West African city of 3.4 million, about a third of whom have no access to the city's sewer system. Instead, they store their waste in pits or septic tanks.



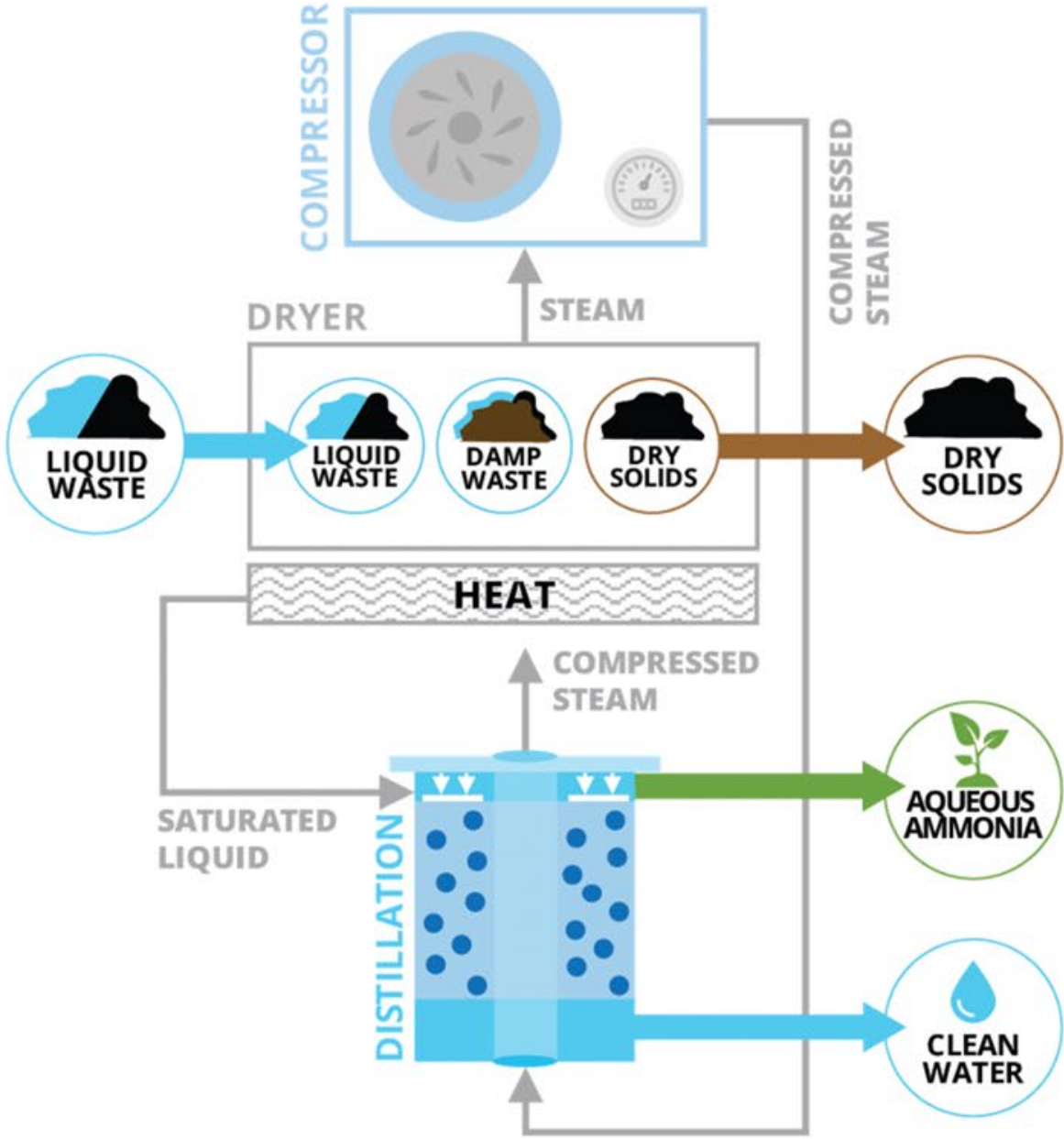
Advertisement

Paid Content by Outbrain



# VARCOR™

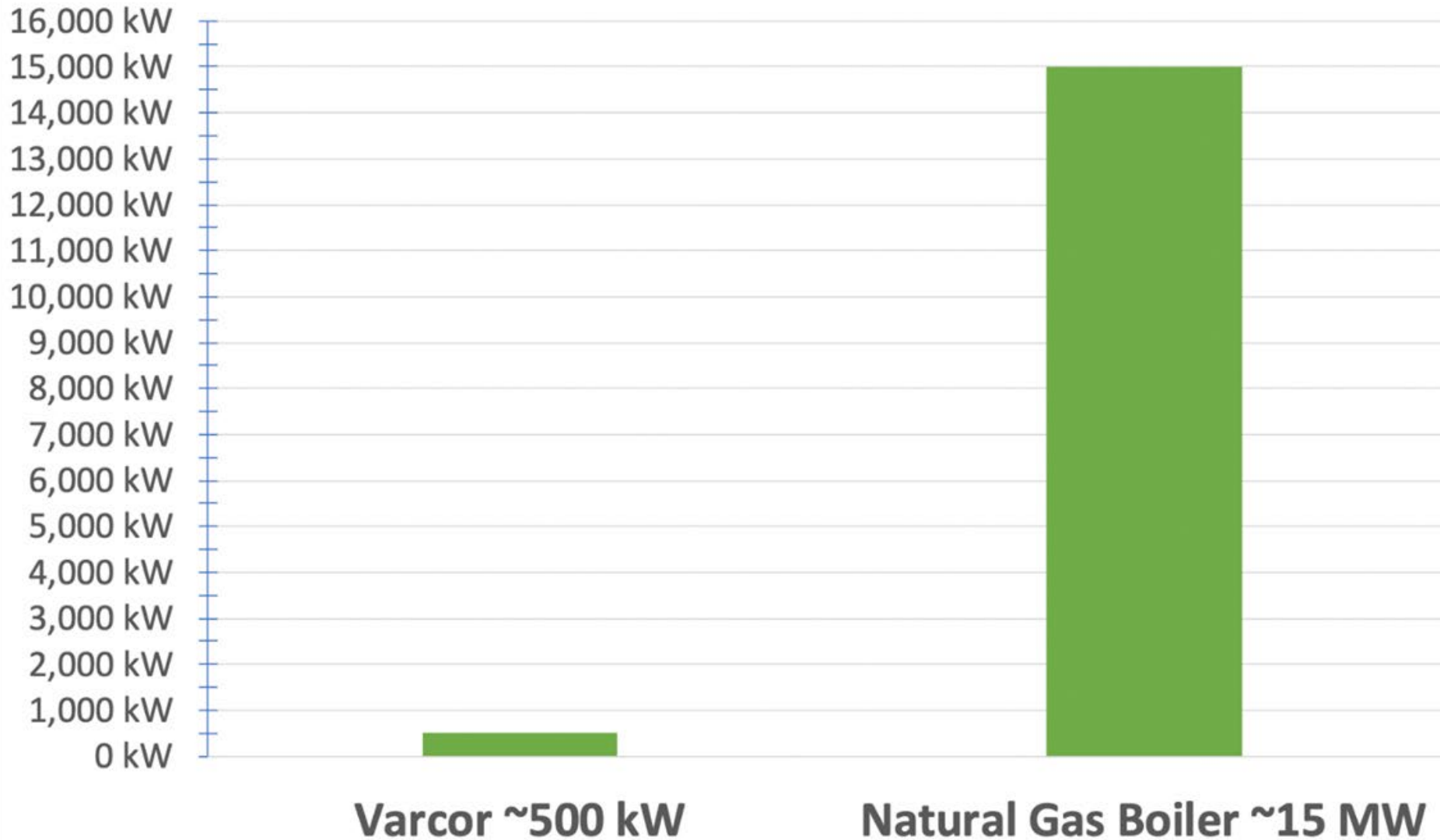
What it Does





# VARCOR™ Energy Input vs Traditional Methods

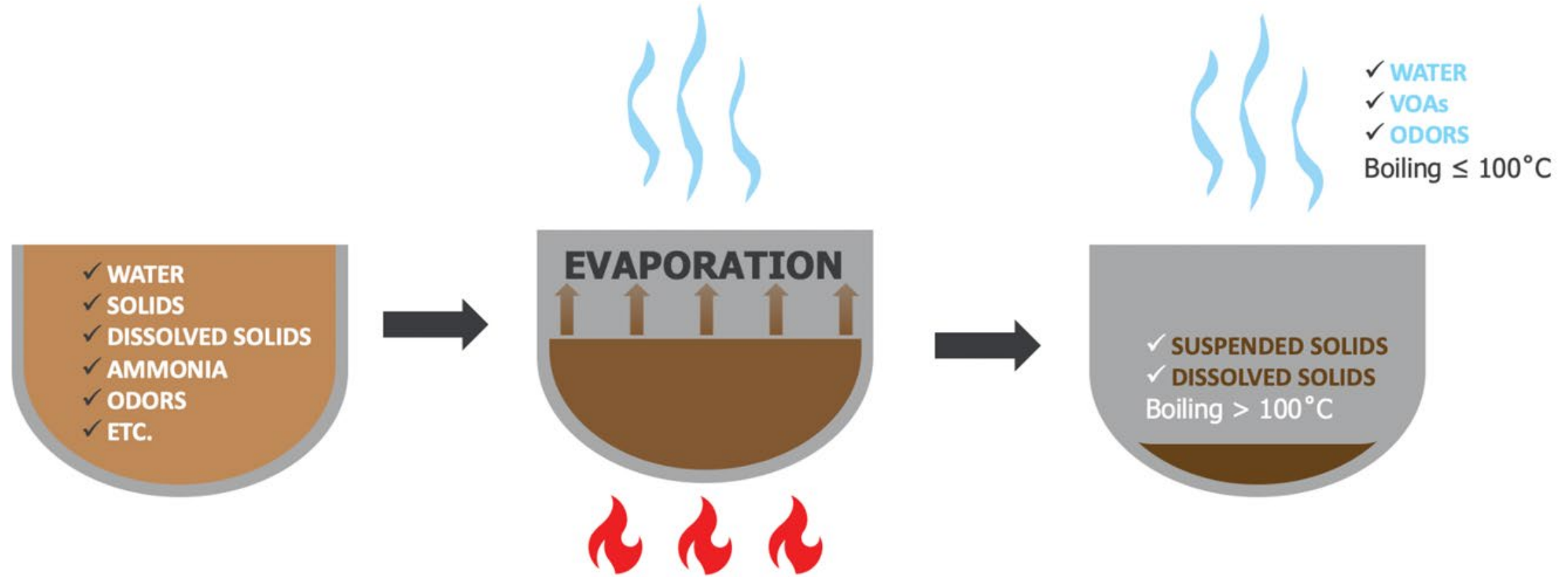
Energy Required to Evaporate 370 Litres / Minute of Water



# VARCOR™

Why is Varcor so effective?

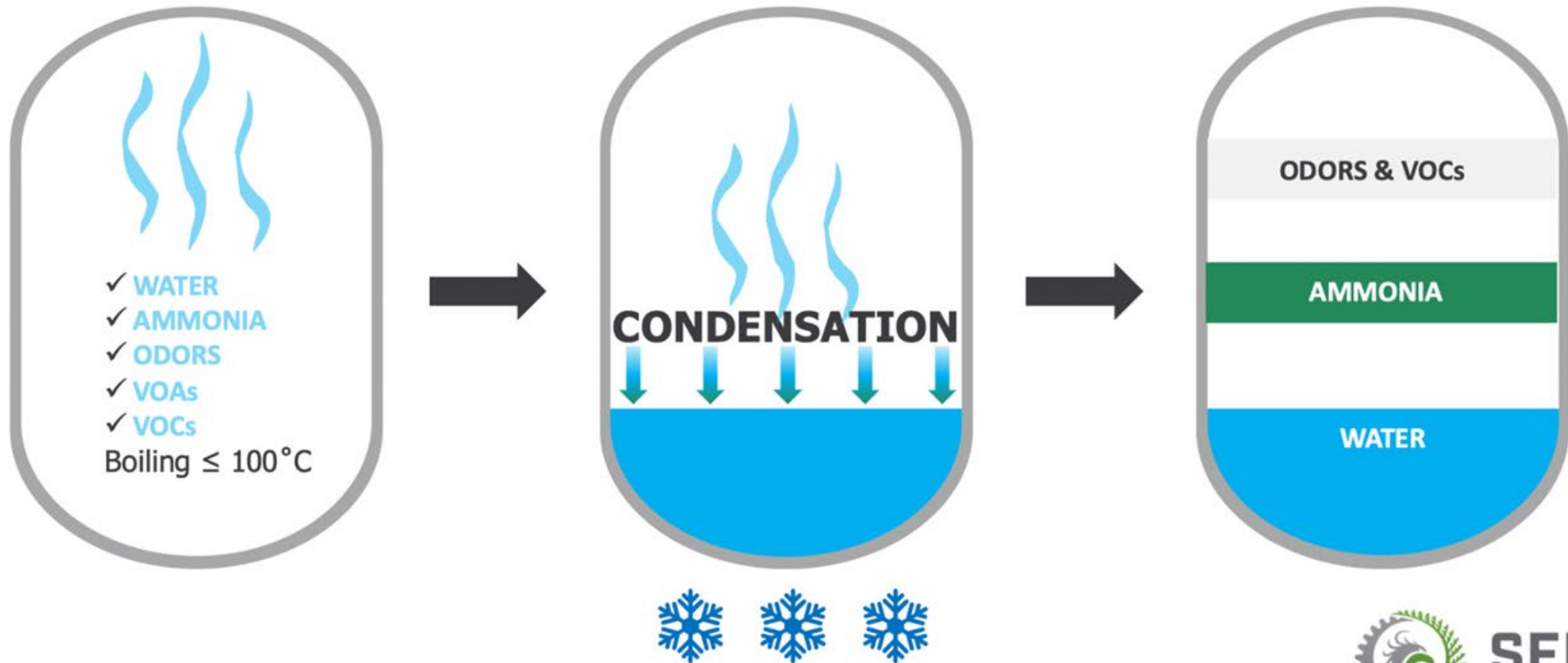
**1.** When you apply heat, evaporation separates the solids from the other components.



# VARCOR™

Why is Varcor so effective?

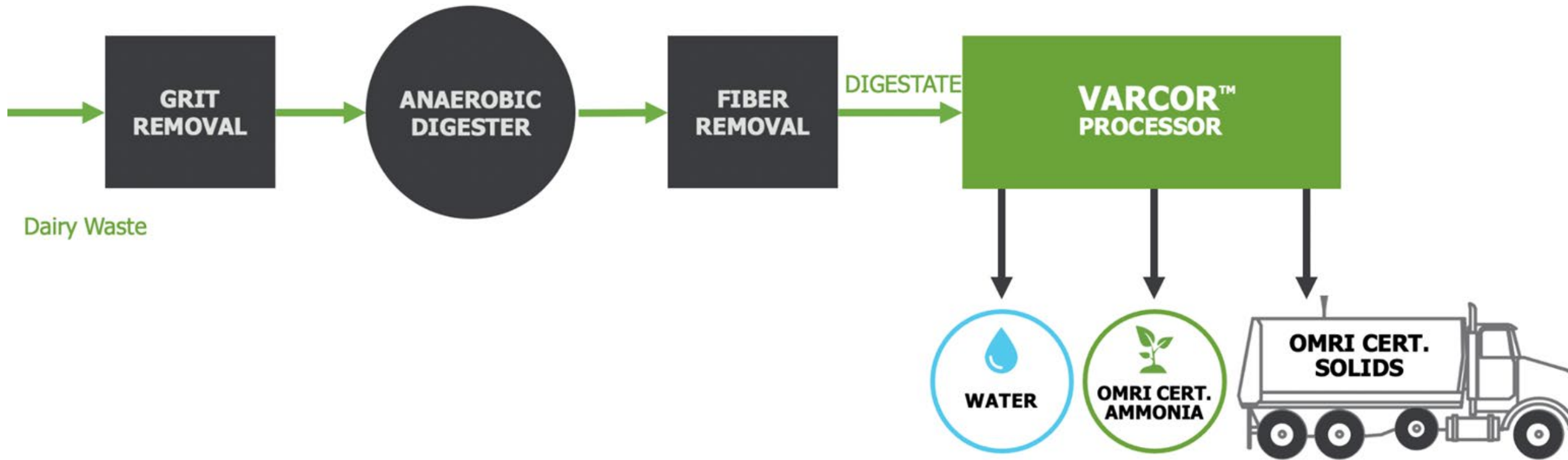
2. As the vapor cools & condenses, it releases each component at a different temperature through distillation.





	STORAGE LAGOONS	ANAEROBIC DIGESTION	VARCOR
<b>KILLS PATHOGENS</b>	X	✓ 90%	✓ 100%
<b>PRODUCES CLEAN WATER</b>	X	X	✓
<b>ELIMINATES RISK OF NUTRIENT &amp; BACTERIA LEACHING OR RUN-OFF</b>	X	X	✓
<b>ENERGY RECOVERY POTENTIAL</b> (Electricity, Heat)	X	✓	✓
<b>REVENUE GENERATION &amp; COST-SAVINGS POTENTIAL</b>	X	✓	✓
<b>UNSUSCEPTIBLE TO BIOLOGICAL UPSET CONDITIONS</b>	X	X	✓
<b>HIGHER AIR QUALITY &amp; LOWER ODOR</b>	X	✓	✓
<b>CREATES DRY, STERILE SOLIDS WITH HIGH PHOSPHORUS CONTENT</b>	X	X	✓
<b>CAN SEPARATE NITROGEN INTO A CONCENTRATED FERTILIZER</b>	X	X	✓
<b>PRECISION APPLICATION:</b> Allows for precise, site-specific, variable rate application of Nitrogen to fields.	X	X	✓

# DAIRY FACILITY WITH DIGESTER



The Varcor also helps to reduce greenhouse gasses by eliminating methane emissions by 33%





This year's numbers are in...with 15,600,000 gallons of manure processed, we upcycled:

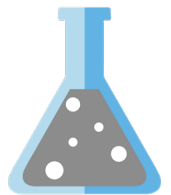
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**12,000,000 gallons of clean water**



**450,000 pounds of dry, odorless NPK**



**78,600 pounds of aqueous ammonia, 1200 ppm, with 65% captured**



The future...





Thank You









ALZBETA KLEIN

CEO/Director General  
International Fertilizer Association



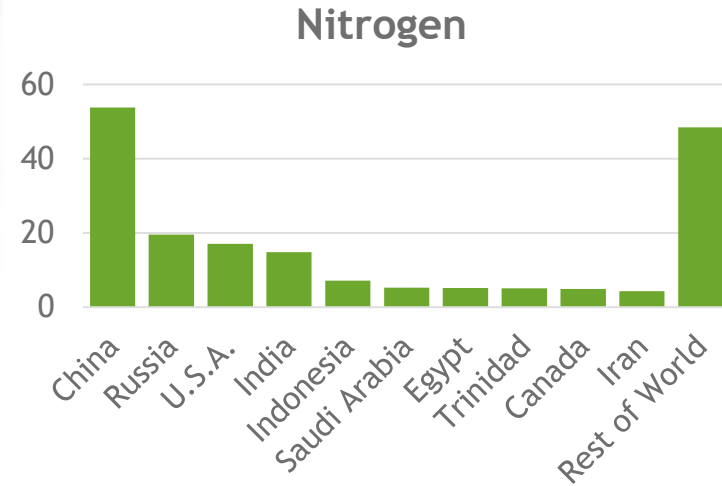
# Global fertilizer market drivers

Prepared by: International Fertilizer Association

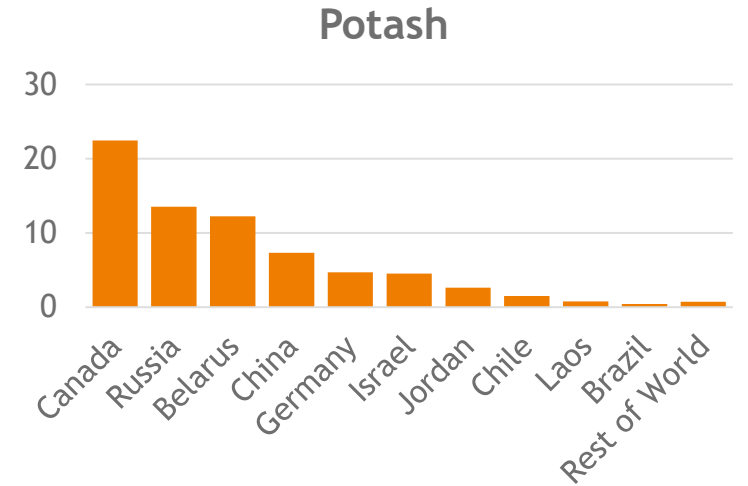
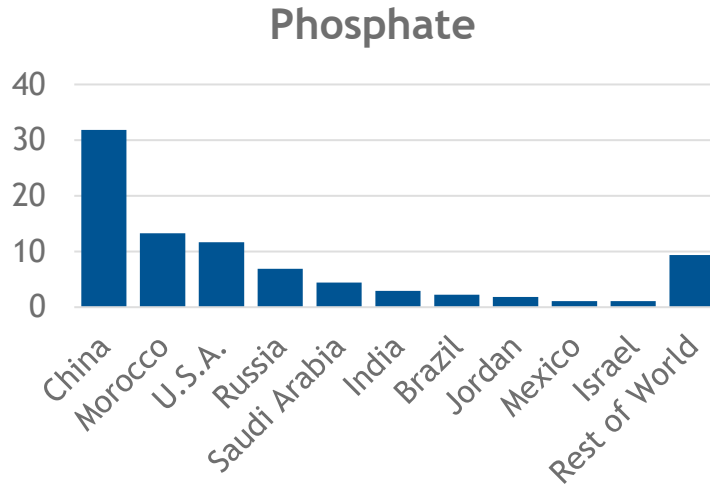
*For: Farm Foundation, March 2023*



# Product market structure and price elasticity matters



Production by country, Mt product



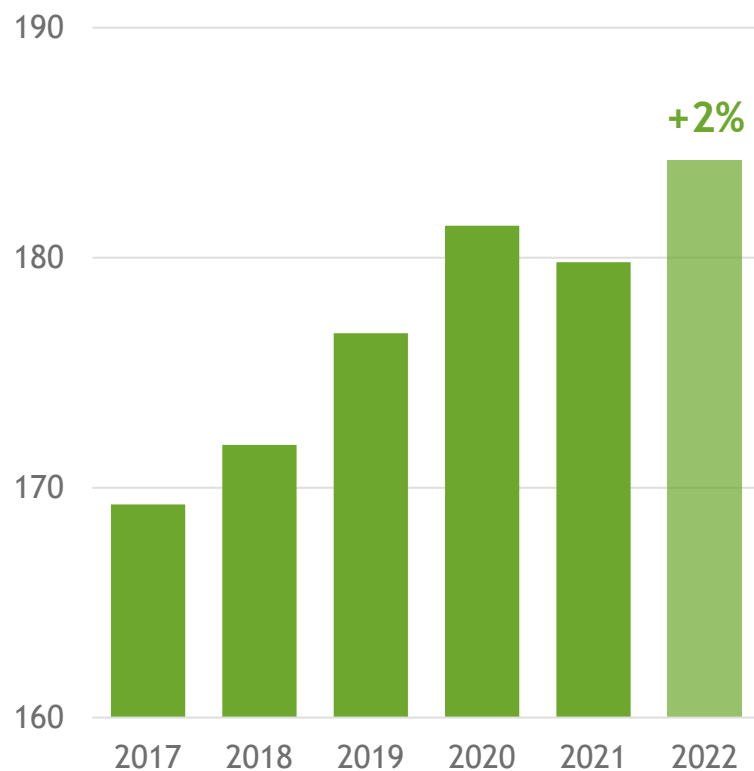
**Energy-intensive**  
**Marginal producers in Europe**  
**Crop price inelastic**

**Exposed to energy-derived products**  
**Use correlated with affordability**

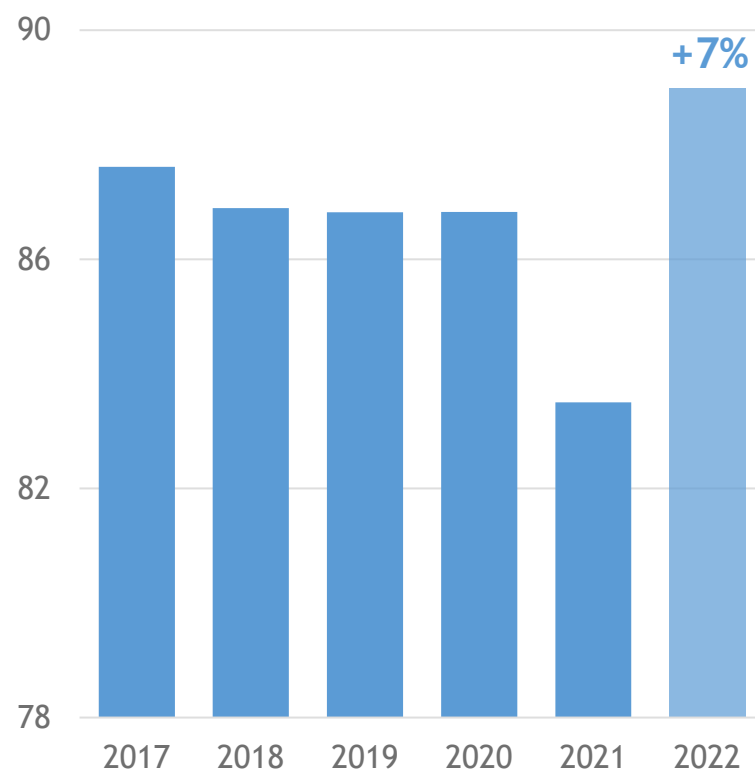
**40% of global trade from sanctions countries**  
**Use correlated with affordability, capped by availability**

# Fertilizer supply was better than expected in 2022

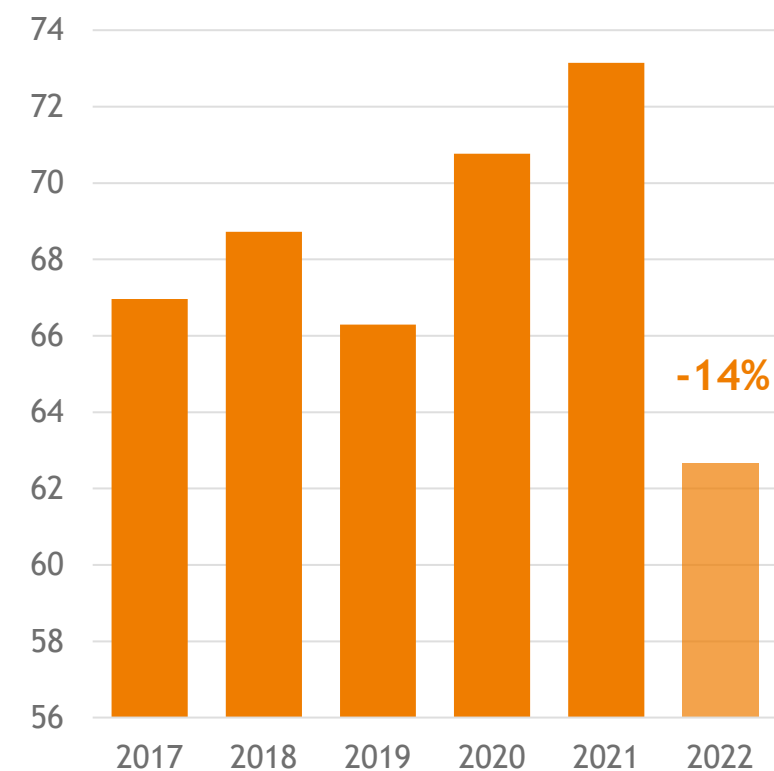
Global urea production (2022 estimate), Mt



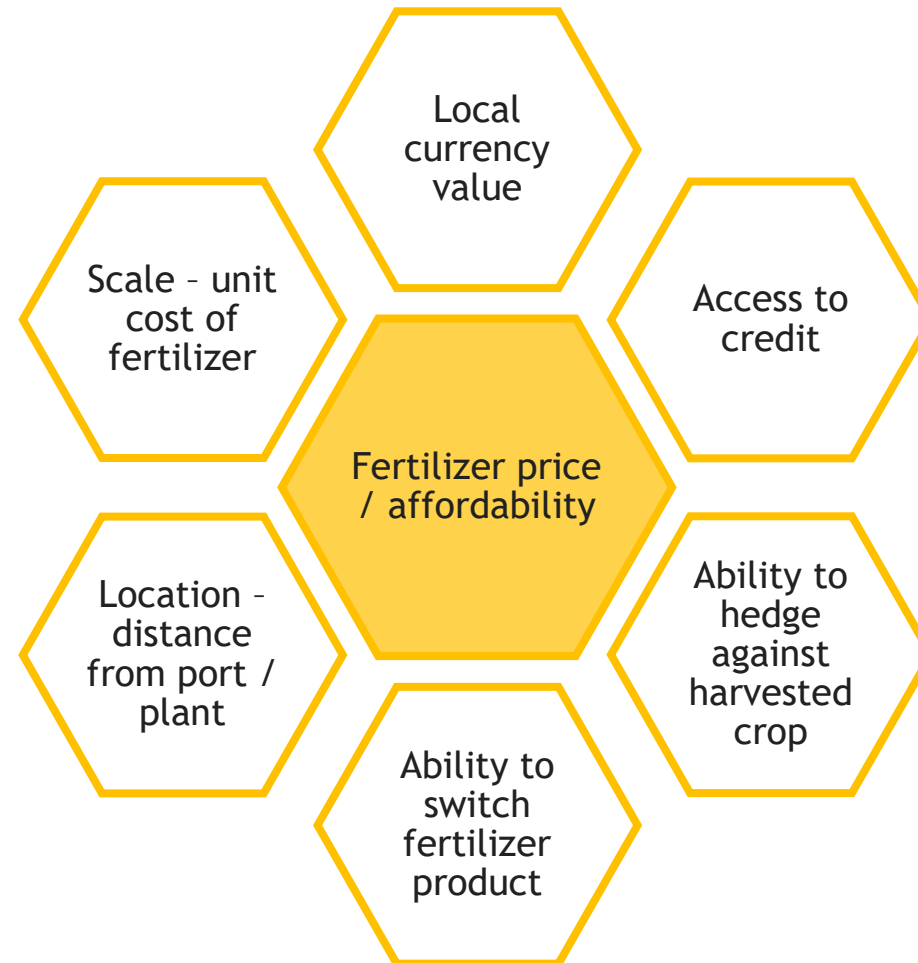
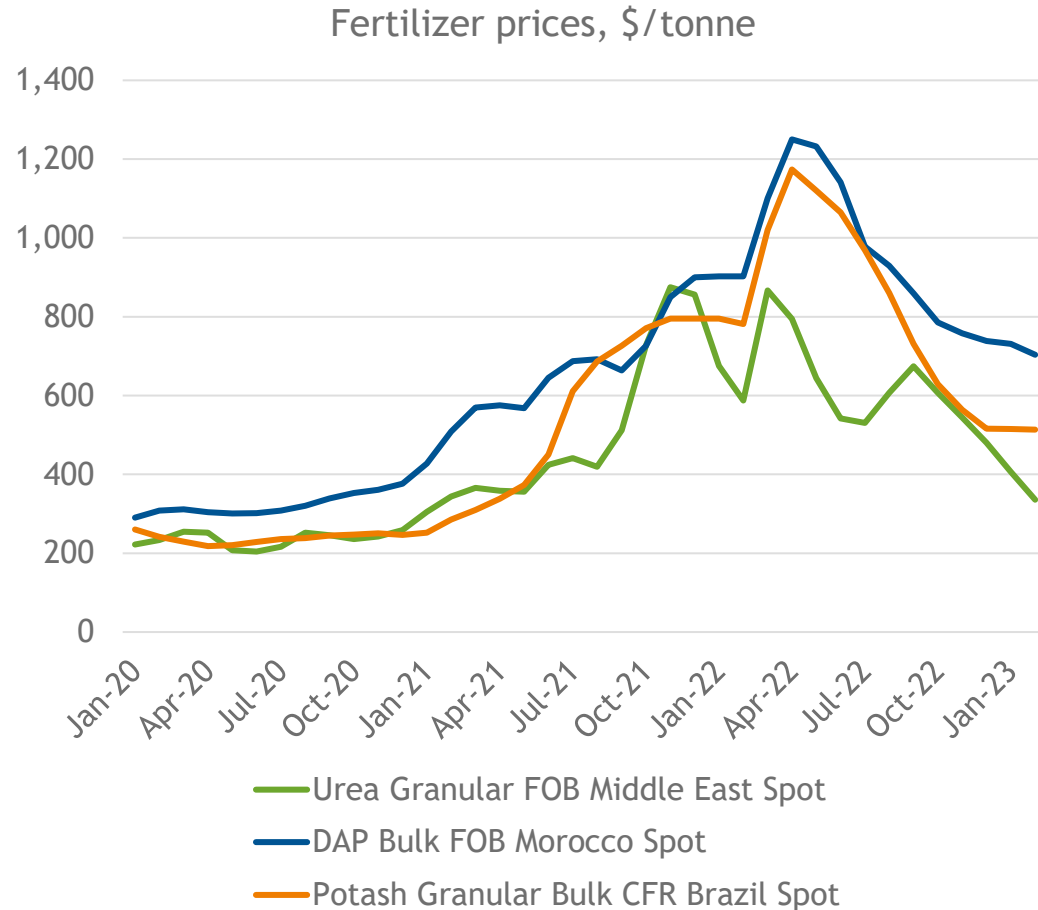
Global PA production (2022 estimate), Mt



Global potash production (2022 estimate), Mt



# Many factors affect farmer affordability



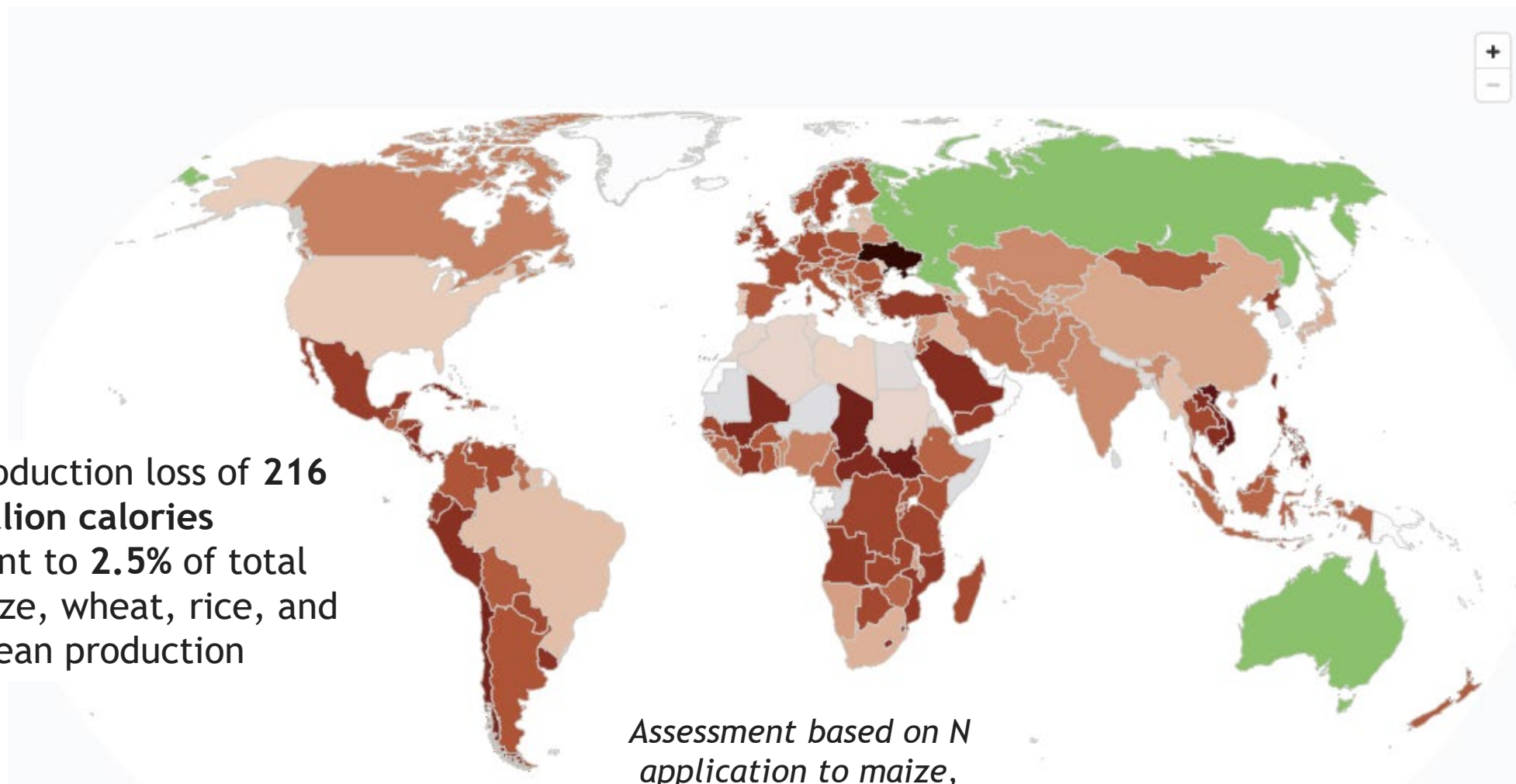
Source: CRU, IFA





# Reduced fertilizer application has implications for global food production

*Projected production change in calories, by country, 2022*



Global production loss of **216 trillion calories**  
Equivalent to **2.5%** of total global maize, wheat, rice, and soybean production

*Assessment based on N application to maize, wheat, rice and soybeans*

Source: Gro Intelligence, IFA, Nov 2022

# Environmental considerations will continue to drive the sector performance

Scope 2 Emissions

Scope 3 Emissions

Biodiversity

## **Reducing Emissions From Fertilizer Use Report**

**Amid an evolving food crisis and in line with environmental goals, the fertilizer industry is helping to reduce agriculture's carbon footprint while contributing to global food security. From the fertilizer factory to the farm, the industry is committed to playing its part in curbing greenhouse gas (GHG) emissions and making food systems more resilient.**

Approximately half the food we eat today has been produced thanks to mineral fertilizers. At the same time, its use is associated with GHG emissions equivalent to an estimated 720 million tonnes of carbon dioxide a year. To help guide a long-term sustainability strategy, IFA is working with its members on decarbonization. In 2021, the International Energy Agency's [Ammonia Technology Roadmap](#) showed pathways to lower emissions in fertilizer production (IFA and the European Bank for Reconstruction and Development provided support). The September 2022, Reducing Emissions from Fertilizer Use report highlights actions to scale up in order to cut scope 3 emissions – the indirect emissions that occur in companies' value chains. The fertilizer industry recognizes that an



# Innovation will drive growth

 **ifa**  
SMART & GREEN  
*where tech meets plant nutrition*



**Virtual**  
CONFERENCE

**▶ REGISTER TODAY**

FEBRUARY 6-8, 2023  
[www.smartandgreen.tech](http://www.smartandgreen.tech)

Thank you







# COREY ROSENBUSCH

President and CEO  
The Fertilizer Institute



# SUSTAINABILITY

in the fertilizer industry



## ABOUT THE REPORT

Participation in the sustainability report is voluntary for TFI members. In 2021, sixteen manufacturing companies participated, which makes up 92% of the total U.S. production of phosphate, potash, and nitrogen. Eighteen retailers, wholesalers, and distribution companies joined as well, making up 33% of the U.S. fertilizer retail industry.



A photograph of two workers in safety gear. One worker in an orange suit and white hard hat is holding a clipboard and looking at it. The other worker in a blue suit and white hard hat is leaning on a white railing and looking at the clipboard. The background shows a white, geometric architectural structure.

## SAFETY AND SECURITY

**2,440**

Industry facilities participating in the ResponsibleAg program.

**1.6X**

Fewer work-related injuries. 2021 was the 2<sup>nd</sup> safest year on record since the report began.

**2.3X**

Lower lost time incident rates. This is the number of recordable injuries & illnesses per 100 employees.





## ENERGY AND ENVIRONMENT

### ENERGY

**39%** of reported total energy used in 2021 was generated from waste heat.

### GREENHOUSE GASES

**31%** of GHGs were captured and not emitted in 2021. This is a **368%** increase of GHG capture since 2013.

### WATER

Participants had a **10%** reduction in water use since 2017. We also recycled enough water to fill **1.6M** Olympic-sized pools.



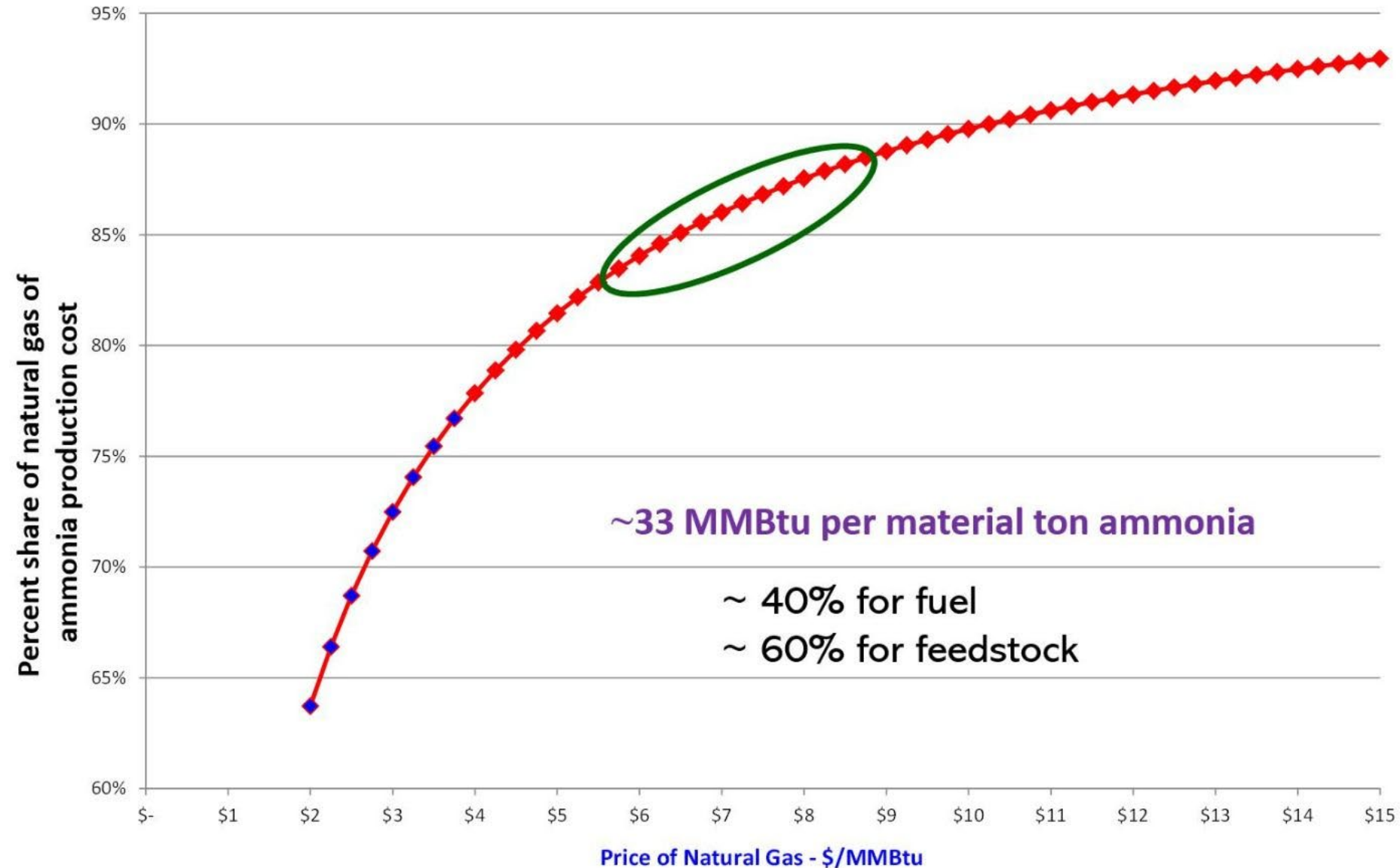
## INVESTING IN THE FUTURE



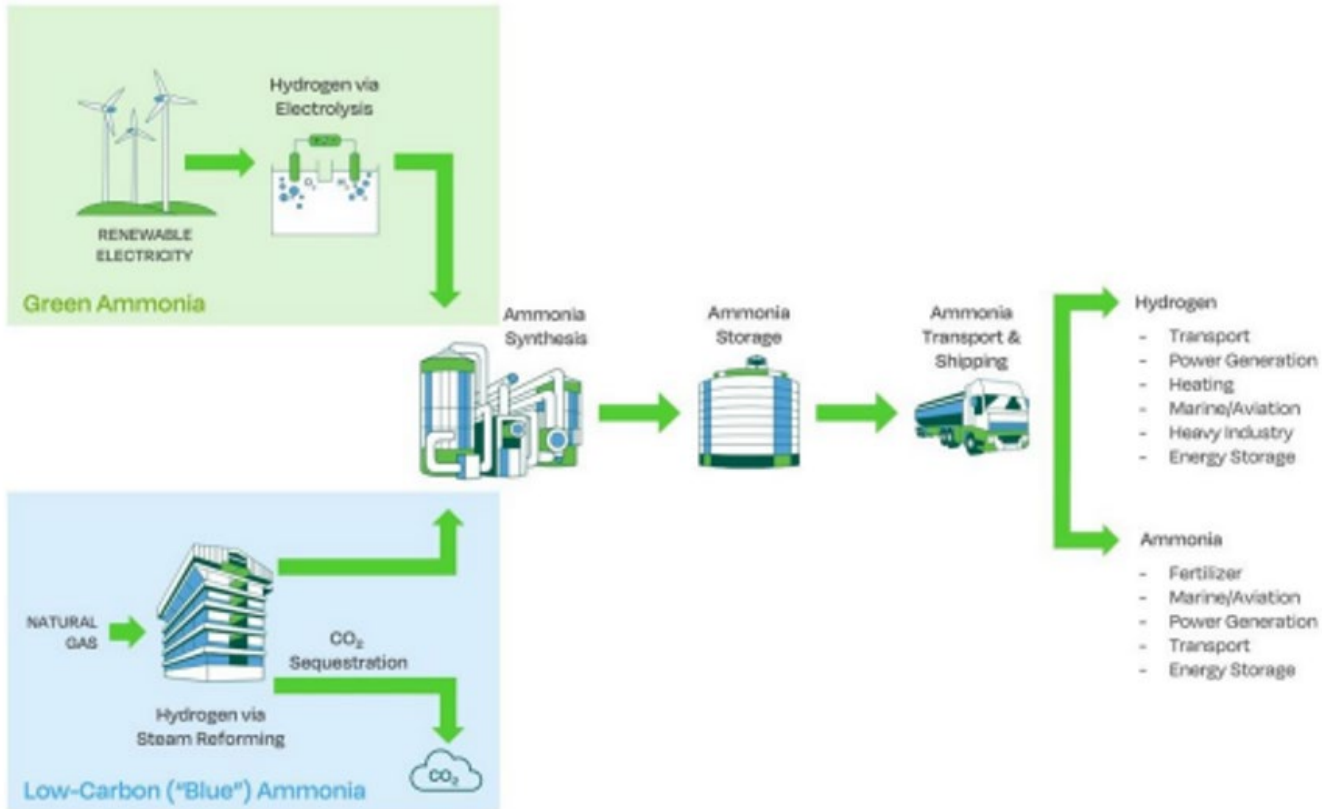
From **2019** through **2021**, companies in this report invested an average of **\$1.19 billion** annually in capital investments to help the industry meet sustainability goals. These investments increase production efficiencies, reduce energy and water use, reduce greenhouse gas emissions, and strengthen the U.S. economy to meet current and future agricultural needs.



# Natural Gas as a Share of Ammonia Production Cost



# LOW-CARBON AMMONIA



## Green & Blue

- “GREEN” AMMONIA REFERS TO AMMONIA MADE WITH HYDROGEN PRODUCED WITH WATER, USING RENEWABLE POWER AND ELECTROLYSIS
- “BLUE” AMMONIA IS MADE FROM HYDROGEN PRODUCED USING A STEAM METHANE REFORMING PROCESS, BUT WHERE THE BI-PRODUCT CO<sub>2</sub> IS CAPTURED AND SEQUESTERED UNDERGROUND. SOME IN INDUSTRY ARE ALSO REDUCING UPSTREAM METHANE EMISSIONS THROUGH THE PURCHASE OF CERTIFIED LOW-EMISSION NATURAL GAS.

# INFLATION REDUCTION ACT (2022)



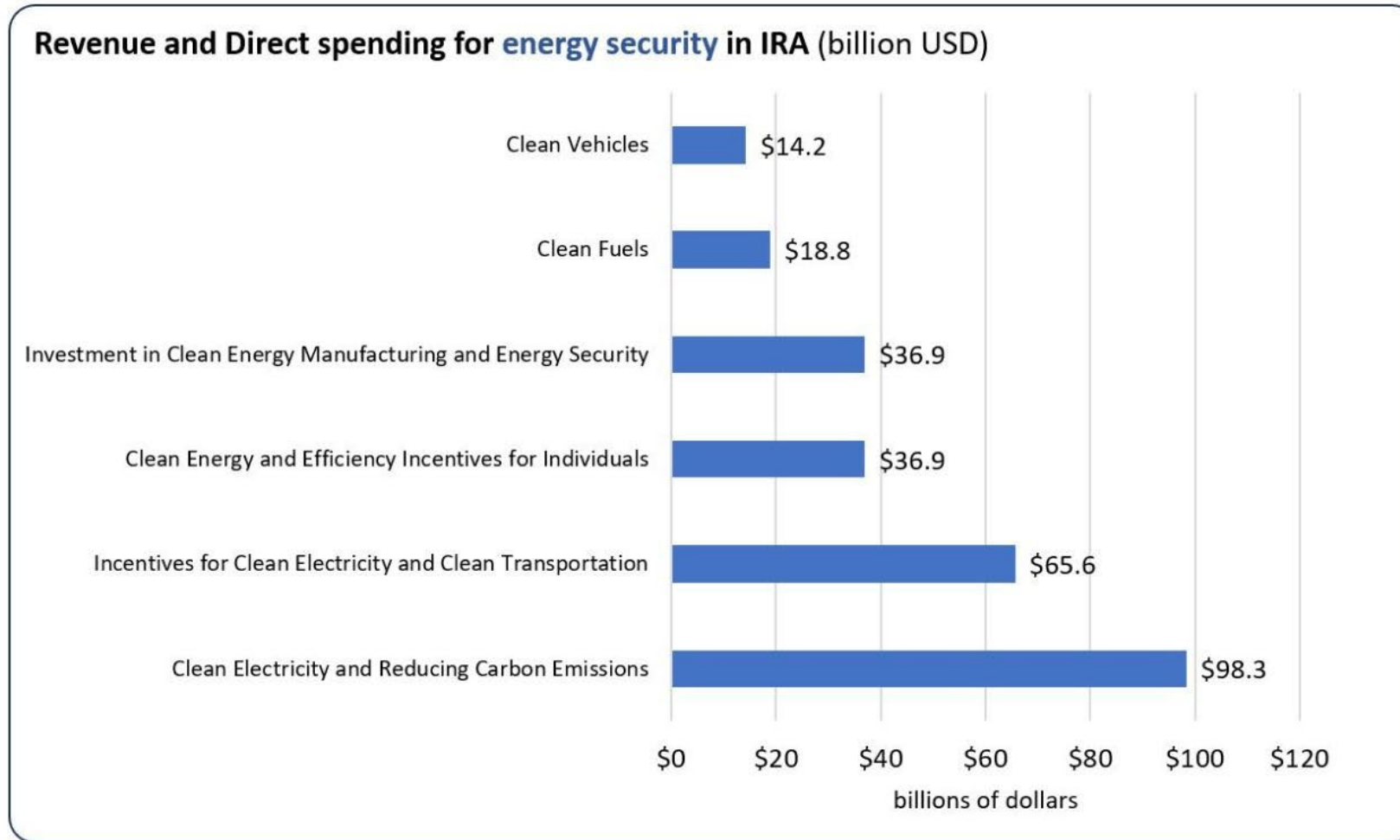
- \$485 Billion additional spending
- CBO estimates offsets of \$790 Billion in savings and revenue

## HIGHLIGHTS

- 15% minimum corporate tax rate
- Increase 45Q tax credit
  - \$85/metric ton for carbon capture, sequestration
  - \$60/metric ton for reutilization
- \$40 Billion to USDA
  - \$20 Billion Conservation Funding (RCPP, EQIP, etc.) – 9.5x more than 2018 farm bill
  - \$20 Billion other ag related (forestry, drought, etc.)
- Increased resources for permitting reviews (increased staff, review tools, etc.)

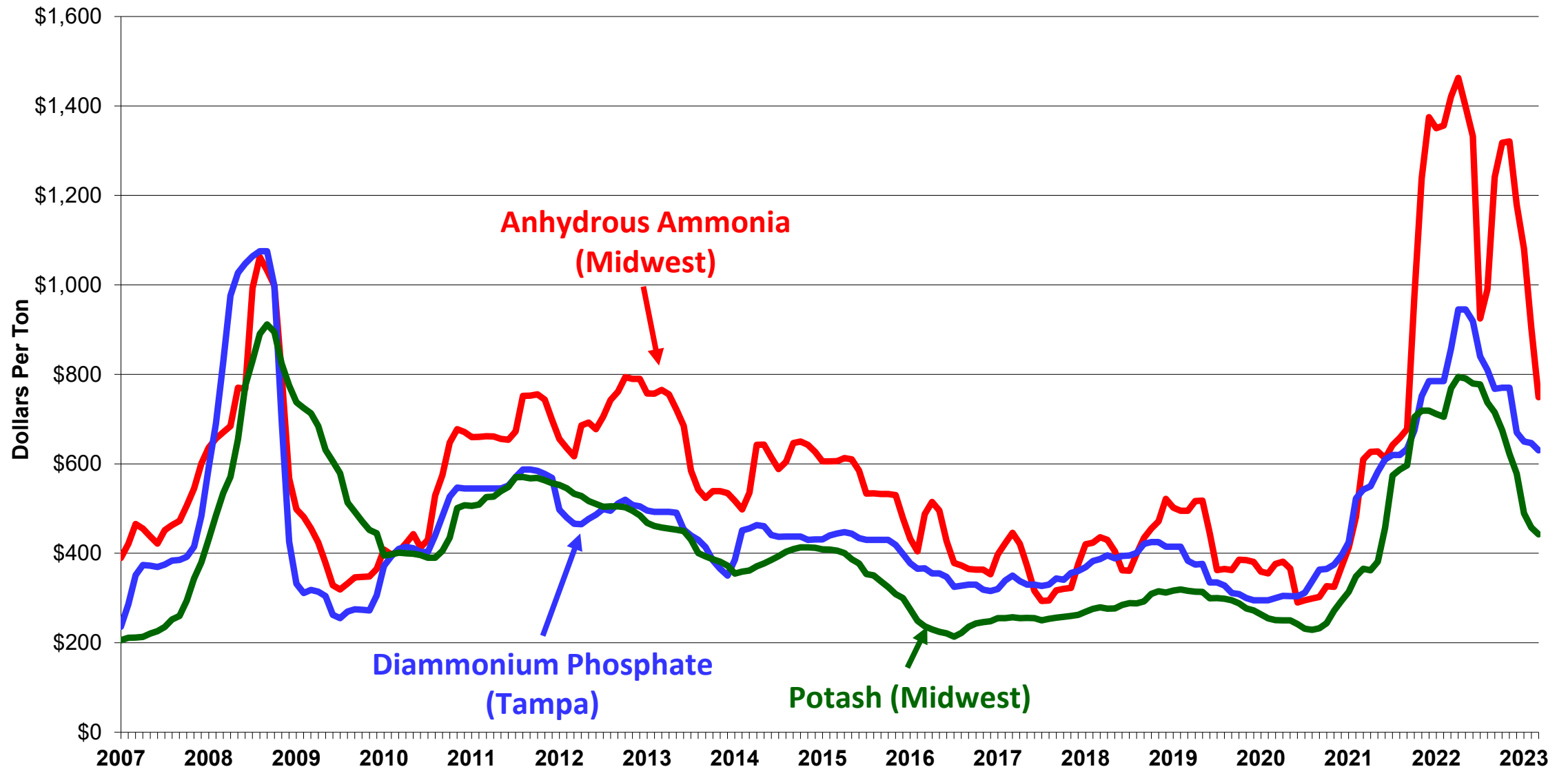


The IRA authorizes \$270.7 billion towards new energy security deployment over the next 10 years



SOURCE CBO

# Monthly Fertilizer Prices: Jan 2007 – Mar 10, 2023



Source: Weekly prices reported in Green Markets (A Bloomberg Company).



## INNOVATION IN FOCUS

Environmental stewardship is a priority for the fertilizer industry and environmentally focused innovations are driving the industry forward and allowing farmers to do more with less.

There are a number of emerging technologies that are aimed squarely at increasing crop yields while lessening impacts to the environment, including:

- Biostimulants
- Enhanced Efficiency Fertilizers
- Microbials





# PARTNERSHIPS FOR CLIMATE-SMART COMMODITIES

## BY THE NUMBERS

The U.S. Department of Agriculture is investing up to **\$2.8 billion** in **70 selected** projects under the first funding pool of Partnerships for Climate-Smart Commodities.

### PROJECTS BY COMMODITY



### PROPOSAL INVESTMENTS

Proposals for the **70** selected projects include plans to match **50%** of the federal investment with nonfederal funds.

### PROJECTS BY AWARD SIZE\*

**25** projects valued at \$25M-45M, **22** projects valued at \$5-20M, **09** projects valued at \$50M-65M, and **14** projects valued at \$70M-95M.

**50+** universities, including multiple **minority-serving institutions**, engaged and helping advance projects.

**50,000+** farms reached, encompassing **25M+** acres of working land engaged in climate-smart production practices.

**Hundreds of expanded markets** and revenue streams for producers and commodities across agriculture ranging from **traditional corn** to **specialty crops**.

More than **50 million metric tons** of carbon dioxide equivalent sequestered over the lives of the projects. This is equivalent to removing more than **10 million gasoline-powered** passenger vehicles from the road for one year.

\*USDA will work with the applicants to define the scope and funding levels. USDA is an equal opportunity provider, employer, and lender.



## Immediate Action Items

Urge China to reduce or eliminate their fertilizer export restrictions.

Encourage use of fertilizer exemptions by financial institutions

Eliminate the cross-border vaccine mandate between the U.S. and Canada

Eliminate hours of service (HOS) restrictions on agricultural commodity shipments

Immediately modernize weight restrictions for 6-axle trucks

Waive Jones Act restrictions

Incentivize growers to adopt 4R Nutrient Stewardship practices to maximize efficient fertilizer use

[FULL DOCUMENT HERE](#)



## Medium to Long-Term Action Items

Make environmental reviews for permitting, including environmental justice screening, fair, equitable, and streamlined

Promote policies that support energy sources, including natural gas

Include potash and phosphate on the Critical Minerals list

Enact climate change policies that protect the global competitiveness of the U.S. fertilizer industry and our farmer customers

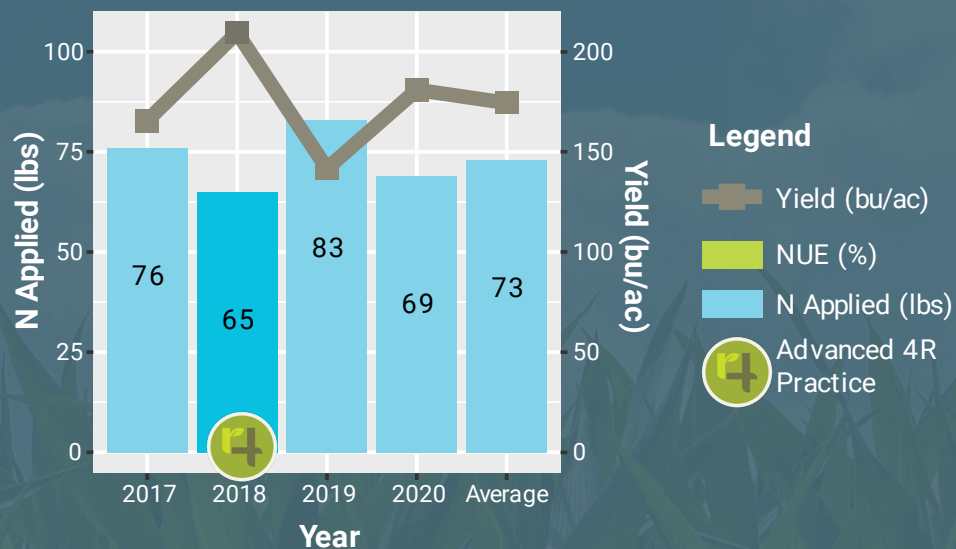
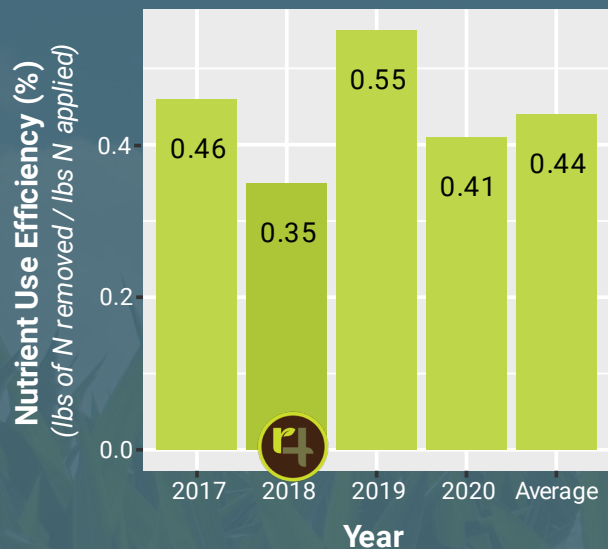
The Surface Transportation Board (STB) should pursue regulatory reforms that promote rail competition, fair rail rates and demurrage practices, and reliable service

Modernize our inland waterway infrastructure

Allow for the sustainable reuse of phosphogypsum

[FULL DOCUMENT HERE](#)





### 4R Case Study: New York Dairy Farm

Sustainability has been the key to making this farmer advocate successful. Their findings show that yield does not have a perfect relationship with N rate, indicating 4Rs can be used to optimize rather than N rate alone. In 2018, the grower had the most advanced 4R practices and the best NUE numbers.

**Nitrogen use efficiency has gone from 1.3 lbs N/bu to 0.9 lbs/bu**

**7 bu/ac yield increase from 2019 to 2020 in wheat**

**Split nitrogen application yielded 207 bu/ac in corn**

**Variable Rate savings: \$22/ac in 2019 \$31/ac in 2020**

### 4R Case Study: Virginia Corn, Soybean, and Wheat Farm

This family farm began to implement 4R practices 11 years ago and have clearly improved their overall nutrient stewardship. These improvements on the farm can largely be attributed to the time and care put into reviewing soil test results, analyzing the data, and understanding the scenarios that go on in each field. Using the newest technology including variable rate and satellite imagery, the grower was able to fine tune their fertilizer applications further.

# Thank You!

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Corey Rosenbusch

[crosenbusch@tfi.org](mailto:crosenbusch@tfi.org)

@CoreyRosenbusch









LINDA THRASHER

President and Co-Founder  
Greenfield Nitrogen



KARL THEIS

Founder  
Greenfield Nitrogen





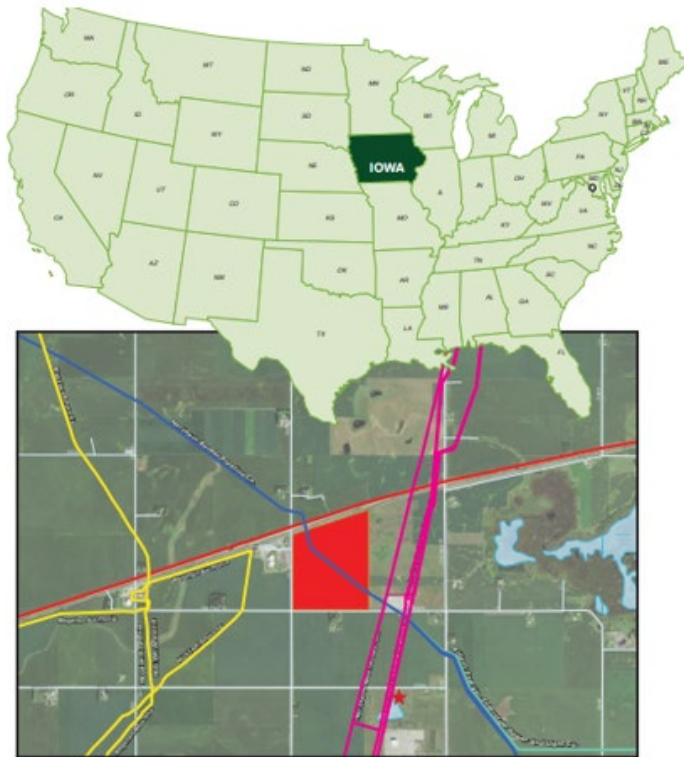
**Greening the Fertilizer Industry**  
March 21, 2023

## **ABOUT GREENFIELD NITROGEN**

Our company was launched with the support of local farmers who wanted to participate in the fertilizer supply chain and have an investment stake in their ammonia crop inputs.

Greenfield Nitrogen is developing a network of green ammonia facilities that maximize the renewable energy from wind and solar and serve the emerging green hydrogen and green ammonia markets.

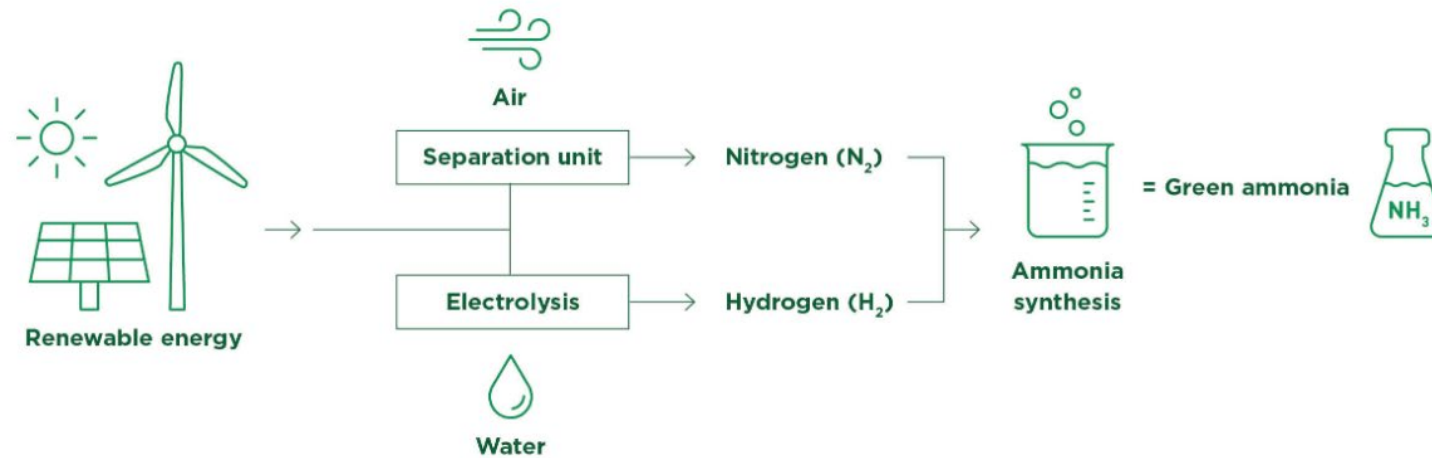
# SHOVEL READY SITE



- 96,000 short tons / year of zero carbon, green ammonia (275 tons per day) and 44,000 tons storage.
- Plant will use ~145 MW of renewable electricity from local wind farms via a smart grid system.
- Key permits are secured, including water and air quality / permit to construct. Site assessments are also complete.
- Local farmers and businesses invested \$7.7M seed capital. Strong support from State of Iowa and local officials.



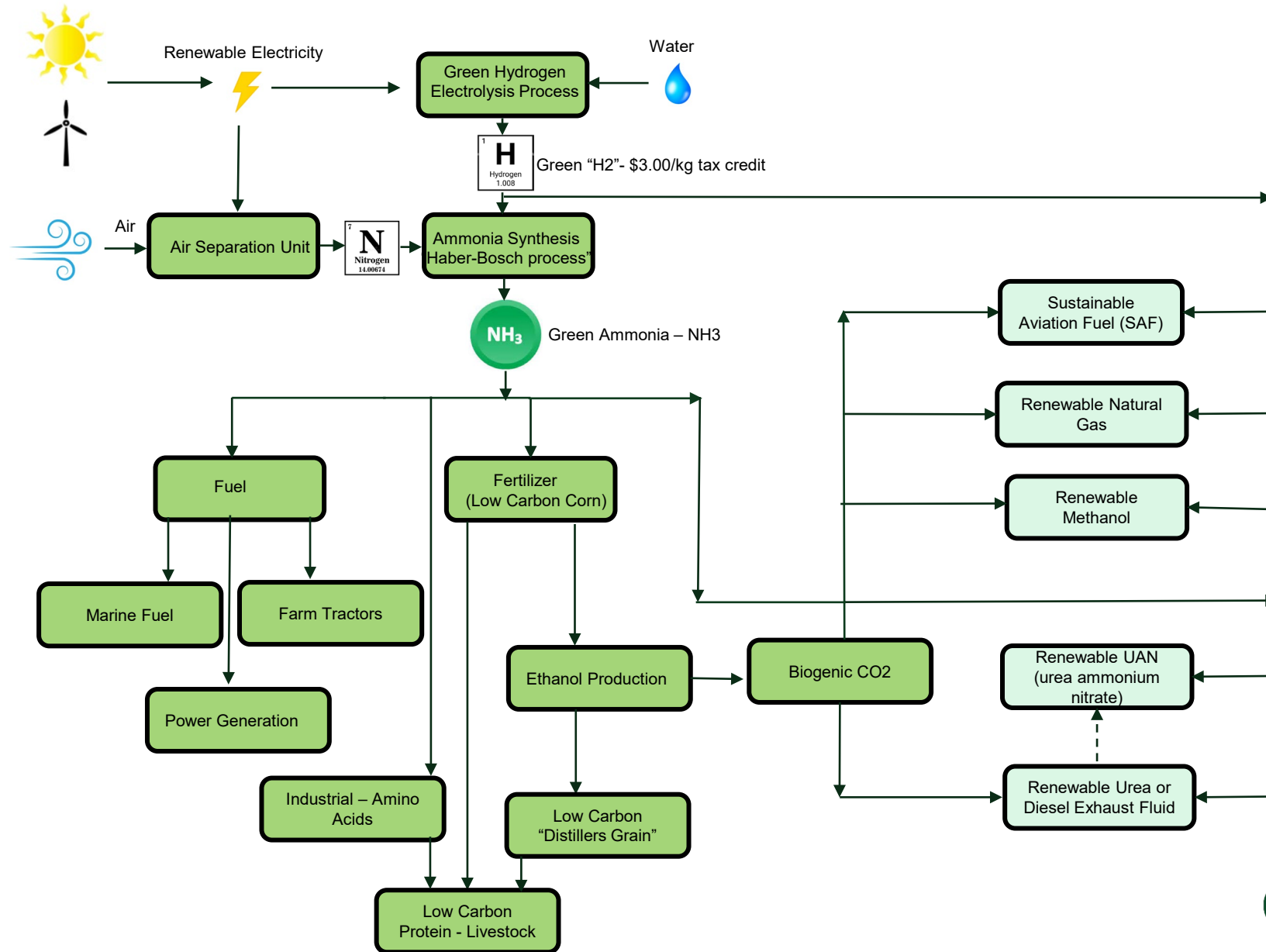
# GREEN AMMONIA: IS IT ALCHEMY?



## NO -- IT'S A REALITY – THANKS TO THE IRA

The hydrogen production tax credit (“45V”) in the Inflation Reduction Act provides up to a \$3 / kg for clean hydrogen production.

# FUTURE OPPORTUNITIES

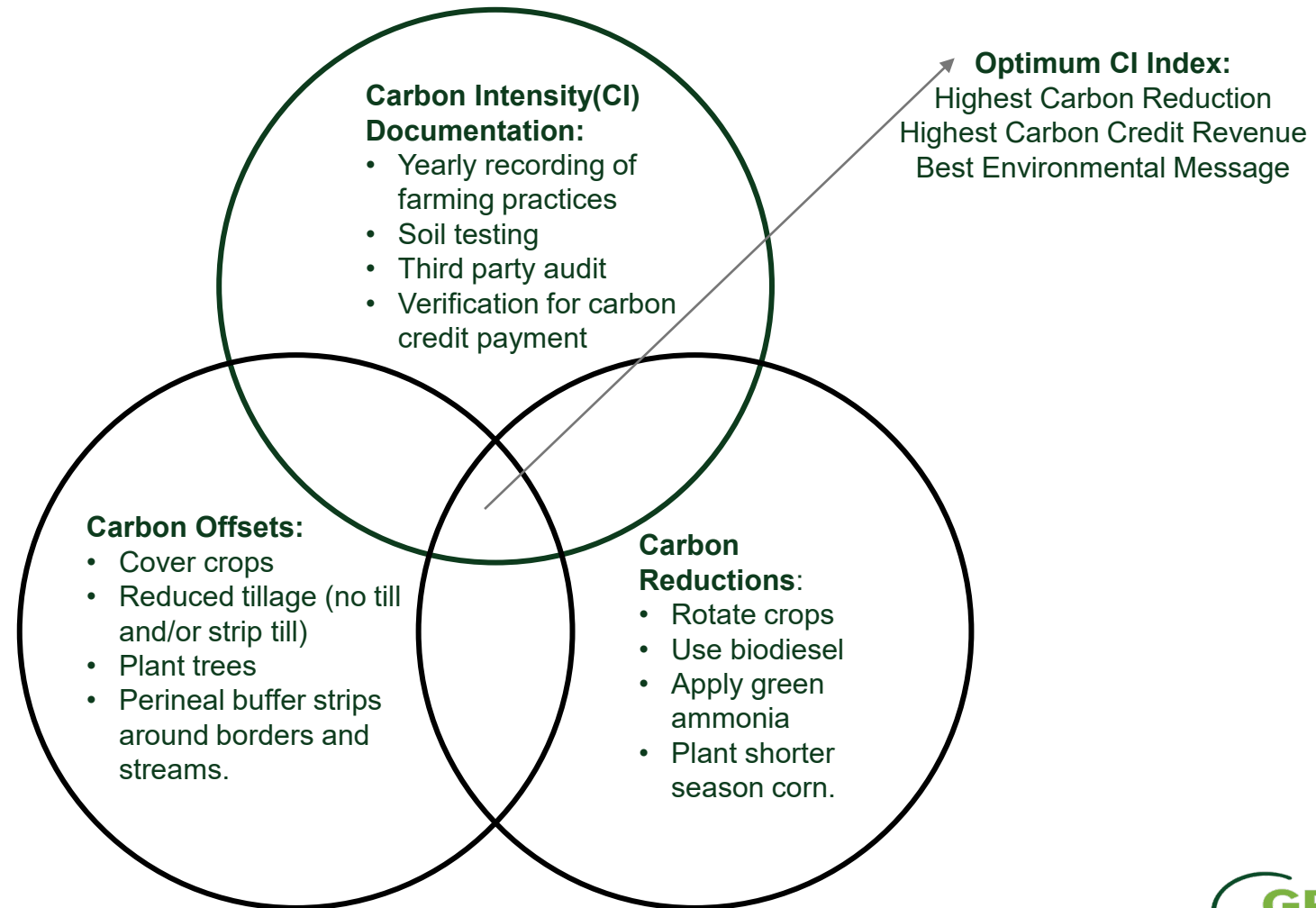


**WHAT DOES THIS  
MEAN TO THE FARMER?**



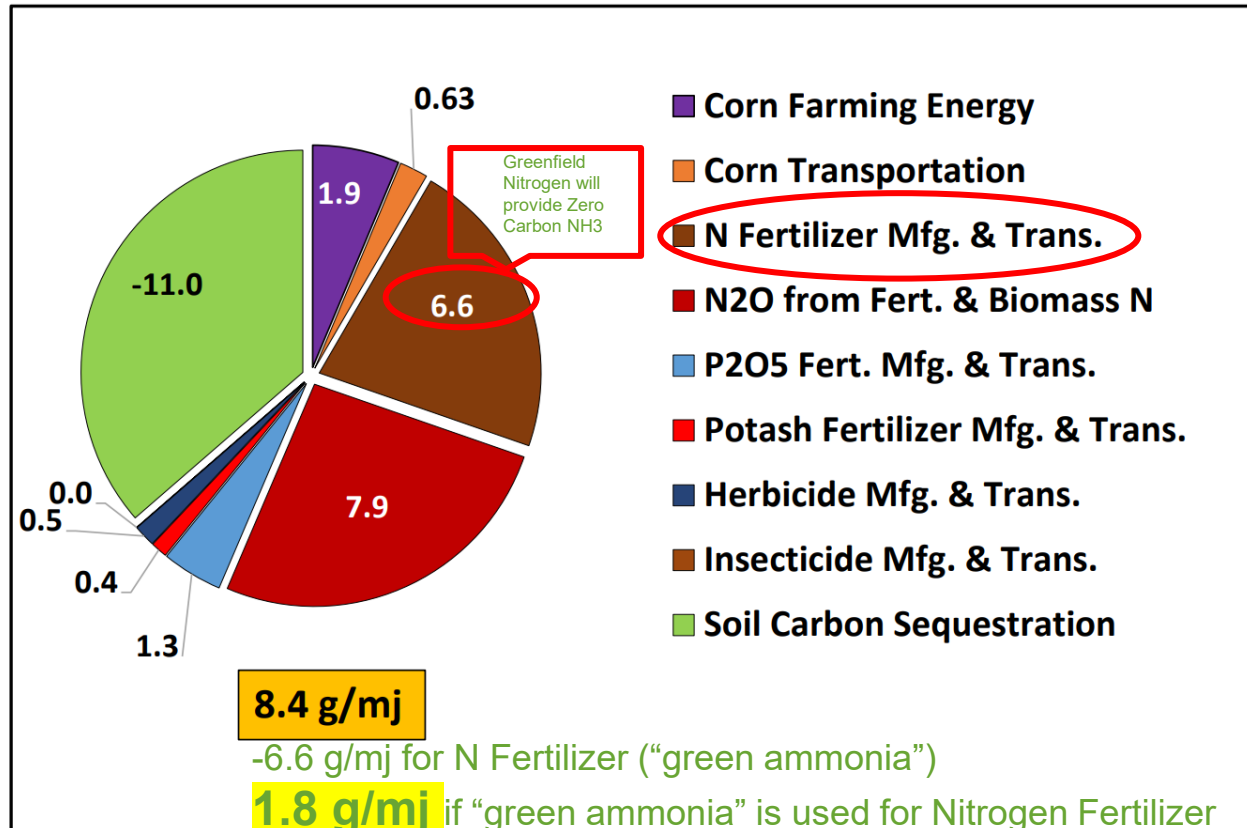


# THE CHALLENGE: OFFSETS, REDUCTIONS, AND CALCULATIONS



# CARBON INTENSITY: CORN PRODUCTION

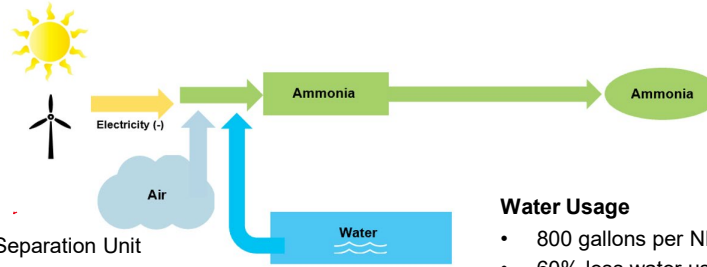
U.S. Department of Energy GREET Model Corn Production Carbon Intensity  
(Lancaster Co. with Optimized Low Carbon Corn Production Practices)



# Green Ammonia vs. Traditional Nitrogen Production Facility

## Greenfield Nitrogen: Zero Carbon Ammonia Facility

*Made with water, wind and sun energy*



### Electrical Usage

- 860 kWh per ton – Loop & Air Separation Unit
- 9000 kWh per ton - Electrolyzer
- 100% renewable energy

### Water Usage

- 800 gallons per NH3 ton
- 60% less water usage

Carbon Dioxide equivalent based on Greenhouse Gas Emissions from GREET® Model



CO2 lb. release per 1 lb. N

0 lb.

Carbon Dioxide equivalent release based on application of 200 lb. of N per Acre



CO2 lb. release per 1 acre

0 lb.



Reduced CO2 lb. release per 1 acre

N/A

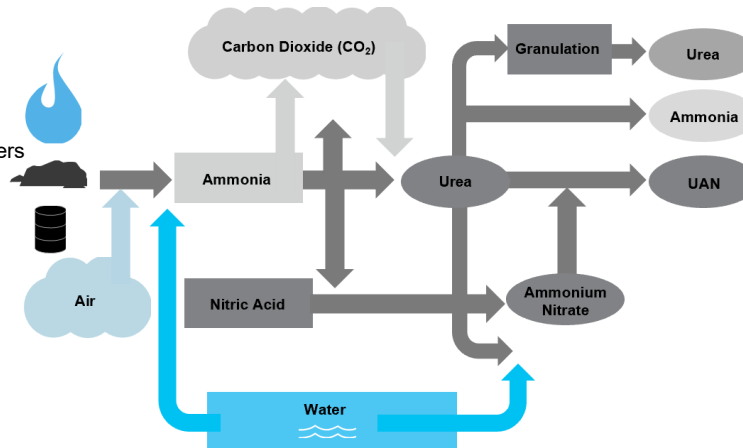
## Traditional Nitrogen Facility: Multiple Products Made with Fossil Fuels

40% of CO2 is used as feedstock; later released through use of nitrogen products at farm field for urea & UAN

- CO2 is used for Urea & UAN Production
- CO2 captured through energy intense Amine wash process

### Energy Usage

- 29 - 45 MMBtu fossil fuel/electrical per NH3 ton
- Requires energy intense boilers



### Water Usage

- 2200 – 2500 gallons of water per NH3 ton

3.19 lb.

639 lb.

639 lb.

2.43 lb.

485 lb.

485 lb.

5.20 lb.

1040 lb.

1040 lb.

**Average CO2 equivalent reduction per acre:**

**721 lb.**





**THANK YOU!**





# 90th Anniversary Gala

Celebrating 90 years of accelerating  
practical solutions for agriculture.

## Save the Date

Thursday, June 15, 2023

5:30 PM

The Drake

Chicago, Illinois

[farmfoundation.org/90thgala](https://farmfoundation.org/90thgala)







# THANK YOU

## **Support our Mission**

Become a Friend of Farm Foundation today!

[farmfoundation.org/friends](https://farmfoundation.org/friends)

**We hope to see you at a future event!**

**#FarmFoundationForum**

